

## РОЗДІЛ 3

# ЕКОНОМІКА ТА УПРАВЛІННЯ НАЦІОНАЛЬНИМ ГОСПОДАРСТВОМ

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### STRATEGY, APPROACHES AND SCHEME OF AGRICULTURAL WASTE MANAGEMENT IN CIRCULAR AGRICULTURE ECONOMY

This article describes the main strategies for sorting and recycling agricultural waste and explores mechanisms for integrating the circular economy in agriculture. Analyzed the main approaches to waste recycling, such as: classical, "zero" and mixed model. Types of natural and unnatural agricultural waste are described on their basis. The complexity of the process of integrating a circular agriculture waste management strategy is described. A recycling scheme was also developed in the circular economy model of agriculture, which includes such processes as: reduction, clean production, green goods, minimization, conversion of resources, cleaning and environmental products. Systematic approaches to the classification of types of agricultural waste are considered and analyzed.

**Keywords:** recycling, agricultural waste, circular agriculture economy, waste management, classification of agricultural waste.

**Problem statement.** Technological development and population growth have led to an increase in garbage generation, including agricultural waste. The rapidity of waste generation has created an urgent need for rapid renewal of units and cycles of collection, treatment and reuse of waste and return to its production processes. Today's strategic waste management models are a process of systematic analysis and action to improve the sorting, supply chain, recycling and reuse of waste needed to improve the environmental and economic situation in the region. The linear production and utilization scheme are not perfect and does not cope with the development of society, namely, the excessive consumption of products and the generation of waste from them. That is why new approaches in the circular agriculture economy are an innovative solution to solve this problem. Thus, the key problem is to systematize all the links of waste conversion and create a unified effective system of sorting, collection and recycling, which will take into account the main factors of the circular economy. It is quite revealing that the system of circular agriculture economy and waste regaining is a fairly new concept and is not a thoroughly studied system of science.

**Analysis of recent research and publications.** Scientific and practical principles of ecological and economic modeling and waste management strategies were developed in their work by Shmelev S.E. and Povel J.R. where the key principles are digitized maps of different districts and analysis of places of garbage collection and sorting [8]. Analysis of literature

sources, such as Allevi E., Gnudi A., Konnov I. and Oggioni J., showed that they describe the scheme of circular garbage collection by the method of coordinated work of the state and private enterprises, where the municipality plays a key role because it establishes waste prices and controls the processing of this waste [7]. Current literature analyzing the integration of the transition from linear recycling to circular recycling considers the work of scholars such as Doner M., Gier R. and Vries H., who describe value-based business models for agricultural waste in their papers. In general, they consider two types of recycling, namely cascade recycling and closed loop type – the circular agriculture economy [4].

**Selection of previously unsolved parts of the overall problem.** It can be argued that the main task of the agricultural waste management strategy is to determine the correct scheme of collection, transportation and utilization of agricultural waste. It follows that there are three key factors in an agricultural waste management strategy: optimal waste collection with the least amount of carbon pathway, rapid sorting and recycling with maximum efficiency, and the least amount of residual waste for burial. This requires an optimal regional strategy and model for the location of collection and recycling of agricultural waste. In general, the management of agricultural waste is complicated by the low awareness of waste classifiers and a number of different approaches to these classifiers.

**The purpose of the article.** The main purpose of the article is to develop a scheme

for integrating waste treatment into the circular economy in agriculture and to identify the main approaches to agricultural waste conversion.

**Presentation of the basic material.**

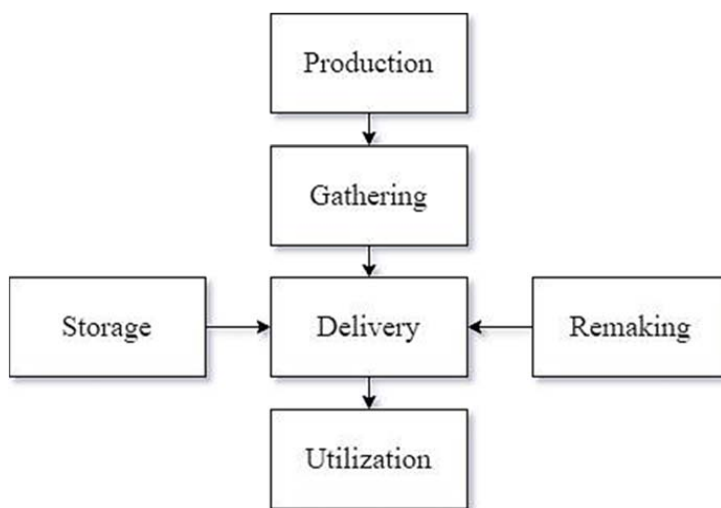
Agricultural waste management is a fairly complex and time-consuming process, in most cases due to the extensive waste generation system, different ways of waste collection and various recycling schemes.

The circular agriculture economy is essentially an offshoot of the conventional circular economy, involving features of agricultural production. For example, according to the U.S. Department of Resource Conservation's recycling process chart, there are such stages of recycling as:

- production process is a quantitative and qualitative activity that can be measured in terms of an agricultural unit type. Waste must be recycled if its quantity is sufficient to cause damage to the environment;
- collection is the moment of the first gathering of agricultural waste from the place of its accumulation to the place of its storage. The main purpose of this point is to determine the optimal method of gathering and location of agricultural waste storage sites, calculation of the necessary equipment, and waste management depending on the type of waste;
- transfer is the moment of garbage transportation at all stages of waste management;
- warehouse – storage facility where waste is temporarily held after the production or treatment stage, for further transportation to the reuse or burial stage. The storage time depends on the qualitative and quantitative parameters of the waste, as well as on the level of waste management optimization. The shorter the storage time of the waste and the higher the turnover rate of the storage area, the better management of the waste can be called;
- recycling is the transformation process that trash undergoes to reduce the negative impact on the environment;
- conversion is the process of treating waste with the moment of waste reuse in the production process [1].

So, the transportation of waste from the first stage of waste generation to the moment of storage, processing and burial (Figure 1). From a scientific point of view, to these stages of processing should be added the stage of sorting, reprocessing, waste-free production and utilization of agricultural waste (Figure 2):

- sorting – the stage of waste distribution into subspecies for processing or separation of non-reheating waste for dumping;
- waste-free production is recycling, which creates a reuse of resources in the enterprise, and the enterprise can be called a "zero waste" enterprise;



**Figure 1. Functioning of linear recycling waste management**

*Source: created by the author*

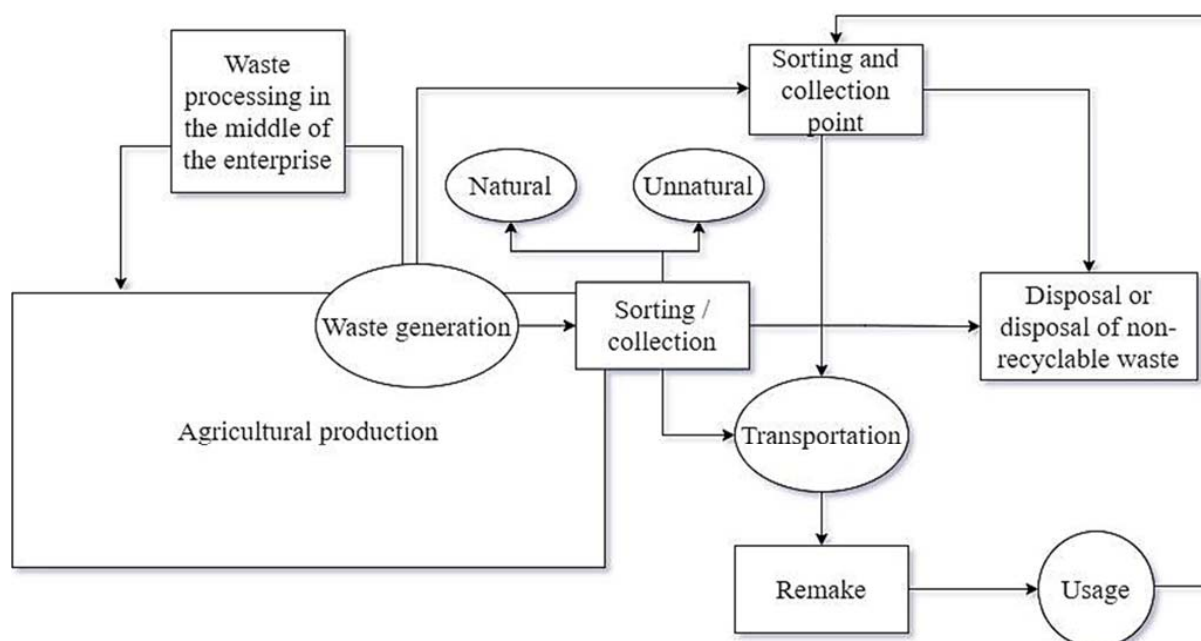
- reprocessing – reuse of already processed raw materials;
- utilization – hardly ever found in the agricultural environment, since waste that cannot be recycled is disposed of. However, with the increasing use of chemicals to grow plants and animals, this type of waste is increasingly appearing in agriculture.

Stages of recycling within the enterprise and reuse of recycled products, once again in the production process are key factors that indicate the integration of the circular agriculture economy in the process of recycling waste at the agricultural enterprise.

Agricultural waste with historical background has a wide classification and variety. Depending on the type of land cultivation and the type of agricultural activity, they can have different types and values. According to the type, agricultural waste is divided into: theoretically possible; technically feasible; economically valuable.

According to the United Kingdom's Chartered Institution of Wastes Management (CIWM), agricultural waste is that which is generated on farmland. This waste is divided into two types: natural and unnatural. Unnatural one is a type of waste that is created during the production of an agricultural product, but is not natural in origin. Such wastes include: pesticide containers, injections and unused animal medicines, plastic bags and sheets. Natural agricultural waste is waste of plant and animal origin that does not contain foreign chemical additives. Therefore, their processing is not as labor-intensive and expensive as the treatment of unnatural agricultural waste [2].

We can say that in every agricultural enterprise the primary filtration and sorting of waste into natural and non-natural should take place. On the other hand, such sorting can also be done locally, but it requires more labor



**Figure 2. Agricultural waste management scheme in the circular agriculture economy**

*Source: created by the author*

and equipment, which in turn will increase the operating costs of processing. That is why the best option for sorting garbage is the moment of its sorting at the point of formation. According to the Swiss Federal Office for the Environment (Bundesamt für Umwelt, BAFU), agricultural wastes are those generated by growing plants or animals in the process of creating agricultural products [5].

In his book, "Informal Sector, Pollution and Waste Management" Sarbajit Chaudhuri noted that in developed countries one of the main tools for advancing waste management and reducing pollution is economic incentives. One of the main levers of control in this situation is the proper reporting of each of the enterprises on the scale of pollution and special audit teams. The same cannot be said for developing countries, because many companies in such countries are "in the shadows," which makes it impossible to properly control pollution. Also, small businesses in these countries cannot afford to buy sewage treatment plants and technologies that reduce pollution. For the most part, all of these anti-pollution measures are aimed at large enterprises and do not take small ones into account. This indicates that waste management policy needs to be divided between the informal and formal sectors of the economy [3]. Despite the fact that the types of agricultural waste are different, the scheme of its processing may also change. Thus, recycling approaches can be divided into:

1. The classic recycling process: sorting garbage according to waste generation; transporting trash to a warehouse to store the sorted trash; trash treatment.

2. «Zero» waste process (possible only for natural agricultural waste): primary recycling

of the product; secondary use of the product on the basis of zero processing rates.

3. The process of mixing agricultural waste: waste sorting based on trash generation; the process of secondary use of the product on the basis of product processing; transportation of residual waste to a warehouse for sorted garbage storage; garbage conversion.

Depending on the processing process, the main goals of the strategy are set. Thus, the strategic goals can be divided into sorting, recycling and zero waste goals of the company. Circular economy is a new type of economic development that takes into account not only economic but also ecological processes. The main difference between the circular economy is the continuity of the processes of production and consumption. Instead, linear economics operates from point A to point B, ignoring the end result of waste and the influence of other factors in both the economic and ecological environment. According to Audrey Kobayashi's book, *The International Encyclopedia of Human Geography*, a circular economy is a shift from a definition of economic growth to a focus on the benefits to society. This makes it possible to separate production from economic activity and reduce the amount of waste. In addition, the transition to renewable energy systems and waste recycling contributes to this [6].

From the point of view of L. Xuan circular agriculture economy is a strategy of sustainable development, the main levers of which are the reduction, reuse and recycling of garbage. On the other hand, it also includes sustainable agriculture, which is also called green agriculture or organic farming. It should be noted that the 3R principle is mostly followed by Asian scientists. L. Xuan identifies that

there are 3 stages in the implementation of the 3R model, including: Reduce (or even minimize) the production of industrial waste and raw material waste; create technology parks; to implement waste processing in the system of circular economy. According to the authors, first of all waste recycling should be integrated at the level of enterprises and technology parks. In the approach to the agrarian circular economy L. Xuan also identifies three aspects that distinguish an agricultural circular enterprise from a simple agricultural enterprise:

1. The development of waste processing in the industry of agricultural production is associated with the study of territory, land management, expansion and construction of certain industries.

2. The ecological circular economy model as a type of ecological protection can work as an additional integration in the field of classical agriculture. However, it should be understood that in the classical model of agricultural production this occurs only with additional investment.

3. Garbage utilization in the agricultural sector is mainly related to recycling and the production of alternative energy by agricultural waste treatment methods.

Thus, it should be noted that agricultural production can be made a separate subject of the circular economy in which the moment of garbage processing is completely closed (Figure 3) [9].

In general, the stages of 3R model implementation of L. Xuan has both positive and negative factors. The first point is realized by optimizing and automating the workflow in production and provides a positive dynamic for both the company and the environment. The second point is not always related to

the environment and depends on the type of technology park and its realization in practice. On the other hand, there is a new type of circular economy, which already includes the moment of recycling as one of the goals of circular economy. In our opinion, the 3R model is suitable for enterprises, but does not include regulation by the state and interaction with the public. There are many benefits to the agricultural sector in terms of a strategy to create a circular economy based on 3R principles. However, L. Xuan in his work misses the interaction with government and society and prescribes a closed system in production itself. In our opinion, this system is a bit utopian, because without the participation of society and the state it is difficult to achieve full-fledged clean circular recycling. It should also be understood that turning waste into energy must be supported by state permits to conduct this activity. From the strategy of creating an circular agriculture economy based on the 3R principles, there are many advantages for the agricultural sector.

**Conclusions and suggestions.** Thus, it can be noted that the scheme of circular economy in agriculture can be divided into a classic waste processing, "zero" waste treatment process and mixed waste recycling process. The waste mix scheme is the most popular in the global distribution among agricultural enterprises, because the enterprise with "zero" waste is complex and capital-intensive. Also, the waste recycling mix strategy is considered to be the most efficient, simple and environmentally friendly system for treating agricultural approaches. Approaches to recycling schemes are described differently in each country, so to summarize all the theories, the stages of sorting, recycling, zero-waste production and waste disposal were added. The added stages

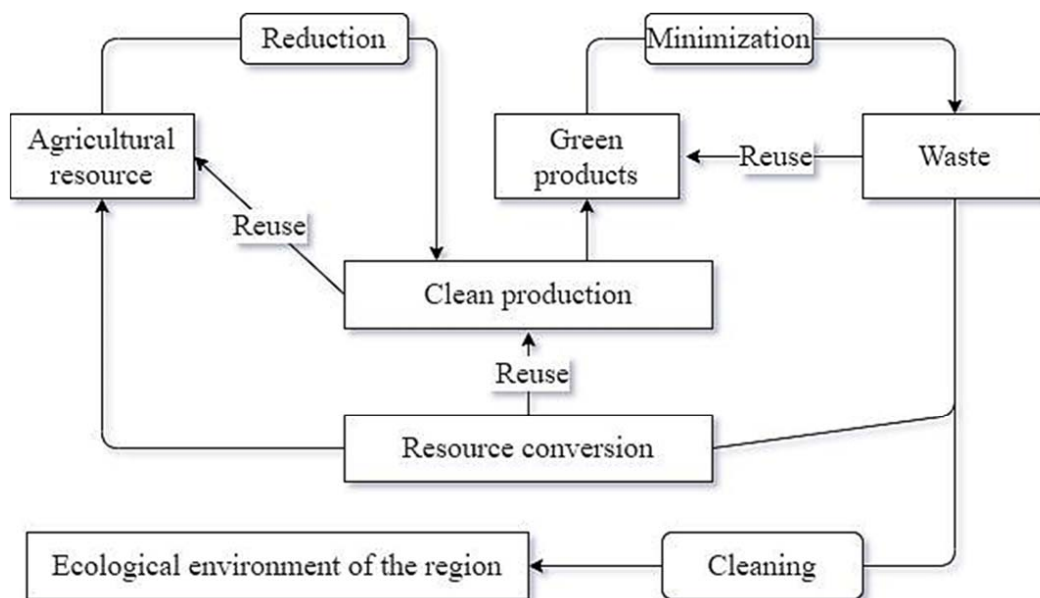


Figure 3. Scheme of circular agriculture economy

Source: L. Xuan, 2011 [6]



create a general strategy of circular agriculture economy, in which waste processing passes from simple linear processing to circular recycling of agricultural waste. On the one hand, linear recycling at all levels is fairly easy to integrate, but it takes a lot of resources, leaves a carbon footprint and can be unprofitable, and therefore not interesting for business. Which, in turn, will lead to a reduction in investment and the

scale of linear recycling. On the other hand, in practice, linear processing of waste is integrated in many countries, and its replacement requires many resources and modernization of waste management systems. At the same time, circular recycling of agricultural waste takes into account both improved economic and environmental performance, which is considered more feasible in the long term.

## References:

1. Agricultural Waste Management Systems (2011). *Agricultural Waste Management Field Handbook*. Washington: The U.S. Department of Agriculture (USDA). 202 p.
2. Chartered Institution of Wastes Management (2021). Quadra. Available at: <https://www.ciwm.co.uk/ciwm/knowledge/agricultural-waste.aspx>.
3. Chaudhuri S., Mukhopadhyay U. (2010) *Informal Sector, Pollution and Waste Management*. New York: Springer, New York, NY. 212 p. DOI: [https://doi.org/10.1007/978-1-4419-1194-0\\_9](https://doi.org/10.1007/978-1-4419-1194-0_9).
4. Donner M., Gohier R., Vries H. (2020) A new circular business model typology for creating value from agro-waste. *Science of the Total Environment*, no 716. pp. 1–11. DOI: <https://doi.org/10.1016/j.scitotenv.2020.137065>.
5. Federal Office for the Environment FOEN (2019). Available at: <https://www.bafu.admin.ch/bafu/en/home/topics/waste/guide-to-waste-a-z/biodegradable-waste/types-of-waste/agricultural-waste.html>.
6. Klein N., Ramos T., Deutz P. (2020) Circular Economy Practices and Strategies in Public Sector Organizations. An Integrative Review. *Sustainability*, no. 10, vol. 12, pp. 3–24. DOI: <https://doi.org/10.3390/su12104181>.
7. Municipal solid waste management in circular economy (2021). A sequential optimization model. Allevi E. et al. *Energy Economics*, no. 100, pp. 105–383. DOI: <https://doi.org/10.1016/j.eneco.2021.105383>.
8. Shmelev S., Powell J. (2006) Ecological-economic modelling for strategic regional waste management systems. *Ecological Economics*, no. 59, pp. 115–130. DOI: <https://doi.org/10.1016/j.ecolecon.2005.09.030>.
9. Xuan L., Baotong D., Hua Y. (2009) The Research Based on the 3-R Principle of Circular agriculture economy Model-The Erhai Lake Basin as an Example. *Energy Procedia*, no. 1, vol. 5, pp. 1399–1404. DOI: <https://doi.org/10.1016/j.egypro.2011.03.242>.

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## СТРАТЕГІЯ, ПІДХОДИ ТА СХЕМА УПРАВЛІННЯ ВІДХОДАМИ СІЛЬСЬКОГО ГОСПОДАРСТВА В АГРОЦИРКУЛЯРНІЙ ЕКОНОМІЦІ

### Резюме

Досліджено головні стратегії сортування та переробки сміття сільського господарства та описано механізми інтеграції агро-циркулярної економіки. Проаналізовано головні підходи переробки відходів, такі як класичний підхід переробки відходів, “нульовий” підхід переробки відходів та мікс-модель переробки відходів. На їх базі розписано типи природного та неприродного сільськогосподарського сміття. Описано складність процесу інтеграції стратегії агроциркулярного управління відходами. Також, було розроблено схему переробки сміття в моделі агроциркулярної економіки, яка включає такі процеси як: зменшення, чисте виробництво, зелені продукти, мінімізація, конвертація ресурсів, очищення та екологічне середовище продуктів. Розглянуто та проаналізовано системні підходи до класифікаційних різновидів сільськогосподарського сміття. Таким чином, можна зазначити, що схема агроциркулярної економіки може поділятися на класичний процес перероблення відходів, “нульовий” процес перероблення відходів та процес міксу переробки відходів. Схема міксу відходів виступає найпопулярнішою у глобальному поширенні серед сільськогосподарських підприємств, адже підприємство з “нульовими” відходами складне та капітало-затратне. Також, стратегія міксу переробки відходів вважається найдієвішою, простою та економічною для екології системою переробки підходів сільського господарства. Підходи до схем перероблювання сміття в різних країнах описуються по-різному, саме тому було додано етапи сортування, повторної переробки, безвідходного виробництва та захоронення відходів для узагальнення всіх теорій. Додані етапи створюють загальну стратегію агроциркулярної економіки, при якій переробка відходів переходить від простої лінійної переробки до циркулярної переробки відходів сільськогосподарського сміття. З одного боку, лінійна переробка сміття на всіх рівнях є доволі простою для інтегрування, проте забирає доволі багато ресурсів, залишає вуглецевий слід та може бути не рентабельною, а це означає не цікавою для бізнесу. Що своєю чергою зменшить кількість інвестицій та масштабність поширення лінійної переробки відходів. З іншого боку, на практиці лінійна переробка відходів інтегрована в багатьох країнах і заміна її потребує залучення багатьох ресурсів та оновлення систем управління відходів. Водночас агроциркулярна переробка сміття враховує в собі і покращені економічні так і екологічні показники, що в довгостроковій перспективі вважається доцільнішим.

**Ключові слова:** переробка, сільськогосподарські відходи, агроциркулярна економіка, управління відходами, класифікація сільськогосподарських відходів.

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## **СТРАТЕГИЯ, ПОДХОДЫ И СХЕМА УПРАВЛЕНИЯ ОТХОДАМИ СЕЛЬСКОГО ХОЗЯЙСТВА В АГРОЦИРКУЛЯРНОЙ ЭКОНОМИКЕ**

### **Резюме**

Исследование показало главные стратегии сортировки и переработки мусора сельского хозяйства и описаны механизмы интеграции агро-циркулярной экономики. Проанализированы главные подходы переработки отходов, такие как классический подход переработки отходов, "нулевой" подход переработки отходов и микс-модель переработки отходов. На их базе расплано типа природного и неестественного сельскохозяйственного мусора. Описаны сложность процесса интеграции стратегий агроциркулярного управления отходами. Также, была разработана схема переработки мусора в модели агроциркулярной экономики, которая включает такие процессы как: уменьшение, чистое производство, зеленые продукты, минимизация, конвертация ресурсов, очистки и экологическую среду продуктов. Рассмотрены и проанализированы системные подходы к классификационным разновидностям сельскохозяйственного мусора.

**Ключевые слова:** переработка, сельскохозяйственные отходы, агроциркулярная экономика, управление отходами, классификация сельскохозяйственных отходов.