



# Multilevel Regression Analysis for Evaluating Cost-Effectiveness of Water Treatment Facilities in Rwanda: An Engineering Perspective

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## Abstract

Rwanda faces challenges in ensuring equitable access to safe drinking water for its population, necessitating robust evaluation of existing and proposed water treatment facilities (WTFs). A multilevel regression model was employed to analyse data from WTFs across different regions in Rwanda, accounting for both fixed effects (e.g., facility type) and random effects (e.g., regional variations). The analysis revealed that the cost-effectiveness of WTFs varied significantly by region, with some facilities showing substantial cost savings compared to initial estimates. This study provides a nuanced understanding of the performance variability among WTFs in Rwanda and offers insights for policymakers and engineers aiming to improve water safety at lower costs. Policymakers should prioritise investments in regions where existing facilities demonstrate high cost-effectiveness, while considering regional-specific interventions for less effective setups. The maintenance outcome was modelled as  $Y_i = \beta_0 + \beta_1 X_i + u_i + \varepsilon_i$ , with robustness checked using heteroskedasticity-consistent errors.

**Keywords:** *Geographic, Multilevel, Regression, Cost-Effectiveness, Water, Treatment, Facilities, Rwanda*



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