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# Impacts of Anthropogenic Activities on Selected Water Quality Parameters of the Kampil Dam (Dalaba), Guinea

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**ABSTRACT**

Drinking water resources in developing countries are under growing pressure from anthropogenic activities. This study assessed the effects of human activities on the physicochemical and microbiological quality of water at the Kampil Dam, in the urban municipality of Dalaba, Guinea. Field observations, a socio-environmental survey, and laboratory analyses were combined. Water samples were collected at three stations (upstream, midstream, and downstream) during four campaigns: two in the rainy season (August–September) and two in the dry season (November–December). Temperature, pH, electrical conductivity (EC), turbidity, and salinity were measured *in situ*, and total coliforms (TC), fecal coliforms (FC), and coagulase-positive staphylococci (ST) were enumerated in the laboratory. Agriculture, urbanization, domestic waste disposal, and brickmaking were the dominant anthropogenic activities. Most physicochemical parameters showed little spatiotemporal variation; however, pH differed significantly between seasons ($p < 0.05$), and turbidity and salinity differed significantly between stations ($p < 0.05$). Microbiological contamination was pervasive across all stations and seasons: TC, FC, and ST concentrations far exceeded the WHO (2022) limit (0 CFU/100 mL), with TC peaking at 370 ± 120 CFU/100 mL in September. These findings indicate a potentially serious public health risk and underscore the need for adequate treatment, including filtration and chlorination, before the water is distributed to the population of Dalaba.

**Keywords:** Water quality; Anthropogenic activities; Microbiological contamination; Physicochemical parameters; Seasonal variation

## 1. Introduction

Access to safe drinking water remains one of the foremost public health and socioeconomic development challenges in sub-Saharan Africa. Freshwater resources in developing countries are increasingly threatened by anthropogenic pressures, including agriculture, rapid urbanization, and inadequate sanitation, as well as by climate-driven shifts in precipitation patterns (Chen et al., 2022; Jones et al., 2023). In Guinea, surface water bodies such as reservoirs are strategic assets for drinking water supply, yet scientific assessments of their quality remain sparse, which hampers evidence-based management (Camara & Bangoura, 2017).

Sub-Saharan Africa is projected to become the dominant future hotspot of surface water pollution, driven by population growth, urban sprawl, and agricultural intensification in the context of inadequate wastewater treatment infrastructure (Jones et al., 2023). Biological water quality, particularly fecal indicator bacteria, is a critical but frequently under-monitored dimension of this problem (WHO, 2022). Fecal coliforms, total coliforms, and staphylococci are internationally recognized indicators of microbiological contamination; their detection in surface water signals a risk of waterborne diseases such as diarrhea, typhoid, and cholera (Tambi et al., 2023).

Recent studies have linked the deterioration of surface water quality to specific land-use pressures. In East Africa, urbanization has been associated with the degradation of river water quality (Chen et al., 2022), and in an urban tropical wetland in Uganda, microbiological and physicochemical quality was shaped by both anthropogenic and natural factors (Byekwaso et al., 2026). Studies in Ethiopia and South Africa have related lake and dam-catchment conditions to agricultural stressors and modified land uses (Engdaw et al., 2025; Mpandeli et al., 2024), and a study of drinking-water reservoirs documented pronounced seasonal dynamics in coliform bacteria (Reitter et al., 2021). Collectively, these studies indicate that land-use change and rainfall-driven runoff influence both turbidity and fecal indicator bacteria. However, they were conducted in systems that differ in hydrology, catchment size, and sanitation context, so their findings cannot be transferred directly to small highland reservoirs. In West Africa, the available information includes overviews of aquatic-ecosystem pollution (Hounkpe et al., 2017). To our knowledge, most investigations concern rivers, wetlands, large lakes, or distribution systems outside the Futa Jallon highlands, and few have combined a field inventory of anthropogenic activities with both physicochemical and microbiological measurements in a small drinking-water reservoir of the Guinean highlands. In Guinea, quantitative data on reservoir water quality remain scarce (Camara & Bangoura, 2017). This lack of site-specific evidence limits the design of targeted protection measures for drinking-water sources such as the Kampil Dam.

The Kampil Dam, located in the urban municipality of Dalaba in the Futa Jallon highlands of central Guinea, is the primary source of drinking water for the local population. It is surrounded by agricultural plots, peri-urban settlements, and artisanal activities, including brickmaking, yet the influence of these land uses on the quality of its water has not been systematically investigated. This study therefore aimed to: (i) characterize the main anthropogenic activities practiced along the dam; (ii) determine selected physicochemical and microbiological water quality parameters across two seasons and three spatial stations; and (iii) explore potential links between these activities and the measured parameters, as a basis for targeted management recommendations.

## 2. Material and Methods

### *2.1. Study area*

The Kampil Dam is located in the urban municipality of Dalaba (10°41′N, 12°15′W), Mamou Region, central Guinea, within the Futa Jallon massif. The climate is Sudano-Guinean, with a pronounced rainy season (April–October; mean rainfall ≈ 1,800 mm/year) and a dry season (November–March). The dam supplies treated drinking water to the town of Dalaba and surrounding peri-urban communities. Three riparian sites (Figure 1) were surveyed: Thièbhéloye (upstream zone), Billy (midstream zone), and Goubhi (downstream zone).

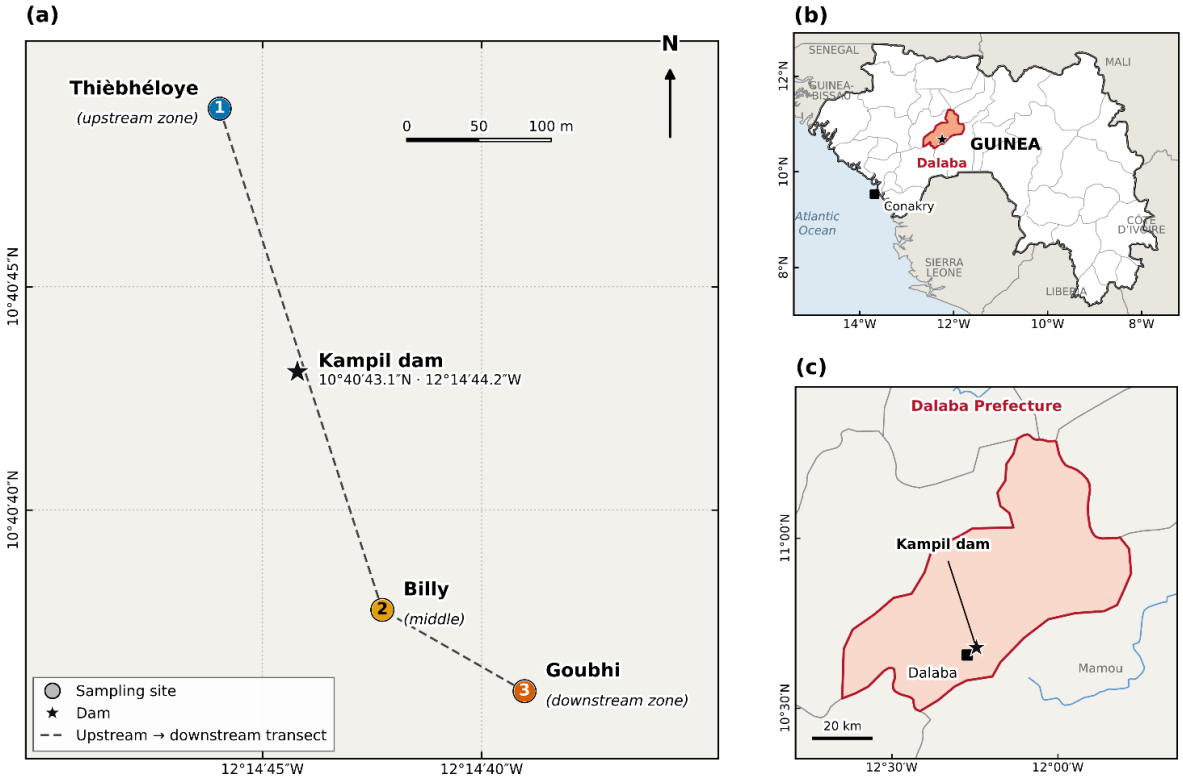



**Figure 1.** Map of the study area

### *2.2. Sampling design and water collection*

Water samples were collected at three monitoring stations (upstream, S1; midstream, S2; and downstream, S3) during four campaigns: August and September (rainy season) and November and December (dry season). This design yielded 12 sampling operations (3 stations × 4 campaigns). At each station and campaign, three field replicates were collected, giving n = 9 samples per campaign, n = 12 per station, and 36 samples in total for laboratory analysis. Samples for microbiological analysis were collected in sterile one-liter polyethylene bottles and transported on ice to the laboratory within six hours.

### *2.3. Physicochemical analyses and microbiological analyses*

Temperature (°C), pH, electrical conductivity (EC, µS/cm), turbidity (NTU), and salinity (mg/L) were measured *in situ* at a depth of approximately 30 cm using a calibrated multiparameter probe (HANNA HI 9829).

Total coliforms (TC) and fecal coliforms (FC) were enumerated by the pour-plate method on Desoxycholate Lactose Agar (DLA), incubated at 37 °C (TC) and 44 °C (FC) for 24–48 h, using a colony-count technique adapted from ISO 4832. This approach differs from the membrane-filtration method on chromogenic agar prescribed by ISO 9308-1, which was not applied here; TC and FC counts should therefore be regarded as presumptive. Coagulase-positive staphylococci (ST) were quantified on Baird-Parker Agar (BPA) at 37 °C for 24–48 h following ISO 6888-1. Results are expressed in CFU/100 mL and were compared with the WHO (2022) limits (0 CFU/100 mL for all indicators).

### *2.4. Characterization of anthropogenic activities*

Anthropogenic activities were inventoried through systematic field observations and structured interviews with eight riparian residents. The information collected covered the type, location, and frequency of each activity and its perceived environmental impact, and an activity–impact matrix was prepared for each riparian site. The interviews were intended as a qualitative complement to the field observations and are not statistically representative of the riparian population. Because activities were not mapped using GIS, their spatial relationship with water quality is inferred qualitatively.

### *2.5. Statistical analysis*

Data were entered into Microsoft Excel. After verification of the homogeneity of variance (Levene's test) and normality (Shapiro-Wilk test), one-way ANOVA was performed in StatView with season or station as the independent factor. Fisher's LSD post hoc test was used for pairwise comparisons (significance level: $p < 0.05$). Replicate samples from the same station and campaign are not fully independent observations; p-values were therefore interpreted cautiously. Given the small sample sizes, statistical power is limited, and non-significant results should not be interpreted as evidence of no effect. Graphs were produced with GraphPad Prism.

## 3. Results and Discussion

### *3.1. Anthropogenic activities along the Kampil Dam*

Four main anthropogenic activities were identified across the four riparian sites: agriculture, domestic waste disposal, urbanization, and brickmaking (Table 1). Domestic waste disposal and urbanization were recorded at all four sites. Agriculture was present at Thièbhéloye, N'Dayridiâbhè, and Billy. Brickmaking was restricted to N'Dayridiâbhè and Billy, two mid-dam sites where clay extraction

from the dam banks was directly observed. The spatial pattern reflects a gradient of anthropogenic pressure from the upstream sector to the downstream intake zone.

**Table 1.** Main anthropogenic activities and potential impacts at each riparian site of the Kampil Dam, Dalaba

| N° | Site | Activities | Potential impacts |
|---|---|---|---|
| 1 | Thièbhéloye | Agriculture; Domestic waste; Urbanization | Nutrient enrichment; bank degradation; runoff contamination |
| 2 | N'Dayridiâbhè | Agriculture; Brickmaking; Domestic waste; Urbanization | Turbidity increase; soil erosion; chemical and microbiological pollution |
| 3 | Billy | Agriculture; Domestic waste; Urbanization; Brickmaking | Hydrological modification; habitat destruction; organic loading |
| 4 | Goubhi | Domestic waste; Urbanization | Chemical and microbiological contamination; public health risk |

### *3.2. Physicochemical water quality*

#### *3.2.1. Seasonal variation*

The physicochemical parameters measured in the two seasons are presented in Table 2. Temperature, EC, turbidity, and salinity showed no statistically significant seasonal variation ($p > 0.05$). Mean turbidity (11.7–13.1 NTU) exceeded the WHO (2022) aesthetic guideline of 4 NTU in all four campaigns. The absence of a significant seasonal effect on turbidity should be interpreted with caution, because turbidity generally increases with rainfall-driven runoff and because the number of sampling events per season was small (two campaigns per season; $n = 9$ observations per campaign). Numerically, EC and salinity were slightly higher in the dry season, consistent with evaporative concentration during low-flow periods. Salinity values (≈ 12 mg/L) were of the same order of magnitude as EC (≈ 25–29 µS/cm), giving a salinity/EC ratio of about 0.4-0.5, as expected for dilute freshwater. By contrast, pH varied significantly between seasons ($p = 0.031$), shifting from slightly acidic conditions in the rainy season (August: 6.54 ± 0.12) to near neutrality in the dry season (December: 7.11 ± 0.15). All pH values remained within the WHO guideline range of 6.5-8.5 (Figure 2).

**Table 2.** Physicochemical water quality of Kampil Dam by season (Mean ± SD)

| Parameter | Rainy season | | Dry season | | p-value | WHO* |
|---|---|---|---|---|---|---|
| | August | September | November | December | | |
| Temp. (°C) | 22.44 ± 0.34a | 24.30 ± 1.80a | 23.79 ± 0.34a | 21.98 ± 0.35a | 0.052 | ≤ 25°C |
| EC (µS/cm) | 24.9 ± 1.6a | 24.6 ± 3.6a | 28.6 ± 2.1a | 27.0 ± 6.7a | 0.599 | < 400 |
| Turbidity (NTU) | 11.7 ± 0.6a | 12.1 ± 1.7a | 13.1 ± 1.7a | 12.4 ± 2.5a | 0.779 | < 4 NTU |
| Salinity (mg/L) | 11.9 ± 1.0a | 11.7 ± 2.0a | 12.4 ± 1.5a | 12.4 ± 3.2a | 0.953 | < 250 |

Mean ± SD. Same letter within a row = no significant difference ($p > 0.05$). *WHO (2022) guidelines.

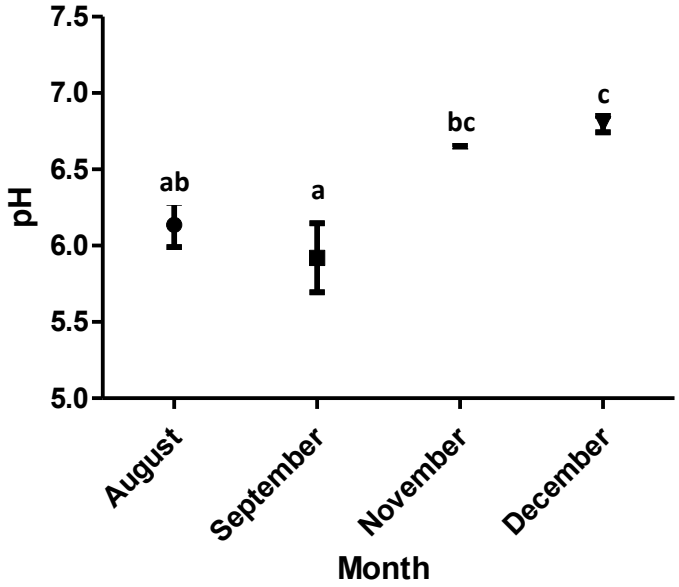



**Figure 2.** pH variation over the seasons at the Kampil Dam

*3.2.2. Spatial variation*

Temperature, pH, and EC did not differ significantly among the three stations ($p > 0.05$; Table 3), which may indicate hydrodynamic mixing within the reservoir, although the small number of stations and sampling events limits this inference. In contrast, turbidity and salinity differed significantly among stations ($p < 0.05$), with upstream values consistently exceeding those at the downstream intake, possibly reflecting localized inputs from agricultural and brickmaking activities in the upstream and mid-dam sectors.

**Table 3.** Physicochemical quality of the water at the Kampil Dam by station (Mean ± SD)

| Parameter | Upstream | Midstream | Downstream | p-value |
|---|---|---|---|---|
| Temp (°C) | 22.5±0.75a | 23.8±1.89a | 23.1±0.92a | 0.4343 |
| pH | 6.21±0.64a | 6.47±0.39a | 6.48±0.24a | 0.6425 |
| EC (µS/cm) | 29.7±4.33a | 25.2±2.15a | 23.9±2.38a | 0.0642 |

Mean ± standard deviation. Values in the same row sharing the same letter are not significantly different ($p > 0.05$).

Turbidity differed significantly between the upstream and downstream stations ($p < 0.05$; Figure 3). The lowest values were recorded at the downstream station, where water is abstracted for treatment and supply to the town of Dalaba.

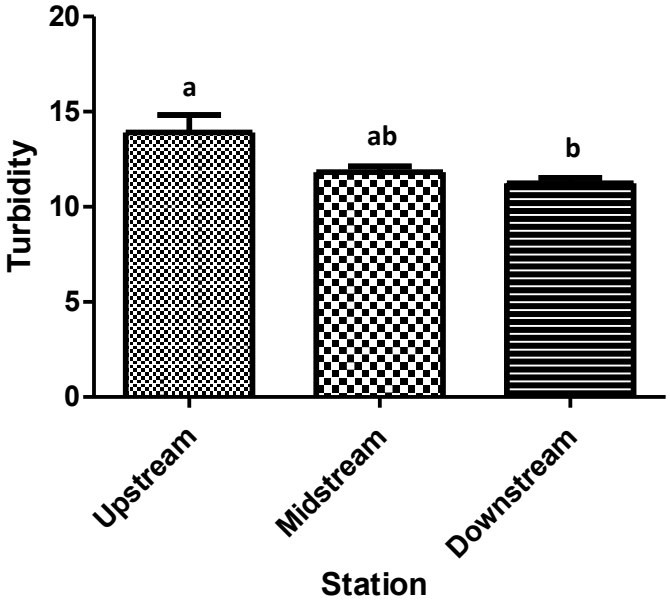



**Figure 3.** Turbidity variation at different stations at the Kampil Dam

### *3.3. Microbiological water quality*

#### *3.3.1. Seasonal variation*

All three microbiological indicators exceeded the WHO (2022) limits at every sampling event (Table 4). TC concentrations varied significantly with season ($p = 0.0018$), peaking in September (370 ± 120 CFU/100 mL), at the height of the rainy season, and declining markedly in the dry season (November: 37.5 ± 9.8 CFU/100 mL; December: 36.7 ± 13.8 CFU/100 mL). FC and ST showed no statistically significant seasonal variation ($p > 0.05$) but remained well above the WHO limits throughout the study period.

**Table 4.** Microbiological water quality of Kampil Dam by season (Mean ± SD)

| Parameter | Rainy season | | Dry season | | p-value | WHO limit |
|---|---|---|---|---|---|---|
| | August | September | November | December | | |
| TC (CFU/100 mL) | 103 ± 90a | 370 ± 120b | 37.5 ± 9.8a | 36.7 ± 13.8a | 0.0018* | 0 |
| FC (CFU/100 mL) | 84.2 ± 111a | 88.0 ± 44.7a | 26.5 ± 13.2a | 21.3 ± 7.0a | 0.416 | 0 |
| ST (CFU/100 mL) | 98.8 ± 18.7a | 95.4 ± 114a | 202 ± 251a | 10.4 ± 8.3a | 0.455 | 0 |

TC: Total coliforms; FC: Fecal coliforms; ST: Staphylococci. Mean ± SD. * $p < 0.05$. WHO (2022) limit for drinking water: 0 CFU/100 mL.

#### *3.3.2. Spatial variation*

No statistically significant spatial differences were observed for TC, FC, or ST among the three stations (Table 5; $p > 0.05$ in all cases). Nonetheless, ST concentrations were numerically highest downstream (198 ± 213 CFU/100 mL), and FC concentrations were also elevated at this station (74.5 ± 93.5 CFU/100 mL), which may suggest incremental contamination along the longitudinal axis of the dam.

**Table 5.** Microbiological water quality of Kampil Dam by monitoring station (Mean ± SD)

| Parameter | Upstream | Midstream | Downstream | p-value |
|---|---|---|---|---|
| TC (CFU/100 mL) | 112 ± 139a | 159 ± 231a | 138 ± 127a | 0.928 |
| FC (CFU/100 mL) | 52.6 ± 57.2a | 37.8 ± 26.6a | 74.5 ± 93.5a | 0.733 |
| ST (CFU/100 mL) | 53.8 ± 59.3a | 53.1 ± 45.5a | 198 ± 213a | 0.246 |

Values in the same row sharing the same letter are not significantly different ($p > 0.05$). Higher downstream ST values may reflect cumulative anthropogenic pressure, but the differences were not statistically significant.

### *3.4. Discussion*

The four activities identified at the Kampil Dam (agriculture, urbanization, domestic waste disposal, and brickmaking) are typical of the anthropogenic pressures affecting peri-urban water bodies across West and Central Africa (Hounkpe et al., 2017; Camara & Bangoura, 2017). Their spatial heterogeneity, with brickmaking concentrated at mid-dam sites and domestic pollution present at all sites, mirrors patterns reported in East African urban rivers, where multiple non-point sources combine to degrade water quality cumulatively (Chen et al., 2022). Agricultural intensification near reservoir margins, with the attendant use of synthetic fertilizers and pesticides, is a well-documented non-point pollution pathway in sub-Saharan Africa, where integrated pest management remains limited (Pericherla et al., 2020; Jones et al., 2023). Brickmaking, through clay extraction and bank disturbance, directly increases suspended sediment loads, a process documented in dam catchments affected by extractive activities in Ethiopia and South Africa (Engdaw et al., 2025; Mpandeli et al., 2024).

The seasonal stability of temperature, EC, and salinity may reflect the buffering capacity of reservoirs, which tend to dampen short-term climatic fluctuations through thermal and chemical stratification (Ayenew, 2020). The slight increase in EC and salinity in the dry season is consistent with evaporative concentration, a well-recognized process in tropical surface waters during low-rainfall periods (Ouyang, 2015). Sitotaw and Geremew (2021) reported similar dry-season increases in conductivity in Ethiopian drinking-water reservoirs receiving limited inflow.

The significant seasonal variation in pH ($p = 0.031$), with more acidic values in the rainy season, is consistent with findings from comparable tropical reservoirs. Khatri and Tyagi (2015) attributed such patterns to increased organic matter inputs and intensified microbial decomposition during wet periods, which release $CO_2$ and lower the pH. Engdaw et al. (2025) reported similar seasonal pH dynamics in Lake Tana (Ethiopia), amplified by agricultural nutrient loading. That all pH values remained within the WHO (2022) guideline range (6.5–8.5) suggests that, from a physicochemical standpoint, the dam water is not acutely compromised with respect to acidity or alkalinity.

The upstream-to-downstream gradient in turbidity and salinity ($p < 0.05$) is consistent with localized sediment and solute inputs from brickmaking and agricultural activities at the mid-dam sites (N'Dayridiâbhè and Billy), with partial settling reducing these values toward the downstream intake.

Turbidity nonetheless exceeded the WHO (2022) aesthetic guideline of 4 NTU in both seasons (11.7–13.1 NTU), highlighting the need for enhanced sedimentation or pre-filtration, particularly at peak rainfall. Chen et al. (2022) similarly documented elevated rainy-season turbidity in East African urban rivers receiving agricultural and urban runoff, and Mpandeli et al. (2024) reported turbidity exceedances in South African dam catchments affected by land-use change. The absence of a significant seasonal difference in turbidity ($p = 0.779$) is, however, unexpected for a tropical catchment, where rainfall-driven runoff and sediment transport usually raise turbidity during the rainy season. It may reflect continuous sediment inputs from bank disturbance and brickmaking throughout the year, the small number of sampling events, or limited statistical power; rainfall data, effect sizes, and confidence intervals would be needed to draw firmer conclusions.

The most critical finding of this study is the pervasive and persistent microbiological contamination of the Kampil Dam water. All three indicator organisms (TC, FC, and ST) exceeded the WHO (2022) limits at every station and in every season, indicating widespread and persistent contamination of the reservoir, possibly of fecal origin, although microbial source tracking was not performed. This outcome is consistent with the broader West African surface water quality crisis documented by Hounkpe et al. (2017) and with findings from South Africa (Maguvu et al., 2020), Ethiopia (Sitotaw & Geremew, 2021), and Uganda (Byekwaso et al., 2026).

The rainy season peak in TC ($370 \pm 120$ CFU/100 mL in September; $p = 0.0018$) is consistent with seasonal patterns reported in other systems. Reitter et al. (2021) reported pronounced seasonal dynamics in the abundance and composition of coliform bacteria in drinking-water reservoirs, which may be driven by surface runoff, increased biological activity, and thermal stratification favoring bacterial proliferation. Byekwaso et al. (2026) specifically attributed seasonal TC peaks in a Ugandan tropical wetland to anthropogenic runoff from agriculture and urban drainage at the height of the wet season, a mechanism that may also apply to the Kampil Dam, where the September peak coincides with the period when agricultural runoff is expected to be most intense. Organic amendments (compost and livestock manure) applied to riparian agricultural plots may further amplify this seasonal loading, although their use was not quantified in this study (Pericherla et al., 2020).

The absence of a statistically significant spatial gradient in microbiological parameters among the three stations ($p > 0.05$), despite numerically higher downstream FC and ST values, is consistent with diffuse, reservoir-wide contamination rather than a single dominant point source, although high variability and small sample sizes limit statistical power. A similar pattern was observed by Byekwaso et al. (2026) in the Lubigi wetland, where spatially uniform fecal indicator levels were attributed to

spatially distributed non-point sources (agricultural leachate, domestic drainage, and urban runoff) acting simultaneously across the catchment.

Higher ST concentrations were recorded downstream (198 ± 213 CFU/100 mL) and in November (202 ± 251 CFU/100 mL). These values may reflect intensified human–water contact (bathing, washing, and watering activities), which is more prevalent near the intake zone during low-flow periods, as well as the persistence of solid waste deposits at the water's edge. WHO (2022) notes that staphylococci in drinking water are primarily of human and animal origin and are associated with inadequate waste management and direct fecal contamination pathways. These explanations remain speculative, however, because the differences were not statistically significant and variability was very high.

The public health implications are potentially serious. Consumption of inadequately treated water from the Kampil Dam may expose the population of Dalaba to pathogens responsible for diarrhea, typhoid, cholera, and skin infections, diseases that cause 2.2 million deaths annually worldwide and disproportionately affect children and immunocompromised individuals in low-income countries (WHO, 2022; Izah & Ogwu, 2025). Sub-Saharan Africa already bears the largest share of this burden, which is projected to worsen without urgent intervention (Jones et al., 2023).

The decoupling between relatively stable physicochemical parameters and severely compromised microbiological quality has important management implications: physicochemical monitoring alone is insufficient to characterize the public health risk. Microbiological surveillance should therefore be prioritized and embedded in routine water quality management at the Kampil Dam. Vorosmarty et al. (2010) emphasized that multiple interacting anthropogenic stressors must be assessed holistically, because their combined effects on freshwater ecosystems and human water security exceed the sum of their individual contributions.

Looking forward, the situation at Kampil Dam reflects a broader regional pattern. Sub-Saharan Africa is projected to become the dominant global hotspot of surface water pollution by 2100, driven by accelerating urbanization and agricultural expansion in the absence of commensurate investment in sanitation and water treatment (Jones et al., 2023). Proactive, integrated catchment management, combining land-use regulation, source control, community engagement, and upgraded treatment, is essential to reverse this trajectory.

## 4. Conclusions

This study shows that the Kampil Dam in Dalaba, Guinea, is subject to significant and multifaceted anthropogenic pressure from agriculture, urbanization, domestic waste, and brickmaking. Physicochemical parameters remained broadly stable, with significant variation limited to pH

between seasons and to turbidity and salinity between stations. In contrast, microbiological quality was critically compromised throughout the study: TC, FC, and ST concentrations exceeded the WHO (2022) limits at all stations and in all campaigns. Total coliform loads peaked in the rainy season, which may be consistent with runoff-driven contamination. These conclusions are limited by the small number of campaigns and stations, the absence of rainfall records and GIS-based land-use mapping, and the use of an adapted colony-count method. Nevertheless, the findings indicate that, in its current state, dam water may pose a significant public health risk if it is not adequately treated.

Future research should extend the analyses to heavy metals and antimicrobial resistance genes, two emerging threats increasingly reported in anthropogenically impacted West African surface waters. It should also determine major anions and cations, which would allow the suitability of the water for irrigation to be assessed, and integrate GIS-based land-use mapping and rainfall records to relate specific activities spatially to water quality.

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## Author Declarations

**Authors' contributions:** Concept and design: A.D., S.K., O.B. and M.L.K.; Field sampling and laboratory analyses: N.T., S.E., M.L.K and P.F.L.; Statistical analysis: A.D. and M.F.; Writing original draft: A.D. and O.B.; Supervision: S.E and W.T.

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## References

Ayenew, T. (2020). Seasonal variation in water quality parameters of tropical reservoirs. *Environmental Monitoring and Assessment, 192*, 1-14. https://doi.org/10.1007/s10661-020-08012-6

Byekwaso, F., Langergraber, G., Weigelhofer, G., Kaggwa, R., Kansiime, F., & Hein, T. (2026). Anthropogenic and natural factors impacting microbiological and physicochemical surface water quality along an urban tropical wetland. *Journal of Water, Sanitation and Hygiene for Development, 16*(2), 108-123. https://doi.org/10.2166/washdev.2026.125

Camara, S., & Bangoura, A. (2017). Valorisation des ressources en eau en Guinée en vue d'un développement économique, social et durable. *Journal of Water and Environmental Sciences, 1*(COP22 special issue), 106-114.

Chen, S. S., Kimirei, I. A., Yu, C., Shen, Q., & Gao, Q. (2022). Assessment of urban river water pollution with urbanization in East Africa. *Environmental Science and Pollution Research, 29*(27), 40812-40825. https://doi.org/10.1007/s11356-021-18082-1

Engdaw, F., Fetahi, T., & Kifle, D. (2025). Increasing anthropogenic stressors influenced the water quality and shifted trophic status of northern Lake Tana Gulf, Ethiopia. *Heliyon, 11*(1), e41162. https://doi.org/10.1016/j.heliyon.2024.e41162

Hounkpe, J. B., Kelome, N. C., Lawani, R. A. N., & Adechina, A. R. M. A. (2017). État des lieux de la pollution des écosystèmes aquatiques au Bénin (Afrique de l'Ouest). *Larhyss Journal, 30*, 149-171.
Izah, S. C., & Ogwu, M. C. (2025). Modeling solutions for microbial water contamination in the global south for public health protection. *Frontiers in Microbiology, 16*, 1504829. https://doi.org/10.3389/fmicb.2025.1504829
Jones, E. R., Bierkens, M. F. P., van Puijenbroek, P. J. T. M., van Beek, L. P. H., Wanders, N., Sutanudjaja, E. H., & van Vliet, M. T. H. (2023). Sub-Saharan Africa will increasingly become the dominant hotspot of surface water pollution. *Nature Water, 1*, 602-613. https://doi.org/10.1038/s44221-023-00105-5
Khatri, N., & Tyagi, S. (2015). Influences of natural and anthropogenic factors on surface and groundwater quality in rural and urban areas. *Frontiers in Life Science, 8*(1), 23-39. https://doi.org/10.1080/21553769.2014.933716
Maguvu, T. E., Bezuidenhout, C. C., Kritzinger, R., Tsholo, K., Plaatjie, M., Molale-Tom, L. G., Mienie, C. M., & Coertze, R. D. (2020). Combining physicochemical properties and microbiome data to evaluate the water quality of South African drinking water production plants. *PLOS ONE, 15*(8), e0237335. https://doi.org/10.1371/journal.pone.0237335
Mpandeli, S., Liphadzi, S., Mabhaudhi, C., Mabhaudhi, T., & Nhamo, L. (2024). Assessing the impact of anthropogenically modified land uses on wetland health: Case of Witbank Dam catchment in South Africa. *Water, 16*(16), 2287. https://doi.org/10.3390/w16162287
Ouyang, Y. (2015). Seasonal variations in water temperature and dissolved oxygen of subtropical reservoirs. *Journal of Hydrology, 530*, 457-468. https://doi.org/10.1016/j.jhydrol.2015.10.025
Pericherla, S., Karnena, M. K., & Vara, S. (2020). A review on impacts of agricultural runoff on freshwater resources. *International Journal on Emerging Technologies, 11*(2), 829-833.
Pwema, K. V., Nsimanda, I. C., Woto, K. G., Nyami, P. J., Mbuyamba, M. T., Kitoko, F. P., Ngombe, M. D., & Lusasi, S. W. (2024). Influence des activités anthropiques sur les ressources halieutiques dans les hydrosystèmes du groupement Kasambanza, Secteur Luniungu, Territoire de Bulungu, Province du Kwilu en République Démocratique du Congo. *Revue Congolaise des Sciences et Technologies, 3*(4). https://doi.org/10.59228/rcst.024.v3.i4.108
Reitter, C., Petzoldt, H., Korth, A., Schwab, F., Stange, C., Hambsch, B., Tiehm, A., Lagkouvardos, I., Gescher, J., & Hügler, M. (2021). Seasonal dynamics in the number and composition of coliform bacteria in drinking water reservoirs. *Science of the Total Environment, 787*, 147539. https://doi.org/10.1016/j.scitotenv.2021.147539
Sitotaw, B., & Geremew, M. (2021). Bacteriological and physicochemical quality of drinking water in Adis Kidame Town, Northwest Ethiopia. *International Journal of Microbiology, 2021*, 6669754. https://doi.org/10.1155/2021/6669754
Tambi, A., Brighu, U., & Gupta, A. B. (2023). Methods for detection and enumeration of coliforms in drinking water: A review. *Water Supply, 23*(10), 4047-4058. https://doi.org/10.2166/ws.2023.247
Vorosmarty, C. J., McIntyre, P. B., Gessner, M. O., Dudgeon, D., Prusevich, A., Green, P., Glidden, S., Bunn, S. E., Sullivan, C. A., Liermann, C. R., & Davies, P. M. (2010). Global threats to human water security and river biodiversity. *Nature, 467*, 555-561. https://doi.org/10.1038/nature09440
World Health Organization. (2022). *Guidelines for drinking-water quality: Fourth edition incorporating the first and second addenda*. WHO. ISBN 978-92-4-004506-4.
World Water Assessment Programme. (2019). *The United Nations world water development report 2019: Leaving no one behind*. UNESCO. ISBN 978-92-3-100309-7. https://unesdoc.unesco.org/ark:/48223/pf0000367306

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