MIKAILALSYS
Journal of Multidisciplinary Sciences

e-ISSN : 2987-2286
p-ISSN : 2987-3924

Index : Dimensions, Scilit, Crossref, Garuda, Semantic, Lens,Google Scholar,Base, etc

https://doi.org/10.58578/mikailalsys.v3i3.7455

Energy Poverty in Sub-Saharan Africa: Policy Implications for Vietnam

Bui Ngoc Tu
Institute for South Asian, West Asian, and African Studies, Viet Nam
buingoctuttct @gmail.com

Article Info:

Submitted:	Revised:	Accepted:	Published:
Sep 20, 2025	Oct 12, 2025	Oct 24, 2025	Oct 29, 2025

Abstract

Energy poverty—defined by inadequate access to reliable and affordable energy services—continues to pose a major barrier to economic development, agricultural productivity, and environmental sustainability in Sub-Saharan Africa (SSA). This study explores the complex interrelationship between energy poverty, environmental degradation, and agricultural productivity in SSA, with the aim of extracting policy insights relevant to Vietnam, a developing country facing similar rural energy access challenges. Drawing on a comprehensive literature review and empirical evidence from SSA, the study identifies that rural electrification significantly boosts agricultural productivity, while environmental degradation exerts a detrimental effect. The impact of renewable energy adoption is found to be context-dependent, with both enabling and constraining factors. Using qualitative synthesis and comparative case study analysis, the research contextualizes these findings within Vietnam's rural development landscape. The results suggest that Vietnam can strengthen energy access and agricultural outcomes by expanding rural electrification programs, investing in decentralized renewable energy systems, and enforcing environmental regulations to prevent resource degradation. Policy recommendations include promoting public-private partnerships, supporting digital innovations for precision agriculture, and tailoring energy strategies to local socio-economic conditions. By leveraging lessons from SSA's experiences, Vietnam can make strategic progress toward achieving energy equity and sustainable development in its rural sectors.

Keywords: Energy Poverty; Sub-Saharan Africa; Agricultural Productivity; Environmental Degradation; Vietnam; Rural Electrification

Introduction

Energy poverty, defined as the lack of access to modern, sustainable energy services, is a pervasive issue in Sub-Saharan Africa (SSA), where approximately 578 million people lacked electricity in 2019 (International Energy Agency, 2020). This energy deprivation significantly impacts agricultural productivity, a cornerstone of SSA economies, and exacerbates environmental degradation, posing risks to sustainable development. In SSA, agriculture employs over half the population and contributes substantially to GDP, yet productivity has declined from 20.6% in 1991 to 17.2% in 2021 (World Bank, 2021). The region's vulnerability to climate change, reliance on rain-fed agriculture, and limited energy infrastructure further compound these challenges (Dimnwobi et al., 2023).

While more advanced in electrification (with 99.7% electricity access in 2020), Vietnam faces similar issues in its rural and mountainous regions, where energy poverty persists, affecting agricultural efficiency and environmental sustainability (Nguyen & Su, 2021). SSA and Vietnam share characteristics of developing economies with significant rural populations and agriculture-driven economies, making SSA's experiences relevant for Vietnam's policy framework. This article explores the nexus of energy poverty, environmental degradation, and agricultural productivity in SSA, drawing lessons for Vietnam to enhance energy access, boost agricultural output, and mitigate environmental impacts. By synthesizing empirical findings and governance perspectives from SSA, the study aims to propose actionable policy strategies for Vietnam to achieve Sustainable Development Goal 7 (affordable and clean energy) and support sustainable agricultural development.

Literature Review

The literature on energy poverty in SSA underscores its detrimental effects on economic and social development, particularly in agriculture. Dimnwobi et al. (2023) conducted a comprehensive study on 35 SSA countries, finding that energy poverty, measured through an aggregate index, positively influences agricultural productivity, primarily through rural electrification. However, access to clean fuels and renewable energy consumption showed negative impacts, attributed to high costs and inefficiencies. The study utilized the ecological footprint to measure environmental degradation, revealing its significant inverse effects on agricultural productivity across SSA. It aligns with findings by Salahuddin et al. (2020), who noted that environmental pollution reduces agrarian output in 24 SSA countries.

Energy access is critical for agricultural productivity. Amuakwa-Mensah and Surry (2021) found that rural electrification in 43 SSA nations significantly boosts agricultural output by enhancing labor productivity and enabling mechanization. Conversely, Omoju et al. (2020) reported that national and urban electrification have limited agricultural impacts due to the sector's low mechanization levels. These findings highlight the importance of targeted energy interventions in rural areas, where agriculture is predominant.

Environmental degradation, particularly climate change, poses significant risks to SSA's agriculture. Ching et al. (2021) demonstrated that CO2 emissions negatively affect food production globally, with SSA being particularly vulnerable due to its reliance on rain-fed systems. Ehuitché (2015) and Mohamed and Nageye (2020) further confirmed that deforestation and land degradation reduce agricultural productivity in Côte d'Ivoire and Somalia, respectively. The ecological footprint, as used by Dimnwobi et al. (2023), provides a holistic measure of environmental impact, capturing both carbon and non-carbon factors, unlike traditional CO2 metrics (Ullah et al., 2021).

Governance plays a crucial role in addressing energy poverty. Gregory and Sovacool (2019) identified three governance perspectives—financial investment, political, and technological—that deter private investment in SSA's electricity infrastructure. Financial risks, such as insufficient local banking capabilities and exchange rate convertibility, limit infrastructure development. Political governance issues, including corruption and patrimonialism, further exacerbate investment uncertainties. Technological governance challenges, such as path dependency and deficient skills, hinder the adoption of modern energy systems. These governance barriers are relevant for Vietnam, where bureaucratic inefficiencies and limited rural infrastructure investment persist (Nguyen et al., 2021).

Vietnam's energy poverty literature highlights progress but also challenges. Nguyen and Su (2021a) noted that while Vietnam has achieved near-universal electricity access, rural areas still face unreliable supply and high costs, impacting agricultural productivity. The country's heavy reliance on coal and hydropower raises environmental concerns, with CO_2 emissions affecting agricultural sustainability (Nguyen et al., 2021). Renewable energy adoption, particularly solar and wind, is increasing but constrained by high initial costs and policy inconsistencies (Do & Burke, 2021). These parallels with SSA suggest that Vietnam can learn from SSA's targeted electrification strategies and governance reforms to enhance energy access and agricultural productivity while mitigating environmental degradation.

Methods

This study employs a qualitative synthesis approach, integrating empirical findings from SSA with comparative case analysis to derive policy implications for Vietnam. Data are drawn from two key studies: Dimnwobi et al. (2023), which provides quantitative insights from 35 SSA countries using the instrumental variable generalized method of moments (IV-GMM), and Gregory and Sovacool (2019), which offers governance perspectives on energy infrastructure investment. The literature review synthesizes peer-reviewed articles from 2010 to 2023, sourced from databases like Scopus and Web of Science, focusing on energy poverty, agricultural productivity, and environmental degradation. Comparative analysis examines SSA's energy poverty challenges and Vietnam's rural energy access issues, identifying transferable policy strategies. The methodology ensures robustness by cross-referencing findings with Vietnam's socio-economic context, particularly its agricultural sector and energy policies.

Results and Discussion

Energy Poverty and Agricultural Productivity in SSA

The empirical analysis by Dimnwobi et al. (2023) provides critical insights into the relationship between energy poverty and agricultural productivity in SSA. Their study, covering 35 SSA countries from 2005 to 2020, found that the aggregate energy poverty index significantly positively influences agricultural productivity, with a 1% increase in the index associated with a 0.053% rise in productivity. This effect is primarily driven by rural electrification (EP3), which enhances labor productivity and enables mechanized farming practices. For instance, access to electricity in rural areas facilitates using irrigation pumps, mechanized tillers, and storage systems, which improve crop yields and reduce post-harvest losses. This finding is consistent with Amuakwa-Mensah and Surry (2021), who reported that rural electrification in 43 SSA nations significantly boosts agricultural output by supplementing traditional inputs such as manual labor and organic fertilizers.

However, the study revealed that national electricity access (EP1) and urban electrification (EP2) do not significantly impact agricultural productivity. This is likely due to the prioritization of electricity for urban industries and residential use over agricultural applications, as SSA's agricultural sector remains unmechanized mainly (Ozturk, 2017). The lack of significant impact from national and urban electrification underscores the need for targeted energy policies prioritizing rural agricultural communities, where most SSA's population resides, and agriculture is the primary livelihood.

More concerning is the negative impact of access to clean fuels (EP4), renewable energy consumption (EP5), and renewable electricity output (EP6) on agricultural productivity. Dimnwobi et al. (2023) attribute these effects to the high costs and inefficiencies associated with clean energy technologies in SSA. For example, the adoption of clean cooking fuels and renewable energy systems often requires significant upfront investments, which are prohibitive for smallholder farmers. Additionally, the infrastructure for renewable energy, such as solar panels and wind turbines, is often underdeveloped, leading to unreliable supply and maintenance challenges. These findings highlight the importance of addressing cost barriers and improving technological infrastructure to make renewable energy viable for agricultural applications in SSA.

Environmental Degradation and Agricultural Productivity

Environmental degradation, measured by the ecological footprint, consistently exhibits an inverse and significant impact on agricultural productivity across SSA (Dimnwobi et al., 2023). The ecological footprint, which captures both carbon and non-carbon environmental impacts, provides a comprehensive assessment of environmental degradation, including deforestation, soil erosion, and water pollution. The study found that increased environmental degradation reduces agricultural output by degrading soil quality, depleting water resources, and increasing vulnerability to climate-induced events such as floods and droughts. This aligns with Salahuddin et al. (2020), who noted that environmental pollution, particularly CO2 emissions, reduces agricultural productivity in 24 SSA countries by affecting soil fertility and crop yields.

Regional variations in the impact of environmental degradation were evident. In Central Africa, environmental degradaation significantly reduced agricultural productivity, likely due to widespread deforestation and reliance on rain-fed agriculture, which is highly susceptible to climate variability (Ehuitché, 2015). In contrast, East Africa showed a positive relationship between environmental degradation and agricultural productivity in some models, possibly due to adaptive agricultural practices such as agroforestry and conservation farming, which mitigate environmental impacts (Dimnwobi et al., 2023). West Africa experienced significant productivity losses from pollution, reflecting the region's high levels of land degradation and soil nutrient depletion (Mohamed & Nageye, 2020). Southern Africa displayed mixed results, with some models indicating positive impacts and others negative, reflecting the region's diverse economic structures and varying levels of agricultural mechanization.

These findings underscore the vulnerability of SSA's agricultural sector to environmental stressors, particularly in regions heavily reliant on rain-fed systems. Climate change exacerbates these challenges by increasing the frequency of extreme weather events, reducing water availability, and promoting pest infestations, all of which negatively impact crop yields (Ching et al., 2021). Addressing environmental degradation is thus critical for sustaining agricultural productivity and ensuring food security in SSA.

Sub-Regional Variations

The sub-regional analysis by Dimnwobi et al. (2023) revealed significant disparities in the effects of energy poverty and environmental degradation on agricultural productivity across SSA's Central, East, West, and Southern regions. In Central Africa, the energy poverty index did not significantly impact agricultural productivity, reflecting the region's limited energy infrastructure and low electrification rates (24% electricity access in 2019, per International Energy Agency, 2020). This lack of impact suggests that energy poverty is so pervasive in Central Africa that it does not yet meaningfully influence agricultural outcomes, highlighting the urgent need for infrastructure investment.

In East Africa, the energy poverty index positively and significantly impacted agricultural productivity, driven by successful rural electrification initiatives. For example, countries like Kenya and Ethiopia have implemented off-grid solar projects and microgrids, improving energy access for rural farmers, enabling mechanized farming and irrigation (Amuakwa-Mensah & Surry, 2021). This positive effect underscores the potential of targeted energy interventions to transform agricultural productivity in regions with supportive policies and infrastructure.

West Africa showed a positive but insignificant impact of the energy poverty index on agricultural productivity. This is likely due to the region's reliance on traditional fuels, such as biomass, and widespread poverty, which limits access to modern energy services (International Energy Agency, 2019). The significant positive effects of national electricity access (EP1), rural electrification (EP3), clean fuels (EP4), and renewable electricity output (EP6) in West Africa suggest potential for productivity gains if energy access is expanded and made affordable (Dimnwobi et al., 2023).

Southern Africa exhibited a negative but insignificant impact of energy poverty on agricultural productivity, possibly due to urban-centric energy policies prioritizing industrial and residential use over agriculture. The region's mixed environmental degradation results reflect its economic diversity, with countries like South Africa having more advanced infrastructure but facing challenges in rural energy access (Gregory & Sovacool, 2019). These sub-regional variations highlight the need for tailored policies for economic, infrastructural, and environmental differences across SSA.

Governance Challenges

Gregory and Sovacool (2019) provide a comprehensive framework for understanding governance challenges that deter private investment in SSA's electricity infrastructure, categorized under financial, political, and technological perspectives. Financial governance barriers include insufficient local banking capabilities, which limit domestic financing for energy projects, and exchange rate convertibility issues, which prevent investors from repatriating profits. Uncommercial tariff regulations further increase financial risks by failing to reflect the actual cost of infrastructure investments. These financial constraints are particularly relevant for Vietnam, where rural energy projects often struggle to attract private investment due to similar financial risks (Nguyen et al., 2021).

Political governance challenges in SSA include corruption, rent-seeking, and patrimonialism, which undermine investor confidence by creating uncertainties around project ownership and revenue security. For example, reallocating project ownership during planning phases can lead to significant losses for investors, discouraging investment (Gregory & Sovacool, 2019). Vietnam faces comparable political governance issues, such as bureaucratic inefficiencies and inconsistent policy implementation, which hinder renewable energy development (Do & Burke, 2021).

Technological governance barriers in SSA include path dependency, where governments and utilities resist transitioning from coal-based systems to renewable energy due to entrenched interests, and deficient technological skills, which impede the adoption and maintenance of modern energy systems. The lack of complementary assets, such as efficient electricity grids, further limits the scalability of energy projects (Gregory & Sovacool, 2019). These technological challenges resonate with Vietnam's experience, where the energy sector's reliance on coal and hydropower limits the integration of renewables, and technical expertise for advanced energy systems is underdeveloped (Nguyen & Su, 2021a).

Relevance to Vietnam

Vietnam's energy poverty challenges, particularly in rural and mountainous areas, mirror SSA's experiences, making SSA's findings highly relevant. Despite achieving 99.7% electricity access in 2020, rural households in Vietnam face unreliable supply, high costs, and limited access to modern energy services, which constrain agricultural mechanization and productivity (Nguyen & Su, 2021). For example, farmers in remote areas rely on diesel generators or biomass, which are costly and environmentally harmful, similar to West Africa's reliance on traditional fuels (International Energy Agency, 2019).

Vietnam's heavy dependence on coal and hydropower contributes to environmental degradation, with CO2 emissions and water resource depletion affecting agricultural sustainability (Do & Burke, 2021). The negative impact of environmental degradation on SSA's agriculture, as evidenced by Dimnwobi et al. (2023), highlights the urgency for Vietnam to adopt eco-friendly agricultural practices and renewable energy sources to mitigate similar risks.

SSA's success in rural electrification, particularly in East Africa, offers valuable lessons for Vietnam. Initiatives like Kenya's off-grid solar projects demonstrate the effectiveness of decentralized energy systems in improving rural energy access and agricultural productivity (Amuakwa-Mensah & Surry, 2021). Vietnam can emulate these models by investing in microgrids and solar home systems for its rural communities, reducing reliance on centralized grids and improving energy reliability.

Governance reforms are equally critical for Vietnam. The financial, political, and technological barriers identified by Gregory and Sovacool (2019) in SSA are applicable to Vietnam, where bureaucratic hurdles, inconsistent policies, and limited private investment in rural energy infrastructure persist. Adopting decentralized energy systems, fostering public-private partnerships, and building technical capacity can address these barriers, enhancing Vietnam's energy access and agricultural productivity while aligning with global sustainability goals.

Conclusion

The study of energy poverty in Sub-Saharan Africa (SSA) offers critical lessons for Vietnam, a nation striving to balance energy access, agricultural productivity, and environmental sustainability. The findings from SSA, particularly the positive impact of rural electrification on farm output and the detrimental effects of environmental degradation, highlight the need for integrated policy approaches that address energy poverty while promoting sustainable development. Vietnam, despite its high electrification rate, faces challenges in rural areas where unreliable energy supply and environmental degradation hinder agricultural progress. By drawing on SSA's experiences, Vietnam can implement targeted strategies to advance Sustainable Development Goal 7 (affordable and clean energy) and bolster its agricultural sector.

First, Vietnam should prioritize targeted rural electrification programs, modeled after SSA's successful initiatives in East Africa, such as Kenya's off-grid solar projects (Amuakwa-Mensah & Surry, 2021). These programs can enhance agricultural mechanization by providing reliable irrigation, processing, and storage electricity, thereby improving crop yields and reducing post-harvest losses. Second, investment in renewable energy infrastructure, particularly solar and wind, is crucial to reduce Vietnam's reliance on coal and hydropower, contributing to environmental degradation (Do & Burke, 2021). Subsidies and low-interest loans can make renewable energy affordable for rural farmers, addressing the cost barriers observed in SSA (Dimnwobi et al., 2023).

Third, adopting decentralized energy systems, as recommended by Gregory and Sovacool (2019), can improve energy access in Vietnam's remote regions. Microgrids and solar home systems can bypass the limitations of centralized grids, ensuring a reliable and cost-effective energy supply. Fourth, stringent environmental regulations, including carbon taxes and incentives for eco-friendly agricultural practices, are essential to mitigate degradation. SSA's experience underscores the need for robust policies to combat soil erosion and deforestation, which Vietnam can emulate to protect its agricultural land (Dimnwobi et al., 2023).

Finally, fostering public-private partnerships can attract investment in energy infrastructure, addressing financial and political governance barriers similar to those in SSA (Gregory & Sovacool, 2019). Vietnam can enhance investor confidence and accelerate energy development by streamlining bureaucratic processes and ensuring policy consistency. These strategies, grounded in SSA's lessons, will enable Vietnam to achieve energy equity, boost agricultural productivity, and promote environmental sustainability, aligning with its vision for a prosperous and sustainable future.

References

Amuakwa-Mensah, S., & Surry, Y. (2021). Association between rural electrification and agricultural output: Evidence from Sub-Saharan Africa. *World Development Perspectives, 25*, 100392. https://doi.org/10.1016/j.wdp.2021.100392

Ching, S. L., Yii, K. J., Ng, C. F., Choong, C. K., & Lau, L. S. (2021). Is food production vulnerable to environmental degradation? A global analysis. *Environmental and Ecological Statistics, 28*, 761-778. https://doi.org/10.1007/s10651-021-00493-5

Dimnwobi, S. K., Okere, K. I., Onuoha, F. C., & Ekesiobi, C. (2023). Energy poverty, environmental degradation and agricultural productivity in Sub-Saharan Africa. *International Journal of Sustainable Development & World Ecology, 30*(4), 428-444. https://doi.org/10.1080/13504509.2022.2158957

Do, T. M., & Burke, P. J. (2021). Renewable energy development in Vietnam: Opportunities and challenges. *Energy Policy, 154*, 112297. https://doi.org/10.1016/j.enpol.2021.112297

Ehuitché, B. T. (2015). An analysis of dynamics of deforestation and agricultural productivity in Côte d'Ivoire. *International Research Journal of Agricultural Science and Soil Science, 5*(4), 103-111.

Gregory, J., & Sovacool, B. K. (2019). Rethinking the governance of energy poverty in sub-Saharan Africa: Reviewing three academic perspectives on electricity infrastructure investment. *Renewable and Sustainable Energy Reviews, 111*, 344-354. https://doi.org/10.1016/j.rser.2019.05.021

International Energy Agency. (2020). *World Energy Outlook 2020*. Paris: IEA.

Mohamed, A. A., & Nageye, A. I. (2020). Measuring the effect of land degradation and environmental changes on agricultural production in Somalia. *Management of Environmental Quality, 32*(2), 160-174. https://doi.org/10.1108/MEQ-02-2020-0032

Nguyen, C. P., & Su, T. D. (2021a). The influences of government spending on energy poverty: Evidence from developing countries. *Energy, 238*, 121785. https://doi.org/10.1016/j.energy.2021.121785

Nguyen, C. P., & Su, T. D. (2021b). The 'vicious cycle' of energy poverty and productivity: Insights from 45 developing countries. *Environmental Science and Pollution Research, 28*, 56345-56362. https://doi.org/10.1007/s11356-021-14614-x

Nguyen, C. P., Su, T. D., Bui, T. D., Dang, V. T. B., & Nguyen, B. Q. (2021). Financial development and energy poverty: Global evidence. *Environmental Science and Pollution Research, 28*(26), 35188-35225. https://doi.org/10.1007/s11356-021-13038-x

Omoju, O. E., Oladunjoye, O. N., Olanrele, I. A., & Lawal, A. I. (2020). Electricity access and agricultural productivity in Sub-Saharan Africa: Evidence from panel data. In E. S. Osabuohien (Ed.), *The Palgrave Handbook of Agricultural and Rural Development in Africa* (pp. 89-108). Cham: Palgrave Macmillan.

Ozturk, I. (2017). The dynamic relationship between agricultural sustainability and food-energy-water poverty in a panel of selected sub-Saharan African countries. *Energy Policy, 107*, 289-299. https://doi.org/10.1016/j.enpol.2017.04.048

Salahuddin, M., Gow, J., & Vink, N. (2020). Effects of environmental quality on agricultural productivity in sub-Saharan African countries: A second-generation panel-based empirical assessment. *Science of the Total Environment, 741*, 140520. https://doi.org/10.1016/j.scitotenv.2020.140520

Ullah, A., Ahmed, M., Raza, S. A., & Ali, S. (2021). A threshold approach to sustainable development: Nonlinear relationship between renewable energy consumption, natural resource rent, and ecological footprint. *Journal of Environmental Management, 295*, 113073. https://doi.org/10.1016/j.jenvman.2021.113073

World Bank. (2021). *World Development Indicators*. Retrieved from https://databank.worldbank.org/

Acheampong, A. O., Shahbaz, M., Dzator, J., & Jiao, Z. (2022). Effects of income inequality and governance on energy poverty alleviation: Implications for sustainable development policy. *Utilities Policy, 78*, 101403. https://doi.org/10.1016/j.jup.2022.101403

Candelise, C., Saccone, D., & Vallino, E. (2022). An empirical assessment of the effects of electricity access on food security. *World Development, 141*, 105390. https://doi.org/10.1016/j.worlddev.2021.105390

Kwakwa, P. A., Alhassan, H., & Adzawla, W. (2022). Environmental degradation effect on agricultural development: An aggregate and a sectoral evidence of carbon dioxide emissions from Ghana. *Journal of Business and Socio-economic Development, 2*(1), 82-96. https://doi.org/10.1108/JBSED-10-2021-0136

Shi, H., Xu, H., Gao, W., Zhang, J., & Chang, M. (2022). The impact of energy poverty on agricultural productivity: The case of China. *Energy Policy, 167*, 113020. https://doi.org/10.1016/j.enpol.2022.113020