THE NATURE OF CONSUMER (HOUSEHOLD SECTOR) FOOD WASTE AND PRIMARY CAUSES BEHIND IT: EVIDENCE FROM ARMENIA (YEREVAN CITY).

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Abstract: This research aims to investigate the extent of consumer (household sector) food waste at the consumer level in Yerevan, in monetary terms. The study delves into the nature of food waste and identifies the primary causes behind it. An online survey was completed by a demographically representative sample of 385 participants. Yerevan residents highlighted a perceived deficiency in societal awareness regarding food waste in their responses: the survey's findings revealed that a noteworthy portion of participants, comprising 40%, rated themselves at four or below; conversely, 19% of respondents indicated a higher level of awareness, assigning themselves ratings of eight, nine, or ten points. The average rating provided by our respondents was 4.9, indicating a comparatively lower evaluation. The results of the study did not confirm our hypothesis regarding the correlation between education level, income level and food waste behavior among respondents. The economic impact of food waste was assessed by articulating the annual monetary losses incurred by individuals for each discarded product. Additionally, it examines the inclinations of Yerevan residents to mitigate waste, shoulder social responsibility, engage with educational initiatives, and suggests potential policy solutions to address the issue effectively.

Keywords: *Food waste, households, consumption, customer behavior*

Introduction:

The growing issue of food waste is becoming increasingly significant on a global scale. In today's geopolitical landscape, it is crucial for developing nations, including Armenia, to align with the necessity of efficiently utilizing resources, reducing waste, and promoting sustainable development practices. As per a 2011 investigation conducted by the Food and Agriculture Organization (FAO), around one-third of the world's food production, approximately 1.3 million tons, is lost annually.(Gustavsson and Cederberg, 2013) It is crucial to note a significant finding from the United Nations Environment Program's 2019 report, which reveals that a substantial 931 million tons of food waste were generated globally. Notably, 61% of this colossal waste originated from households.(Forbes, Quested and O'Connor, 2021)

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A study conducted in Denmark involved the observation of 1474 households, revealing that each household generated an average of 103±9 kg of avoidable food waste annually. Simultaneously, the unavoidable food waste for each household amounted to 80 ± 6 kg per year. (Edjabou *et al.*, 2016) An additional case study is derived from another Nordic country, Finland, where the average annual food waste was 23 kg per individual, 63 kg per household, with a cumulative total of around 120 million kg per year. (Silvennoinen *et al.*, 2014) The primary contributors to food waste in Norwegian households were fresh bread, fresh fruits, vegetables, and leftover dinner meals. The estimated per capita edible food waste in Norway was 46.3 kg based on the findings. On a weekly basis, each household produced an average of 8.86 kg of total waste, comprising 3.76 kg of food waste, 2.17 kg of edible food waste, and 0.60 kg of edible food waste still in its original packaging. (Hanssen, Syversen and Stø, 2016) In Europe, the average proportion of bio-waste in total municipal waste is 37%, but this percentage varies significantly among member states. It ranges from less than 20% in Lithuania, Norway, and Slovenia to over 50% in Greece, Portugal, Slovakia, and Malta.(Bräutigam, Jörissen and Priefer, 2014) An interesting study was carried out in Poland, where it was substantiated that the age factor significantly influences the quantity of food discarded by Polish women. Individuals aged 37 and above were found to waste less food and more frequently reported not engaging in wasteful practices compared to their counterparts. (Jungowska *et al.*, 2021)

With this data in hand, numerous political declarations at the high level have been endorsed both in Armenia and abroad. The Political Declaration, as adopted during the High-level Political Forum on Sustainable Development (HLPF) under the General Assembly's auspices in September 2023, reiterates the commitment of global leaders to effectively execute the 2030 Agenda and its Sustainable Development Goals (SDGs).(Sampedro, 2021) It underscores the dedication to uphold all principles embedded within the agenda, emphasizing the need for substantial changes in consumption and production patterns. This involves the shift towards sustainable economic and business models, the implementation of the 10-Year Framework of Program's on Sustainable Consumption and Production Patterns, and the provision of support to developing nations to enhance their scientific, technological, and innovation capacities. The acknowledgment is made that local and national initiatives promoting zero waste can significantly contribute to the realization of sustainable consumption and production objectives.(UN General Assembly, 2023)

The literature under review underscores the significance of the Comprehensive and Extended Partnership Agreement signed in 2021 between the Republic of Armenia and the European Union. Particularly highlighted in Article 46, this agreement emphasizes the cooperative efforts of the involved parties toward preserving, protecting, improving, and rehabilitating environmental quality. The objective extends to safeguarding human health, promoting the sustainable utilization of natural resources, and advocating for international measures to address regional or global environmental challenges, with specific attention to the domain of waste management. This legal framework provides a foundation for understanding the shared commitment to environmental sustainability between the Republic of Armenia and the European Union. ('Comprehensive and Extended Partnership Agreement between Republic of Armenia and EU', 2021)

Considering that food waste management issues are insufficiently addressed within the Armenian political and socio-economic discourse, this study aims to address the following research questions:

RQ 1: Which types of food are most frequently wasted by consumers in Yerevan, and what is the associated monetary loss for each category?

RQ 2: Is there a correlation between consumers' educational levels, income, and the amount of food waste they generate?

Materials and Methods:

The primary focus of this study is food waste in Yerevan. The conceptual framework involves examining both the quantity and monetary aspects of food waste, along with investigating the underlying causes and the public's awareness of this issue. To gather responses, an online questionnaire was utilized, which underwent a pilot test conducted by Armenian and German professors. Additionally, a preliminary version was shared with 10 informed families, who were tasked with calculating and reporting their food waste over a week. The feedback and corrections obtained from the pilot version guided the refinement of the final questionnaire, which was then administered to the residents of Yerevan. A total of 385 participants underwent the survey. The questionnaire comprises both quantitative and qualitative inquiries. Quantitative questions seek demographic information reflected in the surveys and details related to waste. Qualitative questions aim to explore the reasons behind food waste, its categorization, public awareness, and the extent of government initiatives to enhance awareness and promote investment in the circular economy. Subsequently, a more comprehensive breakdown of the questionnaire's structure and its scoring system is provided in the following subsection. The ensuing step involves a descriptive analysis of the collected data.

After the data collection, the quantitative analysis was carried out using a precise formula developed to convert the collected information into monetary units. The formula considered the reported quantities of food wasted as well as other relevant factors such as the average price of food and the frequency.

The formula for calculating the annual monetary food waste per capita could look like this, for example:

$$W = \frac{W_1 + W_2 + W_3 + W_4 + W_5}{5}$$

Where W is the average annual per capita expenditure for the respective product in money AMD/per person, per year. The following formula was used to determine, $W_1, W_2...W_n$.

$$W_n = \frac{(G_1 t_1 q_1 D) + (G_2 t_2 q_2 D) + (G_3 t_3 q_3 D) + (G_4 t_4 q_4 D) + (G_5 t_5 q_5 D)}{q_1 + q_2 + q_3 + q_4 + q_5}$$

Table 1

The representation of Variable 't' in the study.

Variable	Days	Frequency
t_1	365	daily
t_2	168	several times a week
t_3	52	once a week
t_4	24	twice a month
t_5	12	once a month

Source: Developed by author

The frequency of the "several times a week" option was determined by computing the average number of days in a week, resulting in 3.5 multiplied by 4 weeks and 12

months, equaling 168. Here, 3.5 represents the average days in a week, 4 stands for the weeks in a month, and 12 denotes the months in a year. The variable 'D' signifies the average market price of the relevant food product during July-August 2023, while $q_1, q_2, \ldots q_n$ denote the count of respondents choosing the specified option.

In the data processing phase, algebraic operations were employed to compute statistical indicators, including the arithmetic mean, maximum, and minimum values. Utilizing Excel, corresponding diagrams and tables were generated to present the statistical findings.

Table 2

The representation of variable 'G'

Variable	Grams	Amount of waste caused
G_1	25 grams	less than 50 grams
G_2	75 grams	50-100 grams
G_3	150 grams	100-200 grams
G_4	250 grams	200-300 grams
G_5	300 grams	300 grams and more

Source: Developed by author

The gathered data served as input in the formula employed to compute the annual per capita monetary food waste. This calculation facilitated an accurate quantification of the economic ramifications of food waste on an individual basis. The outcomes of this quantitative analysis yielded explicit and measurable insights into the monetary losses incurred per capita due to food waste. The questionnaire methodology facilitated the acquisition of comprehensive data from a substantial participant pool, subsequently transformed into a quantifiable format. These calculated values stand as evidence-based metrics that can inform decision-making processes and initiatives targeted at diminishing food waste and enhancing resource utilization.

In this study, regression analysis was employed to unravel the intricate relationship between monthly income and the scale of food waste, as well as between the level of education and the extent of food waste. The analytical process was executed through a designated Excel function, with "x" serving as the independent variable and "y" as the dependent variable. Within this methodological framework, the objective was to discern potential relationships and patterns linking these socio-economic factors to the inclination for food wastage. Through this approach, the study aimed to enhance comprehension of the multifaceted underlying behaviors associated with food waste.

Results and discussion:

Demographic data.

In this study, 385 participants were involved, with 73.2% identifying as male, 26.3% as female, and 0.5% selecting the "diverse" category. The gender distribution highlights the composition of the sample and contextualizes the collected data. The age distribution reveals a notable asymmetry, potentially influenced by factors like online questionnaire selection and communication channels. The overrepresentation of the 19 to 29-year-old cohort, followed by the 30 to 45-year-old group, suggests a skewed demographic, with the over 61 age group being the smallest cluster.

The income distribution among our study participants reveals noteworthy insights. Notably, 9.6% reported having no formal income, including two individuals identifying as "diverse." A distinct segmentation is observed, with 6.2% having a monthly income up to 80,000 AMD (EUR 190.47), 34.5% falling within the 80,000 to 200,000 AMD

range (EUR 190.47 to EUR 476.1), and 35.3% earning between 200,000 to 500,000 AMD (EUR 476.1 to EUR 1190). Moreover, 14.3% reported incomes exceeding 500,000 AMD, equivalent to over 1190 EUR per month. These diverse income segments highlight the economic heterogeneity within our survey participants.

Quantitative analysis.

The survey unveiled the prevalent types of food wastage in Yerevan, with lavash and bread standing out as the most discarded items (44.7%). The figure 1 down below distinctly highlights the top five categories of frequently wasted foodstuffs, marked in yellow. The gathered data indicates that vegetables rank as the second most wasted food in Yerevan, constituting 28.6 % of the total, while fruit follows closely in third place with a reported percentage of 27.6% according to the participants. The noteworthy frequency of wastage for lavash and bread aligns with the significant role of cereals and baked goods in the Armenian diet, contributing substantially to the daily energy intake.(Stepanyan *et al.*, 2022)

Figure 1

Top 5 food items most discarded by consumers in Yerevan.
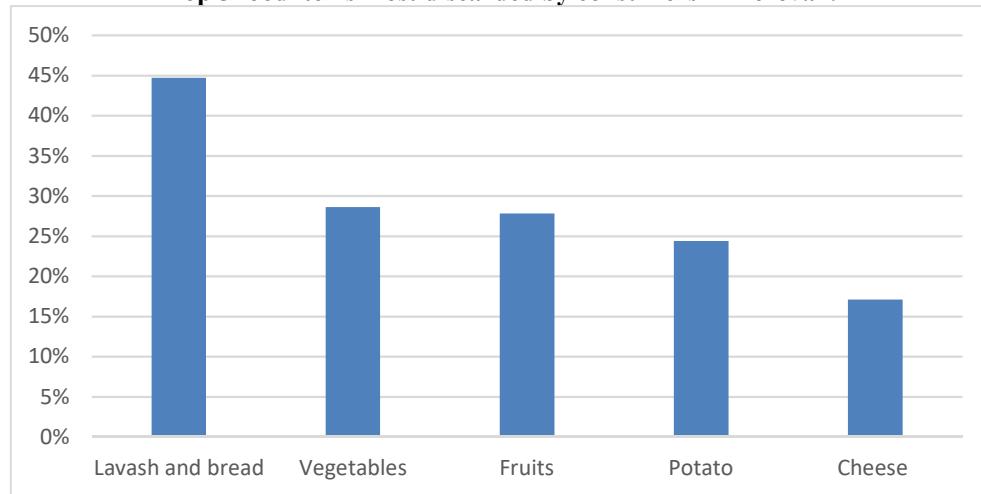
Source: Developed by author

A holistic understanding of the substantial food waste, particularly staple foods, necessitates an interdisciplinary approach that considers both ecological and nutritional perspectives. The wastage of fruits and vegetables reveals a complex phenomenon influenced by various dynamics. This behavior may be attributed, in part, to the prevalent summer season in Armenia, characterized by abundant and affordable fresh fruits in the markets. The data collection period coincided with a season boasting a diverse array of fruits like peaches, apricots, apples, cherries, contributing to the observed wastage. Notably, potatoes emerged as the fourth most wasted food in Yerevan, constituting 24.4% of the total waste in our study.

In August 2023, market statistics indicated an average price of 400 AMD for 1kg of fruits, 300 AMD for 1 kg of vegetables (without potatoes), 200 AMD for 1 kg of Potatoes, 600 AMD for 1kg of Lavash and bread (Prices and Prices Indexes in the Republic of Armenia, 2023). According to calculations, the average annual waste per person for the food category of Lavash and bread was found to be 13,793.82 AMD. Individuals who habitually waste Lavash and bread daily are losing approximately 42,966.85 AMD

annually, while those who waste these items once a month incur an average yearly loss of 630 AMD. Various studies suggest the reuse of bread waste and its valorization as a valuable resource through diverse technological processes aimed at enhancing efficiency across all stages. Numerous techniques for converting excess bread into ethanol, lactic acid, succinic acid, biohydrogen, hydroxy-methyl furfural, proteins, pigments, glucose–fructose syrup, aroma compounds, and enzymes have been extensively examined.(Ben Rejeb *et al.*, 2022) Among respondents from Yerevan, vegetables emerge as the second most wasted food category, with an average loss of 6,927.67 AMD per year, excluding potatoes, which incur an average yearly loss of 4,649.18 AMD. However, those who waste vegetables daily face a significantly higher waste of 20,257.50 AMD annually, while for potatoes, it amounts to 13,781.90 AMD. Conversely, individuals who exhibit heightened awareness of food waste and only waste vegetables once a month incur an average annual loss of less than 370 AMD, and for potatoes, it is 312 AMD. In relation to fruits, the average yearly waste was determined to be 16,750.20 AMD per person. Notably, individuals who waste fruits once a month incur a comparatively modest loss of 1,246 AMD annually. Conversely, those who habitually waste fruits daily face a significantly higher loss, amounting to 51,100 AMD annually.

Discussions

This study provides valuable insights into food waste behaviours in Yerevan, revealing significant trends in the types of food most frequently discarded and the economic consequences for consumers. The findings highlight that lavash and bread, two staple items in the Armenian diet, are the most frequently wasted foods, followed by vegetables and fruits. These results not only underscore the importance of cultural dietary habits but also indicate the potential for targeted interventions to reduce food waste at the consumer level.

The most striking result from this study is the high frequency of lavash and bread waste, which aligns with the findings of Stepanyan et al. (2022), who noted the significant role of cereals and baked goods in the Armenian diet. Bread and lavash are commonly consumed, making them a staple in daily meals. However, their frequent disposal suggests inefficiencies in consumption patterns. A possible explanation for this could be the overproduction or bulk buying of these items, leading to their early spoilage. Additionally, bread, due to its perishability, might not be consumed before it reaches a stage where it is discarded, especially in households with smaller populations or those with insufficient storage facilities. These patterns reflect broader issues related to food handling and storage, which may warrant educational campaigns or more efficient food distribution systems.

The second most frequently wasted food category, vegetables, is particularly noteworthy. Given the seasonal nature of many vegetables in Armenia, it is reasonable to assume that the abundance of fresh produce during the summer months contributes to overpurchasing, leading to higher wastage. The results from this study suggest that a mismatch exists between consumers' purchasing habits and their ability to consume the produce before it spoils, which is consistent with trends observed globally in seasonal food wastage. The findings of this study are consistent with those of several other studies on food waste patterns globally, yet they also highlight unique contextual factors in Armenia. For example, the overrepresentation of bread waste is echoed in other regions where baked goods are culturally significant, yet it also stands as an area with potential for reuse strategies. Their work on valorising bread waste into valuable products such as biofuels or enzymes could be

highly applicable in Armenia, where bread waste represents a considerable portion of the total food wastage. Additionally, the higher-than-expected wastage of vegetables and fruits in Yerevan suggests that the factors influencing food waste in this region may not be entirely linked to economic constraints, but also to consumer attitudes toward freshness and the perceived abundance of these items. This aligns with research from the European Food Information Council (EUFIC), which has found that attitudes toward food quality often dictate consumer waste behaviour. However, unlike some developed economies, Armenia may not have the infrastructure or cultural practices in place to reduce food waste, which could contribute to these high levels of waste. The implications of these findings suggest that reducing food waste in Yerevan could benefit from a multifaceted approach. First, raising public awareness about the economic costs of food waste, particularly in relation to bread, lavash, and vegetables, could help alter consumer behaviour. Public campaigns could encourage consumers to purchase only the amount of bread and vegetables they are likely to consume, thus reducing unnecessary waste. Furthermore, the introduction of food waste management policies that focus on the redistribution of excess food, particularly bread and vegetables, could significantly mitigate the economic and environmental costs. Existing initiatives such as food-sharing platforms (e.g., Too Good To Go) could be adapted to the Armenian market, providing a practical solution for redistributing unsold bread and vegetables at lower prices. Policymakers could also incentivize the establishment of partnerships between food producers, restaurants, and food banks to redirect excess food to those in need. While this study provides valuable insights, it is important to acknowledge its limitations. The sample predominantly consists of younger individuals, who may not fully represent the waste behaviour of older generations, who could have different purchasing and consumption patterns. Future studies should aim to include a broader age demographic to ensure more representative results. Additionally, the reliance on self-reported data could introduce bias, as participants may underreport or misreport their food waste behaviours. A more robust research design might include observational studies or diaries to track food waste over a longer period. Figure 2 shows that the average awareness level among the respondents was below 5 points out of 10, indicating the need for public awareness initiatives to address this issue and improve the situation.

Figure 2

Self-Evaluation Ratings of Respondents' Awareness of Food Waste as a Global Concern
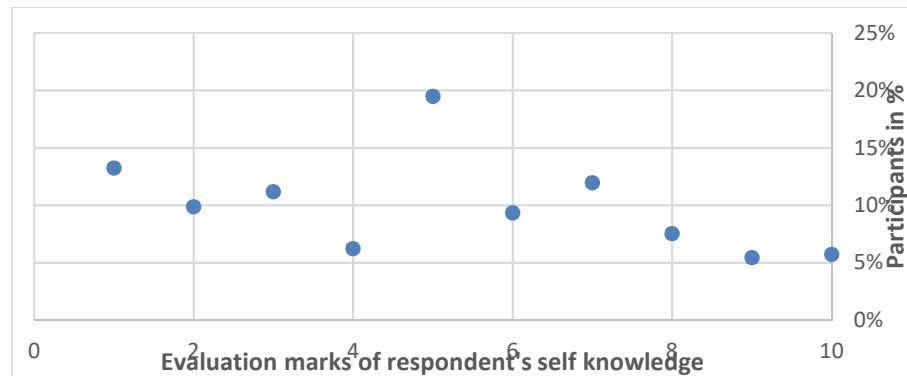
Source: Developed by author

Policy makers, NGOs and activists have much work to do in this manner, and researchers need to find ways how this tendency can be changed, leading us towards sustainable consumption and social awareness. This research shows that further research in different policies of the EU and Armenia needs to be done; also, the tendencies of consumers in the regions of Armenia, and other representatives of the Food supply chain should be investigated.

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