

Development of Circular Economy in Agriculture in Hanoi, Vietnam



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ABSTRACT: The introduction of circular economy principles into closed production systems is essential to address current socio-economic and ecological challenges efficiently. This approach not only saves costs, creates job opportunities, and fosters economic growth but also promotes the sustainable use of natural resources in agriculture. Transitioning to a circular economy model in agriculture contributes to achieving sustainable development goals. In Hanoi, Vietnam, sustainable agriculture development focuses on integrating natural processes and biological resources to enhance productivity while preserving the environment. Challenges persist in shifting from conventional to organic farming methods due to certification complexities and infrastructure limitations. Despite these hurdles, organic farming adoption is increasing, positively impacting agricultural productivity and biodiversity. The gradual expansion of certified organic agriculture in Hanoi indicates promising strides toward environmental conservation and economic development through a closed-loop agricultural system.

KEYWORDS: circular economy, agriculture, Hanoi, Vietnam

1. INTRODUCTION

Agriculture using ecosystems is a production system based on self-promotion and exploitation of natural processes (organic decomposition, biological balance, soil regeneration, soil nutrition...) based on enhancing biodiversity protection. The more circular the agricultural system is, the higher the economic, social, and environmental efficiency. Hanoi is the capital of Vietnam, where the area of agricultural and forestry land is up to 200,000ha, accounting for 58.91% of the total area. The city has about 2,000 hectares of organic farming and more than 10 hectares of organic aquaculture. Compared to conventional production, organic production contributes to improving the quality, competitiveness, and value of agricultural products. Most importantly, organic production, helps farmers change their production mindset towards safety and sustainability. Organic agriculture in Hanoi is a system of combined farming techniques aimed at sustainability and enhancing soil fertility and biodiversity.

Organic farming in Hanoi increased sharply in both area and output. Hanoi's organic cultivation area increased from 84 hectares (in 2016) to 564.2 hectares (in 2022), of which 192.7 hectares were certified organic and 371.5 hectares were converted organic. Specifically, the rice area reached 213.1 hectares (130 hectares certified organic; 83.1 hectares cultivated for organic conversion); vegetables reached 167.4 hectares (of which 62.7 hectares were certified organic; 104.7 hectares were converted to organic cultivation); organic converted fruit trees 73 hectares, organic converted tea 36.5 hectares; Organically converted medicinal plant is 74.2 hectares. The output of organic crop products increased from 2.7 thousand tons (in 2016) to over 13.7 thousand tons (in 2022). Many organic products have been certified and have prestigious brands in the market such as Dong Phu organic rice, Soc Son organic vegetables,...

Although organic agriculture models are being developed in both area and quantity of products, however, the ratio of organic agricultural production area / total agricultural land area is still small, less than 1%. The reason for the slow increase in organic agricultural production area is that organic production takes a long time to convert and improve land, water sources, and closely monitored production processes to produce organic products. By 2022, there will be 1,800 hectares of rice in the city; and 452.8 hectares of vegetables of all kinds produced according to VIETGAP standards. Thus, the proportion of agricultural production area according to VIETGAP standards is still modest, less than 5% / of total agricultural production land. The reason is that farmers still mainly produce small, follow habits, are afraid to comply with regulations and standards.

Proportion of area applied to sustainable rice-intensive system (SRI)

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Up to now, each case in Hanoi has a total SRI application area of 5,202 hectares (accounting for 6.2%); a partial application of 61,932.9 hectares (74.1%). SRI application has brought many positive results both in terms of production efficiency and environment such as: SRI helps farmers improve their income: Productivity increases by an average of 5-7 quintals/ hectare; interest increases by an average of 7 million VND/hectare compared to traditional methods; SRI saves irrigation water: Reduce 2-3 waterings/crop compared to farmers' old farming practices, equivalent to an average reduction of 500-1,000m³/ hectare/crop. SRI reduces greenhouse gas emissions: SRI application areas significantly reduce greenhouse gas emissions compared to traditional farming. In which, CH₄ decreased by 21-14%; N₂O decreased by 15 - 22%, CO₂ decreased by 22 - 27%; the global warming potential in traditionally farmed fields is 26-32% higher than in SRI fields. SRI can limit the use of nitrogen fertilizers and pesticides: In SRI application models, the amount of nitrogen fertilizer used is reduced by an average of 25-30% compared to customary farming due to a reduction in the number of individuals per unit area. On the other hand, when applying SRI, rice plants increase resistance to falls, and good resistance to unfavorable external conditions and pests and diseases, minimizing the use of pesticides in the cultivation process.

In recent years, rice cultivation by the SRI method has had a significant advantage over the old production method, yield and rice output increased while input costs decreased. However, the application of SRI intensive farming system requires reasonable water regulation, the foot of the field must not be too sunken and the application must be flexible, depending on local conditions. Therefore, the application of this model to large-scale farming still faces difficulties, due to the farming habits of farmers, the proportion of rice growing areas applying this method is still stopping at the models.

Ratio of area applying the rice-fish model

The rice-fish model is a potential and unique model of Hanoi that few localities in the country have similar OCOP products. The city currently has 6,399 hectares of fish farming - combined with rice cultivation. The model creates a dual effect because fish and rice have a symbiotic relationship, supporting each other to develop, saving fish feed costs... Bringing high economic efficiency to producers with mackerel yield calculated for 01 hectare reaching over 8.7 tons/hectare, giving profits of over 82 million / hectare for 01 farming crop, 4-5 times higher than conventional rice cultivation. Contributing to the conversion of inefficient and low-lying rice growing areas in Hanoi to produce 1 rice crop + 1 fish crop helps farmers minimize environmental treatment in production, by the natural production trend. However, at present, the fish-rice model in some localities is mainly converted by households, so it is scattered in the fields, not forming a concentrated farming area. Therefore, no water supply and drainage system is suitable for rice intercropping and aquaculture methods. Water sources mainly take advantage of the system of infield canals, which do not meet the requirements due to pollution from plant protection drugs, domestic wastewater, cattle, and poultry raising.

2. METHODOLOGY

The study utilized both synthesis and statistical methods to comprehensively evaluate the theory and current status of the development of circular economy in agriculture in Hanoi. The utilization of the descriptive statistical method in the research on the development of circular economy practices in agriculture in Hanoi has a profound effect on understanding and analyzing key aspects of the agricultural landscape. By employing descriptive statistics to study the utilization rates of organic fertilizers, plant protection drugs, and the challenges in land reclamation in Hanoi, researchers can effectively summarize, present, and interpret the data. This method allows for the identification of trends, patterns, and variations in agricultural practices, facilitating informed decision-making and policy recommendations for promoting sustainable agricultural development. Additionally, descriptive statistics provide a foundation for comparative analysis, validation of research findings, and comprehensive reporting, enhancing the overall depth and quality of research outcomes in the context of circular economy implementation in Hanoi's agriculture.

In the survey of the research, there are 3 target groups including: Sample 01: Households, individuals; Sample 02: Enterprises, cooperatives, farms; Sample 03: Management officials at provincial, district, town, and commune levels, in the 6 selected districts for field investigation. The survey questionnaires were collected, cleaned, and inappropriate ones were removed. Data compilation and processing were done using specialized Excel software. Through the author's in-depth surveys and interviews, in the districts in Hanoi, a sample questionnaire (targeted at households, individuals) was selected for cross-referencing to confirm and reinforce the research results.

3. RESULTS

Rate of use of organic fertilizers and plant protection drugs of biological origin Encourages and mobilizes people to increase the alternative use of plant protection drugs of biological origin and herbs. As a result, the number of plant protection drugs used by Hanoi farmers over the years has always ranked at the lowest level compared to provinces and cities of the country. In the Dong Anh district, plans a vegetable production area with an area of 1,180 hectares, including more than 500 hectares of concentrated and large-scale safe vegetable production. To control the quality of safe vegetable products in concentrated

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production areas, the district has promoted propaganda to raise awareness for people about limiting the use of plant protection drugs. As a result, the number of plant protection drugs used decreased by about 15% compared to previous years, farmers knew how to use organic fertilizers, microorganisms, and herbs, ensuring food safety.

Up to now, the rate of using plant protection drugs with biological sources and herbs in Hanoi fields accounts for about 60% of the total volume of chemicals used. The amount of pesticides used for 1 hectare of agricultural cultivation in Hanoi is 1.6-2kg/hectare, while the national average is about 10kg/hectare. Compared to the national average, the amount of pesticides used in the city is much lower.

Organic fertilizers not only enrich the soil, good for plants, but also create safe, organic agricultural products. Agricultural models in the city have increased the use of organic fertilizers from agricultural by-products in cultivation and animal husbandry. In particular, in the context of a sharp increase in the price of inorganic fertilizers, many types increased by up to 70%. Thanh Xuan Organic Clean Agricultural Service Cooperative (Soc Son district) said that thanks to the use of 100% organic fertilizer, despite the increase in agricultural materials, nearly 30 hectares of organic vegetables of the cooperative were not affected...

The benefits are clear, but in fact, a part of the people still use inorganic fertilizers mainly. The reason is that organic fertilizer needs to be applied in large quantities per unit area, so it is inconvenient to transport and use compared to inorganic fertilizer. Compost production takes a lot of time and labor to collect, process raw materials, and wait for raw materials to decompose.

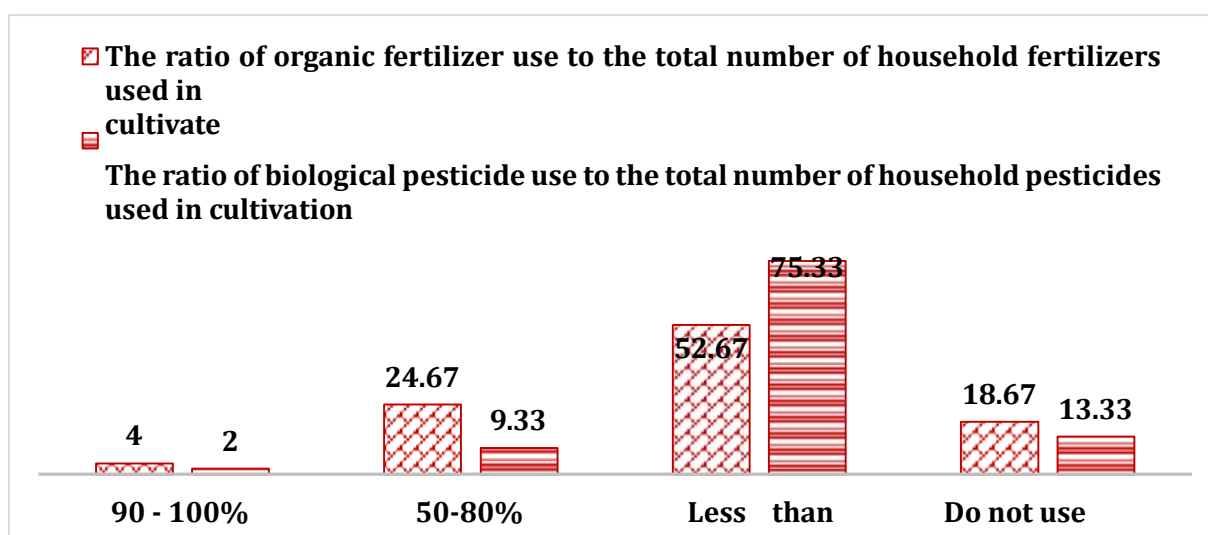


Figure 3.1. Household rates of use of organic fertilizers and biological pesticides
(Source: Author's survey results)

Through a survey of households in some suburban districts of Hanoi, the ratio of organic fertilizer use to the total number of household fertilizers used in cultivation is less than 50%, accounting for the highest rate of 52.67%; then 50-80%, accounting for 24.67%; unused accounted for 18.67%; 90 - 100% accounts for the lowest rate of 4%.; The ratio of biological pesticides to the total number of household pesticides used in cultivation is less than 50%, accounting for 75.33%, not using accounts for 13.33%; 50 - 80%, accounting for 9.33%; 90 - 100% accounts for the lowest percentage of 2 %. The survey results show that farmers have a higher awareness in the use of organic fertilizers, biological plant protection drugs, and probiotics in agricultural production; gradually replacing the use of inorganic fertilizers, and chemical plant protection drugs on plants and livestock, towards sustainable agricultural development.

Activities of land reclamation, water circulation management

For circular agricultural models in Hanoi, most of them are improving and improving soil fertility in the direction of using organic fertilizers, microbiological fertilizers applying new production technologies, sprinkling powdered lime to clean the soil, using microbiological preparations to improve the soil, intercropping, crop rotation ... However, in reality, the current situation of pH in the soil, and organic matter in the soil tends to decrease, making the soil for agricultural production more and more poor, organic matter, and humus in the soil is decreasing and these manifestations are becoming more and more pronounced. One of the main causes is the indiscriminate use of inputs, especially fertilizers and pesticides for agricultural production land. In 2017, to serve the city's agricultural development planning in the direction of sustainability, high production value, cleanliness, and quality assurance, the Hanoi Department of Agriculture cooperated with the Institute of Agrochemical Soil to assess the quality of agricultural land; to develop a database on the current status of quantity and quality of agricultural land and propose land use plans in the direction of sustainable development and efficiency for 3 districts Chuong My, Thanh Oai and Gia Lam.

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The survey results show that people have become more conscious of land improvement through simple and effective measures such as: Using forms of polyculture, intercropping, and crop rotation, accounting for the highest rate of 74.67%; thereafter: Giving the soil to rest after harvest accounts for 60%; Organic fertilizer application accounted for 33.33%; Land cover accounts for 12%. However, this land reclamation has not been regular, or continuous; A part of the population still abuses pesticides, and chemical fertilizers (8%).

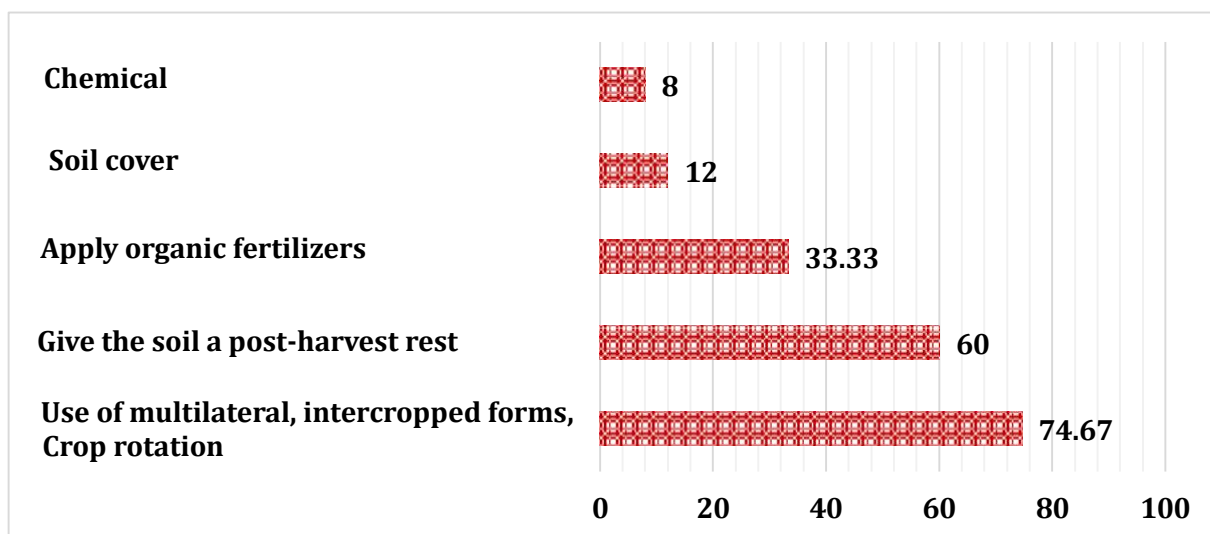


Figure 3.2. Measures used for land reclamation

(Source: Author's survey results)

The management of water resources for agriculture in Hanoi is still unsustainable due to dependence on water sources from rivers flowing through the area, while the water quality from rivers is polluted, and not eligible for agricultural production, and aquaculture. Specifically, the DO (dissolved oxygen in water) index is low; NH₄⁺ and coliform bacteria levels both exceed permissible limits. According to aquaculture households in Tan Minh commune (Thuong Tin district), households always have to stay in the field to take advantage of leading water into the pond, preparing to raise new fish litter. Only on the days when the irrigation company takes the water of the Red River into the Nhue River for spring crop cultivation, the water source is guaranteed to raise fish. Because the current water source of the Nhue River is polluted, it cannot be used for aquaculture. In addition, many agricultural families living along the Nhue River basin are in a similar situation. To ensure the quality of water sources for agricultural production, and environmental protection, Hanoi has implemented many solutions such as the regular operation of 8 existing wastewater treatment plants, with a total capacity of 304,800 m³/day and night. In addition, Hanoi city is accelerating the investment in the construction of wastewater treatment plants in Yen Xa, Phu Do, Van Canh, Thanh Thuy, and Phung Xa, with a total capacity of 474,500 m³/day and night.

Some aquaculture models in the area apply technology in using and managing water resources, typically aquaculture models in Ung Hoa district, Ba Vi, intensive farming, applying strict farming processes from cleaning water filtration and treatment systems, To ensure fish quality, the farm has invested in high-tech equipment such as oxygen nanomachines to supply oxygen to fish, remove alum and toxic chemicals in ponds ... As a result, fish productivity reaches more than 12 tons/hectare/year, 2-3 times higher than semi-intensive farming.

Currently, production models in the area still do not have a modern water management and circulation system to ensure sustainable development due to the need for large investment in water circulation technology, treatment techniques are limited, mainly according to people's experience. Through surveying models on whether or not to use a water management/circulation system, respondents chose Yes accounting for the highest proportion of 50%; followed by Unknown at 38.67 percent and Unidentified at the lowest at 11.33 percent.

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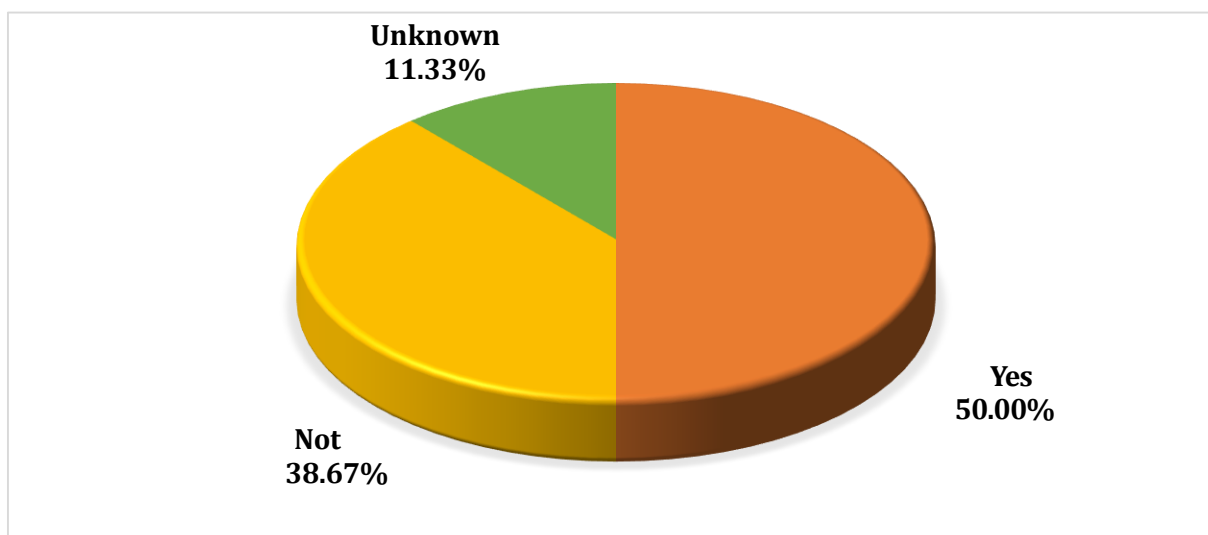


Figure 3.3. About whether or not to use a water management/circulation system
(Source: Author's survey results)

The proportion of abandoned agricultural production land

Currently, in Hanoi city, nearly 5,000 hectares of land are abandoned, causing waste of land resources and significantly affecting the overall development plan of the agricultural sector. In many localities, the situation of people abandoning fields occurs in many communes, especially in areas adjacent to urban areas and low-lying areas. As Ung Hoa district currently has 13,000 hectares of agricultural land, in recent crops up to 700 hectares of farmland has been abandoned. Although Ung Hoa's direction is to develop fisheries that are bringing great benefits, however, inefficient areas of rice land want to convert to aquaculture or fruit cultivation but still have regulations on rice land allocation. leading to the abandonment of fallow fields. At the same time, productivity and efficiency of agricultural production are still low, production depends on weather, epidemics, and market demand, so a large number of workers move to work in other economic areas.

In the city, there are more than 648 facilities using bio-padding; 159,630 establishments constructing biogas works to treat livestock waste... Which, 75% of dairy farms, 44% of beef cattle farms, and 95% of large-scale pig farms outside residential areas have used biogas tunnels. The biogas tunnel construction movement has developed for a long time in the former suburban districts of Hanoi and Ha Tay, leading to many tunnel models with many different scales and designs in Hanoi, but small tunnel models from 6-15m³ account for a large proportion.

In households, biogas is mainly used for cooking for daily life; some craft villages use biogas for secondary production such as wine brewing (Thanh Oai district). Very few households use biogas for lighting, electricity generation, and water heaters. Currently, many biogas tunnels are unusable for many reasons: due to broken tunnels, gas detectors; by design; construction; improper use of processes, due to asynchronous biogas equipment (stoves, rice cookers, lamps...), the quality is not guaranteed; due to improper location layout; due to no longer breeding, due to no longer the need to use, ...

The city has 76 key livestock communes (15 dairy farming communes; 19 beef cattle breeding communes; 29 poultry farming communes). At the same time, Hanoi has developed nearly 1400 large-scale livestock farms outside residential areas, of which, 81 farms have been granted farm economic certificates. According to the results of the investigation, there are still many pig farms that do not have biogas cellars or very small tunnels, which do not handle all the waste released by the farm's pigs. Some tunnels are designed by specialized organizations such as the 11,000 m³ tarpaulin tunnel of Khai Hung Co., Ltd. (Shanxi); 3 biogas tunnels of 800 - 1,000 m³ of Shareholder Livestock Cooperative with concrete, circular cylindrical tanks, with detailed design (funded by FAO).

The rest, most of the tunnels are designed and built by farm owners themselves, with limited investment, so the biogas tunnel model is also very diverse, and inconsistent ... Many tunnels are broken, leaking air; Many tunnels collect gas, but that gas is only used for domestic cooking on the farm, or burning, discarding, which is a waste of energy. The farm of 8000 pigs of Khai Hung Co., Ltd., for many years, has burned about 1,600 - 2,000 m³ of biogas per day, so it is very wasteful. The extraction of biogas for electricity generation is still undeveloped on farms. Some farms build their biogas generators, but the power quality is not high, the efficiency is low, and the amount of biogas collected from livestock waste in the area is still very wasteful

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4. CONCLUSIONS AND SOLUTIONS

Rate of treatment of crop waste for biomass energy recovery

Every year the city can exploit about 70.8 thousand tons of firewood, equivalent to 24.8 kTOE, and more than 1,180 thousand tons of agricultural by-products, equivalent to 338.5 Ktoe. In particular, only about 21% of agricultural by-products are used as fuel, the rest is used for other purposes such as mushroom making and feeding cattle or burning in the field. This is both wasting energy and polluting the environment. The reason is the lack of technology for centralized collection, classification, and treatment of agricultural waste, which needs a large investment in equipment procurement, complicated use, and has not been paid attention to by the people.

In addition, saving production inputs through changing, improving, and using appropriate preparations in diets to increase productivity and economic value in cattle farming and reduce methane emissions; cross and improve domestic cattle breeds with foreign breeds with high-quality and suitable productivity to increase productivity and breeding efficiency.

Organic fertilizer utilization rate//total fertilizer demand

Over the past time, the use of organic fertilizers utilized from agricultural by-products has been deployed in localities in Hanoi. Taking advantage of post-harvest by-products, My Duc district has built a model of applying probiotics to treat rice straw in soybean production. The results showed that, by this new method, soybean yield was higher than conventional methods from 17 to 20 kg/pole, the stubble decomposed quickly after 50 days, reaching 70%; reducing the number of fertilizations and pesticides (1-2 times/season); In particular, plants grow well, limit pests and diseases, minimize environmental pollution and improve soil fertility ...; Huong Ai commune (Thach That district) applies probiotics to treat rice straw in potato cultivation by minimal tillage. Applying this model, local farmers have reduced the number of fertilization times and did not use pesticides to control pests and diseases for crops.

Rate of use of animal feed from pulp and agricultural by-products / total demand for animal feed

Each year the agricultural by-products of Hanoi city generate about 900,403 tons of rice straw, 180,073 tons of rice husk, 90,037 tons of bran, and 205,650 tons of leaf stalks from corn crops, 41,467 tons of soybean stalks. To minimize environmental pollution in livestock, create clean food sources, the use of waste products such as rice, corn, soybean, and corn residue... Processing as feed for cattle not only helps farmers save costs but also earns high profits. Currently, using animal feed from agricultural by-products helps farmers save costs while being proactive in animal feed sources, gradually reducing dependence on industrial bran. There have been localities that have promoted the movement of using agricultural by-products as animal feed such as the Ba Vi farmer model to collect straw, straw milling as feed for cattle, straw collection model to support fish pond farming in My Duc ...

However, the number of livestock households using feed processed from agricultural by-products is still small compared to the actual demand because people do not understand the techniques of processing, mixing, and preserving food... In addition, most of these by-products are used by farmers manually, in the raw form, so the nutritional effect is limited. According to statistics, every year, the amount of corn by-products is also relatively large, but in fact, only 20% of corn by-products are composted for animal feed; The remaining large amount, left by farmers in the fields, is not utilized to cause waste. Soc Son Department of Natural Resources and Environment, currently the amount of straw and rice after harvest in the district is mainly treated as feed for buffaloes and cows (about 11%).

Rate of collection, classification, and treatment of agricultural CTR

According to the survey, most CTR in agriculture is collected and processed by people themselves, almost without the guidance of local authorities and experts. Currently, only about 10% of crop by-products are used as on-site fuel, 5% as industrial fuel, and 3% as animal feed; More than 80% has not been used and discharged directly into the environment or burned to pollute the environment. For corn crops, over 50% of households use leaf stalks and cobs for household cooking purposes; The number of households used for breeding purposes accounts for a negligible proportion. The proportion of households that do not take advantage of corn by-products accounts for about 30%. In animal husbandry, especially in small livestock households, waste treatment has not been focused. Only a small part is used as fertilizer, another part is used directly to irrigate crops and fish farming or discharge to surrounding areas.

The construction of biogas tunnels is difficult because it is only suitable for cattle farmers with a size of at least 5 pigs. The cost of building biogas plants is quite high, so it is not suitable for people's income. Current farms mainly use biogas composting bunkers, but with the existing number of biogas tunnels, only about 50% of the manure emitted from cattle farming is treated. Thus, about 50% of the manure remains untreated. The treatment and use of pulps and by-products of current agricultural models mainly mean "utilization", serving the production process of the model, not turning agricultural by-products and common waste into useful and high-value products. The reason is that the cost to treat agricultural by-products is still large compared to the income of farmers, leading to the loss of organic and nutritious amounts for crops, polluting water and air, and growing land is

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increasingly lacking in organic, severe degeneration. Farmers have not seen the benefits from the scraps... due to a lack of understanding or access to scientific application techniques in the treatment of agricultural by-products.

Through surveying the main forms of recovery, processing, and treatment of phos, and by-products, respondents selected Incineration accounting for the highest rate of 94%; then Composting accounts for 48%; Collection of household waste accounts for 30.67%; Animal feed accounts for 30%; Landfill accounts for 14%; Coating making accounted for 13.33%; Mushroom cultivation accounted for 11.33% and selling to individuals/purchasing organizations accounted for the lowest rate of 6.67%.

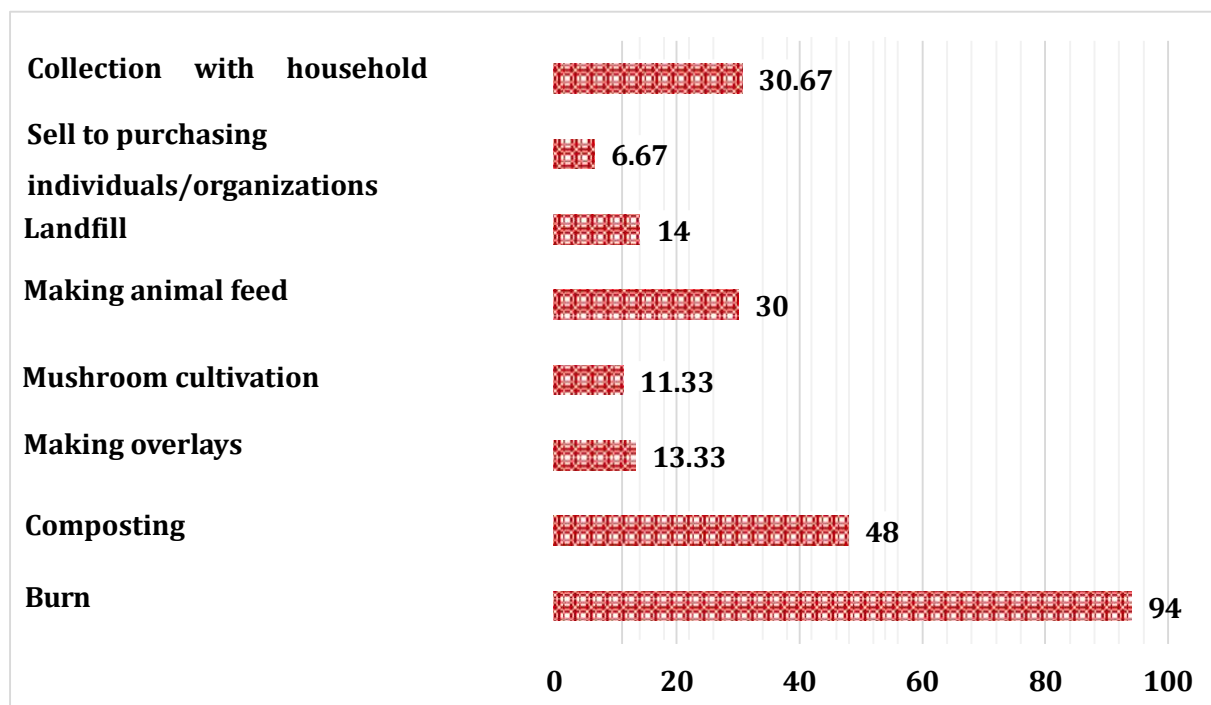


Figure 4.1. Major forms of recovery, processing, and treatment of phosphates and by-products
(Source: Author's survey results)

Hanoi as well as the whole country still lacks staff to research, apply, and transfer technology to treat waste, waste, and by-products in agriculture. Raw materials for recycling are also an obstacle due to the small scale of agricultural production, retail is still popular, and the collection, sub-classification, and agricultural waste for recycling is difficult, making businesses not interested in investing in this field. Agricultural enterprises are largely limited in recycling and reusing technology as well as capital and human resources, so they mainly pay attention to collecting and reusing main by-products in the production process.

Rate of collection and treatment of hazardous agricultural waste

In addition to normal CTR, agricultural production also generates some other types of harmful CTR from the use of plant protection chemicals (pesticides) such as pesticides, and herbicides ... with the main components are plastic, plastic, and paper ... there is adhesion of toxic chemical residues. In some suburban areas of Hanoi, people are not aware of the dangers of this type of waste, so pesticide packaging and pesticide chemicals are still indiscriminately thrown on the banks of fields, ponds, and lakes after being used. This not only adversely affects the environment due to toxic chemicals left in the packaging but also seriously affects people's health. Currently, in Hanoi, only about 50% of districts have organized the collection of post-use plant protection chemical packaging. However, the proportion of packaging collected in separate tanks is approximately 40%, the remaining amount is often collected together with household waste or collected through field cleaning.

Most of the collection activities in recent years have been supported by projects and the State, so when the project ends or is no longer supported, this activity is no longer maintained. In Hanoi, there are popular types of tanks to collect pesticide packaging by phi boxes, 1-compartment or 2-compartment cement tanks, with lids or without lids. The designs of these pesticide packaging collection tanks mostly do not have standards on size, material, and structure of auxiliary accessories to meet the requirements of safe collection.

Regarding the treatment of hazardous agricultural waste such as packaging, bottles containing chemicals, and plant protection drugs, the surveyed people selected: Collected domestic waste, accounting for the highest rate of 59.33%; then classified, stored, and transferred to units with hazardous waste treatment functions, accounting for 52%; On-site landfill accounted for 32.67 percent and others accounted for the lowest rate of 0.67 percent. The above results show that the collection and treatment still have many shortcomings and limitations: other types of hazardous waste from agricultural activities have not

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been thoroughly collected and treated, and there is still a situation where these types of waste are disposed of directly into the environment. In addition, people's awareness of complying with the classification and collection of post-use pesticide packaging is still limited, leading to the situation that people still share other common wastes when collecting and throwing garbage. In addition, the frequency of collection, and the arrangement of waste collection routes and locations are currently unreasonable, affecting the surrounding environment. Funds for arranging collection and treatment are lacking, and resources have not been mobilized to socialize collection and treatment. Some localities have not paid attention to the collection and treatment of hazardous waste from agricultural activities.

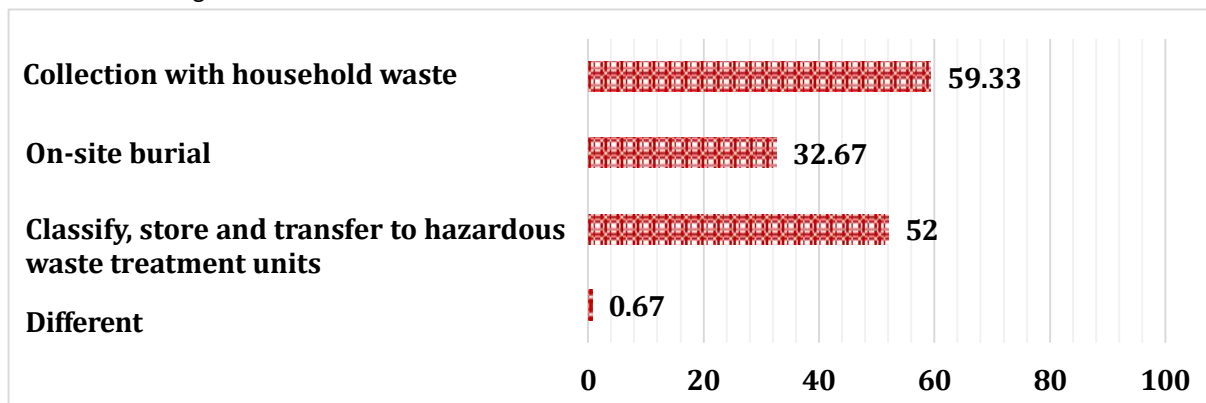


Figure 4.2. The disposal of hazardous agricultural waste
(Source: Author Survey Results)

Rate of use of bio-bags instead of using plastic bags

Hanoi is setting a goal of striving for 100% of traditional markets not to use non-biodegradable plastic bags and switch to using environmentally friendly packaging products to gradually replace disposable, non-degradable plastic packaging products. However, in the practice of surveying traditional markets, residential areas in Hanoi in general, and suburban districts of Hanoi in particular, most people still use non-degradable plastic bags, using plastic items once due to their convenience and cheap nature. In agricultural production, the packaging for agricultural products is mainly still plastic bags, with the characteristics of durability, toughness, and many different sizes, so this rate of packaging by plastic packaging is almost 100%. This is also one of the major sources of plastic waste emissions into the environment.

Through the survey, although the harmful effects of using persistent plastic bags and disposable plastic items on the ecological environment and human health, however, for many reasons such as awareness, convenience, and product cost,.. has become a major barrier to replacing plastic, using bio-bags.

Consumption rate of green and ecological products

Over the past time, the awareness and interest of Hanoi society and consumers for green and ecological products with quality, clear origin, and certification according to national and international standards have been increasingly raised. The demand for organic, Vietgap, safe agricultural products as well as energy-saving and environmentally friendly products is increasing in Hanoi. However, there are still difficulties such as building consumer trust with organic products; the price of organic goods is always higher than that of products produced by traditional methods; transparency of product information;... Increase the collection and recycling of agricultural by-products into commercial products. With a cultivated area and a large total herd of cattle and poultry, Hanoi has an abundant source of agricultural by-products every year. However, most current agricultural models mainly process sources of phons, and by-products to supply local needs, there are no recycled products from phos, or by-products sold in the market.

Regarding the conversion of pulps and by-products in production activities to commercial products of families, surveyed people chose mainly animal feed, accounting for the highest proportion of 55.33%; then Biofertilizers accounted for 52%; Renewable energy (biogas) accounted for 18.67%; None accounted for 13.33%; Mushroom substrate accounts for 2.67%; Bio-pads accounted for 1.33%; Handicrafts accounted for 1.33%; Pharmaceuticals accounted for 0.67%; Food accounted for 0.67 percent and others accounted for the lowest 0.67 percent. The survey results show that most of the by-products are reused for animal feed, and biofertilizer for household production, agricultural by-products have not been recycled into valuable products such as handicrafts fine arts, pharmaceuticals, food,...

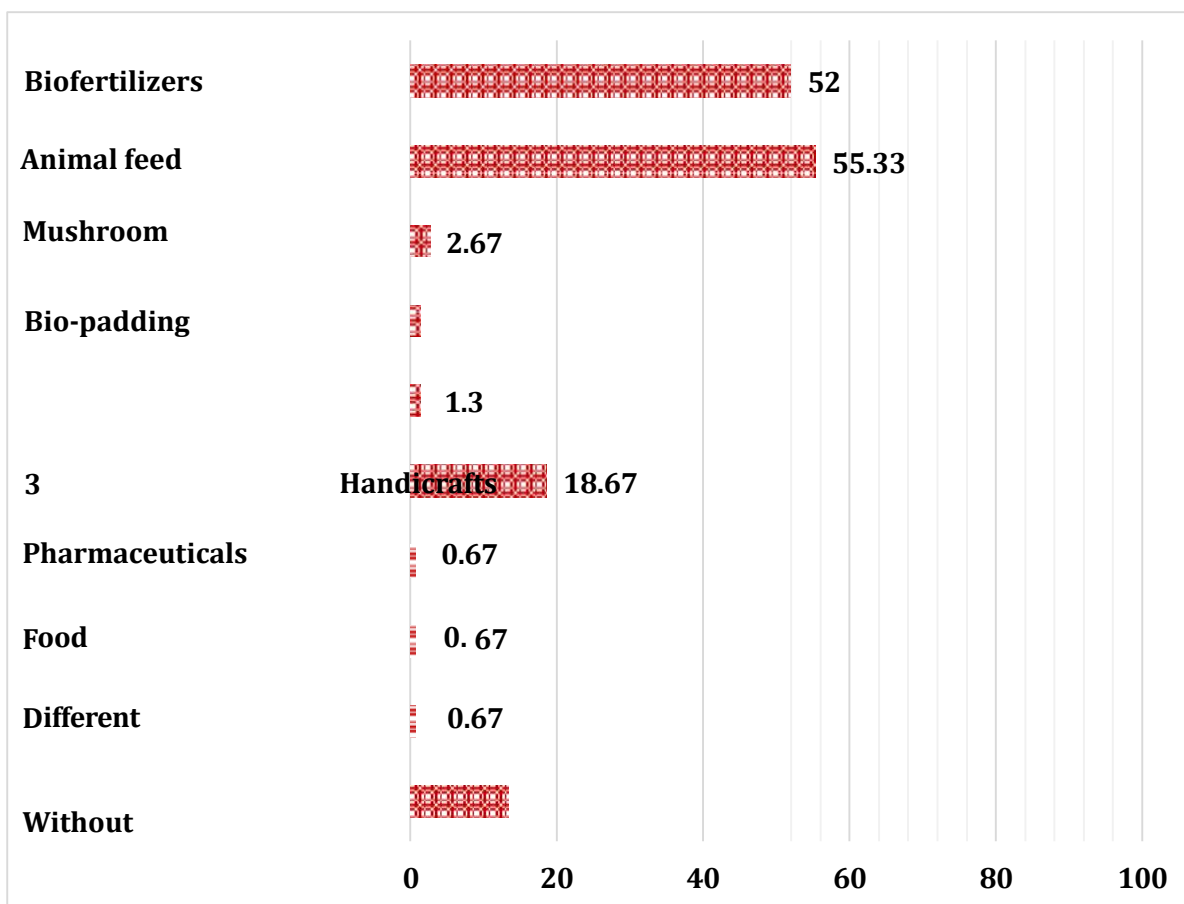


Figure 4.3. The conversion of phonics and by-products in production activities to commercial products of the family (Source: Author Survey Results)

Through a survey of households on the purpose of recovery, processing and treatment of chips and by-products in agricultural production to reduce environmental pollution, accounting for the highest rate of 84%; Utilization and saving of pho and by-products accounted for 62%; Use of renewable energy accounted for 55.33%; Protection of family and community health accounts for 50%; Diversification and improvement of product value accounted for 30.67% and sharing products and output with other producers accounted for the lowest rate of 18.67%.

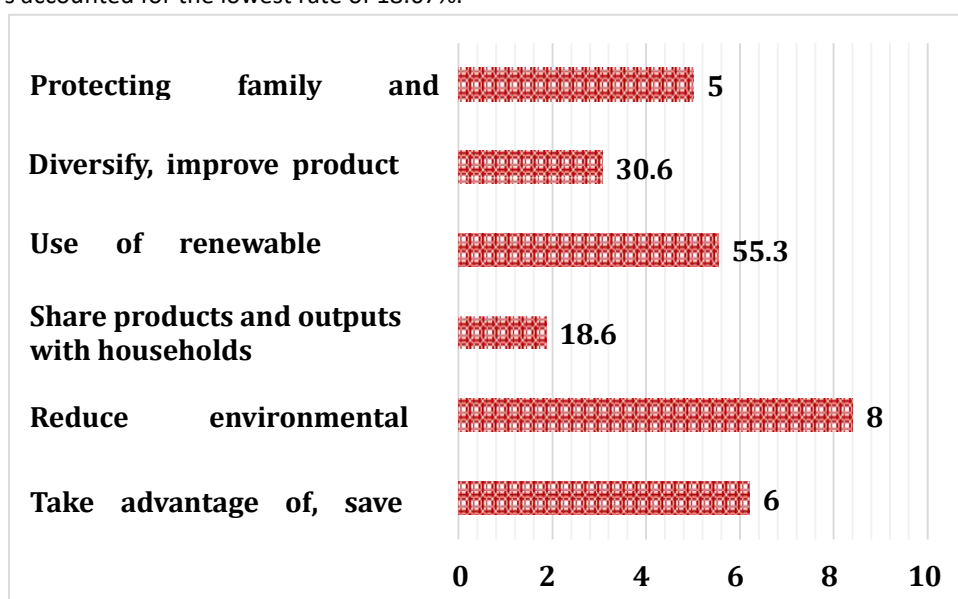


Figure 4.4. Purpose of recovery, processing, and treatment of phosphates and by-products in agricultural production (Source: Author's survey results)

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Percentage of fertilizer from agricultural by-products sold to the market:

Using agricultural waste to create organic fertilizer to fertilize crops is considered a sustainable production direction. Over the past time, many large enterprises have cooperated with localities to invest in producing organic fertilizer from agricultural by-products such as Guilin Group, Song Gianh, T&T 159 ... However, the quantity and products of organic fertilizer are still generally modest compared to inorganic fertilizers (11.6% vs. 86.9%).

Every year, biomass by-products from major crops such as rice, corn, sugarcane, vegetables of all kinds can provide equivalent to about 43.4 million tons of organic, 1.86 million tons of urea nitrogen, 1.68 million tons of monophosphate superphosphate and 2.23 million tons of potassium sulfate. This biomass compensates for nutrients in the soil and is used for crops in agricultural cultivation. However, these nutrients are almost wasted and there are no incentive mechanisms for reuse and recycling.

Proportion of animal feed from agricultural by-products sold on the market

From practice, with an abundant source of agricultural waste mainly rice, corn, soybean, and vegetables, these by-products can be completely processed as feed for cattle and the processing method is also simple and popular such as Composting dry straw in rolls with u - dribbling in bags; composting fresh straw with u - re according to the method of caking, yeast brewing for raising dairy cows, beef cattle ... Over the past time, in some suburban districts with a large number of cattle, farmers have used and processed rice straw, corn stalks, milling by-products... as feed for buffaloes and cows. Hanoi Cattle Breed Joint Stock Company has for many years purchased composted straw with probiotics, creating an on-site feed source for the company's beef cattle breeding. However, no animal feed products processed from by-products have been sold to the market.

Ratio of collection and recycling of commercial agricultural by-products / total waste and agricultural by-products

Currently, many farmers, businesses, and cooperatives do not know how to take advantage and apply scientific achievements to process agricultural by-products, causing waste sources and reducing income when having to spend costs for production. Through surveys, most farmers often handle by-products according to habits or experiences such as Burning straw, corn stalks, and soybeans in the field; burying by-products in the field; used to make fuel; as feed for cattle; composting as fertilizer; mushroom production; as a filler in livestock and discarding by-products in untreated fields to self-decay... In rice production, on average, each year, the city has approximately 1.8 million tons of by-products (1.44 million tons of rice straw, 240 thousand tons of rice husk, 120 thousand tons of bran. But after each harvest, 500,000 tons of rice straw are discarded, while only 13% is used for animal feed, compost as fertilizer, manure for livestock barns accounts for 11%, cooking is 8%, and used to grow mushrooms accounts for 8.1%. In animal husbandry, the main forms of treatment of by-products are Composting; biogas tunnels; and discharged directly into the environment... In general, waste management in livestock still faces many difficulties. Therefore, the ratio of commercial collection and recycling of agricultural by-products to total waste and agricultural by-products is still very modest. Only about 10% of crop by-products are used as on-site fuel, 5% as industrial fuel, and 3% as animal feed; More than 80% has not been used and discharged directly into the environment or burned to pollute the environment.

The ratio of recycled products from agricultural by-products to gross agricultural products

Currently, a small number of phonics and by-products are purchased and consumed on the market such as rice straw purchased by individuals to serve as substrates for mushroom cultivation models, animal feed, biological padding, and soil cover; Buffalo and cow manure purchased for the model of raising cinnamon worms, growing vegetables, raising fish.... however, the product value is low. Or hyacinth stalks, grass stalks can be made into traditional handicraft products in craft villages in Phu Xuyen district, Thanh Oai,...

There are no enterprises that collect, treat, and process agricultural by-products into commercial products sold on the market. The above difficult reason is that there is no mechanism to attract and encourage enterprises to participate in the collection and recycling of agricultural by-products; technology, equipment, and biotechnology to be processed are still limited due to lack of investment capital; lack of a formal market for recycled products from agricultural by-products,...

Conclusion

Vietnam's circular economy plays a crucial role in promoting sustainability. The sustainable agricultural landscape in Hanoi, Vietnam, is evolving, with a focus on integrating natural processes and biological resources to enhance agricultural productivity while preserving the environment. The shift towards organic farming methods has brought about a notable expansion in agricultural output, highlighting a positive trend in sustainable agricultural development. However, challenges persist in fully embracing eco-friendly techniques, particularly in certified organic agriculture, due to certification complexities, infrastructure limitations, and compliance issues. To drive long-term economic viability and environmental sustainability, focused efforts are essential in addressing these challenges. The utilization of innovations such as biogas technology and the conversion of agricultural by-products into commercial products presents opportunities for energy efficiency, waste management, and enhanced resource

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utilization. Continual strides in sustainable practices, resource efficiency, and the adoption of eco-friendly alternatives are pivotal for advancing a circular economy within the agricultural sector and achieving long-term economic and environmental benefits in Hanoi.

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