



A Political Ecology Framework for Solar-Pump Adoption

Smallholder Horticulture and the Hydrosocial Cycle in Kenya's Mwea Irrigation Scheme

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Author notes

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ABSTRACT

{ "background": "The adoption of solar-powered irrigation pumps (SPIPs) is promoted as a sustainable energy and agricultural solution. However, adoption rates among smallholder horticulture farmers within large-scale, state-managed irrigation schemes in sub-Saharan Africa remain poorly understood, with analyses often overlooking the complex socio-political and ecological dynamics.", "purpose and objectives": "This article develops a novel theoretical framework to analyse SPIP adoption, moving beyond techno-economic determinants. It aims to integrate political ecology with the hydrosocial cycle to elucidate how water governance, power relations, and ecological constraints shape adoption processes within a contested irrigation landscape.", "methodology": "The article constructs a conceptual framework through a critical synthesis of political ecology and hydrosocial literature. This framework is then applied to structure analysis of existing case-specific evidence from a state-managed irrigation scheme, illustrating its explanatory utility for understanding adoption barriers and enablers.", "key insights": "The framework reveals that adoption is not merely an individual economic calculation but is fundamentally mediated by pre-existing hydrosocial relations. A key insight is that inequitable water allocation between rice and horticulture zones, governed by rigid bureaucratic schedules, creates a primary structural barrier, making the promised autonomy of SPIPs largely illusory for many smallholders.", "conclusion": "SPIP adoption is deeply embedded in, and constrained by, the historical-political production of the hydrosocial cycle. A political ecology lens is essential for understanding the reproduction of socio-ecological inequalities through seemingly benign technological interventions.", "recommendations": "Future research and policy on SPIP promotion must explicitly analyse the local

hydrosocial configuration. Interventions should prioritise reforming water governance institutions to address allocation inequities alongside technology dissemination to avoid reinforcing existing power asymmetries.", "key words": "political ecology, hydrosocial cycle, solar irrigation, technology adoption, water governance, smallholder farmers, Kenya", "contribution statement": "This article provides a novel theoretical synthesis for analysing renewable energy adoption in agriculture, demonstrating how the hydrosocial

Keywords: *Political ecology, hydrosocial cycle, smallholder agriculture, solar-powered irrigation, East Africa, Mwea Irrigation Scheme, technology adoption*

Article Highlights

- Adoption barriers stem from rigid bureaucratic water schedules, not just cost.
- The promised autonomy of solar technology remains illusory under current governance.
- Technology dissemination risks reinforcing existing socio-ecological inequalities.
- Analysis must integrate water governance, power relations, and ecological constraints.

Core Theoretical Synthesis

Integrates political ecology with the hydrosocial cycle to move beyond techno-economic analyses of renewable energy adoption in agriculture.

This framework reorients policy focus from technology dissemination to water governance reform.

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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