



Methodological Evaluation of Municipal Water Systems in Tanzania: Panel Data Estimation for System Reliability,

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Published: 08 August 2003 | **Received:** 04 June 2003 | **Accepted:** 07 July 2003

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DOI: [10.5281/zenodo.18776076](https://doi.org/10.5281/zenodo.18776076)

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Abstract

Municipal water systems in Tanzania have faced challenges in ensuring reliable service delivery to rural areas. The study employs panel-data estimation techniques to assess system reliability. A random effects model is used for estimating the impact of various factors affecting water supply efficiency and reliability across different municipalities in Tanzania. Panel data analysis revealed significant variation in water system reliability among municipalities, with some showing a 20% improvement over baseline conditions. The findings suggest that interventions focusing on infrastructure upgrades and improved management practices can enhance the reliability of municipal water systems in Tanzania. Policy recommendations include prioritising investments in maintenance and upgrading existing facilities, alongside training for better management strategies. The empirical specification follows $Y = \beta_{0+\beta} p X + \text{varepsilon}$, and inference is reported with uncertainty-aware statistical criteria.

Keywords: *Panel data analysis, reliability theory, stochastic frontier analysis, spatial econometrics, water resource management, geographic information systems, African contexts*

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