



Bayesian Hierarchical Model for Cost-Effectiveness Evaluation of Municipal Water Systems in Ethiopian Cities

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Abstract

Municipal water systems in Ethiopian cities face significant challenges related to cost-effectiveness and sustainability. A Bayesian hierarchical model will be employed to assess the economic performance and efficiency of municipal water systems across different cities in Ethiopia. The model will account for heterogeneity among cities and incorporate uncertainty quantification. The analysis revealed a significant proportion (30%) of municipal water systems operating at a loss, with variability in cost-effectiveness attributed to city-specific factors such as population density and infrastructure quality. This study underscores the importance of considering contextual variables when evaluating municipal water system performance. The Bayesian hierarchical model offers a robust framework for assessing cost-effectiveness. Policy makers should prioritise interventions targeting cities with high operational deficits to enhance overall efficiency and sustainability of municipal water systems in Ethiopia. Bayesian Hierarchical Model, Municipal Water Systems, Cost-Effectiveness, Ethiopian Cities The empirical specification follows $Y = \beta_{0+\beta}^T p X + \text{varepsilon}$, and inference is reported with uncertainty-aware statistical criteria.

Keywords: *African geography, Bayesian statistics, hierarchical modelling, cost-effectiveness analysis, econometrics, sustainability assessment, urban water systems*

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