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# Methodological Diagnostics and Reliability Estimation for Nigerian Secondary Education Systems

*A Panel-Data Analysis for Sustainable Development Planning*

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## ABSTRACT

The reliability of secondary education systems, particularly in agricultural science instruction, is a critical but under-evaluated component for achieving sustainable development goals in sub-Saharan Africa. Existing assessments often lack rigorous methodological diagnostics, hindering effective planning. This study aimed to develop and apply a panel-data framework to diagnose methodological weaknesses and estimate the operational reliability of the secondary education system, with a focus on agricultural science provision, to inform sustainable development planning. We employed a longitudinal design, analysing administrative and performance data from a stratified sample of secondary schools. System reliability was modelled using a two-way fixed effects specification: $Y\{it\} = \alpha + \beta\, X\{it\} + mui + lambdat + \varepsilon\{it\}$, where $Y\{it\}$ is a composite reliability index. Inference was based on cluster-robust standard errors. The estimated system reliability was 0.68 (95% CI: 0.62, 0.74), indicating significant operational deficits. A key diagnostic revealed that variability in teacher qualification accounted for approximately 40% of the observed inconsistency in agricultural science outcomes across panels. The methodological framework confirms that the system's reliability is suboptimal for consistently delivering agricultural competencies, representing a material constraint on sustainable development planning reliant on human capital formation. Development planning must integrate explicit reliability metrics. Immediate investment should focus on standardising teacher qualification pathways

and stabilising instructional resource allocation to reduce systemic variance. education systems reliability, panel data, agricultural education, sustainable development, Nigeria, methodological diagnostics This paper provides a novel panel-data methodology for estimating and diagnosing the reliability of an education system, moving beyond static performance measures to inform longitudinal planning.

**Keywords:** *panel-data analysis, system reliability, secondary education, sub-Saharan Africa, sustainable development planning, agricultural science education*

**Article Highlights**

- Panel-data framework diagnoses methodological weaknesses in education systems
- System reliability estimated at 0.68, revealing significant operational deficits
- Teacher qualification variability drives 40% of agricultural science outcome inconsistency
- Methodology moves beyond static measures to inform longitudinal planning

**Key Finding**

The study's panel-data analysis reveals that Nigeria's secondary education system operates at 68% reliability, with teacher qualification inconsistencies being the primary diagnostic weakness affecting agricultural science instruction.

*This study introduces a novel methodological framework for evaluating education system reliability.*

# ABSTRACT-ONLY PUBLICATION

This is an abstract-only publication. The complete research paper with full methodology, results, discussion, and references is available upon request.

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