African Forest Ecology (Environmental Science)

Multilevel Regression Analysis to Evaluate Municipal Water System Reliability in South Africa's Urban Settings

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Abstract

Municipal water systems in South Africa face challenges such as infrastructure degradation and fluctuating demand, impacting reliability and public health. A multilevel regression model was applied to assess the impact of socioeconomic variables at both local (e.g., population density) and national levels on municipal water systems' reliability. Uncertainty in estimates is addressed with robust standard errors. The analysis revealed that a 10% increase in urban population density corresponds to a 2% decrease in system reliability, indicating the importance of considering local context for improved management strategies. Multilevel regression analysis provided insights into the determinants of municipal water systems' reliability in South Africa, offering a robust framework for future research and policy development. Policy makers should integrate socioeconomic data into decision-making processes to enhance system performance and resilience. The empirical specification follows $Y = \beta_{0+\beta}^{\rightarrow} p\, X + varepsilon$, and inference is reported with uncertainty-aware statistical criteria.

Keywords: *African Geography, Multilevel Regression, Water Supply Systems, Quantitative Methods, Public Health Analytics, System Reliability, Urban Planning Techniques*

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