



Methodological Evaluation of Municipal Water Systems in South Africa Using Multilevel Regression Analysis for Efficiency Assessment,

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Abstract

This scoping review evaluates methodological approaches used in assessing municipal water systems efficiency in South Africa. Multilevel regression analysis was used to measure efficiency gains across municipal water systems. The review considers various levels of analysis, including national, provincial, and local government units. A key finding is the variation in efficiency estimates between different hierarchical levels (national vs. local), highlighting data collection inconsistencies at lower administrative tiers which affect overall system performance evaluations. The study concludes that multilevel regression analysis, when properly applied at all relevant levels of government, can enhance the accuracy and reliability of municipal water systems' efficiency assessments in South Africa. Recommendations include standardising data collection protocols across administrative boundaries to ensure more consistent and comparable performance metrics. The empirical specification follows $Y = \beta_{0+\beta} p X + \text{varepsilon}$, and inference is reported with uncertainty-aware statistical criteria.

Keywords: *Sub-Saharan, regression, multilevel, econometrics, sustainability, infrastructure, performance*

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