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# Enhancing Food Loss and Waste Management for Improved Sustainable Agri-Food System: Empirical Study in the Republic of Armenia

**Davit Markosyan, Vardan Aleksanyan, Sargis Gevorgyan**
*Armenian National Agrarian University*
davitzmarkosyan@gmail.com, v.aleqsanyan@ysu.am, sargis.gevorgyan17@yahoo.com

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**ABSTRACT**

This study investigates the relationship between food security and waste management in Armenia's agri-food system, which faces challenges such as low productivity, small landholdings, soil degradation, and inefficiencies in livestock and crop production. These issues contribute to food insecurity and dependence on imports. Emphasizing the importance of reducing food loss, the research analyzes data from 2005 to 2022 to identify correlations between food loss and variables such as food import, use, and export. The findings indicate that increased imports, use, and exports of food commodities are linked to higher food loss. Statistical and regression analyses highlight the impact of these factors on food waste and security, identifying key areas for intervention. Recommendations for reducing food loss include improving infrastructure for food imports, enhancing supply chain efficiency, and investing in better storage and preservation facilities. The study advocates for applying circular economy principles, such as redistributing surplus food and valorizing food waste. Strategies like community-supported agriculture (CSA) and clustering actors in the agri-food value chain are suggested to reduce waste and promote sustainable practices.

## Introduction

Agriculture is an important sector in Armenia's economy, although its contribution to the country's value-added has been diminishing over the past five years due to low level of productivity and efficiency, lack of infrastructure and market development (MoE, 2024). The favorable soil and climate conditions create huge potential for agriculture to emerge as a leading driver of economic growth in the foreseeable future (EU, 2020). To stimulate the advancement of the agricultural sector, the Government of Armenia is providing ongoing support with targeted policies for improving the status. This support aims to facilitate improved access to finance, encourage the broader adoption of advanced technologies, and enhance farming

productivity. Currently, around 30% of the Armenian workforce is employed in the agriculture. According to the International Trade Administration, over 335,000 farms are currently operational in Armenia, each holding an average land area of 1.4 hectares per household (International Trade Administration). However, these relatively small landholdings hinder the development of an efficient and diversified production system encompassing both crops and livestock. Soil degradation is also a significant concern, compounded by the fact that only 15 percent of Armenia's total territory is arable land, despite agricultural land making up 70 percent of the country's territory. The livestock sector is confronted with several challenges, including unsustainable pasture management and underutilization, persistent livestock diseases, processing and marketing limitations, and declining productivity (International Trade Administration). Due to these factors, imported meat now constitutes half of the nation's meat consumption, reflecting the inadequacies in the domestic livestock sector and the unreliable availability of meat and milk. Notably, there are substantial fluctuations in the supply of dairy products, with most of the milk produced during the summer months and scarce availability during the winter and spring seasons. These constraints undermine Armenia's ability to capitalize on opportunities arising from growing domestic and international demand. In the crop cultivation, as well as in vegetable and fruit processing sector the major issues evolve around the storage, transportation and infrastructure development causing food waste and loss. On the other hand, the agri-food processing sector has been pivotal in the country's economy, dating back to the Soviet era. It has a significant role for rural employment, income generation, and ensuring food and economic security for the state. Moreover, it fosters a stable supply of safe, high-quality food for the population- while contributing to market dynamics and agricultural stability (MoA, 2024). In the food sector, there are 1600 companies, which include fruit and vegetables processing, grape processing, milk processing, meat processing and slaughtering, fish processing, bread baking, confectionary production, mineral and drinking water production, nonalcoholic beverage production, and alcoholic beverage production.

According to the Ministry of Economy of RA, the ramping up of processing operations and increasing export volumes have notably eased agricultural product sales challenges and boosted farm marketability. In 2019, Armenia witnessed a 10.7 % increase in foreign trade turnover of agrifood products, amounting to $1,671.7 million. Imports totaled $866.6 million, constituting 15.7 % of total imports, while exports reached $796.4 million, comprising 30.2 % of total exports. Notably, agrifood exports increased by 12.5 %, driven by products such as fresh fruits, vegetables, beverages, canned goods, and fish.

*Literature Review*

As outlined in the 1996 World Food Summit, food security is achieved when individuals consistently have both physical and economic access to enough safe and nutritious food to meet their dietary requirements and preferences for an active and healthy lifestyle (Shaw, 2007).

There are four major aspects to consider within food security (FAO, 2008):

- *Physical availability of food:* This pertains to the supply aspect of food security and relies on factors such as food production levels, available stock, and trade balances (Gibson, 2012).
- *Economic and physical access to food:* Merely having sufficient food at the national or global level doesn't ensure food security at the household level. Issues regarding inadequate access to food have led to increased attention on factors like income, spending, market dynamics, and prices to achieve food security goals.
- *Food utilization:* Utilization refers to how effectively the body absorbs and utilizes nutrients from food. Adequate nutrient intake depends on factors such as caregiving practices, food preparation methods, dietary diversity, and fair distribution within households. The combination of these factors, along with effective biological utilization, determines individuals' nutritional status.
- *Stability of the other three dimensions over time:* Food security isn't just about having enough food today; it's also about maintaining consistent access over time. Even if an individual's food intake is adequate presently, periodic disruptions in access due to factors like adverse weather, political instability, or economic fluctuations (such as unemployment or rising food prices) can lead to food insecurity and nutritional deficiencies.

For food security to be achieved, all four dimensions must be addressed concurrently and continuously (WB, 2024). From 2015 to 2022, the self-sufficiency rates for various food commodities have displayed notable fluctuations, highlighting the intricate dynamics within agricultural production systems. However, according to the Ministry of Economy, examination of the Republic of

Armenia's national food accounts data for 2019 indicates that the self-sufficiency level of crucial food items, as measured by their energy value, stood at approximately 52.5 % (MoE, 2019). While some commodities, such as potatoes and vegetables, have consistently maintained high levels of self-sufficiency, others, like wheat and maize, have witnessed a decline in their self-sufficiency rates over the same period. These shifts underscore the multifaceted influences impacting food production and self-reliance, ranging from environmental factors and technological advancements to market forces and policy decisions. Notably, the self-sufficiency rates for certain fruits, such as figs and berries, have shown remarkable growth, possibly reflected changing consumer preferences or shifted in agricultural practices. However, challenges remain, particularly in achieving self-sufficiency for staple crops, highlighting the need for targeted interventions and sustainable strategies to enhance food security and resilience. As efforts continue to build a sustainable food system, understanding and addressing the fluctuations in self-sufficiency rates across different food categories become paramount. These fluctuations not only reflect the complexities inherent in agricultural production but also have significant implications for food security and economic stability at both national and global levels. By identifying the underlying drivers of these fluctuations and implementing targeted policies and initiatives, stakeholders can work towards enhancing self-sufficiency in key food commodities while fostering resilience in the face of evolving challenges such as climate change, population growth, and resource constraints (Tchonkouang et al. 2024). Ultimately, achieving sustainable food security requires a holistic approach that considers the diverse range of factors influencing food production, distribution, and consumption, thereby ensuring access to nutritious and affordable food for all (Pawlak and Kołodziejczak 2020). Additionally, the disparities in self-sufficiency rates underscore the interconnectedness of global food systems and the need for collaboration and coordination among nations. While some regions may excel in the production of certain commodities, they may rely heavily on imports for others, highlighting the importance of international trade in ensuring food security (Unnevehr 2003). However, overreliance on imports can also expose countries to risks such as supply chain disruptions and price volatility. Therefore, promoting a balanced approach to food production that integrates both domestic production and trade becomes imperative for building resilient food systems capable of withstanding shocks and meeting the diverse needs of growing populations. Fostering cooperation and investing in sustainable agriculture practices, nations can work together to address the challenges posed by fluctuating self-sufficiency rates and pave the way for a more secure and equitable food future. On top of the self-sufficiency, the Global Food Safety Index was calculated for the first time, revealing an overall score of 57.1 with regards to food security. This score comprised sub-indices of 51.7 for food product availability, 66.2 for accessibility, and 45.4 for quality and safety. In the discourse of the food security, it's imperative to address the issue of food waste in Armenia. This underscores the importance of economic efficiency, emphasizing the need to produce food for those in need while minimizing significant losses due to spoilage or logistical inefficiencies. It prompts a reflection on the ethical concerns imposed by the current production system on our society (Santeramo, 2021). Another study, that has highlighted the role of associations between food waste, loss and food security, belongs to Marsh et al. Their findings suggested that food losses are a persistent issue across most traded agricultural commodities. These studies have given credibility to the body of literature dedicated to investigating how food losses increase the risk of food insecurity, particularly in developing countries reliant on trade and in need of innovative solutions. Below food waste and loss within various parts of the food supply chain in the Republic of Armenia has been investigated. It is crucial to emphasize that when assessing the extent of losses, one must also highlight the level at which the product is produced and imported. According to a study conducted by Urutyan and Yeritsyan (2014), the food waste and loss in Armenian agri-food industry happens due to the following reasons:

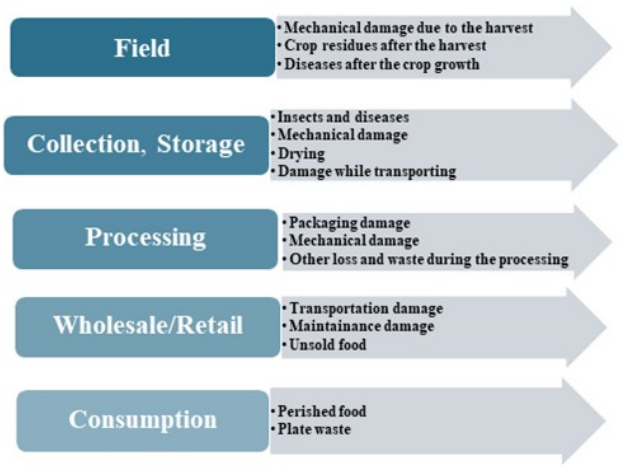


**Figure 1.** The reasons of the agri-food waste and loss

Foods characterized by a relatively elevated self-sufficiency level exhibit a diminished apparent waste volume. For instance, the self-sufficiency level of milk in the Republic of Armenia witnessed an augmentation to 99.34% between 2016 and 2022, in contrast to the average of 85.64% recorded during 2011-2015. Despite a substantial surge in milk imports, amounting to an 83% increase in 2022 compared to 2005, no discernible alterations were noted in terms of losses. Throughout the period spanning 2005-2022, annual milk losses remained below 1% of the total quantity of milk produced and imported. A parallel trend was observed in the case of another highly self-sufficient food product, namely eggs. The self-sufficiency level for eggs from 2016-2022 also stood at 99.34%, with production volume experiencing growth in recent years compared to 2005. In 2022, there was a 45% surge in egg production; however, the waste per imported and produced egg during the same period averaged below 3%.

## Materials and methods

In this study have analyzed annual statistical data collected from the Armstat database. We aimed to analyze the relationship between food loss and different food security indicators across various groups of food commodities, namely grains, vegetables, fruits, meat, and beans, using panel data from 2005 to 2022. Panel data, which combines cross-sectional and time-series data, provides a robust framework to observe and analyze these relationships over time.

As a result, we have acquired 828 observations. The dependent and independent variables are provided below:

**Table 1.** Variables for Food Loss Estimation in Armenia*

| Dependent Variable | Independent Variable |
|---|---|
| Food Loss (thousand tonnes) (FL) | (1) FCI- Food Commodity Import |
| | (2) FCU – Food Commodity Use |
| | (3) FCE – Food Commodity Export |
| | (4) FCP – Food Commodity Production |
| | (5) FCS – Food Commodity Storage |
| | (6) OE – Other Uses |

*Composed by the authors.

Utilizing a log-log model, our analysis expresses the data in terms of percentage changes. This approach offers a nuanced perspective, emphasizing the relative shifts rather than absolute values.

Our next step was to conduct a pair-wise correlation study of the selected dependent and independent variables. Scatter plots reveal moderate to strong relationships between food loss and various food commodity-related factors. Notably, there are robust positive correlations indicating that increases in food commodity imports, production, storage, commodity use, exports, and other uses are linked with increases in food loss.

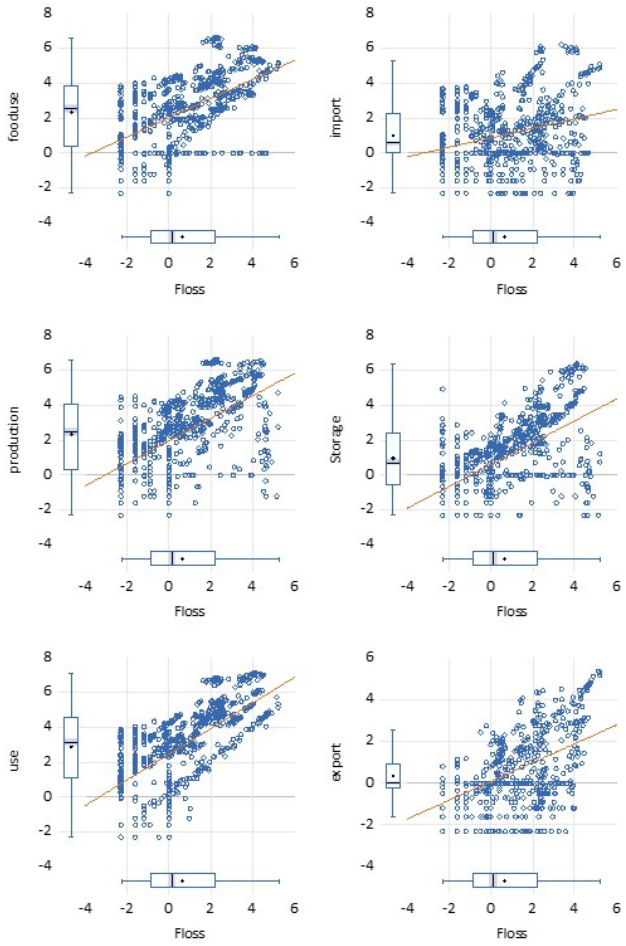


**Figure 2.** Scatter Plot Map of the Variables Selected

## Results and discussions

Import and food use exhibit a positive correlation (0.621), suggesting that higher imports are associated with

increased food use. This relationship implies that regions importing more food tend to consume more, possibly due to better availability and variety. Imports and export show a week positive correlation (0.277), indicating that regions with higher imports also tend to export more. Food use and overall use have a very strong positive correlation (0.902), meaning that higher food consumption directly contributes to overall use of the produce, which is expected. Export and overall use also share a moderate positive correlation (0.281).

**Table 2.** Matrix of Correlation

| Variables | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| (1) FCI | 1.000 | | | | | |
| (2) FCU | 0.621 | 1.000 | | | | |
| (3) FCE | 0.359 | 0.250 | 1.000 | | | |
| (4) FCP | 0.247 | 0.698 | 0.187 | 1.000 | | |
| (5) FCS | 0.318 | 0.574 | 0.244 | 0.708 | 1.000 | |
| (6) FCOU | 0.546 | 0.903 | 0.376 | 0.751 | 0.639 | 1.000 |

*Composed by the authors.

To avoid multicollinearity, we have excluded the FCOU variable from the model due to its strong correlation with "food use." Given our research focus, we determined that it is more appropriate to concentrate on "food use" and omit "overall use" to ensure the clarity and reliability of our analysis.

In analyzing panel data, Pooled OLS, Fixed Effects (FE), and Random Effects (RE) regression models were employed. Pooled OLS, a basic linear regression method, treats all data points equally without considering individual or time-specific variations. FE models, by contrast, eliminate the influence of time-invariant characteristics, like culture, enabling the assessment of net predictor effects. RE models, assuming random and uncorrelated variations across entities, provide flexibility but make stronger assumptions about individual-specific effects. The choice between FE and RE was determined through Hausmann test, which assesses the correlation between individual effects and predictors.

**Table 3.** Hausman Test

| | coef. |
|---|---|
| Chi-square test value | 4.543 |
| P-value | 0.209 |

*Composed by the authors.

The test yielded a chi-square value of 4.543 and a P-value of 0.209. Since the P-value is greater than the significance level of 0.05, we fail to reject the null hypothesis. This indicates that the random effects model is suitable for our data. The results of the regression analysis are provided below and as can be noted from the scatter plot map and the regression output, the coefficients have the signs which were supposed theoretically.

| loss | Coef. | St.Err. | t-value | p-value | [95 % Conf | Interval] |
|---|---|---|---|---|---|---|
| (1) Import | .183 | .0375 | 4.7 | 0.00 | .1092885 | .2567116 |
| (2) Food Use | .686 | .040 | 17.1 | 0.00 | .6074536 | .7649292 |
| (3) Export | .465 | .025 | 17.9 | 0.00 | .4141026 | .5158853 |
| (4) Storage | .070 | .003 | 2.04 | 0.00 | .0028004 | .1512413 |
| (5) Production | .182 | .039 | 4.66 | 0.00 | .1058421 | .2598068 |
| Constant | .618 | .008 | 6.95 | 0.00 | .5333957 | .7933957 |
| Mean dependent var | | 0.732 | SD dependent var | | | 2.088 |
| R-squared | | 0.615 | Number of obs | | | 828 |
| F-test | | 36.25 | Prob > F | | | 0.000 |
| Akaike crit. (AIC) | | 1872.110 | Bayesian crit. (BIC) | | | 1896.021 |

*** p<.01, ** p<.05, * p<.1

The coefficient for Food Commodity Import (FCI) is 0.183, and it is highly significant (p<0.01). This coefficient suggests that a 1 % increase in food commodity imports is associated with an average increase in food loss by 0.183 %. This could be due to several reasons. One possibility is that higher imports of food commodity might need longer transit times and more complex supply chains, increasing the likelihood of spoilage or damage during transportation and storage (Kiaya 2014). In addition, importers may not have the necessary infrastructure or expertise to properly store and handle imported food, leading to higher rates of spoilage or contamination.

The coefficient for Food Commodity Use (FCU) is 0.686, indicating a strong positive relationship with food loss. This variable is also highly significant (p<0.01). A 1 % increase in the use of food commodities is associated with an average increase in food loss by 0.686 %. Increased use might lead to more pressure on the supply chain, potentially causing more waste if the infrastructure is not adequate to handle higher volumes efficiently.

With a coefficient of 0.465, Food Commodity Export (FCE) shows a positive and highly significant (p<0.01)

relationship with food loss. A 1 % increase in food commodity exports is associated with an average increase in food loss by 0.465 %. This could be due to the complexities and challenges involved in exporting goods, such as longer transportation times and the risk of spoilage, which can contribute to higher food loss. The coefficient for Food Commodity Use (Other) (OU) is 0.077, with a p-value of 0.042, making it moderately significant. This positive relationship implies that a 1 % increase in other uses of food commodities is associated with an average increase in their loss by 0.077 %. Diversifying the ways in which food commodities are utilized can add complexity to the supply chain, potentially leading to more waste. Food Commodity Production (FCP) has a coefficient of 0.183, which is highly significant ($p<0.01$). The positive relationship suggests that a 1 % increase in food commodity production is associated with an average increase in food loss by 0.183 %. This correlation can be attributed to several factors. Firstly, higher production levels can lead to excess supply, which may put strain on distribution and storage systems and ultimately increase the amount of food that goes to waste. Additionally, peak harvest periods, market dynamics, and downward price pressures can exacerbate these challenges, prompting farmers to discard excess produce. Quality control issues, logistical constraints, and inadequate storage and preservation facilities further contribute to spoilage and wastage, underscoring the complex interplay between production levels and food loss. The coefficient for Food Commodity Storage (FCS) is 0.08, with high significance ($p<0.01$). This relationship indicates that a 1 % increase in food commodity storage is associated with an average increase in food loss by 0.08 %. Effective storage solutions can significantly reduce spoilage and waste, thereby decreasing food loss. The regression model has an R-squared value of 0.616, meaning that approximately 61.6 % of the variance in food loss is explained by the independent variables included in the model. The overall model is highly significant, as indicated by the F-test ($p<0.01$). The Akaike Information Criterion (AIC) and Bayesian Information Criterion (BIC) values are 1780.033 and 1808.347, respectively, providing measures of the model's goodness of fit. In the context of Armenia, the findings from this regression analysis shed light on the critical factors influencing food loss within the country's agricultural sector. The significant coefficients for Food Commodity Import, Use, Export, and Production emphasize the need for targeted interventions to mitigate food loss at various stages of the supply chain. The highly significant coefficient for Food Commodity Import suggests that Armenia's reliance on imported food commodities may be contributing to increased food loss. To address this, there is a need to enhance the infrastructure and expertise for handling imports, including better transportation, storage, and distribution systems. Reducing transit times and improving the efficiency of supply chains can help minimize spoilage and damage. Similarly, the strong positive relationship between Food Commodity Use and Food Loss indicates that as the utilization of food commodities increases, so does the pressure on the supply chain. Investing in robust infrastructure, including modernized storage facilities and efficient logistics, is essential to handle higher volumes and reduce waste. The positive coefficient for Food Commodity Export highlights the challenges associated with exporting goods, such as longer transportation times and the risk of spoilage. Enhancing export processes and ensuring that exported food commodities are well-preserved during transit can help mitigate these losses. Food Commodity Production also shows a significant impact on food loss, pointing to the need for effective management of production surpluses and improved quality control measures. Implementing better storage and preservation facilities, especially during peak harvest periods, can help reduce spoilage and wastage.

The coefficient for Food Commodity Storage, although lower compared to other variables, underscores the importance of effective storage solutions in minimizing food loss. Investing in advanced storage technologies and practices can significantly reduce spoilage and waste.

Incorporating circular economy principles into Armenia's agricultural sector can further enhance the efficiency and sustainability of food systems. A circular economy approach emphasizes the reduction of waste and the continual use of resources. This can be achieved through several strategies:

- *Redistribution of Surplus Food:* Surplus food that is still safe for consumption can be redistributed for social purposes and other organizations to support vulnerable populations, reducing food waste and improving food security.
- *Valorization of Food Waste:* Food waste can be converted into valuable by-products, such as animal feed, compost, or bioenergy. This not only reduces waste but also creates additional revenue streams for farmers and businesses.
- *Improved Packaging and Storage Solutions:* Using innovative packaging and storage technologies can extend the shelf life of food commodities, reducing spoilage and waste during transportation and storage.
- *Enhanced Supply Chain Coordination:* Implementing better coordination and communication across the supply chain can help match supply with demand more

accurately, minimizing excess production and waste.

- *Education and Awareness:* Raising awareness among consumers and stakeholders about the importance of reducing food waste and adopting circular economy practices can drive behavior change and promote more sustainable consumption patterns.

*Community Supported Agriculture and Cluster Solutions to Existing Challenges*

Due to economic, ecological, and ethical reasons many stakeholders in the agri-food sector agree that a fundamental transformation is necessary, asserting that the current system is unsustainable (German Commission for the Future of Agriculture, 2021). Agroecology is one proposed approach, aiming to transition towards an agri-food system that is sustainable in ecological, economic, and social terms, characterized by direct relationships between producers and consumers (Gliessman, 2016). According to Gliessman (2016) and Méndez et al. (2013), community-supported agriculture (CSA) represents a form of institutional or social innovation that can drive this transformation, providing an alternative to the current system (Mert-Cakal and Miele, 2020).

*"CSA is a direct partnership based on the human relationship between people and one or several producer(s), whereby the risks, responsibilities and rewards of farming are shared, through a long-term, binding agreement" (URGENCI 2016).*

A significant distinction from traditional farming and consumption is that a social mechanism, rather than the price mechanism, governs the market's dynamics (Gruber 2020). CSA members collectively decide on the types of produce, the cultivation methods, and a local distribution channel, basing their choices on moral and ethical considerations and shared values such as regionality (Wellner and Theuvsen 2016). Fostering solidarity between CSA members and farmers is crucial to advancing key principles like responsible resource management, equitable conditions for everyone involved, seasonal and locally based agroecological production, as well as openness, dialogue, and direct personal connections(Carlson and Bitsch 2019). Moreover, CSAs can significantly reduce the waste associated with our food system, which is another strong selling point that can help attract more members. When CSA members become more closely involved in food production, they become more aware of the factors that affect produce quality. They are much more likely to accept completely edible but imperfect-looking produce, such as misshapen carrots or blemished apples, which would likely be rejected by supermarkets. CSA programs can significantly reduce waste through a variety of innovative practices. Firstly, they can supply produce in reusable bags or boxes that can be returned by members. When packaging is necessary, CSAs can opt for recyclable or compostable materials. Loose produce can be placed directly into boxes to minimize packaging needs. To further cut down on plastic waste, CSAs can ask members to recycle plastic punnets or return them for reuse. Offering different share sizes allows members to choose the quantity that best fits their household, thereby reducing the risk of produce going unused. Surplus fruit can be processed into juice or cider, which can be sold or enjoyed at events. Additionally, organizing a team to make chutneys, jams, or fermented foods ensures that extra produce is preserved and utilized. Excess produce can be redirected to charities, food banks, or food waste initiatives such as Food Cycle, helping to ensure that surplus food is put to good use rather than being discarded (European Union, 2019). Volunteers or staff can take home any excess produce, and organizing communal meals using gluts of produce helps ensure that all food is consumed. Vegetable waste can be fed to livestock, and any remaining organic waste can be composted on the farm, completing the cycle of sustainability.

## Conclusions

The study explores the relationship between food loss and food security implications in Armenia. The agricultural sector in Armenia faces challenges like low productivity, small landholdings, soil degradation, and inefficiencies in livestock and crop production. These challenges lead to food insecurity and reliance on imported products. The study emphasizes the importance of addressing food loss to improve economic efficiency and food security. It also analyzes data on food loss in Armenia from 2005 to 2022, emphasizing the relationships between food loss and variables such as food imports, consumption, and exports. The findings suggest that higher imports, use, and exports of food commodities are associated with increased food loss. The study applies statistical methods to demonstrate how these factors influence food waste and food security in Armenia. Through regression analysis, it pinpoints the main determinants contributing to food loss within the country's agricultural sector. Import, use, export, and production of food commodities play significant roles, suggesting a need for interventions at various supply chain stages. Strategies to reduce food loss include enhancing infrastructure for food imports, improving supply chain efficiency, and investing in better storage and preservation facilities. Circular economy principles, such

as redistributing surplus food and valorizing food waste, offer additional ways to minimize waste. Community-supported agriculture and clustering actors in the agri-food value chain are recommended for reducing food waste. CSAs allow for direct producer-consumer relationships, promoting sustainable practices and reducing waste. Cluster solutions involve different sectors collaborating to enhance efficiency and sustainability, ultimately reducing food loss and promoting responsible resource use. Promoting consumer awareness and sustainable consumption practices is also crucial in driving a shift towards a more sustainable food system.

**References**


1. Armstat. (2024, July 25). Armstat bank. Retrieved from https://statbank.armstat.am/pxweb/hy/ArmStatBank/?rxid=9ba7b0d1-2ff8-40fa-a309-fae01ea885bb. Access: 25.07.2024.
2. Carlson, L. A., & Bitsch, V. (2019). Applicability of transaction cost economics to understanding organizational structures in solidarity-based food systems in Germany. Sustainability, 11(4), 1095.
3. EU Platform on Food Losses and Food Waste. (2019, May). Redistribution of surplus food: Examples of practices in the Member States. European Commission. https://ec.europa.eu/food/system/files/2019-05/fw_eu-actions_food-donation_ms-practices.pdf
4. EV Consulting CJSC. (2020). Agricultural value chains assessment report. EU Green Agriculture Initiative in Armenia (EU-GAIA)
5. Gliessman, S. (2016). Transforming food systems with agroecology. Agroecology and sustainable food systems, 40(3), 187-189.
6. Gruber, S. (2020). Personal trust and system trust in the sharing economy: a comparison of community-and platform-based models. Frontiers in psychology, 11, 581299.
7. Kiaya, V. (2014). Post-harvest losses and strategies to reduce them. Technical Paper on Postharvest Losses, Action Contre la Faim (ACF), 25(3), 1-25.
8. Méndez, V. E., Bacon, C. M., & Cohen, R. (2013). Agroecology as a transdisciplinary, participatory, and action-oriented approach. Agroecology and Sustainable Food Systems, 37(1), 3-18.
9. Mert-Cakal, T., & Miele, M. (2022). 'Workable utopias' for social change through inclusion and empowerment? Community supported agriculture (CSA) in Wales as social innovation. In Social innovation and sustainability transition (pp. 307-326). Cham: Springer Nature Switzerland.
10. Ministry of Economy of the Republic of Armenia. (2019). Food Security. https://www.mineconomy.am/en/page/1333 (Access: June 20, 2025)
11. Ministry of Economy. (2020). The strategy of the main directions ensuring economic development in the agricultural sector of the Republic of Armenia for 2020-2030. Ministry of Economy of the Republic of Armenia.
12. Pawlak, K., & Kołodziejczak, M. (2020). The role of agriculture in ensuring food security in developing countries: Considerations in the context of the problem of sustainable food production. Sustainability, 12(13), 5488.
13. FAO. An introduction to the basic concepts of food security. 2008: Rome, Italy.
14. Rosman, A., MacPherson, J., Arndt, M., & Helming, K. (2024). Perceived resilience of community supported agriculture in Germany. Agricultural Systems, 220, 104068.
15. Santeramo, F. G. (2021). Exploring the link among food loss, waste and food security: what the research should focus on?. Agriculture & Food Security, 10(1), 26.
16. Shaw, D. J. (2007). World food summit, 1996. In World food security: A history since 1945 (pp. 347-360). London: Palgrave Macmillan UK.
17. Tchonkouang, R. D., Onyeaka, H., & Nkoutchou, H. (2024). Assessing the vulnerability of food supply chains to climate change-induced disruptions. Science of the Total Environment, 171047.
18. Unnevehr, L. (Ed.). (2003). Food safety in food security and food trade (Vol. 10, p. 38). Washington, DC: International Food Policy Research Institute.
19. Volz, P., Weckenbrock, P., Nicolas, C., Jocelyn, P., & Dezsény, Z. (2016). Overview of community supported agriculture in Europe.
20. Wellner, M., & Theuvsen, L. (2016). Community Supported Agriculture (CSA): a comparative analysis of Germany and Austria.
21. World Bank. What is food security? World Bank. Retrieved from https://www.worldbank.org/en/topic/agriculture/brief/food-security-update/what-is-food-security. Access: 25.07.2024


**Declarations of interest**

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