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PROMOTING CIRCULAR AGRICULTURE IN VIETNAM: POLICY FRAMEWORK AND IMPLEMENTATION CHALLENGES

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Abstract

The transition toward circular agriculture has become an important strategy for promoting sustainable agricultural development in Vietnam. This study examines policy framework supporting circular agriculture and identifies major implementation challenges. Using a mixed qualitative-quantitative approach, the study reviews legal documents, policy reports, and practical circular agriculture models, combined with a survey of experts and policymakers. The findings indicate that Vietnam has gradually institutionalized circular economy principles through key policies such as the 2020 Law on Environmental Protection and Decisions No. 687/QĐ-TTg and 540/QĐ-TTg. Practical models, including low-emission rice farming, integrated farming systems, circular livestock production and the low-input ecological circular agriculture model, have improved resource efficiency and waste recycling. However, implementation remains constrained by fragmented regulations, weak inter-sectoral coordination, limited technical standards, inadequate financial and technological support, and uneven local capacity. The study proposes strengthening the policy framework, technical standards, financial incentives, and institutional coordination to support the large-scale development of circular agriculture in Vietnam.

Key words: *circular agriculture, circular economy, agricultural policy, sustainable agriculture, Vietnam.*

INTRODUCTION

The circular economy (CE) has emerged as an important approach for promoting sustainable development by transforming the traditional linear production model of "take-make-dispose" into a regenerative system based on resource efficiency, waste reduction, reuse, and recycling. Through closed-loop production systems and sustainable resource management, CE contributes to addressing major global challenges such as climate change, environmental degradation, and resource scarcity (UNIDO, 2017). As a result, many countries have increasingly integrated CE principles into national development strategies to promote green growth and sustainable production systems (Chung & Le, 2023; Virsta et al., 2020).

Agriculture has become a priority sector for CE implementation because of its intensive use of natural resources and its significant environmental impacts. Circular agriculture emphasizes the recycling and reuse of agricultural by-products, the integration of crop-livestock-aquaculture systems, renewable energy generation, and low-input ecological farming practices. These approaches not only improve resource efficiency and reduce waste generation but also contribute to enhancing agricultural sustainability and climate resilience. In Vietnam, the transition toward circular agriculture is particularly important given the central role of agriculture in the national economy and rural livelihoods. Agriculture contributes approximately 12-14% of Gross Domestic Product (GDP) and employs nearly 30% of the labor force. However, rapid agricultural intensification has generated increasing environmental pressures associated with excessive use of chemical fertilizers and pesticides, inefficient waste management, and overexploitation of natural resources. According to ISPONRE (2023), Vietnam's agricultural sector generates approximately 94 million tons of crop residues, 69 million tons of livestock waste, and nearly 280 million cubic meters of wastewater annually. While these by-products create serious environmental challenges, they also represent considerable opportunities for resource recovery and circular value creation.

Recognizing these challenges, Vietnam has gradually integrated CE principles into its legal and policy framework. The Law on Environmental Protection 2020 officially

institutionalized CE within the national legal system, while subsequent policies such as Decision No. 687/QĐ-TTg (2022) and Decision No. 540/QĐ-TTg (2024) promoted circular agriculture, low-emission production, and agricultural waste recycling. In practice, several circular agriculture models have been implemented nationwide, including low-emission rice farming in the Mekong Delta, integrated farming system such as VAC (i.e Garden-Pond-Livestock integrated model), circular livestock farming applying biogas technologies, and ecological farming associated with VietGAP (Vietnamese Good Agricultural Practices) and organic agriculture. These models demonstrate the potential of circular agriculture to improve resource efficiency, reduce environmental pollution, increase farmers' incomes, and strengthen climate resilience.

Despite these positive developments, the implementation of circular agriculture in Vietnam remains fragmented and faces significant institutional and practical challenges. Existing policies are still characterized by overlapping regulations, weak inter-sectoral coordination, limited technical standards, and insufficient financial and technological support. In addition, many circular agriculture initiatives remain small-scale and unevenly implemented across regions, while smallholder farmers continue to face difficulties accessing green finance, technologies, and market systems.

Although previous studies have examined circular economy concepts and practical agricultural models, research focusing on the policy framework and implementation challenges of circular agriculture in Vietnam remains limited. Against this background, this study analyzes the policy framework supporting circular agriculture development in Vietnam, evaluates key implementation challenges, and examines practical circular agriculture models. Based on empirical assessment and practical evidence, the study proposes policy recommendations to strengthen institutional capacity and promote the large-scale development of circular agriculture in Vietnam.

LITERATURE REVIEWS

The traditional linear economic model follows a "take-make-dispose" trajectory in which natural resources are extracted, transformed into products, consumed, and eventually discarded as waste. This model relies heavily on continuous inputs of virgin materials while neglecting the environmental costs associated with resource depletion and waste generation (Dung & Hong, 2021). According to Peter et al. (2017), the linear economy contributes significantly to environmental degradation, inefficient resource utilization, and growing dependence on finite natural resources, thereby threatening ecological sustainability and human well-being. As global concerns regarding climate change, biodiversity loss, and resource scarcity intensify, the limitations of the linear model have become increasingly apparent.

In response to these challenges, the CE has emerged as a prominent framework for sustainable development. Unlike the linear economy, CE emphasizes the restoration and regeneration of resources through closed-loop systems in which waste and by-products are reintegrated into production processes (Pearce & Turner, 1990). The Ellen MacArthur Foundation (2012) defines CE as an economic system that is restorative and regenerative by design. Similarly, Geng and Doberstein (2008) and Yuan et al. (2008) highlight the importance of circular flows of materials and energy to minimize waste and improve resource efficiency. Webster (2015) further emphasizes maintaining products and materials at their highest utility and value throughout their lifecycle, while Fan and Fang (2020) argue that CE systems should be intentionally designed to support ecological regeneration and long-term sustainability.

The theoretical foundation of CE is commonly structured around three interconnected strategies: slowing, narrowing, and closing resource loops (Bocken et al., 2016). Slowing resource loops aims to extend product lifespans through durable design, repair, maintenance, and reuse. Narrowing loops focuses on improving resource efficiency by reducing material and energy inputs, often through technological innovation and cleaner production methods. Closing loops involves recovering and recycling materials at the end of product lifecycles to reintroduce them into production systems. Together, these strategies contribute to reducing environmental pressures, minimizing

dependence on virgin resources, and promoting a regenerative economic system capable of decoupling economic growth from environmental degradation.

Morl (2015) identifies five key dimensions of the CE. First, environmentally conscious product design emphasizes reparability, recyclability, and reusability. Second, cleaner production practices focus on emission reduction and cyclical resource use during manufacturing processes. Third, sustainable consumption encourages responsible consumer behavior and environmental awareness. Fourth, effective waste management promotes waste separation, collection, and recycling systems. Finally, CE supports the transformation of waste into valuable secondary resources, thereby closing material loops and reducing ecological impacts. These dimensions collectively highlight the systemic nature of CE and its relevance to sustainable production and consumption.

The application of CE principles in agriculture has attracted increasing scholarly attention in recent years. Circular agriculture is generally understood as a closed-loop production system in which agricultural waste and by-products are reused as inputs for other agricultural activities, thereby enhancing resource efficiency and reducing environmental impacts. Pham Thi Tuyet Giang (2025) defines circular agriculture as a production model integrating scientific and technological innovations, including biotechnology and physico-chemical methods, to improve sustainability and optimize resource use. Similarly, Pham Thai Thuy et al. (2022) emphasize the reuse of agricultural residues and by-products for producing biofertilizers and other high-value outputs through advanced technologies. Tuyen Pham (2024) argues that circular agriculture plays a critical role in achieving sustainable agricultural development goals by simultaneously improving economic efficiency and environmental performance. Chung et al. (2024) further identify major forms of circular agriculture, including organic farming, integrated crop-livestock systems, agroforestry, and circular aquaculture models.

Beyond conceptual discussions, recent studies increasingly focus on the institutional and policy dimensions of circular agriculture. Manh and Pham (2023) observe that Vietnam's policy framework for CE has become more systematic and aligned with market-oriented reforms. However, the authors also emphasize that policy implementation remains constrained by institutional fragmentation, regulatory inconsistencies, and limited enforcement capacity. Similarly, Martinez-Moreno et al. (2024) highlight the importance of stable legislative frameworks, harmonized quality standards, and supportive regulations to facilitate circular transitions in agriculture. Their study also stresses the need for policies promoting the repair, reuse, and sustainable management of agricultural machinery and production systems. Angulo et al. (2024), examining circular agriculture in Ibero-American countries, identify several persistent barriers, including inadequate waste management infrastructure, limited technological capacity, insufficient training, and weak policy incentives.

Overall, the existing literature demonstrates that circular agriculture offers significant potential for improving resource efficiency, reducing environmental degradation, and promoting sustainable rural development. However, the transition toward circular agricultural systems depends not only on technological innovation but also on coherent policy frameworks, institutional coordination, and effective governance mechanisms. Although several studies have examined CE concepts and agricultural applications, research focusing specifically on the policy framework and implementation challenges of circular agriculture in Vietnam remains limited. This study seeks to address this gap by analyzing Vietnam's current policy framework for circular agriculture and identifying the major institutional and practical barriers affecting implementation.

METHODOLOGY

This study applied a mixed qualitative–quantitative approach to analyze the policy framework and implementation challenges of circular agriculture in Vietnam. Secondary data were collected from legal documents, policies, national strategies, and official reports related to the CE and circular agriculture issued by the Ministry of Justice, the Ministry of Agriculture and Environment, and other publicly available sources. In addition, relevant academic

publications, policy papers, and research reports were reviewed to examine the development and implementation of circular agriculture policies in Vietnam. The study also synthesized information on practical circular agriculture models through field visits, observations, and existing case studies conducted in different regions of Vietnam. Representative models included low-emission circular rice farming systems in the Mekong Delta, integrated farming systems such as VAC and rice–shrimp models, circular livestock farming, and low-input ecological agriculture. These practical cases provided important evidence for evaluating the implementation of circular agriculture and identifying institutional, technological, and financial barriers.

To complement the qualitative analysis, an online survey was conducted in June 2025 with 35 respondents, including government officials at ministerial and provincial levels and experts from agricultural universities and research institutions in Vietnam. Respondents evaluated the policy framework based on five criteria: relevance, effectiveness, efficiency, equity, and sustainability using a five-point Likert scale. Descriptive statistics, particularly mean value analysis, were employed to analyze the survey data.

RESULTS AND DISCUSSIONS

Policy Framework Supporting Circular Agriculture Development in Vietnam

Policy framework for supporting the CE development in Vietnam

Before the promulgation of the 2020 Law on Environmental Protection, the concept of the CE had not been formally institutionalized in Vietnam's legal framework. Nevertheless, principles associated with CE such as efficient resource use, pollution prevention, environmental protection, and sustainable development had already been embedded in Party resolutions and national development strategies. Resolution No. 41-NQ/TW (2004) emphasized environmental protection during industrialization and modernization, prioritizing pollution prevention over remediation. Subsequently, Resolution No. 24-NQ/TW (2013) highlighted the restructuring of the economy toward green and sustainable growth in response to climate change. These orientations were further reinforced through Resolution No. 55-NQ/TW (2020), which promoted renewable energy development, efficient resource use, and greenhouse gas emission reduction in line with sustainable development objectives.

Although earlier legislation did not explicitly mention CE, many related legal instruments incorporated circular principles through regulations on environmental management, energy efficiency, natural resource conservation, and waste reduction. These included the Law on Environmental Protection, the Law on Economical and Efficient Use of Energy, the Law on Water Resources, the Law on Forestry, and the Law on Plant Protection and Quarantine. At the strategic level, Vietnam also introduced several important programs supporting green and circular development, such as the Renewable Energy Development Strategy, the National Strategy for Integrated Solid Waste Management, the National Green Growth Strategy, and the National Environmental Protection Strategy. Collectively, these policies established an important institutional foundation for the gradual integration of CE principles into national development planning.

A major turning point occurred with the adoption of the 2020 Law on Environmental Protection, which officially institutionalized the concept of CE in Vietnam's legal system. Article 5 of the Law identifies circular and green economic development as a central orientation in socio-economic planning, while Article 142 specifies the responsibilities of state agencies, enterprises, and individuals in promoting CE practices. The law emphasizes shared responsibility among government bodies, businesses, and society in implementing environmentally sustainable production and consumption models. Furthermore, Decree No. 08/2022/NĐ-CP provided detailed guidance for implementing the Law, including criteria for CE development, mechanisms for waste management, and responsibilities of ministries and provincial authorities. The decree also introduced incentive mechanisms encouraging businesses and local governments to adopt circular production models and improve resource efficiency.

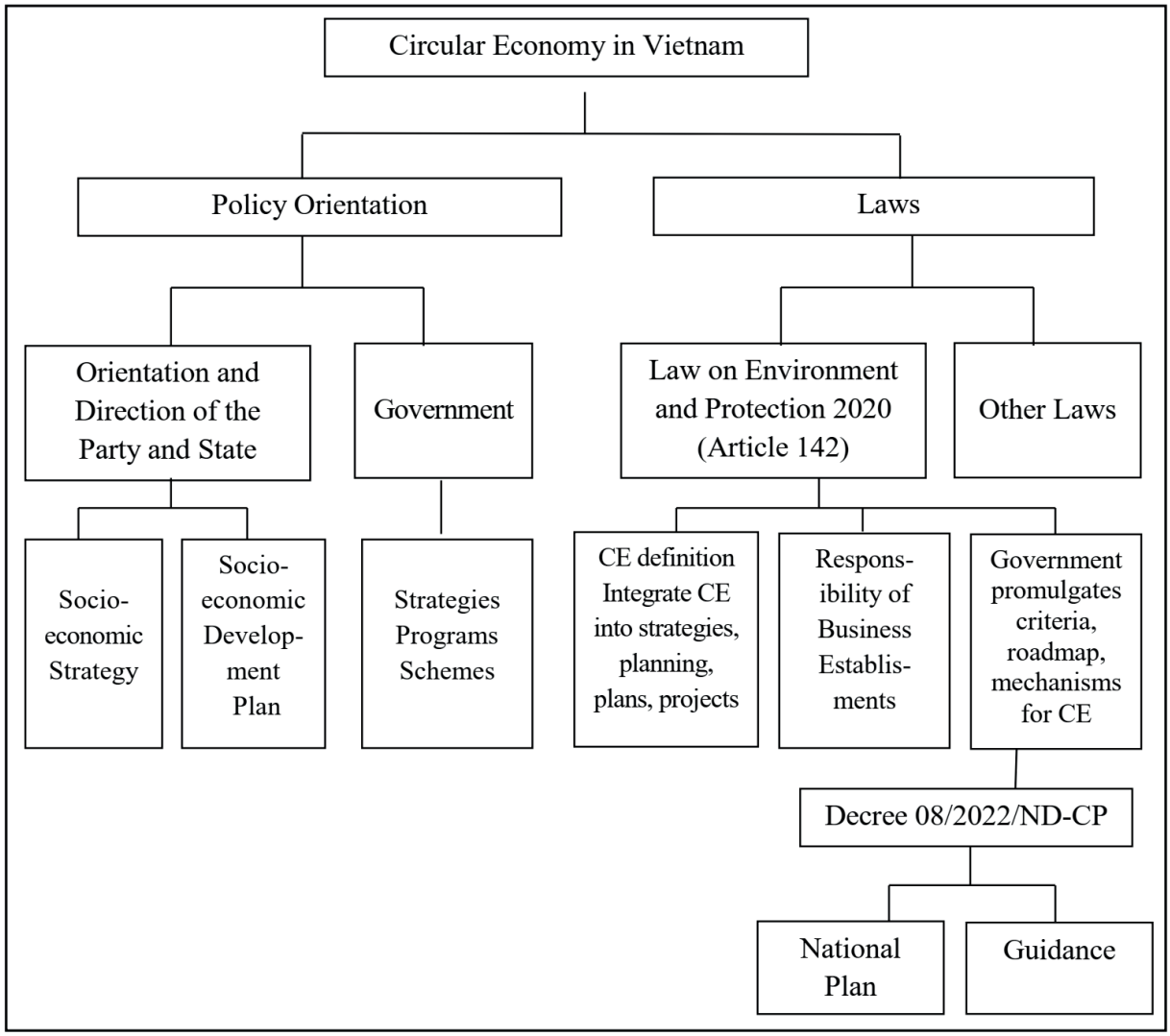

Figure 1. Policy Framework for the Development of CE in Vietnam
(Source: Adapted from Manh & Pham, 2024).

Alongside environmental legislation, Vietnam has increasingly integrated CE principles into broader economic and development strategies. Decision No. 1658/QĐ-TTg approving the National Green Growth Strategy for 2021-2030 emphasizes resource efficiency, innovation, digital transformation, and sustainable infrastructure development as key pillars of green growth. Similarly, Decision No. 450/QĐ-TTg approving the National Environmental Protection Strategy to 2030 identifies CE, green economy, and low-carbon development as strategic priorities for achieving environmental sustainability and climate resilience. In addition, Decision No. 687/QĐ-TTg (2022) officially approved the Scheme for Circular Economy Development in Vietnam, defining CE as a strategic driver for improving labor productivity, enhancing competitiveness, strengthening supply chain resilience, and promoting sustainable economic growth.

Vietnam has also introduced policies to encourage private sector participation in circular development. Decision No. 167/QĐ-TTg (2022) established a support program for private enterprises implementing sustainable business models based on CE principles. The program provides support in strategic planning, technology adoption, financial access, business model development, trade promotion, and market expansion. To facilitate implementation, Circular No. 13/2023/TT-BKHĐT introduced a comprehensive evaluation framework for assessing circular business models, covering strategic orientation, production processes, and

post-consumption recycling and recovery activities.

Overall, Vietnam has gradually developed a relatively comprehensive policy framework supporting CE and circular agriculture development. The policy system demonstrates increasing alignment between environmental protection, green growth, and sustainable agricultural transformation. However, despite significant progress in legal institutionalization, the implementation of CE policies remains constrained by overlapping regulations, limited coordination among stakeholders, insufficient financial incentives, technological barriers, and weak enforcement capacity at local levels. These challenges continue to hinder the effective transition toward a fully circular agricultural system in Vietnam.

Policy Framework Supporting Circular Agriculture Development in Vietnam

Vietnam's policy framework for circular agriculture has gradually evolved from sector-specific regulations on agricultural waste management toward a more integrated approach linking resource efficiency, environmental sustainability, and green growth. Early agricultural legislation primarily focused on controlling pollution and improving the utilization of agricultural by-products. The Law on Crop Production (2018) introduced provisions requiring the collection, treatment, and reuse of crop residues to minimize environmental pollution and encourage their conversion into commercial inputs. Similarly, the Law on Animal Husbandry (2018) established responsibilities for livestock producers regarding the treatment of solid waste, wastewater, and emissions in compliance with environmental regulations. Supporting these laws, Circular No. 19/2019/TT-BNNPTNT provided technical guidance on the treatment and reuse of crop by-products through environmentally friendly technologies and production practices.

The institutionalization of circular agriculture became more explicit after 2020 as CE principles were increasingly integrated into national agricultural and rural development strategies. Resolution No. 19-NQ/TW (2022) identified green, organic, and circular agriculture as central directions for restructuring the agricultural sector toward sustainability and higher value creation. The Resolution emphasized reducing dependence on chemical fertilizers and pesticides, promoting biological and organic inputs, encouraging environmentally friendly livestock systems, and developing ecological aquaculture and sustainable forestry linked with biodiversity conservation and carbon market development. In parallel, Resolution No. 20-NQ/TW (2022) promoted the participation of cooperatives and collective economic organizations in circular agricultural value chains through science, technology, innovation, and digital transformation.

Sectoral development strategies have also incorporated CE principles more directly. Decision No. 1520/QĐ-TTg on the Livestock Development Strategy for 2021–2030 promoted closed-loop livestock production systems and the application of waste treatment technologies associated with organic fertilizer production and renewable energy generation. More importantly, Decision No. 687/QĐ-TTg (2022), approving the Scheme for CE Development in Vietnam, established an overarching framework for integrating CE principles into agricultural production systems. Under this framework, the Ministry of Agriculture and Rural Development (MARD) was assigned responsibility for promoting circular agricultural value chains, strengthening technology transfer, improving the utilization of agricultural by-products, and enhancing resource efficiency in land, water, and agricultural inputs.

A major step toward operationalizing circular agriculture was the issuance of Decision No. 540/QĐ-TTg (2024) on science, technology application, and technology transfer for promoting the CE in agriculture by 2030. Unlike previous policies that mainly provided general orientations, this Decision established specific quantitative targets across agricultural subsectors. By 2030, at least 20% of agricultural science and technology projects are expected to focus on CE research, application, and technology transfer. The policy also aims to reduce post-harvest losses of major agricultural, forestry, and fishery products by 0.5–1% annually. In crop production, 50% of agricultural by-products are targeted for recycling and reuse, including 80% of rice straw collected and reused through appropriate

technologies. In livestock production, 60% of farming households and all large-scale farms are expected to adopt waste treatment and recycling technologies. Similar targets were established for aquaculture and forestry, including the treatment and reuse of aquaculture sludge and wastewater, the recycling of seafood processing by-products, and the utilization of timber residues for biofuels and wood-based products.

The Decision also introduced measures to strengthen institutional and technical capacities for circular agriculture implementation. These include the development of standardized procedures for agricultural waste management and by-product recycling, nationwide training programs for agricultural extension officers, and broader dissemination of recycling technologies to farms and cooperatives. By 2030, 80% of farms and 50% of agricultural cooperatives are expected to have access to circular agriculture technologies and waste management procedures. The policy further aims to increase value added in agricultural value chains by at least 20% through the application of CE technologies in farms, cooperatives, and agribusinesses.

In addition to technical and institutional support, Vietnam has gradually expanded financial mechanisms for circular agriculture. Decree No. 156/2025/NĐ-CP introduced preferential credit policies for circular agriculture projects, allowing households, farms, cooperatives, and cooperative alliances implementing CE-compliant models to access unsecured loans covering up to 70% of project value. The maximum loan limits are set at VND 300 million for individuals and households, VND 500 million for cooperative groups and household businesses, VND 3 billion for farms, and VND 5 billion for cooperatives and cooperative alliances. This represents an important policy effort to reduce financial barriers and encourage investment in circular production systems.

Implementation of Circular Agriculture in Vietnam

Overview of Agricultural Production in Vietnam

Agriculture remains a fundamental pillar of Vietnam's economy, with production systems traditionally centered on the integration of crop cultivation and livestock farming. Major agricultural products include rice, maize, vegetables, fruits, pigs, cattle, buffaloes, and poultry. In 2023, crop production accounted for approximately 66–68% of total agricultural output, while livestock contributed 32–34% (General Statistics Office of Vietnam, 2024). Agricultural production is concentrated mainly in the Red River Delta and the Mekong Delta, which are the country's two most important agricultural regions. Rice continues to dominate the cropping structure, while pig farming represents the largest livestock subsector.

Over the past three decades, Vietnam's agricultural sector has experienced substantial transformation driven by economic reforms and market liberalization policies. The reforms initiated in the 1980s, particularly the 1988 agricultural policy reforms, granted greater autonomy to farm households and liberalized agricultural markets, thereby stimulating productivity growth and structural transformation. As a result, Vietnam successfully transitioned from a food-deficit country to one of the world's leading agricultural exporters. Rice production increased significantly from 11.64 million tons in 1980 to approximately 43.1 million tons in 2023 (General Statistics Office of Vietnam, 2024). Since the early 1990s, Vietnam has consistently ranked among the world's top rice-exporting countries, exporting more than 7.1 million tons of rice in 2023 and generating approximately USD 4.7 billion in export revenue.

Despite these remarkable achievements, the rapid expansion and intensification of agricultural production have generated increasing environmental pressures, particularly in relation to agricultural waste and resource use efficiency. Agricultural production in Vietnam continues to rely heavily on chemical fertilizers, pesticides, plastics, water resources, and intensive farming systems, resulting in substantial volumes of waste and environmental pollution. These challenges have become major drivers for promoting circular agriculture and sustainable production models in recent years.

Agricultural Waste and Environmental Challenges

Vietnam's agricultural sector is a major source of organic waste, wastewater, and plastic pollution across crop production, livestock

farming, and aquaculture. Crop production alone generated approximately 94.42 million tons of agricultural by-products in 2023, including residues from annual crops, fruit trees, and perennial industrial crops (MONRE Vietnam, 2023). Although part of this biomass is reused for animal feed, composting, or energy generation, a considerable proportion remains untreated or is directly burned in open fields, contributing to greenhouse gas emissions and environmental degradation. In addition, agricultural activities generate substantial quantities of pesticide packaging, plastic mulch, and seedling bags, further increasing the environmental burden.

Livestock production also represents a significant source of pollution. In 2023, the livestock sector generated approximately 68.92 million tons of solid waste and more than 260 million liters of wastewater. More than half of livestock waste remains untreated, particularly in small-scale farming systems where waste treatment infrastructure is limited. Plastic waste from feed packaging is also increasing rapidly. Similarly, aquaculture production has generated growing environmental concerns. Intensive aquaculture systems produce large volumes of sludge, wastewater, plastic pond liners, and chemical residues, much of which is discharged untreated into surrounding ecosystems. According to MONRE Vietnam (2023), only 27% of aquaculture sludge and 41% of aquaculture wastewater are adequately treated before disposal.

These findings indicate that Vietnam's agricultural sector faces serious environmental and resource management challenges despite its economic success. The large volume of untreated agricultural waste reflects significant inefficiencies in resource utilization while simultaneously creating opportunities for circular agriculture development. Agricultural by-products, livestock waste, and aquaculture residues can potentially be transformed into valuable inputs such as organic fertilizers, animal feed, renewable energy, and recycled materials. Therefore, the transition toward circular agriculture is increasingly recognized as a necessary pathway for improving resource efficiency, reducing environmental pollution, and supporting sustainable agricultural development in Vietnam.

Practical Circular Agricultural models in Vietnam

The gradual improvement of Vietnam's policy framework on CE and sustainable agriculture has created favorable conditions for the expansion of practical circular agriculture models across different regions of the country. Recent policies such as Resolution No. 19-NQ/TW (2022), Decision No. 687/QĐ-TTg (2022), and Decision No. 540/QĐ-TTg (2024) have emphasized resource efficiency, agricultural waste recycling, low-emission production, and the development of circular value chains. In practice, these policy orientations have been increasingly translated into various circular agriculture models in crop production, livestock farming, aquaculture, and integrated ecological farming systems.

One of the most prominent examples is the Low-Emission Circular Rice Farming Model implemented in the Mekong Delta under the Project on Sustainable Development of One Million Hectares of High-Quality, Low-Emission Rice associated with Green Growth by 2030. The model reflects Vietnam's commitment to green growth, climate change adaptation, and low-carbon agriculture in line with its COP26 net-zero emission commitments. Circular principles are integrated through advanced farming practices such as "One Must, Five Reductions", "Three Reductions, Three Gains", alternate wetting and drying irrigation, and reduced use of fertilizers, pesticides, seeds, and irrigation water. A key component of the model is the reuse of rice straw instead of open-field burning. Rice straw is collected and utilized for mushroom cultivation, organic fertilizer production, animal feed, and other commercial purposes, thereby improving resource efficiency and reducing environmental pollution. After two years of implementation, the cultivated area exceeded 354,000 hectares, while participating farmers reported lower production costs, higher productivity, and increased incomes. The model has also strengthened linkages among farmers, cooperatives, and agribusinesses and contributed to the development of the "Vietnam Green Low-Emission Rice" brand for export markets such as Japan.

Integrated circular farming systems also represent an important form of circular agriculture widely practiced in Vietnam. Traditional models such as VAC (Garden-Pond-Livestock), VACB (Garden-Pond-Livestock-Biogas), VACR (Garden-Pond-Livestock-Forest), rice-shrimp, rice-fish, and agroforestry systems have long demonstrated the potential of closed-loop agricultural production. These models are consistent with recent policy orientations promoting ecological agriculture, waste recycling, and efficient utilization of land and water resources. In particular, rice-shrimp and rice-fish systems in the Mekong Delta create strong circular linkages between crop cultivation and aquaculture, where waste and by-products from one activity become inputs for another. Shrimp and fish waste provide nutrients for rice cultivation, while rice straw and residual grains are reused as feed sources for aquatic species. These systems help reduce chemical inputs, improve soil and water quality, and enhance resilience to climate change. Farmers adopting rice–shrimp systems have reported incomes five to ten times higher than conventional rice monoculture, highlighting the significant economic potential of circular farming models.

Circular livestock farming has also expanded rapidly in response to increasing environmental concerns associated with livestock waste. In line with the Livestock Development Strategy for 2021-2030 and national CE policies, many farms have adopted biogas digesters, composting systems, manure separation technologies, and integrated crop–livestock models. Livestock waste is increasingly reused for organic fertilizer production, aquaculture, and renewable energy generation, thereby reducing pollution and improving resource efficiency. Vietnam currently operates more than 280,000 biogas plants under agricultural and rural development programs. In provinces such as Nghe An, integrated circular livestock systems combining pig farming, biogas production, earthworm cultivation, and organic fertilizer processing have generated substantial environmental and economic benefits. Studies indicate that circular livestock systems can increase profitability by more than 20% through reduced treatment costs and improved resource utilization while also lowering greenhouse gas emissions and environmental pollution.

Another emerging approach is the low-input ecological circular agriculture model, which emphasizes minimizing the use of chemical fertilizers, pesticides, antibiotics, and synthetic growth stimulants while promoting biological and environmentally friendly alternatives. Supported by national policies on green growth, organic agriculture, and food safety, ecological farming models have expanded rapidly through VietGAP-certified production and organic agriculture initiatives. By 2025, Vietnam had more than 8,300 VietGAP-certified agricultural facilities and approximately 174,000-195,000 hectares under organic farming management. Provinces such as Lam Dong, Son La, Dong Nai, Hanoi, and Nghe An have developed ecological farming zones linked with certified value chains and sustainable markets. The application of integrated pest management, organic fertilizers, biological pesticides, and ecological livestock practices has improved soil fertility, biodiversity conservation, and food safety while reducing environmental pollution and greenhouse gas emissions. Economic evidence also suggests that ecological and organic farming systems generate values approximately 1.3-1.8 times higher than conventional production models, contributing to both rural income improvement and sustainable agricultural development.

Overall, these practical models demonstrate that circular agriculture in Vietnam is gradually moving from policy orientation toward real implementation across multiple agricultural subsectors. They also illustrate the important role of government policies, technological innovation, cooperatives, and private sector participation in supporting the transition toward a more sustainable, low-emission, and resource-efficient agricultural system.

Assessment of the Policy Framework Supporting Circular Agriculture in Vietnam

To assess policy framework supporting circular agriculture in Vietnam, an online survey was conducted with 35 respondents, including officials at ministerial and provincial levels and experts from agricultural universities and research institutions. The evaluation applied a five-point Likert scale based on five criteria:

relevance, effectiveness, efficiency, equity, and sustainability. The results indicate that Vietnam's policy framework for circular agriculture is generally viewed positively, particularly in terms of its strategic orientation toward green growth and sustainable agricultural transformation, although important implementation challenges remain.

Table 1. Assessment of policy framework to support circular agriculture in Vietnam

Indicator	1	2	3	4	5	Mean
1. Relevance	0.0	5.7	8.6	60.0	25.7	4.06
2. Effectiveness	5.7	17.1	31.4	37.1	8.6	3.26
3. Efficiency	5.7	14.3	20.0	51.4	8.6	3.43
4. Equity	2.9	22.9	22.9	42.9	8.6	3.31
5. Sustainability	5.7	11.4	20.0	48.6	14.3	3.54

Note: 1 = strongly disagree; 2 = disagree; 3 = neutral; 4 = agree; 5 = strongly agree
(Source: Survey, 2025)

Among the five indicators, relevance received the highest mean score (4.06), suggesting that existing policies are highly consistent with Vietnam's broader development objectives, including climate change adaptation, green growth, low-emission agriculture, and sustainable resource management. Recent policies such as Resolution No. 19-NQ/TW, Decision No. 687/QĐ-TTg, and Decision No. 540/QĐ-TTg demonstrate increasing government commitment to integrating CE principles into agricultural development strategies. The practical expansion of low-emission rice farming, integrated VAC systems, circular livestock models, and ecological farming practices across many provinces further illustrates the growing alignment between policy orientations and actual agricultural transformation needs. In particular, the One Million Hectares of High-Quality, Low-Emission Rice Program in the Mekong Delta reflects a clear policy shift toward combining productivity improvement with greenhouse gas reduction, waste recycling, and climate resilience.

However, effectiveness received the lowest score (3.26), indicating substantial gaps between policy objectives and implementation outcomes. Although many circular agriculture models have produced positive environmental and economic results, their adoption remains uneven and relatively limited in scale. For example, rice straw recycling, livestock waste treatment, and aquaculture waste reuse are increasingly promoted under national policies, yet large quantities of agricultural by-products and wastewater are still discharged untreated into the environment. Many localities continue to face technological constraints, inadequate infrastructure, and limited technical support for implementing circular production systems. In addition, coordination among ministries, local authorities, cooperatives, and enterprises remains fragmented, reducing the effectiveness of policy implementation and limiting the development of integrated circular value chains. Efficiency (3.43) and sustainability (3.54) were evaluated at moderate-to-high levels, reflecting the initial positive impacts of circular agriculture policies on resource efficiency, waste reduction, and value creation. Practical models such as rice-shrimp systems, biogas-integrated livestock farming, and organic agriculture have demonstrated the potential to reduce input costs, improve resource utilization, increase farmers' incomes, and lower environmental pollution. Some ecological and organic farming systems generate economic returns significantly higher than conventional production models, while circular livestock systems have contributed to renewable energy generation and greenhouse gas reduction. Nevertheless, the long-term sustainability of these models remains constrained by limited financial incentives, insufficient investment in technological innovation, and weak market linkages for circular agricultural products. Many circular initiatives still depend heavily on government support and pilot projects rather than stable market-based mechanisms.

The equity indicator received a relatively modest score (3.31), highlighting disparities in access to policy support and circular technologies. Smallholder farmers, who dominate Vietnam's agricultural sector, often face difficulties accessing credit, advanced technologies, training programs, and certification systems related to circular agriculture. Meanwhile, circular farming models are more likely to be adopted by large farms, cooperatives, or enterprises with stronger financial and technical capacities. Regional inequalities are also evident, as provinces with stronger infrastructure, market access, and institutional capacity have been more successful

in implementing circular agriculture initiatives than remote or disadvantaged areas.

Despite considerable progress in policy development, several structural and institutional challenges continue to hinder the effective implementation of circular agriculture in Vietnam. First, the current policy framework remains fragmented and lacks a specialized legal mechanism specifically tailored to circular agriculture. Existing regulations mainly provide broad policy orientations without clear operational guidelines, technical standards, or monitoring systems for assessing circularity in agricultural production. As a result, many agricultural models are described as "circular" despite the absence of standardized criteria related to waste recycling, resource efficiency, emission reduction, or environmental performance. In practice, inconsistencies in the understanding of circular agriculture among local authorities and stakeholders have also created difficulties in policy implementation and evaluation.

Second, inter-sectoral coordination remains weak. Circular agriculture requires strong linkages among agriculture, environment, energy, science and technology, finance, and trade sectors. However, policies are still largely formulated and implemented independently across ministries and agencies, limiting the development of integrated circular value chains (Mai & Nguyen, 2024). For example, initiatives promoting rice straw reuse, organic fertilizer production, livestock waste recycling, or biogas systems often lack synchronized financial support, technical guidance, market development policies, or renewable energy integration mechanisms. Consequently, many circular models such as VAC systems, low-emission rice farming, and circular livestock production remain localized and difficult to scale up nationwide.

Third, financial, technological, and infrastructural barriers continue to constrain the expansion of circular agriculture. Although Decree No. 156/2025/NĐ-CP introduced preferential credit mechanisms for circular agricultural projects, access to green finance remains limited, particularly for smallholder farmers and cooperatives that dominate Vietnam's agricultural sector. High initial investment costs for waste treatment systems, biomass collection, composting facilities, and renewable energy technologies often exceed the financial capacity of rural producers. In addition, agricultural production in Vietnam remains highly fragmented and small-scale, making the collection, classification, and recycling of agricultural by-products economically inefficient. Technology transfer and technical support services also remain inadequate, especially in remote and disadvantaged regions.

Finally, institutional and human resource capacity at local levels remains insufficient. Many provincial agencies and extension systems still lack the technical expertise, human resources, and practical guidelines necessary to effectively support circular agriculture implementation. Awareness of CE principles among farmers, cooperatives, and local officials also remains uneven, while market systems for recycled agricultural products, organic fertilizers, and certified circular products are still underdeveloped. These limitations continue to reduce incentives for investment and slow the transition from pilot circular models toward large-scale and sustainable implementation.

Recommendations for Strengthening the Policy Framework for Circular Agriculture in Vietnam

Although Vietnam has made substantial progress in institutionalizing CE principles within agricultural development strategies, the transition from policy orientation to large-scale implementation remains constrained by fragmented regulations, weak inter-sectoral coordination, limited technological capacity, and insufficient market incentives. Drawing upon policy assessment results and practical experiences from circular agriculture models in Vietnam, several recommendations are proposed to improve the effectiveness and scalability of circular agriculture development.

First, Vietnam should establish a more integrated and specialized legal framework for circular agriculture. Existing regulations remain dispersed across environmental protection, crop production, livestock, aquaculture, and rural development policies, resulting in overlapping responsibilities and inconsistent implementation. A dedicated legal instrument should clearly define circular agricultural

models, technical requirements, waste reuse principles, and responsibilities of stakeholders throughout agricultural value chains. The framework should also introduce operational guidelines and monitoring mechanisms for evaluating circularity performance in agricultural systems. In parallel, CE principles should be systematically integrated into local agricultural planning and sectoral development strategies to improve policy coherence and implementation consistency.

Second, the government should develop standardized indicators, technical standards, and certification systems for circular agriculture. At present, the absence of unified evaluation criteria has resulted in inconsistent interpretation and application of circular agriculture across localities. National standards should therefore be established for composting technologies, biogas systems, livestock waste treatment, rice straw recycling, aquaculture sludge reuse, and organic input production. A national certification and traceability system for circular agricultural products should also be expanded to strengthen market transparency, consumer confidence, and export competitiveness. Practical experiences from VietGAP-certified production, organic farming, and low-emission rice models demonstrate that certification mechanisms can significantly improve product value and market access.

Third, stronger financial incentives and investment support are necessary to accelerate the adoption of circular agriculture models, particularly among smallholder farmers and cooperatives. Although recent preferential credit policies have improved access to finance, many rural producers still face major constraints due to high initial investment costs and limited collateral. The government should therefore expand green credit schemes, preferential loans, tax incentives, and subsidies for waste recycling technologies, renewable energy systems, organic fertilizer production, and low-emission farming practices. Public investment should prioritize infrastructure for biomass collection, waste classification, agricultural by-product processing, and renewable energy development. In addition, startup support programs and innovation funds should be strengthened to encourage enterprises and cooperatives to invest in circular agricultural technologies and business models.

Fourth, promoting science, technology transfer, and digital innovation is essential for improving the efficiency and sustainability of circular agriculture. Vietnam should strengthen research and development programs related to biomass utilization, organic inputs, renewable energy, low-carbon technologies, and precision agriculture. Greater collaboration among universities, research institutes, enterprises, cooperatives, and farmers is needed to accelerate technology commercialization and adaptation to local conditions. Digital technologies such as traceability systems, environmental monitoring, smart irrigation, and digital value-chain management should also be integrated into circular agricultural systems. The practical success of the Mekong Delta's low-emission rice initiative demonstrates how technological innovation can simultaneously improve productivity, reduce greenhouse gas emissions, and increase export value.

Fifth, policies should prioritize the development of integrated circular value chains and regional circular agricultural clusters. Practical models such as VAC, rice-shrimp farming, agroforestry, and circular livestock systems show that stronger linkages among crop cultivation, livestock, aquaculture, processing industries, and waste recycling activities can substantially improve resource efficiency and rural incomes. Therefore, the government should promote cooperative models, enterprise-led production networks, and public–private partnerships that connect production, processing, recycling, and green consumption. Special attention should be given to ecological regions with strong circular agriculture potential, particularly the Mekong Delta, Central Highlands, and mountainous areas, where integrated resource management can generate both economic and environmental benefits.

Finally, strengthening institutional capacity and stakeholder awareness is essential for the long-term success of circular agriculture policies. Many local authorities, extension systems, cooperatives, and farming households still lack sufficient technical knowledge and implementation capacity related to circular agriculture. Comprehensive training programs should therefore be expanded for government

officials, extension officers, enterprises, and farmers, with greater emphasis on practical guidance and technology application. Awareness campaigns should highlight not only the environmental benefits of circular agriculture but also its economic advantages, including reduced production costs, higher value addition, and improved market opportunities. Strengthening the participation of local communities, farmer organizations, cooperatives, and private enterprises will be critical for transforming circular agriculture from isolated pilot initiatives into a mainstream pathway for sustainable agricultural development in Vietnam.

CONCLUSIONS

This study examined the development of Vietnam's policy framework for circular agriculture and assessed its implementation through both stakeholder evaluation and practical agricultural models. The findings indicate that Vietnam has gradually institutionalized CE principles within environmental protection, agricultural restructuring, green growth, and climate adaptation strategies. Key policy instruments, particularly the Law on Environmental Protection 2020, Decision No. 687/QĐ-TTg (2022), and Decision No. 540/QĐ-TTg (2024), have established an important policy foundation for promoting resource efficiency, agricultural waste recycling, and low-emission agricultural development.

The study also shows that circular agriculture has increasingly moved from policy orientation toward practical implementation through models such as low-emission rice farming, integrated farming systems, circular livestock production, and the low-input ecological agriculture. These models have demonstrated positive contributions to resource utilization, waste reduction, renewable energy generation, environmental protection, and farmers' income improvement. In several regions, circular agricultural practices have also strengthened climate resilience and enhanced the competitiveness of agricultural value chains.

However, despite these encouraging developments, significant challenges continue to limit the effectiveness and scalability of circular agriculture in Vietnam. The current policy framework remains fragmented, lacking specialized legal mechanisms, technical standards, and monitoring systems specifically designed for circular agriculture. In addition, weak inter-sectoral coordination, limited technological capacity, inadequate infrastructure, and unequal access to finance and innovation continue to constrain implementation, particularly among smallholder farmers and disadvantaged regions. As a result, many circular agriculture initiatives remain localized and dependent on pilot programs rather than stable market-based systems.

To accelerate the transition toward circular agriculture, Vietnam should prioritize the development of a more integrated and implementation-oriented policy framework. Key priorities include establishing clear technical standards and evaluation criteria, strengthening coordination among relevant sectors and stakeholders, expanding access to green finance and technology transfer, and improving local implementation capacity through training and extension services. In addition, enhancing market linkages and support mechanisms for circular agricultural products will be essential for scaling up adoption and promoting a more sustainable, low-emission, and resource-efficient agricultural system in Vietnam.

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