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How to Enhance Circular Agriculture Models at Micro-Level in Vietnam? A Review

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Abstract

Vietnam's agricultural sector has achieved remarkable progress in recent years, ensuring both food security and export turnover for the country. However, the current focus on productivity and output alone is wasteful and detrimental to the environment. To address this, a shift from linear to circular agriculture is advocated, encompassing not only production but also consumption. While circular economy (CE) in agriculture is a new concept in Vietnam, various stakeholders at the micro-level, such as farmers, cooperatives, and enterprises, have been practicing circular agriculture for some time. Nevertheless, most of these models have emerged spontaneously without cohesive development across regions. Although the Vietnamese government have introduced policies promoting green production and CE, they have provided little guidance on promoting circular agricultural models at the micro-level. This paper presents a concise overview of CE in agriculture, synthesizes typical micro-level models of CE in Vietnam, and proposes policy recommendations to enhance existing circular agriculture models, including raising awareness among stakeholders about circular agriculture, encouraging investment in circular agriculture, enhancing the capacity of agricultural producers in recycling and reusing by-products, and establishing an appropriate legal framework.

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Introduction

According to FAO[1], food demand will increase by 50% between 2012 and 2050. Additionally, the demand structure will be changed due to population growth, urbanization, and an increase in income per capita. Nevertheless, the natural resources serving agriculture become increasingly stressed. Thus, improvements in resource-use efficiency and gains

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in resource conservation should be addressed to meet the growth and changes in food demand as well as to protect the environment. In this context, CE development in agriculture is considered as an important solution, particularly in developing countries. Among different meanings, the CE has been generally perceived as a crucial strategy that helps people to save resources and to reduce the negative environmental impacts of agricultural activities.[2,3]

Vietnam's agriculture sector has made remarkable achievements in recent years, with an average growth rate of 3% per year in the 2010-2020 period,[4] firmly ensuring food security and export turnover of agricultural products. However, the focus on productivity and output in agricultural development has neglected the proper utilization of waste generated during production, resulting in resource wastage and environmental pollution. In Vietnam, there are approximately 12 million households and 23,500 concentrated farms engaged in livestock activities. Poultry and pigs are the most common livestock, with a total of 362 million poultry and 29 million pigs. Each year, around 84.5 million tons of waste from livestock production are released into the environment, with only approximately 20% effectively utilized through practices such as biogas generation, composting, worm farming, and fish feeding. The remaining 80% is wasted, leading to environmental pollution, particularly in water, air, and soil.[5]

The World Bank's Overview Report on Vietnam Agricultural Pollution highlights that livestock production is a major source of ammonia (NH3) emissions into the environment. The increasing number of livestock will further contribute to higher NH3 emissions, with the most substantial increase observed in pig and poultry farming. Alarming statistics reveal that in the Northern region, the pollution level of untreated water from small livestock farms exceeds permissible limits for coliforms. Additionally, the concentration of NH3 in exhaust gas is 7-18 times higher than the permitted level, and the level of hydrogen sulfide (H2S) is 5-50 times higher than allowed.[6] The intensification of farming activities and increased agricultural output has resulted in excessive use of chemical fertilizers, pesticides, and other plant protection chemicals.[7] In response to these challenges, scholars and policymakers have advocated for the application of CE principles in agricultural production and consumption, aiming to produce safe, high-quality products while minimizing waste.

The concepts and principles of CE should form the foundation for designing policies at national, regional, and company levels.[8] At the national (macro) level, the CE is considered a central point of socio-economic development policies as well as laws and regulations. At the regional (meso) level, the CE framework is used for the creation of closed-loop production and consumption systems. At the company (micro) level, this framework is used as a basis for the formulation of corporate product design and recycling strategies.

The concept of CE has recently introduced to policymakers and other stakeholders in Vietnam, but producers (farmers, cooperatives, and enterprises) at the micro-level have been practicing circular economic models for a significant period. Many communities have long-established models of the circular economy, such as VAC (a combination of Garden - Pond - Barn), VRAC (comprising Garden - Farm - Pond - Barn), agroforestry and other environmental friendly production processes. These models combine crop farming, and taking care of animals, doing aquaculture in the form of food chains. Biogas technology for gas recovery was incorporated into these models after 2000.[9] However, most of these models have emerged spontaneously from different stakeholders and developed independently across various regions. Although the Vietnamese government has introduced policies to promote green production and circular economy, there has been limited emphasis on promoting circular agricultural models, particularly at the micro-level.

Based on published documents collected from different sources, this paper aims to: (i) Make a brief overview of CE in agriculture; (ii) Synthesize the typical models of CE in agriculture at the micro-level in Vietnam; and (iii) Propose policy recommendations to enhance the existing models of CE in agriculture at micro-level in Vietnam.

Literature Review of Circular Economy in Agriculture

Circular Economy in Agriculture: Definition

CE concept has been paid attention to in recent years by academics, politicians, and practitioners. The number of peer-reviewed articles on CE has rapidly increased in the period from 2014 to 2016, particularly more than 100 articles on CE topics have been published in 2016 in comparison with 30 ones in 2014[2]. Additionally, a number of consultancy reports and policy guidelines have been issued all over the world.[10]

Concept of CE introduced by reference[11] has been the most influential and has inspired subsequent definitions by other scholars.[12,13,14] These definitions emphasize the natural resources' significance in economic development and highlight the negative impacts of linear and open-ended production and consumption systems. Among various definitions, the Ellen MacArthur Foundation's definition[15] stands out as the most prominent. According to the foundation, CE is "an industrial system that is restorative or regenerative by intention and design. It replaces the 'end-of-life' concept with restoration, shifts towards the use of renewable energy, eliminates the use of toxic chemicals that impair reuse, and aims for the elimination of waste through superior design of materials, products, systems, and, within this, business models" (p7).

In the case of the agricultural sector, Ellen MacArthur Foundation[16] indicated that the CE approach encourages minimal use of external inputs, nutrient loop closing, soil regeneration, and minimizing negative environmental impacts. If this approach is practiced on a large scale, the resources which include land and chemical fertilizer are less required for the agricultural production. At the same time, waste is less discharged into the environment. More specifically, reference[17,18] supposed that circular agriculture is a way to farm sustainably by adopting scientific advances, innovations, and new technologies. The vital components of circular agriculture are integrated crop, livestock, fishery, agroforestry, and waste and water recycling.

Although circular agriculture has been practiced worldwide throughout history, it has been overshadowed by modern agriculture, characterized by large-scale, monoculture, highly intensive, export-orientation, and profit maximization.[19] As a result, policymakers, developers, and large-scale producers have prioritized economic considerations over environmental perspectives.

Regarding social side, circular agriculture is more labor intensive in comparison with linear one. Therefore, in rural areas where people are facing unemployment, the adoption of circular farming practices can create job opportunities, then contribute to poverty reduction. Unlike modern agriculture in which producers need capital to buy seeds, fertilizers, pesticides, and other inputs, circular agriculture requires fewer inputs, and many people, particularly the poor, can invest in this sector. Further, how smallholders have been practicing based on organic, diversified, and mixed farming for health, nutrition, and food security has been overlooked.[20]

Circular Agriculture's Principles

Scholars affirmed that three CE principles proposed by the EMF[17] have been the most influential so far, which are: (i) Identifying and eliminating negative externalities of the production and consumption system; (ii) Making all products, co-products, and by-products in use to utilize resources at the highest value; and (iii) Renewing resources for preservation and enhancement of ecosystems.

These principles have been modified and specified in the case of the agricultural sector.[19] The first principle is the "*conservation and preservation of natural resources*", in which the importance of natural resources and ecological systems are emphasized together with minimizing non-renewable or toxic input use. The second principle focused on the *utilization of resources* in which the role of the cyclic exchange system is underlined. Agricultural production systems can be more efficient through the use and reuse of resources and improved cycles. Natural ecosystems are often affected by efficient food, energy, and water recycling. Three levels can enhance the efficient use of resources, including Improving production with equipment in the advanced agricultural production system; Replacing low resource-efficient products with high ones, Designing a recirculation system by turning the output of one production process into an input into another. The last principle paid attention to multi-purpose use and renewable value. This

principle refers to reducing food waste by taking advantage of waste streams and turning them into valuable inputs for the food and food production chain. Food waste can occur at all stages of the value chain such as production, harvesting, storage, processing, and transportation. CE principles should implement through a value chain from input supply to production, processing, distribution, consumption, and waste discarding. In doing so, all involving stakeholders need to participate in every levels.[21]

Criteria for Evaluating Circular Agriculture

The CE in agriculture needs to be evaluated from indicators that reflect four aspects related to sustainability, such as technical characteristics, environment, economic, and social aspects.[22] There are 23, 13, and 05 indicators that have been synthesized by[18] and are used to measure circular agriculture based on the narrowing, closing, and regenerating strategy, respectively. By synthesizing and analyzing, the authors indicated that all indicators mentioned above cannot cover different aspects relating to sustainability. Almost half indicators strongly emphasized the technical aspect. A variety of environmental indicators have been proposed, but none of them measures all greenhouse gas emissions. The most shortcoming in criteria measuring agricultural circularity expresses in the social area.

From the various sources, the relevant indicators which are used for monitoring circular system production in agriculture are: (1) reuse and recycling of bio-based materials into new products; (2) loss of material; (3) food waste; (4) pesticide and fertilizer use; (5) nutrient balance; (6) renewable energy use; (7) carbon emission output; and (8) additional financial benefits from the circular business mode. By examining typical cases in developing countries, withdrew three aspects of circular agriculture evaluation, including economic, social, and environment.[23] Additionally, reference[21] indicated economic, environmental and social benefits of circular agriculture. These authors convinced that CE practices in agriculture are able to bring various benefits including: supply chain security improvement, production efficiency, opportunities for value construction, consumers' novel experiences, and additional revenue for businesses through by-products' selling. Together with economic benefits, CE in the agriculture have witnessed environmental welfare, such as soil and water quality advancement, and GHG emissions reduction. In addition, social welfare will be improved as indirect outcomes of circular agricultural practices in environmental health enhancement, food availability, and job creation.

Circular Economic Models in Agriculture at Micro-level in Vietnam

Traditional and Modern Models

Three patterns at different scales of the CE in agriculture in Yunnan Province (China) have been shown to recycle economy modes in families, in villages, and in ecological agriculture park.[24] Three popular models of circular agriculture in practice have been revealed by,[25] including mixed farms (mixed crop-livestock farming), organic farming (eliminating the dependence on chemical fertilizers, pesticides, and plastic), and agroforestry. In Vietnam, CE principles were applied by producers in agricultural production at the micro-level and formed some typical models such as: "Garden - Pond - Barn" (VAC), "Garden – Farm - Pond - Barn" (VRAC), "Garden - Pond - Barn – Biogas" (VACB), and so forth. These models apply a closed cycle in which most of waste and by-products are returned as input materials for other production processes through the application of biotechnology, physic-chemical technology, and advanced technologies along with flexible adaptation in business organizations.

VAC - "Garden - Pond – Barn" Model

The VAC model has been widely applied in Vietnam since the 1980s and considered the simplest form of circular agriculture,[26] in which: (i) The garden is the cultivation activity. In the garden, farmers plant a combination of many kinds of crops and trees with different layers to take advantage of solar energy and soil nutrients. Normally, farmers grow vegetables, beans, some spices, and medicinal plants in the garden's corner. If farmers have a large garden, they can grow timber combined with fruit trees as a fence to cover the wind; (ii) In the pond, people usually raise many types of fish at different layers. By doing so, farmers can take advantages of food sources from the garden and livestock waste for fish; (iii) Barn is a place where cattle (pig, goat, cow, and buffalo) and poultry were raised.

VAC has created an integrated agricultural production model, linking farming with animal husbandry, minimizing waste, and following nature. The VAC model has been improved by the development level of agricultural production as well as the ecological conditions of each territory across the country, that is "Garden - Pond - Barn – Biogas" (VACB); "Garden - Pond – Barn – Forest" (VACR) in mountainous provinces; "Garden - Pond – Lake" (VAH) in the Central provinces.

Implementing the VAC model not only brings high economic efficiency but also helps to reduce GHG emissions. Especially, the VACB model has helped to manage agricultural waste, rationally use agricultural waste and by-products as fertilizer to return soil fertility, safely treat animal waste, create renewable energy, create renewable energy sources of fuel for daily life, fight against environmental pollution and contribute to reducing greenhouse gas emissions and reducing greenhouse effects. The VAC model in Vietnam was initially small, to contribute to food security, hunger eradication, and poverty alleviation.

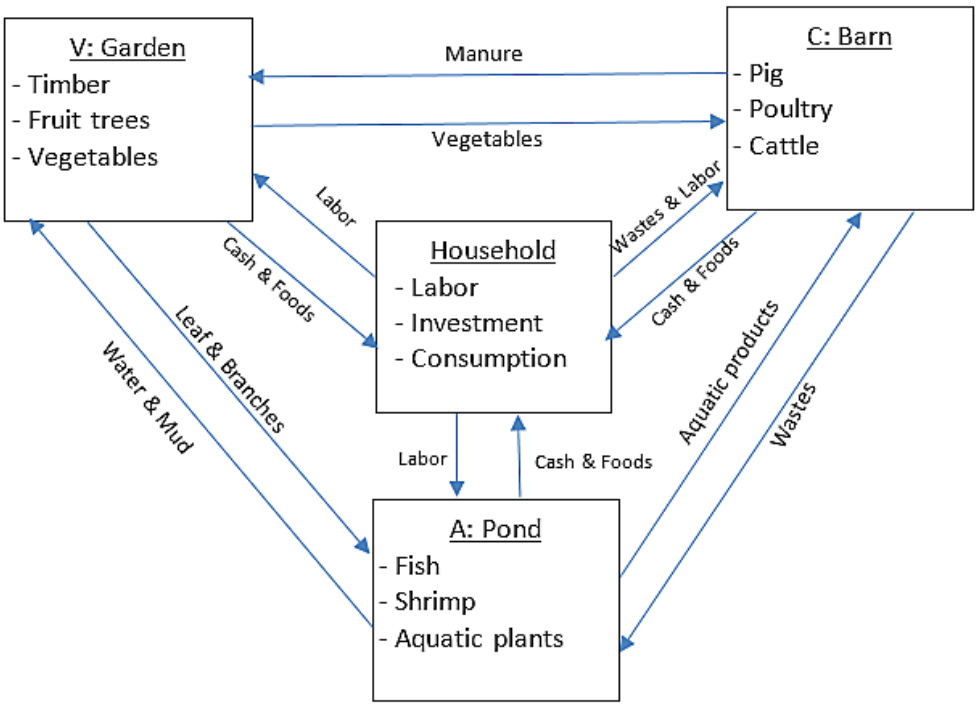

Fig 1: Circular relationship of V, A, and C components

The VAC model (Fig 1) has gained significant popularity and widespread adoption across the country. It has undergone improvements and demonstrated flexibility in its applications, benefiting numerous households, farms, cooperatives, and enterprises in organizing production and business activities. However, despite its success, the VAC model still faces certain limitations. These include its predominantly small scale, tendency towards self-sufficiency, and inadequate technology integration, particularly in the crucial stages of processing, packaging, preservation, and traceability. As a result, productivity remains low, quality lacks uniformity, and the overall value-added and competitiveness of the VAC model are adversely affected.[27]

Models of "rice – shrimp" and "rice – fish"

The "rice-shrimp" model has been applied since the early 2000s in Mekong Delta, while the "rice-fish" model has been implemented in the lowland and flooded areas in the Red River Delta. These models have been evaluated as the most relevant ones in the coastal saline areas. In these models, shrimp or fish is raised in the rice field, and their excrement and

leftover food are used as a nutritional supplement for rice. On the contrary, when the rice is harvested, shrimp are released into the field, and the stubble and scattered rice become a source of food for shrimp and fish. In these models, crops and livestock do not need pesticides and antibiotics. Therefore, they both create clean products and protect the environment. The models of "rice-shrimp" and "rice-fish" can create income that is as higher as 5 to 10 times as rice only.[28] Although the “Rice-Shrimp” model has brought significant economic benefits for farmers, it is not stable because of the following reasons: (1) Infrastructure in shrimp-rice farming localities has not kept pace with the expansion of production areas; (2) The disease of both rice and shrimp, as well as fish, is very complicated; (3) The prices of feed and other inputs fluctuate unpredictably; and (4) Farmers' accessibility to technology is limited. Their practices are mainly based on traditional experiences.

Model of Zero-Waste Organic Farms

The zero-waste organic farm model combines different stages of agricultural production (crop and livestock) into a closed cycle in which an output of one process becomes an input of the other. All wastes in previous agricultural production such as manure, urine of cattle, poultry, straw, and others are processed to become resources.[29] This model has been implemented by agricultural producers in different localities across the country. The model includes “biogas technology” and “composting”. In the biogas technology model, people employed biogas facilities to process processed (pig manure, chicken manure, cattle dung) into gas to use as domestic fuel. For composing strategy, by-products from cultivation (straw, corn, beans), domestic waste, and livestock waste (pig manure, chicken manure, cattle dung) are decomposed as organic fertilizer. When the agricultural and domestic wastes are reused as fertilizer, the production process becomes cleaner and greenhouse gas emission is reduced.

4F Model in Agriculture

4F (Farm-Food-Feed-Fertilizer) model is considered the first real circular economy in agriculture which has been initiated by Que Lam Group in 2020.[28] 4F is a closed cycle which includes pig raising, annual crop production, animal feed and microbial fertilizer manufacturing. The waste from pig raising is collected and processed into microbial organic fertilizers for cultivation (Fig 2). Implementing the 4F model helps to increase economic efficiency, prevent disease, contribute to ecological environmental protection, and reduce greenhouse gas emissions. So far, the 4F model has been scaled up to 30 provinces in Vietnam. The manure that is processed by microbiological techniques is provided to farmers who grow maize, watermelon, tea, and dragonfruit across the country. In the 4F, the CE principles are applied from agricultural production to consumption.

Model of "green cycle" in Dairy Farm

This is a husbandry model applied by Vinamilk Company to develop a nature-friendly dairy farm. Vinamilk Company has built and operated a dairy farm system according to Global GAP and European organic standards. In these farms, the company has implemented a closed and green process from tilling, planting grass, and taking care of cows to waste treatment. Thanks to biogas technology, livestock waste is treated to fertilize pastures and to improve the soil. Another part of the waste has been converted into CH4 gas which is used to heat water for farm operations. The renewable and reuse of energy not only bring economic efficiency but also reduce CO_2 emissions significantly.[30] By implementing this sustainable approach, Vinamilk Company aims to create a dairy farm model that operates in harmony with nature, minimizing environmental impact while ensuring the production of high-quality dairy products.

In summary, although circular economic models in agriculture have brought economic and environmental benefits, the micro-circular agricultural models in Vietnam still have the following limitations: (i) Small-scale implementation: Most circular models in agriculture in Vietnam exist at a small-scale, primarily at the household level. The adoption of circular economy principles in larger agricultural operations is limited; (ii) Reliance on resource exploitation: Agricultural production in Vietnam is predominantly reliant on resource exploitation, including the use of growth stimulants, pesticides, and inorganic fertilizers. This approach hinders the widespread application of circular economy principles in agriculture; (iii) Very few fully circular systems of agricultural production in the country: Only a fraction of enterprises, farms, and

individuals have applied CE principles completely in some capacities. The view that society as a whole has regarding the growth of agriculture in a cyclical manner is not synchronized and is only partially completed,[9] (iv) Capacity to recycle, reuse by-products, agricultural waste is limited (80% discharged directly into the environment),[31] (v) Partial adoption of advanced technologies: Some large-scale agricultural enterprises have invested in advanced technologies for recycling and treating agricultural and forestry by-products. However, these technologies are often employed only at certain stages of production, resulting in raw products with limited added value.[9]

Challenges and Solutions for Development of Circular Agriculture Models in Vietnam

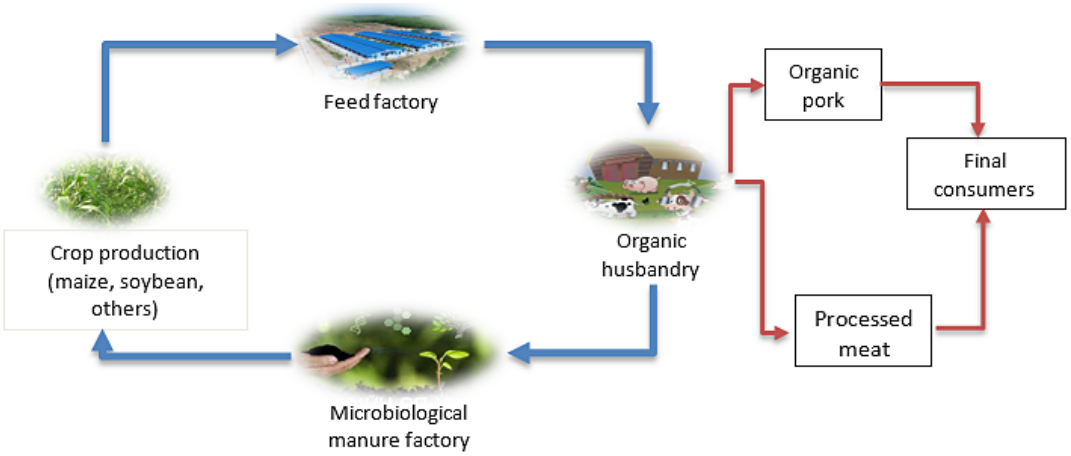

Fig 2: The 4F model initiated by Que Lam group

Reference[32] identified seven obstacles for development of circular economy (technological solutions, private sector engagement, critical scale, financial risk, adequate information, financial resources, and cultural barriers), whereas reference[33] indicated six fundamental barriers for transformation from linear to circular economy (institutional, organizational, legal, economic, behavior, and technology). In Vietnam, barriers for development of CE in agriculture present at both macro and micro levels.

At the Macro level

(i) Inadequate legal framework: Vietnam lacks a comprehensive legal framework for circular economy development, including the absence of criteria for evaluating and classifying the development level of circular economy practices. The implementation of legal documents in this area is still ineffective, and there is a need for complete standards and technical regulations on products, goods, and waste to support the application of circular economy measure; and (ii) Limited capital investment, technology, infrastructure, and qualified experts: Vietnam faces challenges in terms of inadequate investment, technology, infrastructure, and a shortage of qualified experts in the field of circular economy.[34]

At the Micro level

(1) Lack of awareness and understanding: There is insufficient awareness among stakeholders, including businesses, enterprises, and farmers, about the role, benefits, nature, content, and criteria of circular agriculture, (2) Consumer behavior: Consumers in Vietnam do not exhibit positive attitudes toward products made from by-products, scrap, and recycled materials. Furthermore, there is a lack of products labeled with circular economy attributes in the market, limiting consumer acceptance,[35] (3) Limited motivation among major agricultural producers and businesses: The lack of pressure and incentives for major agricultural producers and businesses hinders their transition to a circular economy model. The agricultural value chain does not currently have well-established links where circular economy practices can be applied, and the connections between producers and

businesses are still weak, preventing the closure of the circular chain.[34]

To overcome these barriers as well as to scale-up the successful existing models and to develop the new ones, the following solutions are recommended.[36]

First, institutionalizing CE in agriculture: The government should establish a comprehensive system of laws, policies, and administrative procedures that promote CE in agriculture. Specific attention should be given to circular agriculture, and policies encouraging the business community to invest in and develop CE models should be enacted.

Second, designing a roadmap for implementation: A roadmap should be developed to guide the implementation of CE in agriculture, starting from the micro level and gradually scaling up to the macro level. Agricultural producers and businesses should be the central driving force in this process. The roadmap should also incorporate financial mechanisms to support the achievement of CE goals in agriculture.

Third, enhancing social communication and awareness: Communication efforts should focus on raising awareness among producers about environmental protection issues and the benefits of circular agriculture. Producers, traders, and consumers should be encouraged to participate in collection and recycling activities. Support in terms of capital and technology should be provided, especially for the development of markets for secondary materials and recycled products.

Fourth, establishing evaluation criteria: A set of evaluation criteria, including frameworks and soft criteria, should be developed to assess the implementation of CE in agriculture. This will help in forming a database system on CE in agriculture, which can be utilized for management, control, and scaling up successful CE models across the country.

Fifth, investing in social communication and education: Public awareness about circular agriculture should be raised through targeted communication strategies and training programs at various educational levels, including high schools, colleges, universities, and short-term training courses. The aim is to change perceptions regarding production and consumption, promoting the use of renewable energy, fully recyclable and reusable products, and emphasizing resource recovery from used product.

Concluding Remarks

Developing a CE in agriculture contributes to the improvement of production and business efficiency by reducing natural resources (land, water, reuse of wastes, biogas treatment as fuel), reducing greenhouse gas emissions, protecting the environment, and adapting to climate change. Therefore, the development of CE in agriculture is considered an inevitable trend all over the world.

The review revealed that since very early, Vietnam has had circular agriculture models close to CE, such as the economic model of “Garden - Pond – Barn” (VAC) and “Garden – Farm-Pond – Barn” (VRAC). Recently, Vietnam has appeared more CE models in agriculture such as “rice- shrimp”, “zero-waste organic farm”, and “green cycle” dairy farm. Almost all models have been spontaneously existed at small scale and have not received any support from the government. Although a number of legal documents with provisions related to CE models have been promulgated by Vietnam government, there’s no article paying attention to enhance the development of CE models in agriculture at micro-level.

Based on the theoretical overview and synthesis of the existing models of CE in agriculture in Vietnam, policy recommendations are drawn as follows: (i) An adequate legal framework for CE in general and CE models in agriculture at micro-level in particular needs to be constructed, in which a set of criteria to identify and evaluate the development of the CE models in agriculture needs to be issued; (ii) Knowledge of policy makers, producers, businesses, and consumers of the CE models in agriculture from design to implementation should be upgraded; (iii) Capacity-building efforts should be directed towards experts in the field of CE, ensuring they possess the necessary skills and knowledge. Lastly, support in terms of capital, technology, and market expansion should be provided to producers and businesses pursuing CE models in agriculture.

By implementing these policy recommendations, Vietnam can create a favorable environment for the development of CE models in agriculture, facilitating

their growth and adoption across the country. This will contribute to sustainable agricultural practices, economic growth, and environmental protection.

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Conflict of Interest
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References

1. FAO. The future of food and agriculture – Trends and challenges. Rome. 2017.
2. Kirchherr J., Denise R. & Marko H. Conceptualizing the circular economy: an analysis of 114 definitions. *Resources, Conservation and Recycling.* 2017, 127(04): 221-232. https://doi.org/10.1016/j.resconrec.2017.09.005.
3. Stegmann P., Londo M., & Junginger M. The circular bioeconomy: its elements and roles in European bioeconomy clusters. *Resources, Conservation and Recycling.* 2020, X6: 100029. DOI:10.1016/j.rcrx.2019.100029
4. Nguyen Xuan Cuong. The bright spots of Vietnam's agricultural industry in the period 2016 - 2020. *Communist Review.* 2020, 956. Retrieved from https://www.tapchicongsan.org.vn/web/english/economy/detail/-/asset_publisher/mqd1ARxqSObP/content/the-bright-spots-of-vietnam-s-agricultural-industry-in-the-period-2016-2020 on March 28 2023.
5. Pham Thi Tram. Circular Economy in Agriculture in Vietnam and Solutions for Development. *Journal of Environment.* 2020, 9(2020).
6. Dinh, Tung Xuan. "An Overview of Agricultural Pollution in Vietnam: The Livestock Sector." Prepared for the World Bank, Washington, DC. 2017.
7. Nguyen, Tin Hong. "An Overview of Agricultural Pollution in Vietnam: The Crops Sector." Prepared for the World Bank, Washington, DC. 2017.
8. Christensen T. B. & Hauggaard-Nielsen H. Circular Economy: Practices, knowledge bases and novelty. *Journal of Transdisciplinary Environmental Studies.* 2020, 18 (1): 2-16.
9. Pham Thai Thuy, Tran Thi Thuy Sinh, and Nguyen Hong Quan. Development of Circular Economic Models in Agriculture in Phu Tho Province. *Journal of Science and Technology Hung Vuong University.* 2022, 29 (4): 28 – 37.
10. Kipping M., Clark, T. The Oxford Handbook of Management Consulting. Oxford University Press, Oxford, United Kingdom. 2012.
11. Pearce D.W. & Turner R.K. Economics of Natural Resources and the Environment, Hemel Hempstead: Harvester Wheatsheaf. 1990.
12. Su B., Heshmati A., Geng Y. & Yu X. A review of the circular economy in China: moving from rhetoric to implementation. *Journal of Cleaner Production.* 2013, 42 (2013): 215-227. doi:10.1016/j.jclepro.2012.11.020.
13. Geissdoerfer M., Savaget P., Bocken N. M. P. & Hultink E. J. The circular economy – A new sustainability paradigm? *Journal of Cleaner Production.* 2017, 143: 757-768. Retrieved from https://doi.org/10.1016/j.jclepro.2016.12.048 on March 3, 2023.
14. Ghisellini P., Cialani C. & Ulgiati S. A review on circular economy: the expected transition to a balanced interplay of environmental and economic systems. *Journal of Cleaner Production.* 2016, 114:11-32. Retrieved from http://dx.doi.org/10.1016/j.jclepro.2015.09.007 on March 3, 2023.
15. EMF - Ellen MacArthur Foundation. Towards the Circular Economy: Economic and business rationale for an accelerated transition. 2012. Retrieved from https://www.ellenmacarthurfoundation.org/publications/towards-the-circular-economy-vol-1-an-

economic-and-business-rationale-for-an-accelerated-transition on 26 March 2023.
16. EMF - Ellen MacArthur Foundation. Completing the Picture: How the Circular Economy Tackles Climate Change. 2019. Retrieved from https://ellenmacarthurfoundation.org/completing-the-picture on 30 March 2023.
17. EMF - Ellen MacArthur Foundation. Schools of Thought – Performance Economy. 2015. Retrieved from https://www.ellenmacarthurfoundation.org/circular-economy/concept/schools-of-thought on 30 March 2023.
18. Velasco-muñoz, J. F., Mendoza, J. M. F., Aznar-sánchez, J. A., & Gallego-schmid, A. Circular economy implementation in the agricultural sector: Definition, strategies and indicators. *Resources, Conservation & Recycling.* 2021, 170(2021): 105618. https://doi.org/10.1016/j.resconrec.2021.105618.
19. Bianchi F., Christy van Beek, Daniëlle de Winter, and Ellen Lammers. Opportunities and barriers of circular agriculture. Food & Business Knowledge Platform. 2020. Retrieved from https://www.nwo.nl/en/cases/opportunities-and-barriers-circular-agriculture on 30 March 2023.
20. Schneider P., Rochell V., Plat K, Jaworski K. Circular Approaches in Small-Scale Food Production. *Circular Economy and Sustainability.* 2021, 1:1231–1255. https://doi.org/10.1007/s43615-021-00129-7.
21. Cairns S., Sonia Cyrus Patel, Anna Jessop, and Michael Mullen. A Circular Agriculture and Agri-Food Economy for Canada: A Report of The Clean Growth in Agriculture and Agri-Food Project. *Smart Prosperity Institute.* 2021. https://institute.smartprosperity.ca/sites/default/files/Report%20-%202021%20-%20CE%20and%20Agri%20Food.pdf
22. Akerman E. Development of Circular Economy Core Indicators for Natural Resources - Analysis of existing sustainability indicators as a baseline for developing circular economy indicators. Master of Science Thesis, Stockholm. 2016.
23. Posthumus B. Circular Agriculture in Low and Middle Income Countries. Food & Business Knowledge Platform. 2019. Retrieved from https://knowledge4food.net/wp-content/uploads/2020/03/191016_fbkp-circular-agriculture-lmics_discussionpaper.pdf on 31 March 2023.
24. Xi, Huang. Models of Circular Economy on Agriculture in Yunnan Province. *Energy Procedia.* 2011, 5 (2011):1078–1083. doi:10.1016/j.egypro.2011.03.190.
25. Kristinn S.V. Helgason, Kenneth Iversen & Alex Julca. Circular agriculture for sustainable rural development. Policy Brief N0.105. Development Research Branch, Economic Analysis and Policy Division, UN DESA. 2021. Retrieved from https://www.un.org/development/desa/dpad/wp-content/uploads/sites/45/publication/PB_105.pdf on 29 March 2023.
26. MONRE – Ministry of Natural Resources and Environment. "Garden - Pond – Barn Farm" Model helps to increase resilience and to recover quickly to the impacts of climate change. 2021. Retrieved from https://monre.gov.vn/Pages/mo-hinh-vuon-%E2%80%93-ao-%E2%80%93-chuong-gia-tang-kha-nang-chong-chiu-va-phuc-hoi-nhanh-truoc-nhung-tac-dong-cua-bdkh.aspx on 31 March 2023.
27. Hoang Van. Solutions for Sustainable Development of VAC Model. 2021. Retrieved from https://kinhtenongthon.vn/giai-phap-phat-trien-ben-vung-kinh-te-vac-post46753.html on 2 April 2023.
28. Nguyen Thi Mien. Developing circular economy in agriculture in Vietnam: Some issues and recommendations. *Journal of Political Theory.* 2021, 3(2021).
29. Nhu Trang. The zero-waste farming model in Vietnam. *Journal of Environment.* 2014, 2(2014). Retrieved from http://tapchimoitruong.vn/moi-truong-va-cong-dong-84/M%C3%B4-h%C3%ACnh-n%C3%B4ng-nghi%E1%BB%87p-kh%C3%B4ng-ch%E1%BA%A5t-th%E1%BA%A3i-t%E1%BA%A1i-Vi%E1%BB%87t-Nam-21297 on 30 March 2023.
30. Tuyet Nhung. Vinamilk – A company has well implemented model of circular economy. 2022. Retrieved from https://vietnamnet.vn/vinamilk-doanh-nghiep-thuc-hien-tot-mo-hinh-kinh-te-tuan-hoan-2090857.html on 3 April 2023.

31. Kieu Anh. Processing agricultural by-products: Burning ten thousand billions VND every year. 2019. Retrieved from https://tuyengiao.vn/khoa-giao/khoa-hoc/xu-ly-phu-pham-nong-nghiep-dot-bo-hang-chuc-ngan-ty-dong-moi-nam-123523 on 2 April 2023.
32. The OECD. Business Models for the Circular Economy: Opportunities and Challenges from a Policy Perspective. 2019. https://www.oecd.org/environment/business-models-for-the-circular-economy-g2g9dd62-en.htm
33. Cramer J. How Network Governance Powers the Circular Economy. Amsterdam Economic Board. 2020. www.amsterdameconomicboard.com
34. Thuy Trinh Thu. Circular Economy: Drivers and Barriers to Development – Experience from Other Countries to Vietnam. Proceedings of the International Conference on Emerging Challenges: Strategic Adaptation in the World of Uncertainties (ICECH 2022). 2023, 320-341. 10.2991/978-94-6463-150-0_22.
35. Nguyen Thi Phong Lan & Nguyen Thi Kim Ngan. Benefits of Circular Economy: From Theory to Implementation in the World and the Problems to Vietnam. Proceedings of the 13th International Conference on Socio-economic and Environmental Issues in Development (ICSEED 2021). 2021, 1815-1824. https://khoamoitruongdothi.neu.edu.vn/vi/hop-tac-quoc-te-2202/13th-neu-kku-international-conference-on-socio-economic-and-environmental-issues-in-development-icseed-2021-1421
36. Pham Tuyen. Circular economic model with green economy development in Vietnam. Academy of Journalism and Communication.2022. http://lyluanchinhtri.vn/home/en/index.php/practice/item/1116-circular-economic-model-with-green-economy-development-in-vietnam.html