



Methodological Evaluation of Municipal Water Systems in Kenya Using Panel Data for Cost-Effectiveness Analysis

Wambugu Kibet¹, Omondi Wanjohi², Orindi Chepkonga^{3,4}, Kipruto Muriuki³

¹ Pwani University

² Department of Artificial Intelligence, Jomo Kenyatta University of Agriculture and Technology (JKUAT)

³ Technical University of Kenya

⁴ Kenya Medical Research Institute (KEMRI)

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Correspondence: wkibet@outlook.com

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Author notes

Wambugu Kibet is affiliated with Pwani University and focuses on Computer Science research in Africa.

Omondi Wanjohi is affiliated with Department of Artificial Intelligence, Jomo Kenyatta University of Agriculture and Technology (JKUAT) and focuses on Computer Science research in Africa.

Orindi Chepkonga is affiliated with Technical University of Kenya and focuses on Computer Science research in Africa.

Kipruto Muriuki is affiliated with Technical University of Kenya and focuses on Computer Science research in Africa.

Abstract

This study addresses a current research gap in Computer Science concerning Methodological evaluation of municipal water systems systems in Kenya: panel-data estimation for measuring cost-effectiveness in Kenya. The objective is to formulate a rigorous model, state verifiable assumptions, and derive results with direct analytical or practical implications. A mixed-methods design was used, combining survey and interview data collected over the study period. The results establish bounded error under perturbation, a convergent estimation process under stated assumptions, and a stable link between the proposed metric and observed outcomes. The findings provide a reproducible analytical basis for subsequent theoretical and applied extensions. Stakeholders should prioritise inclusive, locally grounded strategies and improve data transparency. Methodological evaluation of municipal water systems systems in Kenya: panel-data estimation for measuring cost-effectiveness, Kenya, Africa, Computer Science, original research This work contributes a formal specification, transparent assumptions, and mathematically interpretable claims. Model estimation used $\hat{\theta} = \operatorname{argmin}\{\theta\} \operatorname{sumiell}(y_i, f\theta(\xi)) + \lambda \operatorname{Vert}\theta \operatorname{rVert} 2^2$, with performance evaluated using out-of-sample error.

Keywords: Kenyan, GIS, econometrics, panel-data, cost-benefit, sustainability, optimization

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