



Long-term Efficacy of Wastewater Treatment Technologies in South African Coastal Cities on Bacterial Contaminant Reduction

Sipho Mphela¹, Tshiamo Mogapi^{1,2}

¹ University of the Witwatersrand

² North-West University

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Correspondence: smpihela@yahoo.com

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Author notes

Sipho Mphela is affiliated with University of the Witwatersrand and focuses on Medicine research in Africa.

Tshiamo Mogapi is affiliated with North-West University and focuses on Medicine research in Africa.

Abstract

Wastewater treatment technologies are crucial for reducing bacterial contaminants in coastal cities of South Africa, where environmental health is a significant public concern. A longitudinal study design was employed to track the performance and acceptance of different wastewater treatment methods in South African cities. Data collection included surveys, monitoring water quality parameters, and periodic assessments of technology adoption rates. Over a five-year period, significant reductions in bacterial contaminant levels were observed where advanced treatment technologies were implemented, with an average reduction rate of 75% for *Escherichia coli* compared to initial baseline conditions. However, the variability across different municipalities highlighted challenges related to technology maintenance and cost. The study underscores the effectiveness of certain wastewater treatment methods in reducing bacterial contaminants but also identifies barriers such as funding constraints and operational inefficiencies that need addressing to ensure consistent efficacy and sustainability. Investment strategies should prioritise the adoption of robust, economically feasible wastewater treatment technologies with strong community engagement for effective long-term implementation. Enhanced monitoring and maintenance protocols are recommended to maintain treatment performance. Treatment effect was estimated with $\text{logit}(\pi) = \beta_0 + \beta_1 X_i$, and uncertainty reported using confidence-interval based inference.

Keywords: *Longitudinal study, wastewater treatment, bacterial contaminants, South Africa, coastal cities, public health, environmental epidemiology*

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