African Security Studies (Political Science focus)

Methodological Evaluation of Off-Grid Communities Systems in Ghana Using Panel Data for Cost-Effectiveness Analysis,

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Abstract

The study aims to evaluate the cost-effectiveness of off-grid communities systems in Ghana, focusing on their reliability and affordability over time. A mixed-method approach was employed, combining quantitative analysis with qualitative insights. Panel data were collected over five years (-) from community surveys and energy system performance metrics. Statistical models including regression analysis and propensity score matching were used to estimate cost-effectiveness and reliability. The panel data reveal that solar photovoltaic systems are the most reliable in terms of daily power supply (80% uptime), with significant reductions in electricity costs compared to diesel generators (25% decrease). Solar PV systems demonstrate superior cost-effectiveness and reliability, making them a preferred choice for off-grid communities in Ghana. Policy makers should prioritise the adoption of solar photovoltaic technologies in rural areas as they offer substantial economic benefits and environmental sustainability. Model estimation used $\hat{\{\theta\}} = argmin\{\theta\} sumiell(yi, f\theta(\xi)) + \lambda lVert\theta rVert 2^2,$ with performance evaluated using out-of-sample error.

Keywords: *Sub-Saharan, Africa, Panel, data, Spatial, econometrics, Randomized, experiments*

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