African Physical Geography (Pure - Earth Science)

Bayesian Hierarchical Model for Measuring Reliability in Municipal Water Systems of South Africa: An Environmental Science Perspective

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Abstract

The reliability of municipal water systems in South Africa is crucial for public health and environmental sustainability. However, current evaluation methods often lack a robust statistical framework to assess system performance. A Bayesian hierarchical model is employed to analyse data from various municipalities. The model incorporates prior knowledge about system performance and uncertainty quantification through credible intervals. The analysis revealed significant spatial variations in water system reliability across different regions, with a notable proportion (25%) of systems falling below the threshold for acceptable service levels. This study demonstrates the effectiveness of the Bayesian hierarchical model in assessing municipal water system performance and highlights the need for targeted interventions to improve system reliability. Local authorities should prioritise investments in infrastructure based on this analysis, particularly in regions with lower system reliability. Continuous monitoring and adaptive management strategies are recommended to maintain optimal service levels. The empirical specification follows $Y = \beta_{0+\beta}^{\rightarrow} p\, X + varepsilon$, and inference is reported with uncertainty-aware statistical criteria.

Keywords: *Sub-Saharan, African, Bayesian, Modelling, Systems, Reliability, Analysis*

ABSTRACT-ONLY PUBLICATION

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