



Bayesian Hierarchical Model for Measuring Adoption Rates in Municipal Water Systems of Ghana: A Methodological Evaluation

Amoako Boateng^{1,2}, Quartey Amankrah^{3,4}, Agyingpong Asare^{1,5}, Kofi Mensah⁶

¹ Noguchi Memorial Institute for Medical Research

² Department of Cybersecurity, University for Development Studies (UDS)

³ Food Research Institute (FRI)

⁴ Water Research Institute (WRI)

⁵ University for Development Studies (UDS)

⁶ Department of Artificial Intelligence, Water Research Institute (WRI)

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Correspondence: aboateng@outlook.com

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Author notes

Amoako Boateng is affiliated with Noguchi Memorial Institute for Medical Research and focuses on Computer Science research in Africa.

Quartey Amankrah is affiliated with Food Research Institute (FRI) and focuses on Computer Science research in Africa. Agyingpong Asare is affiliated with Noguchi Memorial Institute for Medical Research and focuses on Computer Science research in Africa.

Kofi Mensah is affiliated with Department of Artificial Intelligence, Water Research Institute (WRI) and focuses on Computer Science research in Africa.

Abstract

The adoption of water management technologies in municipal systems is essential for improving public health outcomes and resource efficiency. A Bayesian hierarchical model was developed to analyse data from multiple municipalities. The model accounts for spatial and temporal variations using prior distributions informed by existing literature and field observations. The analysis revealed significant variation in adoption rates across different regions, with a notable increase in the use of advanced filtration systems over traditional methods. This study provides robust evidence to support the effectiveness of Bayesian hierarchical models for measuring adoption rates in municipal water systems. The identified factors offer insights into strategies for promoting technology adoption. Local governments and community organizations should prioritise interventions that address specific barriers, such as financial constraints and technological familiarity, to enhance overall adoption rates. Model estimation used $\hat{\theta} = \text{argmin} \{ \theta \} \text{sumiell} (y_i, f\theta(\xi)) + \lambda \text{Vert}\theta \text{rVert}^2$, with performance evaluated using out-of-sample error.

Keywords: *Bayesian statistics, hierarchical modelling, spatial analysis, econometrics, stochastic processes, predictive analytics, African geography*

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