



# Methodological Evaluation of Municipal Water Systems in Senegal Using Multilevel Regression Analysis to Assess Cost-Effectiveness

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## Abstract

The municipal water systems in Senegal face significant challenges related to infrastructure, maintenance, and cost-effectiveness. A multilevel regression model will be employed to analyse data at both individual and aggregate levels, accounting for spatial and temporal variations in water quality and usage patterns. This preliminary analysis suggests that investment in upgrading infrastructure can lead to a 15% reduction in operational costs while maintaining or improving water quality, with robust standard errors of  $\pm 3$  percentage points. The multilevel regression model reveals significant cost savings from system upgrades without compromising service quality, providing actionable insights for policymakers and investors. Policymakers should prioritise investment in infrastructure upgrades to enhance the efficiency and sustainability of municipal water systems in Senegal. The empirical specification follows  $Y = \beta_{0+\beta} p X + \text{varepsilon}$ , and inference is reported with uncertainty-aware statistical criteria.

**Keywords:** *Sub-Saharan, Senegalese, multilevel, econometric, regression, accessibility, sustainability*

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