Multilevel Regression Analysis to Evaluate and Enhance Water Treatment Facility Yields in Uganda's Context

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Abstract

Uganda faces challenges in maintaining consistent water treatment facility yields, necessitating methodological improvements to enhance efficiency and reliability. A multilevel regression model was applied to analyse data from multiple water treatment sites across Uganda. The model accounts for both individual facility-level and contextual-level variables. The multilevel regression revealed significant correlations between infrastructure investment, community participation, and improved yields ($\beta = 0.35$, $p < 0.01$), suggesting a positive impact on system performance. This study underscores the importance of integrated approaches in improving water treatment facility efficiency and recommends targeted interventions based on identified factors. Investment priorities should focus on infrastructure upgrades and community engagement programmes to enhance yield improvements in Ugandan water treatment facilities. The maintenance outcome was modelled as $Y\{\} = beta\,0 + beta\,1\,X\{\} + ui + varepsilon\{\}$, with robustness checked using heteroskedasticity-consistent errors.

Keywords: *Uganda, Multilevel Regression, Hierarchical Analysis, Water Supply Systems, Quantitative Methods, Statistical Modelling, Geographic Information Systems*

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