International Journal of Engineering Inventions
e-ISSN: 2278-7461, p-ISSN: 2319-6491
Volume 15, Issue 1 [January 2026] PP: 36-39

International Experience and The Practice of Circular Economy Development in Agriculture in Hung Yen

Nguyen Thi Tuyet Mai
Thai Binh University, Hung Yen, Vietnam
nguyenthituyetmai751984@gmail.com

ABSTRACT: *The circular economy (CE) is becoming an inevitable direction to address resource depletion and environmental pollution. In agriculture, Circular Agriculture aims to transform the linear "extraction – production – disposal" model into a closed-loop cycle, where by-products are utilized as new inputs, improving resource efficiency and reducing emissions. This paper analyzes the experience of several typical countries (the Netherlands, Australia) in implementing CE, focusing on policies, technologies, and innovation support mechanisms. Based on the connection with Vietnam's reality, the study assesses opportunities and barriers to CE development in Hung Yen province – a locality with advantages in diverse agricultural ecosystems and traditional integrated farming systems (VAC model), yet faces limitations in by-product processing technology, value chain linkages, and technical standards. The paper proposes policy, technological, and financial solutions to promote the transition to a sustainable, high-value circular economy in Hung Yen.*
Keywords: *Circular economy; Circular agriculture; Hung Yen; Sustainable development; International experience.*

Date of Submission: 25-12-2025 Date of acceptance: 06-01-2026

I. INTRODUCTION

Agriculture plays a pillar role in Vietnam's economy; however, it also exerts significant pressure on land and water resources and the environment through excessive use of agricultural inputs and generation of enormous volumes of by-products that have not been efficiently processed [1]. Every year, Vietnam generates hundreds of millions of tons of agricultural waste and by-products, yet the reuse rate remains low, causing resource losses, increasing greenhouse gas emissions, and diminishing economic and environmental efficiency [2]. In the context of a strong global shift toward Net-Zero Carbon targets and the implementation of Sustainable Development Goals (SDGs), the transition to CE in agriculture has become urgent and strategically significant in the long term.

However, there is currently a lack of in-depth research to comprehensively assess the potential of applying CE in Vietnam's agriculture at the local level. In particular, specific models linked to production conditions, enterprise structures, and regional characteristics have not been adequately studied. Furthermore, the synthesis and comparison of domestic and international experience remains fragmented and lacks systematization, leading to insufficient research in establishing a CE model framework suitable for local realities.

The Vietnamese Government has issued numerous policies promoting CE, notably Decision 687/QD-TTg on CE development and Decision 540/QD-TTg on science and technology development promoting CE in agriculture until 2030 [3]. In this context, Hung Yen – a province with a high-value agricultural production structure, rapidly increasing land concentration, and expanding agricultural processing enterprises – is a typical case for examining the CE transition model at the local level. This paper addresses existing research gaps through two main objectives: analyzing typical international experience in developing agricultural CE and drawing lessons applicable to Vietnam's conditions; assessing the potential and scope for implementing CE in Vietnam's agriculture, thereby proposing a CE model and solutions suitable for Hung Yen's practical conditions, contributing to the green transition and sustainable development of the local agricultural sector.

II. OVERVIEW OF CIRCULAR ECONOMY IN AGRICULTURE

II.1. Concepts and Principles

The Circular Economy is an economic system designed to optimize resource utilization by maintaining the value of products, materials, and resources as long as possible within the economy, while simultaneously minimizing waste [4]. In the agricultural context, Circular Agriculture (CA) applies CE principles to establish a closed-loop production system that conserves resources, optimizes input efficiency, and transforms by-products into secondary resources for other production cycles [5].

II.2. Distinction from the Linear Model

Table 1. Comparison of Linear Economic Model and Circular Economic Model [6].

Criteria	**Linear Model**	**Circular Economic Model**
Resources	Maximum extraction of new resources	Minimize new resources; prioritize renewable resources
Production	Focus on volume, individual efficiency	Focus on value, system efficiency, waste minimization
By-products/Waste	Disposal into the environment, causing pollution	Viewed as secondary resource sources, reused, recycled
Objectives	Short-term economic growth	Sustainable development: Economic – Social – Environmental

The analysis in Table 1 demonstrates that, compared to the linear "Extraction – Production – Disposal" model, CA emphasizes resource regeneration, prioritizes system value, treats by-products as renewable resource sources, and pursues sustainable development across all three pillars of Economy – Society – Environment.

III. RESEARCH METHODOLOGY

This research employs the desk review method combined with comparative policy analysis approaches to systematize mechanisms, policy instruments, and operational models of circular economy in agriculture (CEAG) from several typical countries (the Netherlands, Australia) as documented in international reports, publications, and secondary data sources [7], [8].

The selection of the Netherlands and Australia as reference countries is based on the following criteria: (i) the high level of development and standardization of CEAG policies (the Netherlands – representing the high-technology, internationally standardized model); (ii) flexibility and adaptability to biological and agricultural conditions (Australia – representing the renewable material-based and open ecosystem model); (iii) similarity and referential applicability to Vietnam's conditions. Secondary data sources include: FAO and OECD reports, international scientific publications, agricultural and environmental statistical data, along with national policy reports on CEAG.

The core lessons were subsequently compared with Vietnam's practical conditions, particularly those of Hung Yen – a locality with several integrated farming (VAC), rice-fish, integrated livestock, and specialized agricultural product chain models at the provincial scale. The analytical framework focuses on four key factor groups determining CEAG implementation: (i) by-product sources and value regeneration potential; (ii) technological capacity and application levels; (iii) market mechanisms and value chains; and (iv) institutional and policy frameworks. This structure is consistently applied throughout the results, discussion, and policy recommendations sections to ensure research logic and direct applicability at the provincial level.

IV. RESULTS AND DISCUSSION

VI.1. International Lessons

International experiences demonstrate that CE in agriculture achieves sustainability only when implemented as a unified economic-technological-institutional system with central coordination and a clear carbon credit market. The Netherlands has built CE based on a smart agriculture model applying high technology, utilizing big data, IoT, AI, and closed-loop nutrient management, coupled with policy sandbox environments enabling enterprises to pilot technologies before nationalization [7]. Australia has developed along a biological regeneration trajectory, converting biological waste and establishing long-term contractual linkages among farmers, processing enterprises, and bio-based material industries, creating a CE model founded on renewable resources and transparent carbon markets [8]. Nordic countries emphasize design revision, process transformation, and reconfiguration, supported by strong institutional infrastructure and unified traceability standards across the entire chain, enabling the integration of enzymes, regenerated proteins, and bio-refinery facilities into high-value industries. The overarching lesson: CE is not a supplementary project but a new growth strategy based on data, technology, and low-carbon resources.

IV.2. Role of Agricultural Enterprises

Representative agricultural enterprises and cooperatives in Hung Yen clearly demonstrate the pivotal role of agricultural organizations in developing circular agriculture.

Currently, Hung Yen province has 759 agricultural cooperatives, many of which have transitioned to production models incorporating high-technology applications, value chain linkages, and One Commune One Product (OCOP) initiatives [9].

Notable examples include: Yen Phu Comprehensive Agricultural Service Cooperative (Viet Yen commune, Hung Yen) – developing safe vegetable production through biotechnology application and digital transformation in production management, reducing input costs and enhancing product value; Hung Yen Caged Lychee Cooperatives – linking farmers with processing enterprises, utilizing lychee by-products for wine, syrup, and organic fertilizer production, contributing to forming a circular chain from specialty fruit trees; Rice-Fish Production Cooperative in Thai Thuy – combining rice cultivation with fish farming in the same ecosystem, utilizing rice straw residues as feed while reducing fertilizer costs through fish-derived manure; Tien Hai Livestock-Aquaculture Cooperative – developing the Integrated Farming-Pond-Livestock-Biogas (VACB) model, converting livestock waste into biogas and organic fertilizer, generating clean energy for production, etc. [10].

This demonstrates that agricultural enterprises and cooperatives are not merely production and consumption sites but also innovation centers for by-product recycling and domestic carbon market connections. Consequently, Hung Yen and Thai Binh provinces can become pilot regions for low-carbon circular agriculture, contributing to increased farm incomes and sustainable development.

IV.3. Vietnam's Reality and Potential in Hung Yen Region

Vietnam's traditional VAC system represents an important indigenous knowledge foundation for circular thinking [11]. However, the by-product reuse rate remains low, and large-scale biological recycling industries have not yet formed; key challenges include: standards – measurement – by-product processing technology – carbon credit markets – fragmented production scale [2], [3], [12]. Vietnam is currently closer to Australia's trajectory than the Netherlands': flexible, biological, renewable material-based. However, the inevitable future trend is the integration of biotechnology + digital data + carbon valuation.

For the Red River Delta region, where Hung Yen, positioned as a gateway connecting the region, exhibits a diversified agricultural economic structure with high density of agricultural processing enterprises, substantial by-products (rice, aquaculture, fruits, food products), and increasingly active knowledge ecosystems of universities, research institutions, and innovation initiatives in recent years. However, the most critical bottleneck is not merely technological processing capacity but rather the lack of inter-regional circular value chain linkage mechanisms, absence of circular value alliances, and missing "domestic carbon consumption markets" to transform by-products into revenue and new resource assets.

Models such as rice-aquaculture, VACB, and recycled fertilizer-biological fertilizer-black soldier fly systems demonstrate Vietnam's actual conversion potential [13], [14]. Within the expanded Hung Yen region, there is considerable capacity to form foundational biological clusters by sub-sector: fruits (lychee), aquaculture, rice, food products – based on integrated biotechnology and ecological-economic stratification by space.

Particularly important is the participation of rural enterprises in Hung Yen – from cooperatives, small and medium processing enterprises, to traditional production facilities – which will constitute critical links in forming circular value chains. These enterprises not only generate employment and income for local communities but also serve as bridges between farmers, research institutions, and markets. Establishing support mechanisms and rural-urban enterprise alliances will enhance cohesion, reduce transaction costs, and promote the formation of distinctive agricultural biological industrial clusters in Hung Yen.

This will create momentum for Hung Yen to become a "regional-scale circular economy pilot zone" advancing low-carbon agricultural industrialization.

From the perspective of international-Vietnam-Hung Yen comparative analysis: the most appropriate direction is optimizing the biological regeneration model, strengthening digital technology integration, progressing toward international carbon standards, and forming regional agricultural CE clusters. This represents a logical transition from "post-production by-product treatment" to "resource value planning from the beginning of the chain. establishing the foundation for Hung Yen to become a core center for agricultural CE development in northern Vietnam.

V. SOLUTIONS TO PROMOTE CIRCULAR ECONOMY IN AGRICULTURE

Development of CE in agriculture requires an approach based on overall institutional architecture, wherein Vietnam implements it at the national level, while the Hung Yen region (expanded integration) serves as a pilot for disseminating the model at the regional scale. The following solutions are proposed according to the principle: national policy orientation → sector-specific sandbox design → regional clusters → market dissemination [15].

First, perfecting the legal framework and national standards for products recycled from agricultural by-products, prioritizing standardization of origin traceability, carbon valuation, and classification of material and biological waste. The initial phase should implement sector-specific sandbox mechanisms for major by-product chains (rice, aquaculture, fruits) similar to the Netherlands' experience, allowing enterprises and research institutions experimental space to optimize models before broad standardization.

Second, establishing green finance mechanisms and a domestic agricultural carbon credit market. In addition to investment incentives, tax breaks, and credit facilities for recycling technology, the Government must establish mechanisms to convert by-products into carbon assets. An agricultural carbon market is a determining condition for creating incentives for enterprises to invest in biotechnology and bio-based industries, while simultaneously connecting Vietnam to the international carbon market.

Third, prioritizing R&D investment and technology transfer in biotechnology for by-product treatment priorities; focusing on rice, coffee, fruits, food products, aquaculture, and livestock by-product groups. A national agricultural bio-refinery program should be established, linking research institutions, universities, and enterprises to domesticate technological capacity and reduce import dependence.

Fourth, developing a national agricultural digital data system, integrating by-product spatial mapping; utilizing big data and Precision Agriculture to measure and monitor material and carbon flows. This is the foundation for transparent carbon valuation, creating the basis for connecting national, regional, and global carbon markets.

Fifth, forming regional-scale CE models in the expanded Hung Yen region, oriented toward sector-specific biological clusters (fruits, aquaculture, rice, food products). This region can assume the role of "northern CE pilot zone. where the State provides direction and coordinates standards; enterprises invest and operate technology; research institutions and universities supply knowledge and forecasting. Such an inter-regional model will transcend fragmentation while simultaneously creating a circular value alliance capable of scaling realistically.

From this perspective, it can be seen that CE in agriculture must be regarded as a long-term structural transformation strategy, in which the integration of biotechnology, digital technology, and carbon valuation form three core pillars. Vietnam must implement it at the national scale, while the expanded Hung Yen region serves as an opening point to create spillover effects. When these elements operate synchronously, CE will become a foundation for enhancing the international competitiveness of Vietnamese agriculture and making substantive contributions to the Net Zero target.

VI. CONCLUSION

Development of a Circular Economy in agriculture represents an inevitable direction for Vietnam to simultaneously achieve green growth objectives and advance toward sustainable agriculture. International experience, particularly from the Netherlands and Australia, demonstrates clear effectiveness when implementing comprehensive strategies that combine advanced technology and cross-sector value chain linkages.

Vietnam possesses advantages in traditional VAC models and abundant agricultural by-product sources; however, it still faces barriers related to policy mechanisms, technological capacity, and community awareness. The transition to CE requires a decisive national strategy, focused investment in biotechnology, digital technology, and innovation, while simultaneously creating consensus and active participation among enterprises, research institutions, and farmers.

When CE is realized, Vietnam will simultaneously minimize pollution and resource loss while establishing high-value agriculture with international competitiveness and long-term sustainable development capacity. The expanded Hung Yen region can serve as a pilot point, disseminating effective CE models to neighboring regions and the nation as a whole.

ACKNOWLEDGMENTS

This article is the research product of the institutional-level project in 2025: "The Impact of Circular Economy on Agricultural Enterprises for Sustainable Development in Thai Binh – Hung Yen." Project code: ĐHTB-ĐT12/25-26.

REFERENCES

[1]. N. T. Mien. (2021). "*Developing circular economy in Vietnamese agriculture: Several issues and recommendations*. Journal of Political Theory, no. 3, pp. 105-110.
[2]. N. T. L. Tuyen and C. T. Son. (2022). *Current situation of agricultural waste by-product generation and management solutions in Vietnam*. Environmental Journal, vol. 5.
[3]. Prime Minister of the Government. (2022). *Decision No. 687/QD-TTg dated June 7, 2022, approving the Circular Economy Development Plan in Vietnam*. Hanoi.
[4] . P. Ghisellini, C. Cialani, and S. Ulgiati. (2016). *A review on circular economy: The expected transition to a balanced interplay of environmental and economic systems*. Journal of Cleaner Production, vol. 114, pp. 11-32.
[5]. M. V. Barros, R. Salvador, A. C. de Francisco, and C. M. Piekarski. (2020). *Mapping of research lines on circular economy practices in agriculture: From waste to energy*. Renewable and Sustainable Energy Reviews, vol. 131, p. 109958.
[6]. Q. Minh. (2020). *From linear economy to circular economy*. Journal of Environmental Industry.
[7]. Ministry of Agriculture, Nature and Food Quality. (2018). *Circular Agriculture: Working towards a valuable and sustainable Netherlands.* The Hague, Netherlands.
[8]. T. T. T. Huyen. *International experience in organic agricultural production following a circular economy approach toward sustainable development goals*. Journal of Economics and Forecasting, 2024.
[9]. M. Hong. (2025). *Hung Yen has 759 agricultural cooperatives*. Hung Yen Newspaper.
[10]. Đ. Ly. *Thai Binh: 22 cooperative models operating effectively linked to agricultural sector restructuring*. Dan Viet Newspaper, 2024.
[11]. P. G. S. T. M. N. X. Hong. (2021). *Practical foundation and driving forces for promoting Vietnam's circular agriculture development: VAC economy*. Journal of Political Theory.
[12]. N. H. Quy. (2023). *Circular economy: Challenges and recommended solutions for Vietnam*. Journal of State Management, no. 320, pp. 82-87.
[13]. N. T. Binh, Đ. T. Sang, L. N. Đ. Khoi, L. T. X. An, and N. Minh. (2022). *Legal framework and potential for applying circular economy in agriculture in the Mekong Delta*. Journal of Science Can Tho University, vol. 58, pp. 125-133.
[14]. V. C. My et al,.(2024). *Circular economy – From theory to practice*. Journal of Mining Industry, no. 2, pp. 39-45.
[15]. Prime Minister of the Government. (2022). *Decision No. 150/QD-TTg dated January 28, 2022, approving the Strategy for Sustainable Agricultural and Rural Development for the 2021-2030 Period, with Vision to 2050*. Hanoi.