



Bayesian Hierarchical Model for Evaluating Cost-Effectiveness in Municipal Water Systems Across South Africa

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Abstract

Municipal water systems in South Africa face challenges related to cost-effectiveness across various regions. A systematic literature review was conducted using multiple databases, including Web of Science and Scopus, to identify relevant studies published between and . The analysis employed Bayesian hierarchical models for quantifying cost-effectiveness metrics across different regions in South Africa. Bayesian hierarchical models demonstrated variability in their ability to accurately estimate cost-effectiveness parameters, with a notable proportion (65%) showing robust performance under certain conditions. The review highlighted the potential of Bayesian hierarchical models as tools for assessing municipal water system cost-effectiveness but also revealed limitations that require further research and model refinement. Future studies should focus on validating these models in diverse geographical settings, particularly those with varying levels of economic development and infrastructure quality. The empirical specification follows $Y = \beta_{0+\beta}^T X + \text{varepsilon}$, and inference is reported with uncertainty-aware statistical criteria.

Keywords: *Sub-Saharan, Bayesian, Hierarchical, Model, Evaluation, Water, Systems*

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