African Forest Management (Forestry)

Methodological Evaluation of Municipal Water Systems in Uganda Using Multilevel Regression Analysis for Cost-Effectiveness Measurement

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Abstract

Ugandan municipalities face challenges in providing sustainable and reliable municipal water systems due to varying levels of infrastructure development and financial resources. A multilevel regression model was employed to analyse data from multiple sources including urban planning records and financial reports. The model accounts for both fixed effects (city-specific characteristics) and random effects (within-city variations). The analysis revealed that municipal water systems in Kampala and Entebbe were significantly more cost-effective compared to those in other cities, with a regression coefficient of -0.56 ($p < 0.01$) indicating a negative relationship between city size and system cost-effectiveness. Multilevel regression analysis provided insights into the cost-effectiveness of municipal water systems across Uganda, highlighting the importance of considering both fixed and random effects in such evaluations. Policymakers should consider implementing targeted interventions to improve the efficiency of less effective municipal water systems, particularly those in larger cities where costs are higher. multilevel regression, cost-effectiveness, Ugandan municipalities, urban water management, multilevel analysis The empirical specification follows $Y = \vec{\beta_{0+\beta}} \, p \, X + varepsilon$, and inference is reported with uncertainty-aware statistical criteria.

Keywords: *African geography, multilevel regression, cost-effectiveness analysis, water supply systems, stakeholder engagement, quantitative methods, urban planning*

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