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Addressing food waste: An analysis of causes, impacts, and solutions in modern societies

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Abstract: *Purpose*: The primary aim of this paper is to explore the issue of food waste in contemporary societies, its causes, consequences, and potential solutions. *Methodology*: The authors conducted a survey among households in the Lower Silesian Voivodeship of Poland to diagnose the structure and causes of food waste. They also analyzed statistical data on food waste in European Union countries. *Results*: The study found that the most food waste occurs in Germany, France, and Italy, while the least occurs in Malta, Luxembourg, and Slovenia. The authors concluded that food waste harms three interconnected areas of sustainable development goals: environmental, economic, and social. *Theoretical Contribution*: This paper contributes to the ongoing discourse on food waste by providing a comprehensive analysis of its causes and impacts backed by empirical data. It adds value to sustainability studies by linking food waste to broader socio-economic and environmental issues. *Practical Implications*: The authors propose several measures to reduce food waste, such as planning purchases, processing food, sharing food with relatives or pets, using conventional and non-standard methods of food storage, and increasing the level of education and awareness about the issue. Individuals, communities, and policy-makers can implement these practical suggestions to address the problem of food waste.

Keywords: sustainability, food chain, food waste, reducing food waste, balancing consumption, surveys

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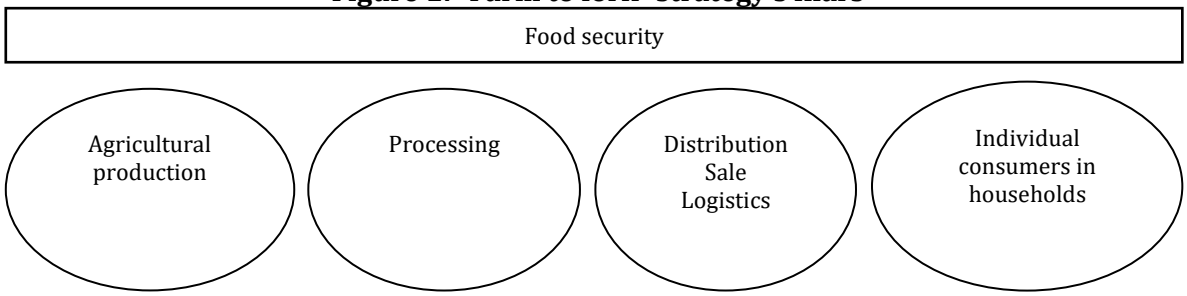
1. Introduction

Food waste is a serious social problem on a global scale. It applies to many countries around the world, both developed and developing. It turns out to be paradoxical that in a situation of nutritional poverty occurring in many geographical areas and social classes, many tons of food are still wasted. The 2021 UN report indicates that the main links in food supply chains causing food waste are households, retail stores, and the catering industry. The scale of this phenomenon is 931 million tons per year, of which nearly 570 million tons (61.2%) are generated at the household level (Food Waste Index Report, 2021). An essential step in changing the current European Union food system into a sustainable model was the development of the "Farm to Fork" Strategy by the Council of the European Union in 2020. The priorities next to food security are (Figure 1).

Figure 1: "Farm to fork" strategy's filars



Source: own study based on (European Council, n.d.).

Food waste harms three related areas with the sustainable development goals[1]. These are: environmental, economic, and social areas (Table 1).

Table 1: Negative effects of food loss

The area of negative effects of food loss		
Environmental	**Economic**	**Social**
Vain use of water	Increase in global costs	Objectives in achieving food security in starving world regions
Vain use of soil	Cumulative costs on the entire length of the food chain	Unethical practices
Vain use of energy	Losses incurred by all supply chain operators	People's malnutrition
Vain use of packages	Lack of possibility of introducing food marketing because of its low quality	Increased number of malnourished people
Vain use of other resources and materials used for food production and distribution and disposal of unsold products	Decreasing economic value of the products	Lack of access to food for many people
Global warming	Financial losses	Increased consumption
Emission of methane	Additional costs in relation to the treatment of wasted food	Lack of confidence in the security of the food supply
The need to manage the greater mass of organic and inorganic waste	Increased investment connected with the employment of people, purchase of raw materials, maintaining systems providing health security as well as maintenance of machinery equipment	
	Increasing food costs	
	Increase in the price of foodstuffs	
	Rise in the cost of production	

Source: (Dąbrowska, Zielińska, Monastyrskyi & Drozda, 2023, pp. 11).

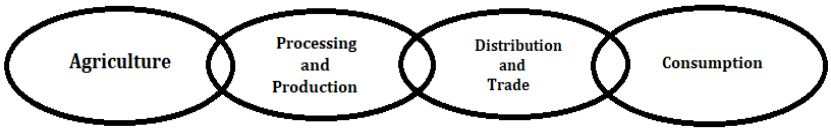
[1] For more on sustainable development, see, among others in.: (Ashby, 2022; Atkinson, Dietz, Neumayer, Agarwala (Eds.) 2014; Baker, 2015; Blewitt, 2014; Burchard-Dziubińska, Rzeńca & Drzazga, 2014; Jabareen, 2008; Lee, He & Yuan, 2023; Mohamad Taghvaee, Assari Arani, Nodehi, Khodaparast Shirazi, Agheli, Neshat Ghojogh,... & Ahmadi Rahbarian, 2023; Rogers, Jalal & Boyd, 2012; Roosa, 2020; Sachs, Kroll, Lafortune, Fuller & Woelm, 2022).

2. Literature review

Changes in food production and consumption result from ongoing civilization changes and the globalization of food markets. The positive manifestations of globalization include the emergence of new markets, access to new raw materials, products, and processing technologies, as well as increased availability of food products with different quality characteristics. The negative aspects of the changes are overconsumption and food waste, which are noticeable in developed countries. Unsustainable production and consumption are the causes of food waste. For this reason, it can be concluded that food waste is inextricably linked to irrational management processes at various stages of the food chain (Śmiechowska, 2015, Tarczyńska, 2021). Food losses and waste are sources of the most critical threats to food security[2]. The others include population growth, increasing demand for food with shrinking water and land resources, climate change, loss of biodiversity of agricultural varieties, new plant and animal diseases, rising energy and food prices, fight for arable land with biofuel producers, industry and urbanization and speculation on the food price market (Kwasek, 2013).

Nowadays, food production is a very complex process. Local farms or processing plants can produce a finished product based solely on raw materials. Other entities are forced to use raw materials from agricultural producers and services provided by other entities, which supply them with individual raw materials, materials, and components necessary to produce the finished product, thus becoming links in the supply chain. For this reason, it can be said that in the modern economy, food products are the result of cooperation between links within the "food chain" (Chechelski, 2015) (see Figure 2 and Table 2).

Figure 2: Links in the „food chain"



Source: own study.

Table 2: Links in the food chain

Industry of means of production and services	Agriculture	Food industry	Trade	Consumer
Producers of means of production: - pesticides and artificial fertilizers, - veterinary medicines, - seeds and breeding, - institutions conducting genetic research, - ingredients and additional substances, - machine and devices, - clearing and disinfecting agents, - packaging materials, - means of transport, - building materials Providing services: -consulting and training in various fields (science), - financial, insurance, credit, - Communications and IT, - service of various industries, - transport, storage, logistics, - marketing and advertising	- producers of agricultural produce - Animals breeders, - fishing, hunting, and forest undergrowth management activities	- processing: * preliminary * deepened, * secondary, * feed producers and waste processing	- international, - wholesale, - retail	-consumption: * individual, * collective, * institutions and organizations related to consumer education and supporting him on the market

Source: (Chechelski, 2015, pp. 50).

[2] For more information on food safety, see, among others in.: (Adamczyk, 2019; Karaczun & Kozyra, 2020; Kwasek & Kowalczyk, 2023; Michalczyk, 2019; Motarjemi & Mortimore, 2023; Motarjemi & Warren, 2023; Rybińska, 2021; Suhag, Upadhyay & Mishra, 2023; Wiśniewska & Wyrwa, 2022).

The problem of food waste and losses occurs in all links of the food chain. The reasons for this state of affairs can be found in many sources (Table 3).

Table 3: Sources of food waste in „food chain"

Agriculture	Processing and industry	Trade and distribution	Consumption
- natural causes: * climate and weather conditions, * pest attack, * attack of plant diseases and animals, * parasite attack, - inappropriate storage of agricultural produce, - improper use of plant protection products, - overproduction (supply exceeds demand), - failure to meet visual standards - production limits for given product groups, - failures of systems regulating the operation of infrastructure, - sanitary negligence, - production of genetically modified food, - incorrect settings of parameters of machines and devices supporting agricultural production,	- failures of systems regulating the operation of infrastructure, - sanitary negligence, - failure to meet standards and norms, - storing food products in inappropriate conditions, - transporting food products in unsuitable conditions, - overproduction (supply exceeds demand), - strict quality controls caused by growing market requirements, - legal provisions that are unfavorable to producers and limit the free transfer of products, - failure to meet visual standards	- failures of systems regulating the operation of infrastructure, - sanitary negligence, - inappropriate organization of food distribution, - transporting food products in unsuitable conditions, - storing food products in inappropriate conditions, - incorrect demand forecasting, - no application of the FEFO (First Expired, First Out) principle - random events, e.g., in the transport process, accidents, damage to the means of transport, - failure to comply with the rules and regulations regarding the transport of live animals, - legal provisions that are unfavorable to traders and limit the free transfer of products, - the product range is not adapted to the regional needs of customers	- failures of systems regulating the operation of infrastructure, - sanitary negligence, - change in eating attitudes, - overconsumption, - creating unnecessary inventories, - ill-considered purchases, - no application of the FEFO (First Expired, First Out) principle, - lifestyle diseases and allergies, - familiar and easy access to food, - storing food products in inappropriate conditions, - low level of awareness caused by lack of nutritional education, - purchases of larger quantities due to economic profitability resulting from promotion, - no use of conventional and unconventional methods of food preservation, - lack of adaptation to customer needs in facilities offering collective catering (hospitals, schools, kindergartens, restaurants)

Source: own study.

Food waste has serious economic, social, and ecological consequences that affect people's quality of life and have many adverse effects on the natural environment (Table 4).

Table 4: Negative consequences of food waste

Economic	Social	Ecological
- increase in production costs, - increase in food prices, - loss of invested financial resources, - costs of managing bio-waste and packaging waste, - costs related to pest and rodent control and preventing the spread of diseases.	- food impoverishment of societies, - growing amount of waste, - limited access to full-value products, - ethical aspect caused by an imbalance in food availability in different regions of the world, - limited availability of healthy food for people experiencing poverty, - growing food exclusion.	- shrinking water resources3, - increase in CO2 emission4, - increasing the greenhouse effect, - shrinking non-renewable energy resources, - disruption of the ecosystem, - approaching wild animals closer to residential buildings, - growing amount of waste, - soil degradation, - introducing plant protection products into the ecosystem, - unsustainable use of natural resources.

Source: own study.

The article aims to diagnose the structure and causes of product waste in households based on survey research and to analyze the interdependence of selected variables used in the survey.

3. Food waste in the economies of the European Union - statistical approach

European Union

According to data from the Eurostat platform from 2020, the total food wasted per capita in the European Union was 131 kg (Table 5).

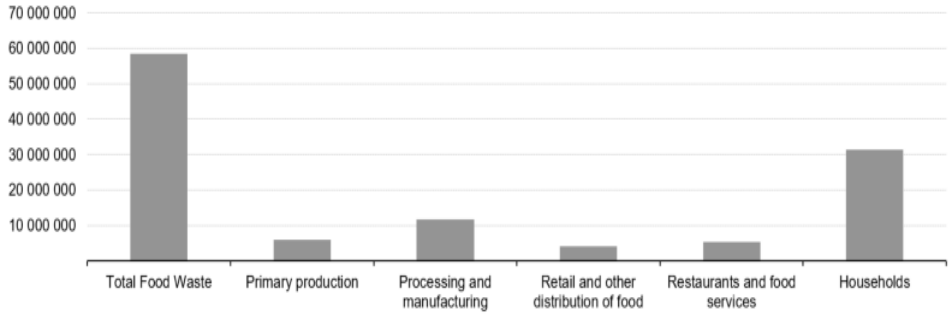
Table 5: Total food wasted per capita in the European Union per one citizen

Sectors	Number in [kg]
Households	70
Manufacture of food products and beverages	26
Primary production	14
Restaurants and food services	12
Retail and other distribution of food	9

Source: (Eurostat, n.d.).

In 2020, people in the European Union wasted 59 million tons of food (Figure 3).

Figure 3: The number of food wasted in the European Union in 2020 by sector



Source: (Eurostat, n.d.).

[3] It takes 5,000 to 10,000 liters of water to produce 1 kg of beef, 1 kg of pork - 6,000 liters of water, 1 kg of poultry - 4,000 liters of water (Gosiewska, 2013). Producing 1,000 kg of green coffee requires 11,500 liters of water (Coltro, Mourad, Oliveira, Baddini & Kletecke, 2006). The production of 1 kg of potatoes uses 300 liters of water and 1 liter of milk - 1,000 liters of water (vitapedia.pl).

[4] Producing 1 tonne of food produces 4.2 tonnes of carbon dioxide emissions (Pokrywka, 2012).

The data presented in Figure 3 shows that over 31 tonnes of wasted food came from households, accounting for over 53% of the total food wasted in the European Union. Nearly 12 million tons of food were wasted in the "manufacture of food products and beverages" sector, constituting 20% of the total food wasted in the European Union countries. More than 6 million tons (which accounted for 11% of the share) were recorded in the "primary production" sector. The "restaurants and food services" sector notes more than 5 million tons of food wasted (9% of the share). Finally, the "restaurants and food services" sector documented over 4 million tons of food (which accounted for 7% of the share)".

Table 6 shows the values of food waste in 2020, divided into European countries, measured in tons of fresh weight, divided into sectors.

Table 6: The values of food waste in 2020, divided into European countries, measured in tons of fresh weight, divided into sectors

Country	Total food waste	Primary production	Processing and manufacturing	Retail and other distribution of food	Restaurants and food services	Households
EU	58512559	6067377	11806452	4079709	5275265	31283755
Belgium	2881897	38699	1862177	73591	88333	819097
Bulgaria	596844	228472	156435	15708	14375	181854
Czechia	972445	27022	100339	64394	37941	742749
Denmark	1286488	66452	596599	99500	62544	461392
Germany	10922321	190203	1612505	762352	1860980	6496282
Estonia	166513	23612	31622	19976	10739	80564
Ireland	770316	70413	219453	60894	178507	241048
Greece	2048189	372204	375158	150472	220032	930323
Spain	4260845	845620	1419257	348219	213023	1434726
France	9000000	1059000	1926000	800000	1096000	4119000
Croatia	286379	40916	9866	4180	15072	216345
Italy	8650456	1270638	510018	343535	193915	6332349
Cyprus	354021	43564	169706	50268	27145	63338
Latvia	275304	32487	36107	14765	35436	156509
Lithuania	382665	81202	28057	27342	4495	241570
Luxembourg	92580	7384	10692	8525	8739	57240
Hungary	905068	16587	187391	41952	19331	639806
Malta	79589	759	4668	3910	23016	47235
Netherlands	2811000	463045	1031407	209805	83035	1023708
Austria	1211534	13879	173734	84326	201956	737639
Poland	4002099	670547	544972	320396	190293	2275921
Portugal	1890712	101384	61719	214233	237486	1275891
Romania	:	:	:	:	:	:
Slovenia	143570	93	10757	15290	42666	74764
Slovakia	455587	71889	4113	15825	7110	356650
Finland	641258	48011	162278	57555	77914	295500
Sweden	905000	22000	53000	97000	98000	635000
Norway	769967	162158	29088	61281	97547	419893

Source: (Eurostat, n.d.).

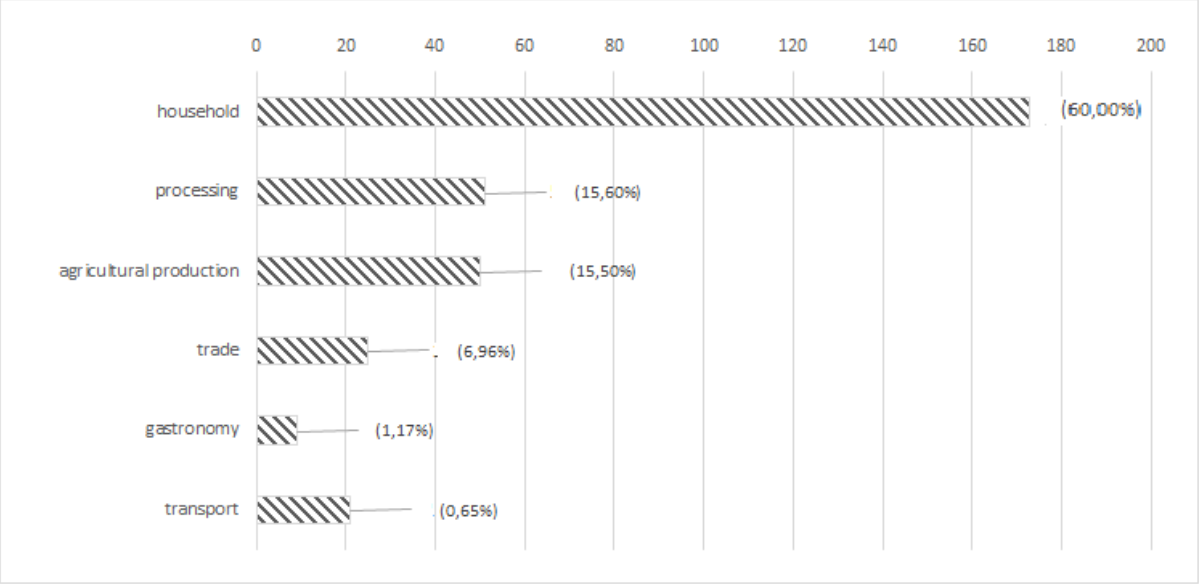
Based on the data in Table 6, it can be concluded that the most food was wasted in 2020 in Germany, France, and Italy, and the least in Malta, Luxembourg, and Slovenia. The reasons for this state of affairs include, among others:

- number of inhabitants (Germany, France, and Italy are the countries with the most significant number of inhabitants in Europe),
- GDP indicator (Germany, France, and Italy are the countries with the highest GDP indicator in Europe).

Poland

According to the Supreme Audit Office report in Poland, citizens wasted nearly 5 million tons of food in 2021. 60% of wasted food came from households, 15.60% - from processing, 15.50% - from agricultural production, 6.96 - from trade, 1.17% - from gastronomy, and 0.65% - from transport (Figure 4).

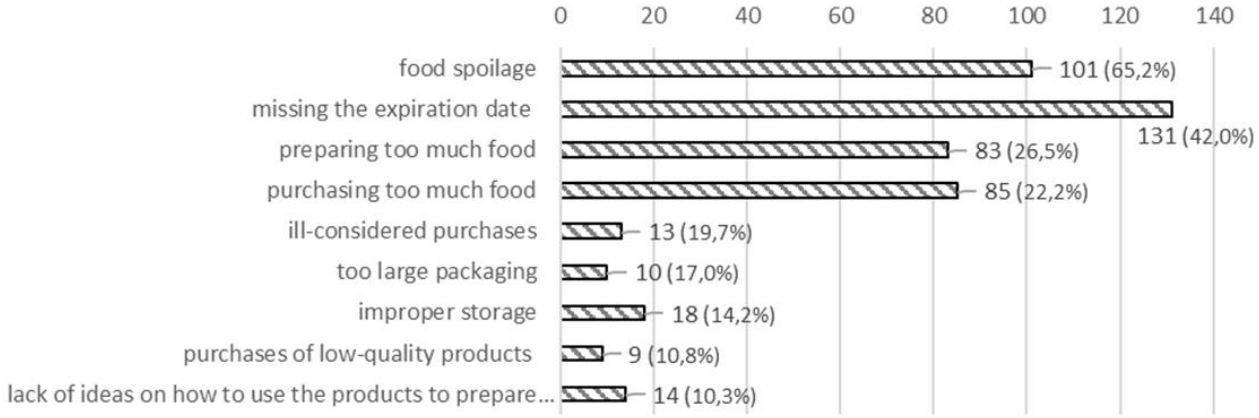
Figure 4: Food waste in Poland in 2021 divided into sectors



Source: Own study based on (Najwyższa Izba Kontroli, n.d.).

The most common reasons for food waste in Polish households include 65.2% - food spoilage, 42.0% - missing the expiration date, 26.5% - preparing too much food, 22.2% - purchasing too much food, 19.7% - ill-considered purchases, 17.0% - too large packaging, 14.2% - improper storage, 10.8% - purchases of low-quality products and 10.3% - lack of ideas on how to use the products to prepare dishes (Figure 5).

Figure 5: Food waste in Poland in 2021, including the causes of waste



Source: Own study based on (www. 3).

4. Materials and methods of food waste

The survey research was conducted in April - August 2023.

The main aim of the study.

The study aims to determine the structure and causes of product waste in households and the possibilities of reducing it.

Method, technique, and research tool.

The research method was based on social research, whereas the individual survey technique was chosen. A survey questionnaire was simultaneously a research tool. The survey questionnaire consisted of 8 questions with closed and open cafeteria, conjunctive (multiple choice), and disjunctive

(single choice). The survey targeted people running households and living in the Lower Silesian Voivodeship.

The study group's characteristics

The survey was conducted based on a survey questionnaire posted on the google.pl platform.

231 randomly selected people took part in the study. The study group was characterized by considering two variables: sex and age.

The study participants included 149 women and 82 men (Table 7). The examined people were of the following age: up to 20 years old - 122, 21-30 years old - 13, 31-40 years old - 35, 41-50 years old - 34, and over 50 years old - 27 (Table 8).

Table 7: Number of people participating in the research survey by sex

Answer	Number of answers	Share
female	149	64,5 %
male	82	35,5 %
total	231	100%

Source: own study based on own research.

Table 8: Number of people participating in the research survey by age

Answer	Number of answers	Share
up to 20 years	122	52,8 %
21-30 years	13	5,6 %
31-40 years	35	15,2 %
41-50 years	34	14,7 %
above 50 years	27	11,7 %
Total	231	100%

Source: own study based on own research.

Table 9 presents the characteristics of people participating in the research survey concerning the relationship between two variables.

Table 9: Characteristics of people participating in the research survey concerning the relationship between two variables

Sex	Age										Total	
	up to 20		21-30		31-40		41-50		above 50			
	nr	%	nr	%	nr	%	nr	%	nr	%	nr	%
female	86	70,5	5	38,5	21	0,6	21	61,8	16	59,3	149	64,5
male	36	29,5	8	61,5	14	0,4	13	38,2	11	40,7	82	35,5
total	122	100	13	100	35	1	34	100	27	100	231	100

Source: own study based on own research.

5. Results

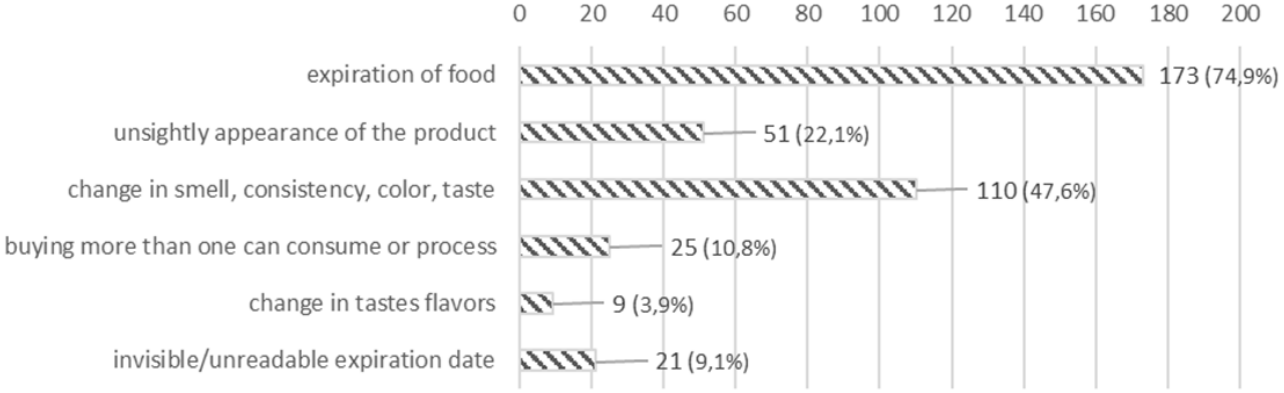
The surveys' collective results are presented.

24 respondents answered several times a week, 46 - most often after holidays and celebrations, 62 - several times a month, and 99 - occasionally during the year.

For question 2: What food items do you most often throw away? The question was a multiple-choice question. 101 respondents answered bread, 131 - fruit and vegetables, 83 - meat and cold cuts, 85 - dairy products, 13 - sweets, 10 - dry products, 18 - canned meat and fish, 9 - powdered desserts, and 14 - spices.

Figure 6 shows the collective results of the surveys for question 3: What are the main reasons you throw away food in your household? The question was a multiple-choice question. The respondents indicated the leading causes of food waste in the household: 173 - expiration of food, 51 - unsightly appearance of the product, 110 - change in smell, consistency, color, taste, 25 - buying more than one can consume or process, 9 - change in tastes flavors, 21- invisible/unreadable expiration date.

Figure 6: The collective results of the surveys for question 3: What are the main reasons you throw away food in your household?

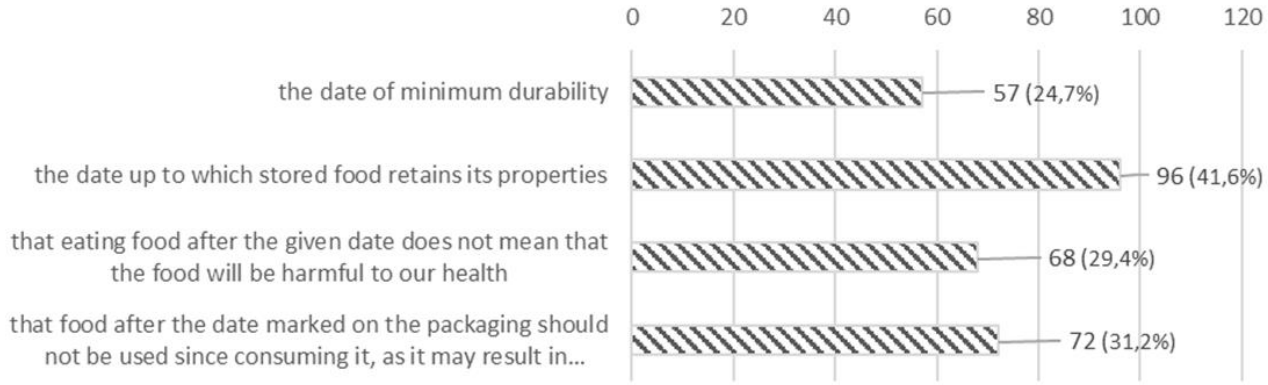


Source: own study based on own research.

For question 4: *When buying food, do you pay attention to the expiration date?* The question was a single-choice question. 166 respondents answered yes, 10 - no, 55 - sometimes.

Figure 7 shows the collective results of the surveys for question 5: According to your knowledge, the information on food packaging saying "Best before" means? The question was a multiple-choice question. 57 respondents indicated the date of minimum durability, 96 - the date up to which stored food retains its properties, 68 - that eating food after the given date does not mean that the food will be harmful to our health, and 72 - that food after the date marked on the packaging should not be used since consuming it, as it may result in illness or severe health problems.

Figure 7: The collective results of the surveys for question 5: According to your knowledge, the information on food packaging saying "Best before" means?



Source: own study based on own research.

For question 6: According to your knowledge, the information on food packaging saying "Use by" means that? The question was a multiple-choice question. 116 (50,2%) respondents answered that the product should be consumed no later than the expiry date, 53 (22,9%) - eating the product after the expiry date may cause serious health consequences, 47 (20,3%) - this is an absolute shelf life, 71 (30,7%)- the manufacturer guarantees that by the indicated date the purchased product is of the highest quality.

For question 7: What do you do with food you have not used? The question was a multiple-choice question. 117 (50,6%) respondents answered that they throw it into the trash, 31 (13,4%)- share it with someone close to them, such as neighbours, 109 (47,2%)- donate it to animals, 22 (9,5%)- secure it and hang it next to the trash can with the hope that someone will use it, 5 (2,2%)- donate it to a food bank (community refrigerators), 63 (27,3%)– process, freeze.

To question 8: What can you do to reduce food waste? The respondents most often gave the following answers:

- buy less (47 answers),

- plan shopping (37 answers),
- process food (27 answers),
- give to people and animals in need (24 answers),
- I do not know (21 answers).

According to the authors, the answer "I do not know" to the question may be caused by the following reasons:

- the lack of a friendly state and law promoting behaviours and attitudes limiting food waste and the lack of an adopted social policy emphasizing the problem of food waste,
- lack of consideration of food waste as a source of the social security crisis and lack of prepared preventive programs,
- low level of theoretical and practical education in this area, resulting in a lack of knowledge and awareness of available solutions to avoid food waste and a lack of knowledge about rational bio-waste management,
- low level of involvement of food-producing entities in social campaigns promoting not wasting food and illustrating the importance of the problem, increasing social awareness,
- lack of implemented nationwide solutions in the field of food waste prevention, including the lack of prepared and implemented solutions about logistic activities aimed at optimizing flows in agri-food chains,
- lack of an integrated time-synchronized mobile application system enabling access to information on the possibility of purchasing food at attractive prices related to the product life cycle.

6. Analysis of correlations for selected survey questions regarding food waste in households

The interpretation of survey results on food waste in households was extended to include an analysis of interdependence for two selected pairs of questions; the analysis aimed to determine the relationship and its strength between the selected pairs of questions. The term dependence refers to the examined dependent feature (explained - Y) and independent features (explanatory - *X*).

In statistical research for mass phenomena, stochastic correlation, which occurs between two questions in the survey, is used. Changing the value of one question changes the probability distribution of the other question.

There are many measures for examining stochastic dependence. This article describes the stochastic relationship determined using the Czuprow convergence coefficient (T_{XY}, T_{YX}):

$$T_{XY} = T_{YX} = \sqrt{\frac{\sum_{i=1}^{k}\sum_{j=1}^{l}\frac{(f_{ij} - f_i \cdot f_j)^2}{f_{ij} - f_i \cdot f_j}}{\min(k,l) - 1}}$$

$$f_i = \frac{n_i}{N}$$

$$f_j = \frac{nj}{N}$$

$$f_{ij} = \frac{n_{ij}}{N}$$

In which:

N - total number of respondents,

min (*k,l*) is the smallest number of rows or columns in the correlation table.

The Czuprow convergence coefficient only allows determining the strength of the relationship, including for qualitative data (Zielińska & Sej-Kolasa, 2004).

The correlation analysis was performed separately for the two question pairs.

The following questions were selected in the first pair:

Y – respondent's age

X – How often do you throw out food?

Based on the survey results obtained from 231 respondents (N = 231), a correlation table was developed (Table 10).

Table 10: Correlation table for the respondents' ages and the question "How often do you throw away food?"

How often do you throw away food?	Respondent's age					n_i
	up to 20	21-30	31-40	41-50	above 50	
Several times a week	14	2	4	1	3	24
Most often holidays and celebrations	26	3	4	6	7	46
Several times a month	32	6	10	8	6	62
Occasionally, during the year	50	2	17	19	11	99
n_i	122	13	35	34	27	231

Source: own study based on own research.

Then, the Czuprow coefficient of variation was calculated:

$$T_{XY} = T_{YX} = \sqrt{\frac{\sum_{i=1}^{k}\sum_{j=1}^{l}\frac{\left(f_{ij} - f_i \cdot f_j\right)^2}{f_{ij} - f_i \cdot f_j}}{\min(k,l) - 1}} = 0{,}124$$

Based on the data analysis in Table 10, there is a minimal relationship (0.124) between the analyzed first group of questions. However, considering the increase in ecological and economic awareness of society and the knowledge of food preservation methods, the article's authors hypothesized that such a relationship would not only occur but also be characterized by a significant strength. The correlation results did not confirm the hypothesis.

In the second pair authors selected the following questions:

Y – Respondent's sex

X – When buying groceries, do you pay attention to the expiration date?

Based on the survey results obtained from 231 respondents (N = 231), a correlation table was developed (Table 11).

Table 11: Correlation table for the respondent's gender and the questions "When buying groceries, do you pay attention to the expiry date?"

When buying groceries, do you pay attention to the expiration date?	Sex		n_i
	Female	Male	
yes	114	52	166
no	4	6	10
sometimes	31	24	55
n_i	149	82	231

Source: own study based on own research.

Then, the Czuprow coefficient of variation was calculated:

$$T_{XY} = T_{YX} = \sqrt{\frac{\sum_{i=1}^{k}\sum_{j=1}^{l}\frac{\left(f_{ij} - f_i \cdot f_j\right)^2}{f_{ij} - f_i \cdot f_j}}{\min(k,l) - 1}} = 0{,}154$$

The data analysis in Table 11 shows a non-significant relationship (0.154) between the analyzed second group of questions. However, considering the shopping culture and cultural patterns, the article's authors hypothesized that such a relationship would also be characterized by a significant strength, which still needs to be confirmed by the research.

7. Conclusions

The issues discussed in the article are fundamental from a practical point of view, as evidenced by the number of publications on this subject and the increase in food waste in global bodies and organizations.

The article aimed to diagnose the structure of the causes of product waste in households based on survey research and to analyze the interdependence of selected variables used in the survey. The goal has been achieved.

Based on the analysis of the literature and statistical data, the following conclusions were drawn:

1) food waste harms the areas of interest for sustainable development, i.e., the environmental, economic, and social areas;
2) the negative consequences of food waste include shrinking water resources, ecosystem disruption, increase in food prices, loss of invested financial resources, food impoverishment of societies, growing food exclusion;
3) the problem of food waste and losses occurs in all links of the food chain, starting from agriculture, through processing and industry, distribution and trade, and ending with consumption;
4) the leading causes of food waste concerning links in the food chain include natural causes, overproduction, failure to meet standards and norms, legal provisions unfavourable to producers limiting the free transfer of products, transporting and storing food products in inappropriate conditions, lack of application of the FEFO principle, familiar and easy access to food, low level of awareness caused by lack of nutritional education, lack of use of conventional and unconventional methods of food preservation;
5) taking into account the European Union countries, the most food is wasted in Germany, France, and Italy, and the least in Malta, Luxembourg, and Slovenia;

Based on the conducted research, the following conclusions were drawn:

1) the dominant products in the structure of food waste among respondents are:

- vegetables and fruits– 56,7%,
- bread – 43,7%,
- dairy products – 36,8% and
- meat and cold cuts – 35,9%;

2) the respondents indicated the most important causes of food waste in their households:

- food expired – 74,9%,
- change in smell, consistency, colour, taste – 47,6% and
- the unaesthetic appearance of the product – 22,1%;

3) respondents do not know about the information on the packaging, i.e., "best before" and "use by";

However, based on the interdependence analysis, the following conclusions were drawn:

1) there is a minimal relationship (0.124) between the questions: respondent's age and *"How often do you throw away food?"*

a non-significant relationship (0.154) was found between the questions: respondent's sex and "*When buying groceries, do you pay attention to the expiry date*?".

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Conflicts of interest

The authors declare no conflict of interest.

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