



# Methodological Assessment of Regional Monitoring Networks in Senegal: Panel Data Estimation for System Reliability Evaluation

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### Abstract

Regional monitoring networks in Senegal have been established to assess environmental conditions across various regions. These networks are crucial for policy-making and resource management but require rigorous evaluation. A mixed-method approach was employed, combining quantitative analysis with qualitative insights from interviews and literature review. Panel data were collected on network efficiency, coverage, and feedback mechanisms, analysed using generalized estimating equations (GEE). The GEE model revealed that the regional monitoring system in Senegal had a moderate reliability score, with significant variation across different regions. This study provides evidence-based insights into the current state of regional monitoring networks, highlighting areas where improvements are needed to enhance system effectiveness. Recommendation for enhancing network performance includes increasing funding for under-resourced regions and developing standardised protocols for data collection and analysis. Model estimation used  $\hat{\theta} = \underset{\theta}{\operatorname{argmin}} \{ \sum_{i=1}^n (y_i - f(\theta(\xi)))^2 + \lambda \|\theta\|_2^2 \}$ , with performance evaluated using out-of-sample error.

**Keywords:** *Sub-Saharan, Geographic Information Systems, Panel Data, Time Series Analysis, System Reliability, Sampling Theory, Spatial Statistics*

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