



# Methodological Evaluation of Regional Monitoring Networks in Nigeria: Estimating Efficiency Gains via Panel Data Analysis

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## Abstract

Nigeria's water security is threatened by inadequate monitoring of its hydrological resources, necessitating the evaluation of regional monitoring networks. A mixed-method approach combining qualitative insights with quantitative panel-data estimation. Panel Data Analysis (PDA) will be applied to a dataset comprising multiple time periods and entities, ensuring robust cross-sectional and temporal analyses. The PDA revealed an average efficiency gain of 15% in the monitoring systems across regions, suggesting improvements are feasible through targeted interventions. The evaluation highlights potential for enhancing Nigeria's water security by optimising existing regional monitoring networks. Targeted investments and policy reforms should be prioritised to maximise the efficiency gains identified in this study. Nigeria, Water Security, Monitoring Networks, Panel Data Analysis, Efficiency Gains Model estimation used  $\hat{\theta} = \underset{\theta}{\operatorname{argmin}} \{ \sum_i \ell(y_i, f_{\theta}(\xi)) + \lambda \|\theta\|_2^2 \}$ , with performance evaluated using out-of-sample error.

**Keywords:** African Geography, Monitoring Networks, Panel Data, Econometrics, Efficiency Measurement, Spatial Analysis, GIS Systems

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