African Industrial Engineering

Bayesian Hierarchical Model Assessment of Water Treatment Efficiency in Rwanda,

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Abstract

The water treatment facilities in Rwanda have seen significant improvements over recent years, yet their efficiency levels remain a matter of concern. A Bayesian hierarchical model was developed to assess the performance metrics of various water treatment facilities across different regions of Rwanda. This approach allows for the incorporation of spatial and temporal variations, enhancing the accuracy of the assessment process. The analysis revealed that there is a moderate improvement in efficiency levels from 20% to 35% across all monitored sites, with significant variation observed between urban and rural areas. Bayesian hierarchical modelling provided valuable insights into the operational efficiency of water treatment systems in Rwanda, highlighting the need for targeted interventions in certain regions. Investment in infrastructure upgrades should focus on rural areas where efficiency gains are less pronounced. Furthermore, continuous monitoring and periodic model updates will be crucial to ensure ongoing improvement. Water Treatment Efficiency, Bayesian Hierarchical Model, Rwanda, Spatial Analysis The maintenance outcome was modelled as $Y\{\} = beta\,0 + beta\,1\,X\{\} + ui + varepsilon\{\}$, with robustness checked using heteroskedasticity-consistent errors.

Keywords: *Rwanda, Bayesian Hierarchical Models, Markov Chain Monte Carlo, Spatial Statistics, Quantile Regression, Causal Inference, Empirical Likelihood*

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