



Methodological Evaluation of Municipal Water Systems in Senegal Using Multilevel Regression Analysis for Efficiency Gains

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Abstract

This Data Descriptor focuses on the evaluation of municipal water systems in Senegal through a methodological approach that employs multilevel regression analysis. Multilevel regression analysis was applied at two levels: individual water points (level 1) nested within villages (level 2), aiming to account for both micro-level operational variables and macro-level contextual influences. The model includes fixed effects for village characteristics, random intercepts for each village, and control variables such as population density and climate data. The analysis revealed significant variance in water point efficiency across villages, with a coefficient of determination (R^2) of approximately 0.65 indicating that the multilevel model accounts for around 65% of the variability in system performance. This study demonstrates the utility and effectiveness of using multilevel regression analysis to evaluate municipal water systems in Senegal, providing insights into factors affecting efficiency and potential areas for intervention. Future research should explore additional policy mechanisms aimed at enhancing water point performance based on these findings. Policy recommendations include targeted interventions within villages identified as having particularly low system efficiencies. Model estimation used $\hat{\theta} = \operatorname{argmin}\{\theta\} \operatorname{sumiell}(y_i, f\theta(\xi)) + \lambda \operatorname{Vert}\theta \operatorname{rVert} 2^2$, with performance evaluated using out-of-sample error.

Keywords: Sub-Saharan, multilevel, regression, stratified, econometric, performance, accessibility

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