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Research Article

From Soil to Sustainability: Vietnam's Green Agricultural Transition

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Abstract: *As Vietnam confronts the dual challenges of climate change and sustainable development, green agriculture has emerged as a strategic pathway to align economic growth with environmental protection. Although agriculture accounts for 14% of GDP and employs over one-third of the workforce, the sector faces increasing ecological and institutional pressures. This study examines Vietnam's transition to green agriculture—defined as environmentally sustainable, resource-efficient, and socially inclusive farming—aligned with global frameworks, such as the Sustainable Development Goals (SDGs) and the Paris Agreement. Through literature review, policy analysis, and assessment of national initiatives, the study highlights both achievements and ongoing barriers. Key policies, including the 2022 Strategy for Sustainable Agriculture and Rural Development and several integrated proposals approved in 2023–2024, underscore Vietnam's commitment to ecological farming, particularly through the use of organic fertilizers, biological pesticides, and integrated plant health management. However, challenges such as limited technology access, fragmented policies, and inadequate financial mechanisms constrain large-scale adoption. The paper proposes a four-pillar strategy to accelerate the green transition: (1) incentivizing green technologies, (2) investing in innovation, (3) promoting digital transformation, and (4) designing tailored financial solutions. Institutional reform, value chain integration, and human capital development are identified as essential enablers of sustainable development. This research presents a comprehensive framework that integrates policy, technology, finance, and capacity-building, thereby contributing to the broader discourse on sustainable agriculture in developing countries and positioning green transformation as both an environmental and economic opportunity for Vietnam.*

Keywords: *Green Agriculture, Sustainable Development, Climate Resilience, Policy Reform, Rural Transformation.*

I. INTRODUCTION

Agriculture has long been the backbone of Vietnam's economy, contributing approximately 14% of GDP and employing over 38% of the workforce. However, the sector faces mounting pressures from climate change, environmental degradation, and the global demand for sustainable practices. In recent decades, intensive farming methods—marked by excessive chemical inputs, deforestation, and soil erosion—have compromised ecosystems, reduced biodiversity, and threatened long-term food security. As Vietnam strives to balance economic growth with ecological preservation, the transition to green agriculture has emerged as a critical pathway to achieving sustainable development.

Green agriculture, defined as farming practices that prioritize environmental health, resource efficiency, and socio-economic equity, aligns with global initiatives such as the United Nations Sustainable Development Goals (SDGs) and the Paris Agreement. For Vietnam, this shift is not merely an environmental imperative but also an economic opportunity. The country is one of the world's largest exporters of rice, coffee, and seafood, and adopting sustainable practices could enhance its competitiveness in international markets, which eco-conscious consumers and stringent carbon regulations increasingly shape.

Despite its potential, Vietnam's journey toward green agriculture remains fraught with challenges. Smallholder farmers, who constitute 70% of the agricultural workforce, often lack access to capital, technology, and knowledge about sustainable methods. Policy frameworks, while progressive on paper, face implementation gaps due to fragmented governance and limited enforcement. Additionally, the tension between short-term productivity gains and long-term sustainability creates resistance to change among stakeholders.

This paper examines the development of green agriculture in Vietnam, focusing on identifying scalable and context-specific solutions to these barriers. By synthesizing existing research, analyzing case studies, and evaluating policy measures, the study aims to answer two key questions: (1) What are the primary drivers and obstacles in Vietnam's transition to green agriculture? (2) How can stakeholders—policymakers, businesses, and farmers—collaborate to build a resilient and inclusive green agricultural system?

The following sections structure the discussion: A literature review explores global and local perspectives on sustainable agriculture, followed by results and discussion that highlight Vietnam's progress and pitfalls through empirical data and case analyses. Finally, the conclusion offers policy recommendations and underscores the urgency of integrating green practices into Vietnam's national development strategy. By bridging theory and practice, this paper seeks to contribute to the growing discourse on sustainable agriculture in developing economies.

II. LITERATURE REVIEW

A) Global Perspectives on Sustainable Agriculture

The concept of sustainable agriculture has evolved as a response to the environmental and socio-economic crises triggered by industrialized farming. Globally, practices such as organic farming, agroecology, and precision agriculture have gained traction for their ability to reduce chemical inputs, conserve water, and enhance soil health (Pretty et al., 2018). The United Nations Food and Agriculture Organization (FAO) emphasizes that sustainable agriculture must balance three pillars: environmental stewardship, economic viability, and social equity (FAO, 2021). For instance, the European Union's "Farm to Fork Strategy" aims to reduce pesticide use by 50% and expand organic farming to 25% of agricultural land by 2030, reflecting a systemic shift toward sustainability (European Commission, 2020).

In developing economies, green agriculture often intersects with climate resilience. Studies in India and Bangladesh have highlighted the role of Climate-Smart Agriculture (CSA) in mitigating crop losses through the use of drought-resistant seeds and agroforestry (Lipper et al., 2014). Similarly, African nations have adopted conservation agriculture to combat soil degradation, demonstrating that context-specific solutions are critical for success (Thierfelder et al., 2018). These global examples underscore the importance of aligning agricultural practices with local ecological and socio-economic conditions.

B) Theoretical Frameworks for Green Transition

The transition to green agriculture is underpinned by several theoretical frameworks. Sustainable intensification advocates for maximizing yields while minimizing environmental harm, often through technological innovations like drip irrigation or biofertilizers (Garnett et al., 2013). Conversely, agroecological systems prioritize biodiversity and traditional knowledge, arguing that small-scale, diversified farms are inherently more resilient (Altieri, 2018).

The circular economy model also offers insights, promoting resource efficiency by recycling agricultural waste into energy or organic fertilizers (Ellen MacArthur Foundation, 2019). For example, Vietnam's rice sector could adopt circular practices by converting rice husks into biochar or biogas, reducing both waste and reliance on fossil fuels. These frameworks, while distinct, share a common goal: decoupling agricultural productivity from ecological degradation.

C) Green Agriculture in Vietnam: Progress and Challenges

Vietnam's agricultural policies have increasingly incorporated sustainability principles. The government's National Green Growth Strategy (2021–2030) prioritizes low-carbon practices, while the Agriculture Restructuring Plan promotes high-value, eco-friendly crops like organic vegetables and shrimp (Prime Minister of Vietnam, 2013). Pilot projects, such as the VietGAP (Vietnamese Good Agricultural Practices) certification, have improved food safety and reduced pesticide use in fruit and vegetable supply chains.

However, scholarly critiques reveal persistent gaps. Research by Nguyen et al. (2025) notes that smallholder farmers—the backbone of Vietnam's agriculture—often lack access to green technologies due to high costs and limited extension services. Meanwhile, rapid urbanization and industrial expansion have encroached on arable land, exacerbating land-use conflicts. Additionally, while Vietnam's organic farming area has grown to 1.5% of total farmland, this remains far below the global average of 1.7%, signaling slow adoption rates.

D) Knowledge Gaps and Research Opportunities

Existing literature predominantly focuses on technical solutions (e.g., organic fertilizers, renewable energy) but under-explores systemic barriers such as policy fragmentation and market access. Few studies have addressed the role of digital tools (e.g., blockchain for traceability) or gender dynamics in Vietnam's green transition despite women constituting 60% of the agricultural labor force (Vietnam Agriculture Newspaper, 2025). Furthermore, while international comparisons exist, there is limited research on tailoring global models to Vietnam's unique institutional and cultural context.

This paper addresses these gaps by analyzing both technological and socio-political drivers of green agriculture, with a focus on developing scalable and inclusive strategies.

III. RESULTS AND DISCUSSION

In the context of increasingly severe climate change and the irreversible global trend toward green transformation across all sectors, developing green agriculture has become an imperative pathway for Vietnam. The Strategy for Sustainable

Agriculture and Rural Development to 2030, with a Vision to 2050, approved by the Prime Minister in January 2022, reaffirms the nation's commitment to fostering agriculture that is efficient and sustainable in economic, social, and environmental dimensions. Concurrently, the strategy emphasizes the need for responsible, modern, and sustainable agricultural production, prioritizing ecological, organic, and circular farming models that reduce carbon emissions, enhance environmental friendliness, and strengthen climate resilience.

Building on past achievements and aiming for higher goals in sustainable agricultural development, the Plant Protection Department submitted three critical proposals to the Ministry of Agriculture and Rural Development (MARD) for approval in late 2023 and early 2024 (Figure 1). These proposals incorporate multifaceted solutions spanning technical improvements, policy reforms, scientific advancements, safe input utilization, and enhanced regulatory oversight, inspection, and public awareness campaigns. While distinct in focus, the three projects are intrinsically interconnected. They aim to mobilize resources, leverage technological innovation, and optimize synergies to enhance production efficiency, ensure food safety, and contribute to the conservation of ecology and biodiversity. By integrating organic inputs, biological pest control, and holistic plant health management, the projects collectively advance Vietnam's transition to low-emission, climate-resilient agriculture aligned with global sustainability frameworks**.**

Figure 1. Proposals for higher goals in sustainable agricultural development
*(**Source:** created by the authors)*

The Project on Developing Production and Utilization of Organic Fertilizers by 2030, with a Vision to 2050, aims to harness Vietnam's potential and existing organic material resources for organic fertilizer production. This initiative seeks to mitigate environmental pollution, reduce greenhouse gas emissions, and balance inorganic-organic nutrient ratios to enhance soil health, thereby supporting sustainable agriculture. By fostering safe agricultural products, the project prioritizes consumer health protection and improves economic efficiency in agricultural production.

The Project on Developing the Production and Application of Biological Pesticides by 2030, with a Vision to 2050, aims to accelerate the production and adoption of biological pesticides. This initiative aligns with the broader goal of transitioning to green, ecological, safe, and sustainable agriculture. It emphasizes strengthening research capacity, technological application, and mastery of advanced production techniques for biological pesticides, ensuring alignment with global agroecological standards.

The Project on Integrated Plant Health Management (IPHM) aims to enhance crop health, improve resistance to pests and adverse weather conditions, and increase production efficiency by 2030. By integrating science-based pest management practices, the initiative ensures food safety while contributing to ecological conservation and biodiversity preservation. Collectively, these projects underscore Vietnam's commitment to harmonizing agricultural productivity with environmental sustainability and climate resilience.

A) Promoting Sustainable Agricultural Solutions in Vietnam

The adoption of green agricultural models in Vietnam has gained significant momentum, driven by progressive policy frameworks that aim to align domestic practices with global sustainability standards. Nationwide, initiatives to transition toward eco-friendly and climate-resilient farming systems are becoming increasingly evident, reflecting both adherence to international market demands and efforts to mitigate the impacts of climate change.

To advance sustainable agriculture, four strategic pillars emerge as critical for systemic transformation (Figure 2):

Incentivizing Sustainable Technology Adoption: The integration of biological pesticides, organic fertilizers, and eco-friendly inputs into farming systems necessitates targeted subsidies, capacity-building programs, and awareness campaigns. Such measures aim to reduce reliance on chemical inputs while enhancing environmental stewardship.

Advancing Research and Technological Innovation: Scaling climate-resilient crop varieties and precision farming techniques requires substantial investment in agricultural research and development (R&D). Strengthening collaboration between academic institutions, research organizations, and farming communities is pivotal to translating technological advancements into practical, large-scale applications.

Harnessing Digital Transformation: The incorporation of Fourth Industrial Revolution technologies—such as the Internet of Things (IoT), Artificial Intelligence (AI), and blockchain—into agricultural practices holds transformative potential. These tools enhance productivity, supply chain traceability, and resource efficiency, while the parallel development of a skilled workforce ensures effective implementation.

Designing Context-Specific Financial Mechanisms: Accessible credit schemes tailored to the needs of smallholders, cooperatives, and agribusinesses are essential for scaling sustainable practices. Simplifying loan procedures and aligning repayment schedules with agricultural production cycles can alleviate financial constraints and incentivize long-term investments.

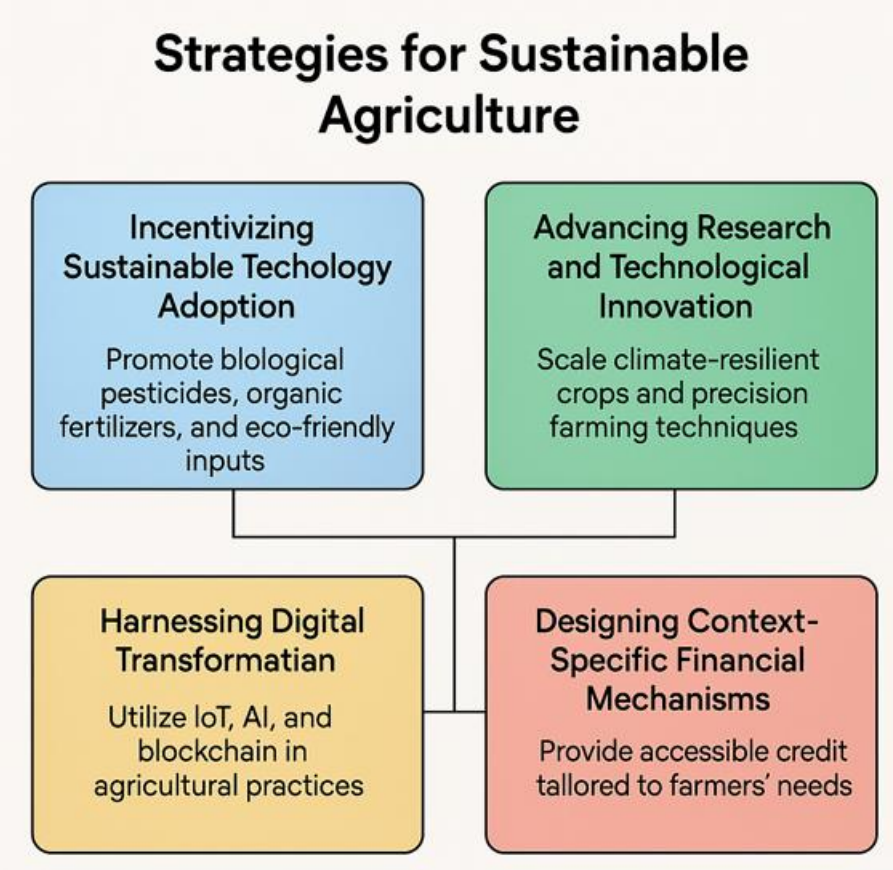

Figure 2. Strategies for sustainable agriculture

*(**Source:** created by the authors)*

The successful implementation of these strategies hinges on robust institutional frameworks and cross-sectoral coordination. By harmonizing technological innovation, financial accessibility, and human capital development, Vietnam can position itself as a regional leader in low-emission, climate-resilient agriculture, thereby contributing to global sustainability agendas.

IV. CONCLUSION

The pursuit of green agricultural transformation in Vietnam represents not only an environmental imperative but also a socio-economic opportunity. Achieving this transformation necessitates a strategic, multi-dimensional approach that embeds sustainability across all levels of the agricultural system. Central to this process is the development of an enabling policy environment. By refining the legal and institutional frameworks—such as offering targeted investment incentives, facilitating cooperative development under the 2023 Cooperative Law, and expanding access to agricultural credit—Vietnam can mobilize both public and private resources toward sustainable practices. In parallel, enhancing agricultural insurance schemes and implementing risk-mitigation mechanisms will provide essential safeguards for smallholders and incentivize climate-resilient production models.

Restructuring agricultural production systems is equally critical. Greater integration across value chains can facilitate stronger linkages among farmers, cooperatives, and enterprises, thereby promoting scalable green production. Regional prioritization policies that direct investment toward upland and disadvantaged areas will help unlock local resource potential and support inclusive rural development. At the same time, fostering partnerships that bridge production, processing, and distribution will ensure the long-term viability of green supply chains.

Science, technology, and innovation must serve as the backbone of this transition. Advancing digital transformation, expanding the use of precision technologies, and promoting high-tech agricultural zones will improve both productivity and environmental performance. These efforts require strong institutional coordination, increased R&D investment, and policy alignment to ensure the effective adoption of digital tools such as blockchain, IoT, and remote sensing. Government-led mandates and public-private partnerships can accelerate technological diffusion and support the development of eco-friendly production standards that align with global market demands.

Finally, building human capital is indispensable for a successful green transition. Professionalizing the farming workforce through vocational training, enterprise-led education, and enhanced extension services will enable farmers to adopt sustainable practices more effectively. Special attention must be given to strengthening grassroots technical capacity and attracting a new generation of agricultural professionals to rural areas, thereby ensuring the continuous transfer of knowledge and innovations to the field.

In summary, Vietnam's shift toward green agriculture necessitates an integrated, long-term vision that combines regulatory reform, production restructuring, technological advancements, and human capital development. Through coordinated and inclusive action, the country can develop a low-emission, resilient agricultural sector that supports both environmental sustainability and rural prosperity.

Interest Conflicts

The authors declare that there is no conflict of interest concerning the publishing of this paper.

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All authors contributed equally to this work.

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