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Bayesian Hierarchical Model Assessment of Water Treatment Facility Efficiency in Nigeria, 2009

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Abstract

Water treatment facilities in Nigeria often face challenges related to efficiency, which can affect their ability to meet public health standards and environmental regulations. A Bayesian hierarchical model was employed to analyse data from multiple water treatment plants. The model accounts for both facility-specific and site-level variations, incorporating prior knowledge about the efficiency of similar systems in other regions. The analysis revealed that certain facilities showed significant room for improvement in terms of energy use and chemical dosing, with proportions exceeding 20% underperforming relative to best practices identified from benchmark studies. This study highlights the potential for substantial efficiency gains through targeted interventions, suggesting improvements could lead to cost savings and better environmental outcomes. Facility managers should focus on optimising energy consumption and chemical dosages based on findings from this analysis. Additionally, regular maintenance and training programmes can enhance overall performance. The maintenance outcome was modelled as $Y\{\} = beta\,0 + beta\,1\,X\{\} + ui + varepsilon\{\}$, with robustness checked using heteroskedasticity-consistent errors.

Keywords: *Bayesian statistics, Hierarchical modelling, Water treatment systems, Nigeria geography, Methodological evaluation, Quantile regression, Spatial analysis*

ABSTRACT-ONLY PUBLICATION

This is an abstract-only publication. The complete research paper with full methodology, results, discussion, and references is available upon request.

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