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CIRCULAR ECONOMY IN THE CONTEXT OF FOOD SECURITY

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Abstract: *Ensuring food security is one of the major global challenges facing humanity. This issue is becoming even more critical in the context of a growing world population, inefficient use of limited resources, rising global waste (particularly food waste) climate change, and an increasing number of undernourished people. These trends highlight the urgent need to organize economic systems in ways that help mitigate such global problems. In recent years, the circular economy has emerged as a promising approach, which underscores the relevance of this article.*

The aim of the article is to develop a set of measures for introducing circular economy principles into agriculture in order to enhance the level of food security in the Republic of Armenia. To achieve this objective, the study examines global food security issues, outlines the negative consequences of a linear economic model, identifies the key principles and advantages of a circular economy, substantiates the importance of applying circular approaches in agriculture, and assesses the current state of food security in Armenia. The research employs historical, analytical, comparative, abstract, and statistical methods.

The findings indicate that the linear economic model is no longer sustainable. Addressing food security challenges requires a transition to a circular economy framework at the individual, organizational, state, and global levels. If the recommended measures for implementing a circular economy in the context of food security are adopted by the Republic of Armenia and other developing countries, they can help solve not only food security issues but also reduce waste, improve the efficient use of natural resources, preserve ecosystems, and address a range of related problems.

Keywords*: global challenges, food security, linear economy, circular economy, food waste, circular economy actors*

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INTRODUCTION

Today, the world faces a number of global challenges that pose a serious threat to humanity. In particular, according to UN forecasts, the world population, which actually stood at 8.2 billion in 2024, will reach 10.3 billion in 2084 [1]. The world is currently facing an extreme food security situation, with 280 million people worldwide facing hunger every day [2]. It is obvious that this problem will become even more acute as the population grows. The main problem with food security, especially in developing countries, is high food prices, which force poor families to spend the majority of their income on food [3]. The solution to world hunger is not to lower food prices, but to increase people's incomes [4]. At the same time, it should be noted that the distribution of world food between different countries is highly uneven, which is due to both economic and political reasons. Food waste is higher in developed countries, accounting for

approximately 40% of food produced. The causes of food waste vary from country to country. For example, in developed countries, food waste is driven by overproduction and consumer behavior. And in developing countries, the causes of food waste are underdeveloped infrastructure, non-innovative storage approaches, consumer behavior, inefficient organization of production processes, etc. It should also be noted that 2.01 billion tons of solid waste are generated worldwide annually, a figure predicted to reach 3.4 billion tons by 2050, causing significant environmental damage [5].

To satisfy their needs, humans use natural resources, which are physical or biological formations found in nature [6] . Studies by various organizations show that demand for natural resources will continue to increase in the coming decades. Thus, by 2030, the demand for energy will increase by 50%, the amount of minerals, ores, fossil fuels, and biomass consumed globally per year by 2050 will increase by almost three times, and the demand for water used for various purposes will increase by 50% [7] . Currently, there is already an objective need for effective management of natural resources. The management of natural resources such as land, water, plants, animals, etc. focuses on how their use affects current and future generations [5] . Agricultural activity is one of the sectors with the greatest negative impact on nature, resulting in a reduction in biodiversity, including flora and fauna. To meet the growing demand for food, pesticides have been used, which have a negative impact on food quality and human health [8].

Taking into account the above, an objective need has arisen to develop and implement approaches to economic activity that will enable more effective solutions to address issues related to food security. All of this has determined the relevance of the presented article.

This article argues that implementing circular economy measures in agriculture is central to increasing food security in the Republic of Armenia. The aim is to propose actionable steps that enable this transformation. To achieve the set goal, the following tasks have been set:

- study the main issues related to global food security,
- present the negative consequences of organizing a linear economy,
- Identify the main principles and advantages of the circular economy.
- justify the importance of applying a circular economy in agriculture,
- present the current state of food security in Armenia.

LITERATURE REVIEW

The main goal of economic activity is the maximum satisfaction of people's unlimited needs within the framework of limited resources. Morselettp P. in his study shows that the economy has always been a mix of circular and linear applications but in varying proportions [9]. The linear economy has been applied since the industrial revolution, the essence of which is that the resources used in the production and consumption process turn into waste after the first use [10]. In a linear economy, the transformation of resources into products is accompanied by resource consumption, elimination, and environmental pollution. Studies have shown that the linear economy is no longer justified and there is a need to transition to a new economic model, which is the circular economy (CE). There are over 100 definitions of the circular economy. The main idea of the circular economy is the efficient use of limited resources and the reduction of waste. In general, the circular economy includes the 10Rs framework. Rethink (change current lifestyles, strategies, policies, and the way products were designed, made, and used to meet the

needs of a CE), Repurpose (use products for multiple purposes), Refuse (don't use toxic materials and non-renewable resources in the design, make, and consumption of products), Reduce (decrease resources in production and consumption, generating value while decreasing environmental impact), Reuse (find new product uses (second hand products)), Repair (maintain and repair products to avoid wasting), Refurbish (improve products that bring more value and decrease environmental impacts), Remanufacture (create new products from second hand products), Recycle (process waste materials into products or reuse the raw materials of products), Recover (recover energy from waste, recovering eco-systems and resources) [11]. F. Sariatli notes that the circular economy implies a conception or system that keeps the added value of a product as much as possible and eliminates the waste [12]. The organization of a circular economy is conditioned by certain costs, which are largely associated with the introduction of the latest technologies. It should be noted that the circular economy requires not only innovative technologies, but also innovative participants who are ready for change in terms of both new policies and decision-making tools [13].

According to H. Katunar, circular economy in agriculture provides environmental advantages, and when applied in the long term, it can also provide economic and social benefits [14]. Food is a key concept in the Sustainable Development Goals, and a circular economy in agriculture can contribute to achieving other sustainable development goals, such as eradicating world hunger, achieving food security and sustainable agriculture, improving health and well-being, reducing food waste, managing natural and other resources effectively in consumption and production processes, reducing water pollution, and preventing land degradation worldwide [15]. Rood et al. concluded in their scientific paper that an innovative food system through a circular economy contributes to the regeneration of natural capital in the food value chain, new processes for processing food waste, as well as the establishment of sustainable food security [16]. Through a circular economy, the dangers and risks caused by climate change become manageable, which makes it possible to reduce negative impacts on the environment and ensure a healthier lifestyle [11]. Scientific research on the circular economy has been conducted since the early 2000s. In this regard, China, Japan, and EU countries are among the leading countries [11] . However, studies on the circular economy in the context of food security are only a decade old. As for the Republic of Armenia in particular, some theoretical work has been carried out in this direction over the past few years. There is much work to be done here to achieve greater economic, social, and environmental benefits.

METHODOLOGY

Historical, analytical, comparative, abstract, and statistical methods were used for the studies. The analysis was based on numerical data and publications from international organizations, as well as from the Statistical Committee of the Republic of Armenia.

DISCUSSION

Relations related to ensuring food security in the Republic of Armenia, as well as the main directions of state policy in regulating this sector, are regulated by the Law of the Republic of Armenia "On Ensuring Food Security", adopted in 2002 [17]. In 2023, the Government of the Republic of Armenia adopted the "Food Security System Development Strategy", the main goal

of which is to ensure physical and economic access to food that meets health standards for all groups of the population, as well as to create prerequisites to withstand adverse changes in the domestic and foreign markets and the negative consequences of possible emergency situations [18] . Armenia has achieved a high level of self-sufficiency in potatoes, vegetable crops, fruit, grapes, sheep and goat meat, eggs, and fish. An above-average level of self-sufficiency is ensured for beef, pork, and milk. The level of self-sufficiency remains extremely low, especially in vital food items such as wheat, pulses, vegetable oil, poultry meat, and sugar.

Food losses have become a serious problem in the Republic of Armenia. Losses refer to the volume of food that is destroyed or unfit for consumption at all stages of transportation and storage, from production (after harvest), processing and storage to consumption. The extent of losses depends on the presence of imperfect sales and storage systems [19]. According to 2018 data, the amount of losses (calculated at retail prices) for certain types of vegetables alone amounted to about 37 billion Armenian drams. It is noteworthy that this amount significantly exceeded the volume of vegetable imports during the same period. In addition, according to experts, a significant part of the losses is due to the traditional culture of food consumption in households, the low level of organization of the domestic market and local production, as well as the unsustainable use of food surpluses and residues in the public food sector [20]. In Table 1, the total food supply and food losses are presented.

Table 1

Supply and loss volumes of selected food products, thousand tons (2024)[1]

Food type	Total supply	Losses	Percentage (%)
Wheat	907.8	37.4	4.1
Potatoes	501.7	19.1	3.8
Vegetables and melons	1025.1	94.4	9.2
Fruit and berry (except grapes)	510.2	19.7	3.9
Leguminous crops	10.1	0.1	1.0
Eggs	40.7	1.0	2.5
Milk	832.8	9.2	1.1
Beef	69.0	0.3	0.4
Poultry	56.8	0.2	0.4
Grapes	206.2	5.5	2.7

As can be seen from the table, the largest losses occur in vegetables, which account for 9.2% of the total. Wheat is in second place with this indicator at 4.1%, followed by fruit and berry at 3.9%. The least food waste comes from poultry, at 0.3%. Table 2 presents the self-sufficiency levels of key food commodities for 2022-2024.

Table 2

[1] The table was compiled and calculations were made by the author based on data published by the Statistical Committee of the Republic of Armenia: Food Security And Poverty, January – March 2024 , Yerevan, 2025, Armstat, Statistical Bulletin, p. 63-71,

Food Self-sufficiency ratio, %[2]

Food type	2022	2023	2024
Wheat	24,4	27,9	22,8
Potatoes	98,4	99,2	106,2
Vegetables and melons	102	97,4	99,6
Fruit and berry (except grapes)	102	103,1	100,5
Leguminous crops	26	35,2	38,4
Eggs	99,2	98,8	98,9
Milk	83,4	80,2	78,6
Beef	89,7	90,7	88
Poultry	25,3	25,4	26
Grapes	106,6	106,6	103,7

Considering the low level of food security in the Republic of Armenia and the presence of food waste, there is a need to transition to a circular economy at the levels of individuals, organizations, and the entire state, and recommendations related to this are presented in the suggestions section. Humanity causes enormous damage to the planet with the waste generated by its economic activities. Added to this is the inefficient use of limited natural resources. These two main problems can be solved through the circular economy model, where waste reuse makes it possible to reduce the amount of waste and the volume of resources used (Figure 1) .

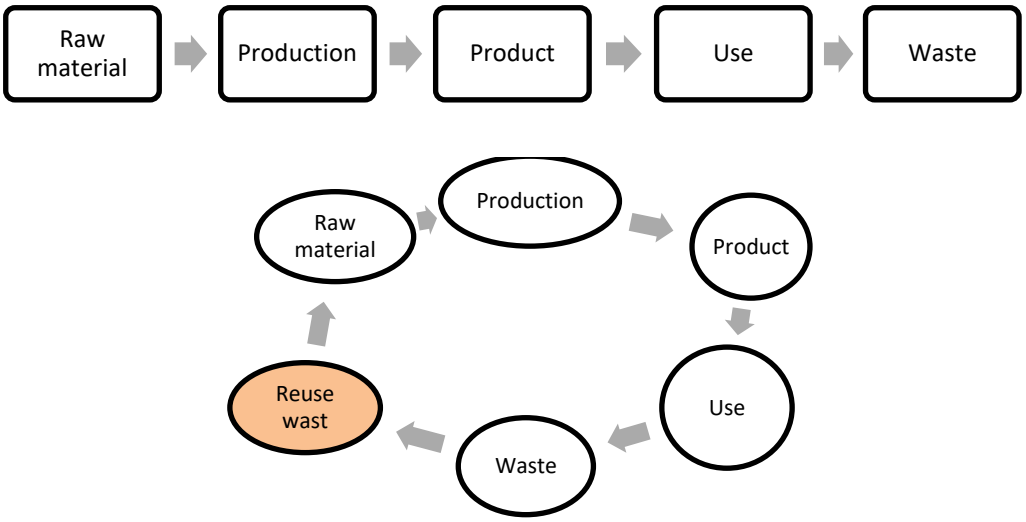

Figure 1. The value chains of linear economy and circular economy models[3]

The practical application of the circular economy model, in general and in the agricultural sector in particular, poses several challenges. In particular, M. Haji-Rahimi et al. have identified 16 such challenges. They mentioned the following as such challenges:

[2] The table was compiled and calculations were made by the author based on data published by the Statistical Committee of the Republic of Armenia: Food Security And Poverty, January – March 2024 , Yerevan, 2025, Armstat, Statistical Bulletin, p. 63-71,
[3] The diagram was composed by the author.

- conducting agricultural activities using traditional methods,
- low literacy level among farmers,
- small and fragmented agricultural plots,
- low productivity of agricultural activities,
- containment of agricultural product prices,
- irrational subsidies provided for pesticides and fertilizers,
- insufficient means of product storage,
- improper and unscientific use of agricultural inputs,
- high prices for precision farming equipment,
- weakly developed transport infrastructure,
- insufficient internet connection infrastructure,
- lack of banking services,
- shortage of personnel in the field of agricultural research,
- the weak link between research, education, innovation, and farmers,
- the lack of workshops that recycle industrial waste,
- Insufficient rural and agricultural wastewater treatment facilities [20].

Meanwhile, Dumitrescu-Popa I. S., and others have noted inequality in society and consumer behavior as challenges on the path to a circular economy [21]. One of the most important challenges in the transformation to a circular economy is the appropriate legal and regulatory mechanisms that govern economic processes, product design, intellectual property rights, and cross-border trade. The complex interactions between the legal framework and innovative approaches required for a circular economy present both opportunities and threats [22].

It is worth noting that all the challenges mentioned above related to the implementation of the circular economy model also exist in Armenia. Therefore, the introduction of the circular economy model must begin with measures to eliminate these challenges.

CONCLUSION

Considering the huge volumes of waste generated on planet Earth, as well as the growing demand for natural resources, as well as the number of hungry and malnourished people in the world from the perspective of food security, we can conclude that the negative social and environmental consequences of the linear economy are greater than its economic benefits, which is why there is an objective need to increase the share of the circular economy in the overall economy. The introduction of a circular economy is impossible to imagine without numerous, diverse obstacles. These obstacles relate to both a country's socio-economic situation and people's behavior, as well as to societal inequality and gaps in the legal framework.

If we summarize the results of our research, we can present the following definition of a circular economy in the context of food security: “In agriculture, the circular economy is the process of achieving greater quality and quantity of food through more efficient resource management and less waste generation” . In this regard, September 29 is an important day, which is a day for disseminating information on food loss and waste and implementing appropriate measures. The day is co-convened by the Food and Agriculture Organization of the United Nations (FAO)and the United Nations Environment Programme (UNEP). This year, it will be awarded for the 6th time [23].

Policy Implications

To manage and reduce food waste and ultimately ensure greater food security, it is crucial to develop a systemic approach among all participants in the circular economy, grounded in a caring attitude towards nature. In the context of food security, circular agriculture should be implemented at three levels: the state, food producers, and consumers.

At the state level, developing an appropriate legislative framework for the circular economy is important. It is proposed to develop and implement the RA Law "On Promotion of the Circular Economy", which should regulate relations related to the organization of the circular economy in all sectors of the economy. Then, other sub-legislative acts arising from that action should be developed, through which separate action plans will be defined. As already mentioned, the circular economy is based on innovation. Here, the work of the scientific community (scientists and researchers) in this direction is emphasized, with solutions aligned with international experience. It is important to apply tax incentives and other incentives to all participants in the food value chain who will implement the circular economy model in their activities. As well as imposing certain sanctions on those businesses that operate in a linear economy model, contributing to increased waste and the supply of non-organic food. Disseminate information about the circular economy through all possible means (television, radio, and YouTube programs, social networks, seminars, informational brochures, etc.). September 29, as the International Day of Awareness of Food Loss and Waste (IDAFLW), should be celebrated with even greater pomp and scale. The state, using all its structures and capabilities, should establish close cooperation between various specialists (ecologists, economists, technologists, IT specialists, scientists, businessmen, etc.). It is possible to effectively organize a circular economy across larger land areas, which is why the state should continue its work to create cooperatives that will enable larger land plots.

Food producers must transition to a circular economy model. Here, the use of plant residues and animal manure to produce organic fertilizer is emphasized, as is the widespread use of drip irrigation and rainwater in the Republic of Armenia's agriculture. Proper crop rotation is also important for maintaining soil fertility. To organize circular agriculture more effectively, the branches of animal husbandry and crop production should be combined. Composting plants should be built directly on the farm. To reduce transportation costs and prevent food loss during transport, it is necessary to organize the production and processing of agricultural products closer to cities. It is necessary to replace outdated technologies with the latest ones.

Consumers need to change their behavior to effectively organize a circular economy. It is necessary to develop a caring attitude towards the environment among them. Proper garbage sorting is important here. To reduce food waste, consumers need to better estimate their food needs and throw away less food. It is proposed to impose penalties on consumers who generate more food waste than the prescribed amount or who do not dispose of it in the designated bin. In summary, a circular economy model benefits everyone: the state, producers, consumers, and, most importantly, nature and future generations.

Conflict of Interest

The author declares no conflicts of interest.

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