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POLICY ANALYSIS

A Bayesian Hierarchical Model for Evaluating Water Treatment System Adoption in South Africa

A Policy Analysis for Infrastructure Governance

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ABSTRACT

Background: The governance of water treatment infrastructure in South Africa faces significant challenges, including variable adoption rates of advanced systems and a lack of robust, data-driven evaluation frameworks for policy intervention. Existing assessments often rely on aggregate statistics that mask critical regional and technical heterogeneities.

Purpose and objectives: This policy analysis aims to develop and demonstrate a novel Bayesian hierarchical modelling framework to evaluate the determinants of water treatment system adoption. The objective is to provide a methodological tool for infrastructure governance that quantifies adoption drivers and their uncertainties, informing targeted policy.

Keywords: *Bayesian hierarchical modelling, infrastructure governance, water treatment systems, Sub-Saharan Africa, policy analysis, technology adoption*

Article Highlights

- Bayesian hierarchical model quantifies adoption drivers and their uncertainties for targeted policy.
- Substantial regional variation captured via municipality-level random effects in the analysis.
- Framework shifts policy focus from capital expenditure to sustained operational funding.
- Probabilistic, multi-level modelling recommended for diagnosing infrastructure adoption barriers.

Methodological Contribution

A novel Bayesian hierarchical logistic model integrates multi-level data on technical, financial, and institutional factors to evaluate water treatment system adoption, providing a tool for evidence-based infrastructure governance.

This analysis provides a data-driven framework for rethinking water infrastructure policy in Sub-Saharan Africa.

ABSTRACT-ONLY PUBLICATION

This is an abstract-only publication. The complete research paper with full methodology, results, discussion, and references is available upon request.

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