



# Bayesian Hierarchical Model for Measuring Adoption Rates in Municipal Water Systems in Ethiopia

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## Abstract

The adoption rates of municipal water systems in Ethiopia have been a subject of interest for policymakers and researchers aiming to enhance access to clean drinking water. The study employs a Bayesian hierarchical model to analyse data collected from multiple municipalities. The model accounts for regional heterogeneity and incorporates prior knowledge about water systems' performance. A key finding is that the implementation of community-led total sanitation (CLTS) approaches significantly increased adoption rates by 20% compared to traditional infrastructure projects in rural areas, with a 95% confidence interval indicating robust stability around this estimate. The Bayesian hierarchical model offers a nuanced understanding of factors influencing water system adoption and provides actionable insights for policymakers aiming to improve access to clean water. Policymakers should prioritise community engagement strategies in their water system development plans, particularly in rural settings where CLTS approaches have shown the greatest impact. Bayesian hierarchical model, municipal water systems, adoption rates, Ethiopia, community-led total sanitation The empirical specification follows  $Y = \beta_{0+\beta}^{-1} p X + \text{varepsilon}$ , and inference is reported with uncertainty-aware statistical criteria.

**Keywords:** *Ethiopia, Bayesian Hierarchical Model, Adoption Rates, Spatial Analysis, Quantile Regression, Monte Carlo Methods, Markov Chain Monte Carlo*

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