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(RESEARCH ARTICLE)

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Impact of untreated wastewater discharges from high-rise buildings on the water quality of the Niger river in Bamako

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Abstract

Rapid urban growth in Bamako, characterized by the proliferation of high-rise residential buildings (S+R+6 and above), has led to a significant increase in domestic wastewater production. In the absence of adequate collective sanitation systems, a large proportion of this wastewater is discharged untreated into the Niger River, the main receiving water body of the city. This study assesses the environmental impact of untreated wastewater discharges from high-rise buildings on the physico-chemical quality of the Niger River and demonstrates the effectiveness of prior treatment using a faecal sludge treatment plant (FSTP). A comparative approach was adopted, combining field sampling, laboratory analyses, and compliance assessment against international standards. The results reveal substantial degradation of river water quality downstream of discharge points, marked by elevated biochemical oxygen demand (BOD_5), chemical oxygen demand (COD), suspended solids, and nutrients. After treatment, a significant reduction in pollutant loads was observed, with effluent quality approaching international guideline values. The findings highlight the urgent need for structured collective sanitation solutions for high-rise buildings and provide valuable insights for sustainable urban water management in West African cities.

Keywords: Drinking water supply; Suburbs of Bamako; Unplanned urbanization

1. Introduction

Surface water resources play a crucial role in ensuring water supply, food security, ecosystem stability, and socio-economic development. In rapidly urbanizing regions of Sub-Saharan Africa, rivers flowing through major cities are increasingly exposed to intense anthropogenic pressures, particularly from domestic wastewater discharges (Dejoux, 1988; UNEP, 2018).

The Niger River is the backbone of Mali's hydrological system and a vital resource for the city of Bamako. Beyond its ecological and hydrological importance, the river supports domestic water supply, irrigation, fisheries, and cultural activities. However, the accelerated and often unplanned urban expansion of Bamako has significantly altered the balance between wastewater generation and treatment capacity. The recent emergence of high-rise residential buildings along the riverbanks has further intensified this imbalance, resulting in large volumes of untreated wastewater being discharged directly or indirectly into the river (Diallo et al., 2022; World Bank, 2020).

Several studies have documented the adverse impacts of urban wastewater discharges on surface water quality in African cities, including organic pollution, nutrient enrichment, and microbiological contamination (Yapo et al., 2019; Traoré et al., 2021). Nevertheless, limited research has specifically addressed the contribution of high-rise buildings to

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river pollution and the potential of decentralized treatment systems, such as faecal sludge treatment plants (FSTPs), to mitigate these impacts.

The main objective of this study is therefore to evaluate the impact of untreated wastewater from high-rise buildings on the water quality of the Niger River in Bamako and to assess the effectiveness of prior treatment using an FSTP as a sustainable sanitation solution adapted to dense urban environments.

2. Study Area

The study was conducted in the urban district of Bamako, the capital city of Mali, located in the central part of the country. The Niger River flows through the city over a distance of approximately 20 km, dividing it into two main banks. The climate is Sudano-Sahelian, characterized by a long dry season (October–May) and a rainy season (June–September), during which river discharge increases significantly.

High-rise buildings targeted in this study are mainly located in densely urbanized neighborhoods along the riverbanks. These buildings generate substantial quantities of domestic wastewater (blackwater and greywater), which are often discharged through overloaded septic systems or directly into the environment due to the lack of adequate collective sanitation infrastructure.

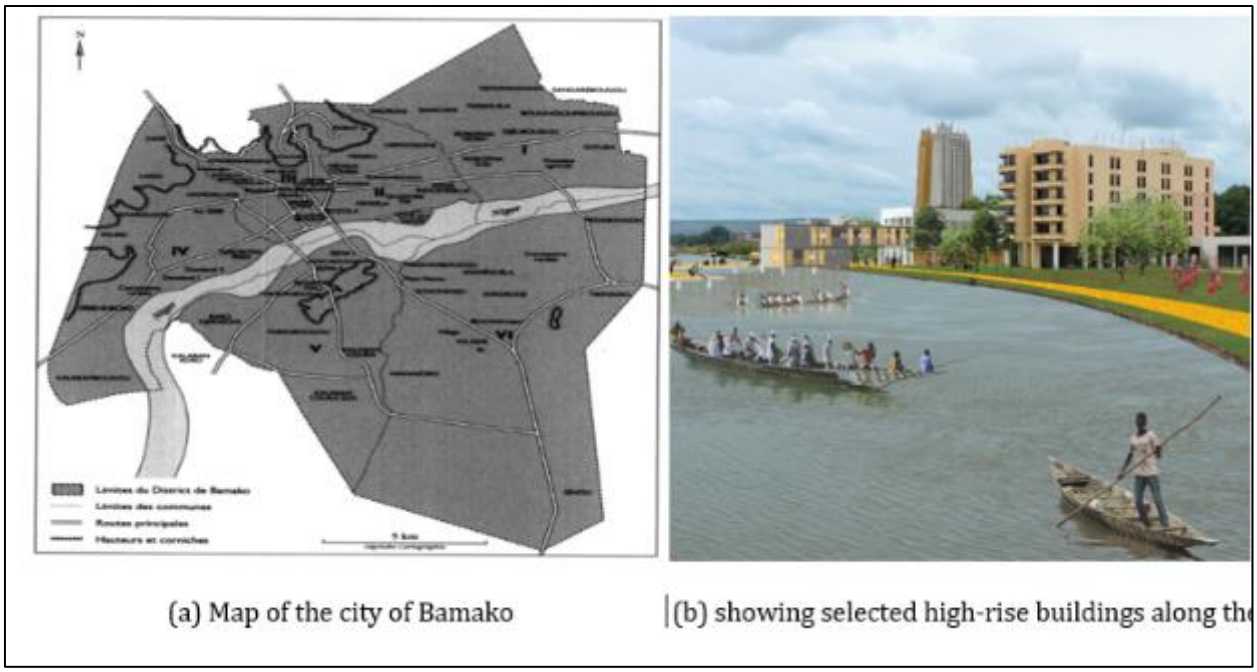


Figure 1 Location of the study area

3. Materials and Methods

3.1. Overall Approach

A comparative "before-and-after treatment" approach was adopted to assess the impact of wastewater discharges on river water quality and the performance of the faecal sludge treatment plant.

3.2. Sampling Strategy and Analytical Methods

Wastewater samples were collected at the outlets of selected high-rise buildings before treatment and at the outlet of the FSTP after treatment. River water samples were taken upstream and downstream of the discharge points.

The following physico-chemical parameters were analyzed: temperature, pH, biochemical oxygen demand (BOD_5), chemical oxygen demand (COD), total suspended solids (TSS), ammonium (NH_4^+), nitrates (NO_3^-), and phosphates (PO_4^{3-}).

All analyses were performed according to standard methods recommended by APHA (2017). The results were compared with World Health Organization (WHO) guidelines and United Nations Environment Programme (UNEP) recommendations for wastewater discharge and surface water quality.

4. Results

4.1. Degradation of River Water Quality Downstream of Discharges

The results show a marked deterioration of water quality downstream of untreated wastewater discharge points. BOD_5 concentrations frequently exceeded 50 mg/L, indicating a high load of biodegradable organic matter. COD and TSS values also increased significantly downstream, reflecting strong anthropogenic pressure on the river.

Nutrient concentrations (NH_4^+ and PO_4^{3-}) were elevated in downstream samples, suggesting a high risk of eutrophication. Similar trends have been reported in other West African rivers affected by urban wastewater discharges (Konaré et al., 2022; Yapo et al., 2019).

Figure 2 Illustration of wastewater discharge before and after treatment

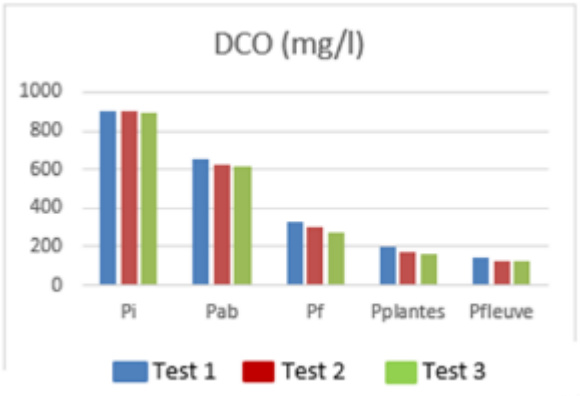
4.2. Performance of the Faecal Sludge Treatment Plant

After treatment through the FSTP, substantial reductions in pollutant concentrations were observed. BOD_5 and COD were reduced by more than 70% and 65%, respectively, while TSS levels dropped below 30 mg/L. Nutrient concentrations also decreased significantly, demonstrating the plant's capacity to reduce both organic and nutrient pollution.

These results are consistent with findings by Toure et al. (2024), who highlighted the effectiveness of FSTPs in treating high-strength domestic wastewater in dense urban settings.

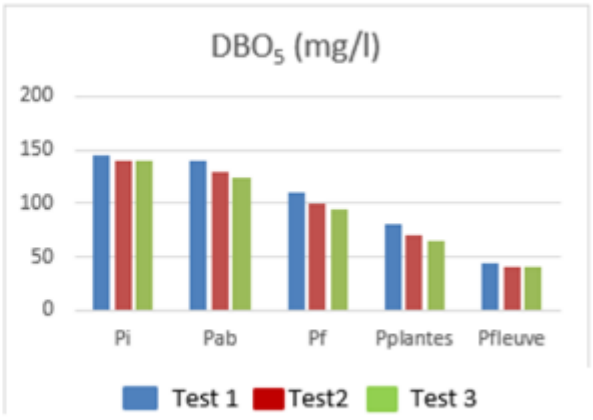
DCO (mg/l)

Parameters	Test 1	Test 2	Test 3
Pi	900	900	895
Pab	650	625	620
Pf	325	300	270
Pplants	195	170	165
P.River	140	130	125



DBO5 (mg/l)

Parameters	Test 1	Test 2	Test 3
Pi	145	140	140
Pab	140	130	125
Pf	110	100	95
Pplants	80	70	65
P.River	45	40	40



COD (mg/l)

Parameters	Test 1	Test 2	Test 3
Pi	0,11	0,11	0,12
Pab	0,15	0,16	0,16
Pf	0,17	0,19	0,2
Pplants	0,43	0,47	0,55
P.Rivers	4	4,1	4,2

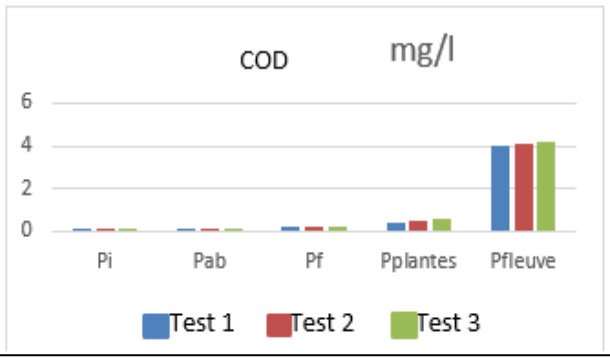


Figure 3 Graphs of the analyzed parameters

4.3. Improvement of River Water Quality After Treated Discharges

Downstream river samples collected after the implementation of wastewater treatment showed a gradual improvement in water quality. The positive impact of treatment was particularly evident during the dry season, when river flow is low and dilution capacity is limited. Under these conditions, untreated discharges have a stronger impact, making treatment interventions even more critical.

5. Discussion

5.1. Contribution of High-Rise Buildings to Urban River Pollution

The findings confirm that high-rise buildings represent significant point sources of organic and nutrient pollution in urban environments. The high concentration of wastewater generated per unit area exacerbates the pressure on receiving water bodies, especially in cities lacking collective sewerage systems (World Bank, 2020; Traoré et al., 2021).

5.2. Relevance of FSTPs as Urban Sanitation Solutions

The observed performance of the FSTP demonstrates its suitability as a decentralized sanitation solution for high-density urban areas. Unlike conventional sewer systems, FSTPs require lower investment costs and can be adapted to local socio-economic and spatial constraints (UNEP, 2018; Toure et al., 2024).

5.3. Environmental and Hydrological Implications

Reducing pollutant loads through prior treatment contributes to limiting eutrophication, preserving aquatic ecosystems, and improving public health conditions. According to Dejoux (1988), controlling urban wastewater discharges is a prerequisite for maintaining the ecological integrity of African rivers. The results of this study reinforce this assertion and provide empirical evidence supporting integrated urban water management strategies.

6. Conclusion

This study demonstrates the significant negative impact of untreated wastewater discharges from high-rise buildings on the water quality of the Niger River in Bamako. The results clearly show that prior treatment using a faecal sludge treatment plant can substantially reduce pollutant loads and improve the quality of the receiving water body.

Implementing collective and decentralized sanitation solutions adapted to high-rise buildings is therefore essential for sustainable urban development in Bamako and similar West African cities. The findings provide a strong scientific basis for policy formulation, infrastructure planning, and further research on urban wastewater management in rapidly growing cities.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

References

[1] APHA. (2017). Standard methods for the examination of water and wastewater. American Public Health Association.

[2] Dejoux, C. (1988), la pollution des eaux continentales africaines ; expériences acquises, situation actuelle et perspectives. Edition de l'ORSTOM, Collection TRAVAUX et DOCUMENTS n°213 Paris 1988. 513p.

[3] Diallo, A. D., Traoré, S., & Konaré, M. (2022). Urban pollution in West African rivers. Journal of Environmental Management, 310, 114–125.

[4] Konaré, M., Traoré, A., & Zoma, I. E. (2022). Assessment of surface water quality using water quality indices. Environmental Monitoring and Assessment, 194(6), 1–15.

[5] Traoré, A., Samaké, M., & Diallo, S. (2021). Urban sanitation challenges in Sahelian cities. Journal of Water and Health, 19(4), 612–624.

[6] Toure, A., Diallo, S., & Ba, M. (2024). Experimentation of a faecal sludge treatment plant for high-rise buildings sanitation in Bamako. Afriquesciences, 20(3), 45–58.

[7] UNEP. (2018). Water quality guidelines. United Nations Environment Programme.

[8] WHO. (2017). Guidelines for drinking-water quality. World Health Organization.

[9] World Bank. (2020). Urban sanitation and water pollution in Sub-Saharan Africa. World Bank Publications.

[10] Yapo, O. B., Kouamé, K., & Koné, D. (2019). Domestic wastewater management in African cities. Water Practice and Technology, 14(2), 354–365.