

DEVELOPMENT OF CIRCULAR ECONOMIC MODELS IN AGRICULTURE IN PHU THO PROVINCE

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Abstract

The concept and practice of the circular economy model in agricultural production has begun to be mentioned and interested in Vietnam recently. The circular economy model in agricultural production is a closed-loop production process in which most of the waste and by-products are returned as raw materials for other production processes through the application of technology, biotechnology, physico-chemical technology and scientific and technical advances to become fertilizer products, useful, safe and high-quality products, reducing waste and loss, especially waste, cause environmental pollution. However, the research and evaluation on theory and practice as well as solutions to develop the circular economy model in agricultural production in Vietnam in general and Phu Tho province in particular are still very limited. The objective of this paper is to clarify the development and to provide information of the circular economy models in Phu Tho province, thereby identifying limitations, causes and proposing some solutions to develop circular economic models in the agricultural sector in the coming time.

Keywords: *Circular Economy, Models, Agricultural Sector, Phu Tho province.*

1. Introduction

The circular economy is a new way of creating value, and ultimately prosperity. It works by extending product lifespan through improved design and servicing, and relocating waste from the end of the supply chain to the beginning-in effect, using resources more efficiently by using them

over and over, not only once. In a circular economy, however, products are designed for durability, reuse and recyclability, and materials for new products come from old products. As much as possible, everything is reused, remanufactured, recycled back into a raw material, used as a source of energy, or as a last resort, disposed of [1]. Over time, one approach called “circular economy” to

sustainable development has gained traction among economists and policymakers worldwide, including Vietnam [2-5].

In recent years, Vietnam's agriculture sector has been engaged exclusively in expanding its output and productivity, adhering to a so-called linear economic model. Because of this, businesses, people, and management agencies are facing increasingly serious challenges, such as the inefficient use of agricultural and forestry by-products and the widespread burning of rice straw and other forms of agricultural waste, such as animal waste, that pollutes the environment. Taking into account the nature and development of the circular economy model, it becomes clear that traditional production models in Vietnam are similar to the circular economy, but do not constitute a truly circular economy model. Many communities have long-established models of the circular economy: Collecting manure to feed crops, VAC (Garden - Pond - Barn), VRAC (Garden - Farm - Pond - Barn), and eco-economic models, etc. These models combine farming and taking care of animals in the form of food chains. After the year 2000, gas recovery by biogas technology was added to these models. In 2020 and 2021, The National Assembly and the government approved the Environmental Law and the Master plan on developing the circular economy in Vietnam, concretizing goals and policies to support and promote circular economy development in the coming period [6-8].

Numerous circular agricultural production methods have been implemented in recent years and are undergoing steady improvements, such as (1) Several regions and municipalities have benefited from the biogas program in animal husbandry by

putting into motion initiatives like biogas cellars, composting, bio-buffers, earthworm farms, manure separators, irrigation systems that use water recycled from biogas, and biogas generators. (2) The following are examples of investments in technology and resources made by Vietnamese businesses, especially in some livestock farms that apply manure separators, biogas technology, and some households have applied a closed agricultural production model without waste, etc. These models have helped in the recovery and settlement of a large number of by-products in agro-forestry production, such as straw, rice straw, rice husks, corn stalks, cobs, bark, branches, and leaves after harvest, sawdust, livestock waste, poultry, etc., to process them into useful products, organic fertilizers, and most importantly, they have helped to solve the problem of environmental pollution [5].

A case study in Nam Dinh province, one farmer invested in building a pig farm with an area of 14,000 m², according to the circular economy model. This model has a closed cage, mosquito net, ventilation system, water supply, and automatic surveillance camera. In addition, there is a biological padding on the floor of the pig farm. According to a new method, input costs such as electricity, water, and disease prevention and control are all reduced. In which, the amount of clean water decreased by 70%-80%. Pigs gain weight quickly thanks to eating well, sleeping well, delicious meat, and higher price (3 thousand VND compared to normal pork price in the market) [9].

Another cases in Dong Thap province: This province has a number of circular economic models that have been implemented effectively. For instance: the model of collecting waste as fertilizer with the model

of “river in a pond” to be able to collect waste for farming; the model of an organic straw mushroom grown in a closed house, without using any chemicals that enhanced many times when straw mushrooms are processed into nutritional powder, vegetarian fish sauce, dried mushrooms, and fresh mushrooms. In order to create many effective circular economic models, the province needs to create a transparent and stable legal corridor, and an open and favorable business and investment environment for businesses; giving incentives in terms of administrative mechanisms and procedures, finance, and access to resources; replicating effective economic models in order to create effects in all socio-economic activities of the province, etc. [10].

The purpose of this article is to clarify the development and to provide information of the circular economy models in Phu Tho province, thereby identifying limitations, causes and proposing some solutions to develop circular economic models in the agricultural sector in the coming time.

2. Methods

Desk research was used to conduct analyses, come to findings, and meet study goals on the development of the circular economy in agriculture in Phu Tho province (the acceptable research method represents the kind of quantity approaches taking the source of information into account). This article used secondary data for analysis.

(i) Research question: As the first step, the study focuses on the following research question; “What are the development of the circular economic models in agricultural sector in Phu Tho province?”

(ii) Data collection and processing: Secondary data were collected from the Phu Tho Department of Agriculture and Rural Development, Phu Tho Statistics Office, Phu Tho Union of Science and Technology Associations, and Phu Tho People’s Committee. After collecting data, it is classified, aggregated, cleaned, and entered into the Excel spreadsheet to calculate the necessary criteria and to derive tables (for instance: share of the land use in agricultural sector; major agricultural products can be recycled in the province).

(iii) Statistical analysis: The study used descriptive statistics and comparative analysis to see the fluctuations and the structure of the analytical criteria.

3. Results and discussion

3.1. Overview of agriculture in Phu Tho province

3.1.1. The implications of several statistical indicators

In 2021, the agriculture, forestry and fishery sector increased by 3.23% compared to 2020, and this sector contributed 0.63% points of Gross Regional Domestic Product (GRDP) in Phu Tho province. The sector plays an important role in the long-term development of the province because of several reasons: (i) Agricultural land accounted for 83.38% of total land used (Table 1); (ii) Approximate 81% population are living in rural areas (about 1,219 thousand persons) and 83.4% labour force at working age are in rural areas (about 716.5 persons); (iii) the share in GRDP (at current price) was 20,18% [11].

Table 1. Agricultural Sector in Phu Tho province (as of December 31, 2021)

Ord	Indicators	Total (ha)	Structure (%)
I	Total land use	353,456.20	100.00
I.1	Agricultural land	294,706.83	83.38
I.1.1	Agricultural production land	117,950.37	33.37
a	Annual crop land	62,009.04	17.54
b	Perennial crop land	55,941.33	15.83
I.1.2	Forestry land covered by trees	167,476.54	47.38
I.1.3	Water surface land for fishing	8,747.92	2.47
I.1.4	Others	532.01	0.15

Source: Phu Tho Statistics Office, Statistical Publishing House, 2022

The Provincial People's Committee promulgates the Agriculture, Forestry and Fisheries Development Plan for the 2021-2025 period in association with the restructuring of agricultural production towards large-scale concentrated production, application of advanced and eco-friendly technologies. environment, towards building Phu Tho into the leading development province of the Northern Midlands and Mountains Region [12].

The structure of varieties put into production has had a strong shift, changing from "quantity" to "quality" (the percentage of high-quality rice is over 50%, high-quality tea 77.6%, aquatic varieties with economic value. high economic output accounts for over 50%, foreign pig breeds 95%, high yielding hybrid cows 77%); expanding production areas according to safe and sustainable standards (Tea area certified for safety (RA, VietGAP) 3.67 thousand ha, area of pomelo produced in the direction of safety reaching 1.77 thousand ha ; the forest area certified for sustainability is 17.8 thousand ha), agricultural production in the direction of organic, cyclic, ecological, ... forming concentrated production areas of key crops and livestock (currently there are 549 concentrated crop production areas with a total scale of 14.4 thousand ha); The average product value per hectare of arable

land and aquaculture is VND 112 million/ha. Collective economy and agricultural cooperatives have been gradually renewed and improved in efficiency, with 24 cooperatives initially applying high technology to production, 18 cooperatives registering collective trademarks (Source: The Phu Tho Department of Agriculture and Rural Development, 2022).

In order to improve the value and efficiency of agricultural production, production linkage activities and the formation of concentrated production areas have received more and more attention, which has supported the formation and development of production linkages, supplying safe agricultural, forestry and fishery food along the value chain with good efficiency. By 2020, the province will have 61 agricultural cooperatives participating in production linkages; 89 farms participated in cooperative activities, linking production and consumption of products; forming 78 supply chains of safe agricultural, forestry and aquatic products; About 80 livestock establishments cooperate with investment companies to raise cattle and poultry on a large scale, applying high technology, according to the value chain (Source: The Phu Tho Department of Agriculture and Rural Development, 2022).

3.1.2. Potential circular agriculture in Phu Tho province

For agricultural purposes, there are potential products that can be considerably in Phu Tho province, for example, biomass from by-products, cattle and poultry manure, forestry. Specifically, the ability to recycle the biomass into organic fertilizers and other valuable products for agricultural and

forestry reproduction is a major benefit of having access to this biomass source. On the other hand, it will become a source of garbage that is released into the environment and causes more and more severe pollution if there is no adequate strategy and solution. The following are examples of major products and their potential (Table 2).

Table 2. Major Products can be recycled in Phu Tho province in 2022

Ord	Indicators	Quantity	Unit
1	In the field of crop production: The estimated biomass from agricultural by-products	About 800,000	Tons/per year.
2	In the field of livestock: Estimated total solid waste in the province (cattle and poultry manure)	About 2 million	Tons/per year.
3	In the forestry sector: The estimated biomass from forestry by-products (annually)	About 700,000	m ³

Source: The Phu Tho Department of Agriculture and Rural Development, Phu Tho Union of Science and Technology Associations

3.2. Phu Tho province’s agricultural circular economy development

3.2.1. Circular agriculture models

The province’s agriculture and forestry production has made great strides recently. However, due to pressing practical problems in the treatment of agricultural and forestry by-products, especially livestock waste, the problem of developing products circularly has recently been interesting and applied in practice in the form of models from programs and projects or invested from large-scale enterprises, farms, and households. The province has made it clearer how to use biomass energy, biogas, and building production models that include waste treatment. The Department of Agriculture and Rural Development has supported the Low Carbon Agriculture Project (LCASP) and tested a way to separate and press livestock waste. Results in several different areas, such as:

In the treatment of livestock waste: Animal waste treatment measures that are

being applied commonly in the province include:

Model 1: Biogas technology application: More than half of all pig families now employ biogas facilities to process their swine manure, and 97 percent of all pig homeowners with farm sizes of 100 pigs or more have adopted this practice.

Model 2: Composting: This strategy has been used by a significant number of people and more than 43 percent of livestock operations, particularly in regions that are known for their production of vegetables, tea, and fruit trees. This is one of the solutions that is considered to be beneficial, friendly to the environment and contributes to improving the environment of arable land and enhancing crop productivity. Consequently, it is one of the solutions that is recommended.

Model 3: Bio-cushion: This technology has been implemented at the majority of the centralized chicken farms, and distribution

of it among poultry producers has nearly reached complete saturation.

Model 4: Cultivation of earthworms: Districts like Thanh Son, Tan Son, Thanh Thuy, Lam Thao, Yen Lap, Ha Hoa, and Phu Ninh all have worm farms that are over 1,000 square meters in size. Raising earthworms has helped with partial waste treatment, provided high-grade protein for animal feed, and produced a source of quality fertilizer for crops.

Model 5: Using a separator: Thirteen large-capacity separator systems are supported by the LCASP project, while the remaining seven small-capacity separators are funded through individual investments. Currently, this method is used on roughly twenty animal farms. Manure separators have helped produce a huge quantity of solid manure for farming while reducing stress on biogas facilities.

Model 6: Using a watering system after biogas: Considered a relatively efficient method, it aids in the comprehensive treatment of wastewater in cattle and boosts production yields. Twenty or more districts in Doan Hung, Phu Ninh, Thanh Son, Phu Tho town, and Thanh Ba have implemented this policy.

Model 7: Using biogas generator: Some livestock houses have begun to implement the reuse of biogas, initially for reasons of good efficiency, with the goals of contributing to the conservation of the environment and saving money on the monthly expenditures of energy at the farm.

Model of treatment of crop residues: It is estimated that cultivation in the province results in approximately 800,000 tons of by-products each year. In order to partially utilize these by-products, people have implemented a number of different measures, such as using them as fuel, forage in animal

husbandry, barn filler, biological cushion, composting, tree stump cover, as a substrate for mushroom production, and so on.

Model of waste treatment in forestry production: About 15-20 percent of the by-products that are produced in the forestry industry have been recycled through processes such as: burning for the post-harvest treatment of cuticles; grinding into sawdust; pressing bran to make biochar; charcoal for burning wood; producing plywood paper or as raw materials for tea drying; incinerators for breweries, paper mills, and other such businesses; and ground into sawdust. In addition, a number of large businesses have implemented the most cutting-edge processing technology in the world. One example of this is the DTK Phu Tho Co., Ltd., which treats approximately 600 tons of chicken manure per day that is discharged during the breeding process through the process of microbial fermentation using technology and lines that are imported from Japan.

3.2.2. Limitations and causes

There is no fully circular system of agricultural production in the region; only a fraction of the province's enterprises, farms, and individuals use it 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 complete. In addition, there are no large enterprises or focal enterprises in the province that have the potential and the experience to concentrate on purchasing and processing agricultural and forestry by-products for the purpose of turning them into organic fertilizer and other useful products. This is a problem because these types of businesses are essential to the province's economy.

There is not a lot of enthusiasm among people in making use of organic fertilizers to

encourage biodiversity in the soil, improve its texture, and safeguard it. The amount of waste, agricultural and forestry by-products that are thrown away without being treated, which results in the waste of biomass resources and pollution of the environment, is significant. The percentage of agricultural and forestry by-products that are recovered and recycled is still relatively low.

Some large farms and livestock enterprises are the only ones to apply cutting-edge technologies, scientific breakthroughs, and cutting-edge machinery for recycling and treatment of agricultural and forestry by-products, and they only do so at certain stages, resulting in raw products with little added value. The results of the survey revealed several gaps in our understanding of the following existing animal waste treatment technologies: (i) However, biogas technology is only utilized in homes and pig farms, and it often fails to adequately treat feces and wastewater, especially in tiny tanks; gas is sometimes not used up and dumped into the environment or burned, resulting in waste and local environmental degradation; (ii) The usage of manure separators, post-biogas irrigation systems, and biogas generators is still quite uncommon and not nearly sufficient to provide a comprehensive solution to the issue.

The following are some of the primary causes behind the aforementioned drawbacks and restrictions:

Firstly, the work of informing, propagandizing, advocating for, and guiding businesses and people in particular in the application of technological advances and the development of production in a circular manner has not yet achieved high levels of success; There is a significant proportion of houses, farms, and enterprises that do not comply with environmental protection standards.

Secondly, attracting businesses to engage in this subject is still difficult, in part because the firms themselves are not particularly enthusiastic or interested in investing. This makes it difficult to attract businesses to participate in this field.

Thirdly, the new agricultural production is centered on boosting productivity, expanding output, and decreasing costs; nevertheless, it has not paid the necessary attention to developing in a way that is sustainable and kind to the environment. However, the production scale is low and output is dispersed among individual families; there is still substantial resistance to altering conventional agricultural production practices in favor of agroforestry.

Fourthly, the cost of investment and operation of a number of industries and solutions, such as manure separators, post-biogas watering systems, and biogas generators, is still high. These costs are beyond the investment and application capacity of farmers, particularly small-scale households, farms, and farms.

3.2.3. Developing agricultural circular economy models for Phu Tho province

(i) Promoting propaganda and training on the development of circular agriculture

The provincial media agencies and socio-political organizations will step up their efforts in propaganda and awareness-raising for agricultural producers, businesses, and management levels across the board, as well as for society as a whole, regarding the future direction and trend of the development of circular agriculture.

Raise people's understanding of the benefits of recycling waste and agroforestry byproducts; Educating people (mainly producers) about the benefits of using organic fertilizers in agriculture, while

phasing out the usage of inorganic fertilizers and maximizing the utilization of waste by-products in on-site treatment.

Integrating and allocating resources to train and foster the contingent of managers at all levels, technicians, enterprises, and people on developing circular agriculture and changing production methods; propaganda on the Law on Environmental Protection; popularization, application of both old and modern waste collection and treatment techniques and technologies; separation of trash from its source to create biomass for use in either on-site or commercial waste treatment waste source.

In order to encourage universities, colleges, and professional schools in the province to provide training in agriculture, forestry, fishery, agricultural economics, land management, an environmental compilation of technical documents, agricultural extension, and circle teaching on agricultural production, the goal of this action is to encourage these areas of study.

(ii) Enhancing agricultural science and technology

The development of science and technology for transforming agricultural and forestry waste into goods such as Biogas technology; technology to convert biomass into sugar, bio-ethanol, and biological chemicals; microbiological technology for processing and preserving animal feed; industrial processing of biomass waste by-products into fertilizer, microbial organic plant protection drugs that return minerals and nutrients to the cultivated soil and a number of other methods and technologies such as biological products, earthworm farming, investment in manure separators, watering after biogas, biogas generators, etc.

Conducting operations in accordance with VietGap, organic standards, and safety

regulations in order to enhance productivity, quality, and product value; and working in accordance with the concept of material rotation. Encourage the use of biological products in order to increase the efficiency of use, improve the competitiveness of products, and reduce emissions to the environment.

(iii) Regarding policies to support, encourage development, and attract investment

Apply the policies of the government in a way that is both flexible and prioritizing to businesses so that they would invest in the field of the treatment of agricultural and forestry byproducts.

In addition, branches and localities have the ability to implement Resolution No. 05/2019/NQ-HDND dated July 6, 2019, of the Provincial People's Council for agricultural production in a circular manner; review and research in order to be able to supplement the policy in practice if it becomes necessary. Creating general resources for circular agriculture production models and projects by guiding the integration of socio-economic development programs, science and technology tasks, agricultural and industrial extension, and the national target program on new rural construction, sustainable poverty reduction, etc. Support people have access to tools, equipment, and technologies that are used in harvesting and processing, recovering post-harvest waste, and treating waste.

(iv) Consolidating communication and organize the implementation of the government's master plan for developing circular economy, building a long-term plan for Phu Tho province

Incorporating the development of a circular economy into the socioeconomic development strategies, master plans, and plans, as well as branches and fields,

of the province and the area. Research and incorporate the growth of the local economy into policies, projects on regional linkages, and activities in order to put into effect Prime Minister's Decision 1658/QD-TTg dated October 1, 2021, approving the National Strategy on Growth green period 2021-2030, vision to 2050. Developing human resources and actively pursue the attraction of investment capital in order to contribute to the growth of the local economy. The Prime Minister's Decision No. 687/QD-TTg dated June 7, 2022, approving the Master Plan for Economic Development in Vietnam is the guiding document for all levels of government to ensure that the country's economic future is secure.

(v) Enhancing the application of high technology to successfully develop the circular economy models in the agricultural sector. In addition, there is a solution to increase capital to support farmers, producers and agricultural enterprises in developing more effective circular economic models.

4. Conclusion and Future Studies

Developing the circular economy in order to create a driving force for innovation and improve labor productivity, promoting green growth in conjunction with economic restructuring, renovating the growth model (especially in agricultural sector) in the direction of increasing efficiency, circular cohesion between businesses and economic sectors, improving competitiveness, and increasing the resilience of enterprises and supply chains to external shocks, contributing to the achievement of economic prosperity and environmental sustainability. Implementing circular economic models towards a green economy that is free of

carbon emissions and contributes to the overarching goal of reducing the rate at which the earth's temperature is rising worldwide. From experience from Nam Dinh province and Dong Thap province, applying circular economic models brings many benefits for agricultural producers and for the environment in general.

Based on the secondary data in agricultural sector in Phu Tho province, the authors suggest some policy recommendations: Promoting propaganda and training on the development of circular agriculture; Enhancing agricultural science and technology; Giving policies to support, encourage development, and attract investment about circular economy; (iv) Consolidating communication and organize the implementation of the government's master plan for developing circular economy, building a long-term plan for Phu Tho province

Research should be stepped up, and plans and roadmaps should be developed to collect, use, and analyze data to support information and communication technology solutions that work well with the circular economy models in Phu Tho province. Consider creating and piloting implementation in the province, analyzing results, and reproducing successful models after doing research, reviewing, and evaluating the existing condition of economic development in a number of prioritized industries and fields as well.

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PHÁT TRIỂN MÔ HÌNH KINH TẾ TUẦN HOÀN TRONG LĨNH VỰC NÔNG NGHIỆP TRÊN ĐỊA BÀN TỈNH PHÚ THỌ

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Tóm tắt

Gần đây, khái niệm và thực hành mô hình kinh tế tuần hoàn trong sản xuất nông nghiệp đã bắt đầu được đề cập và quan tâm ở Việt Nam. Mô hình kinh tế tuần hoàn trong sản xuất nông nghiệp là quá trình sản xuất theo chu trình khép kín mà hầu hết các chất thải, phế phụ phẩm được quay trở lại làm nguyên liệu cho quá trình sản xuất khác thông qua việc áp dụng công nghệ sinh học, công nghệ hóa lý và các tiến bộ khoa học kỹ thuật để trở thành các sản phẩm phân bón, sản phẩm hữu dụng, an toàn, chất lượng cao, giảm lãng phí, thất thoát, nhất là giảm các chất thải gây ô nhiễm môi trường. Tuy nhiên, các nghiên cứu, đánh giá về lý luận và thực tiễn cũng như các giải pháp để phát triển mô hình kinh tế tuần hoàn trong sản xuất nông nghiệp ở Việt Nam nói chung và tỉnh Phú Thọ nói riêng còn rất hạn chế. Mục tiêu của bài báo này là làm rõ hơn xu thế phát triển và cung cấp các thông tin về mô hình kinh tế tuần hoàn trên địa bàn tỉnh Phú Thọ, từ đó, xác định các hạn chế, nguyên nhân và đề xuất một số giải pháp để phát triển các mô hình kinh tế tuần hoàn trong lĩnh vực nông nghiệp trên địa bàn tỉnh trong thời gian tới.

Từ khóa: Kinh tế tuần hoàn, Mô hình, Nông nghiệp, Phú Thọ.