



Research article

Consumers' stance on food waste in the Czech Republic, Poland, and Slovakia

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Abstract: This work focuses on the area of food waste from the subjective perspective of the consumers themselves. The key source of data is a questionnaire survey with a sample selection of 3,429 respondents from the Czech Republic, Poland, and Slovakia, which are countries with historical and cultural ties. This survey was orchestrated in 2019 and it aimed to uncover the consumers' stances on this area. For every country involved, the results proved that the most common reason for food waste is that the food spoils when stored. One's stance on food waste is influenced by identifiers such as age, education, economic activity, and perceived income. A significant difference between the surveyed countries can be seen in the fact that Poles have over a 10× greater chance of wasting the smallest amount of food. Descriptive statistics, contingency analysis, and logistic regression were used to analyze the data. It is evident that subsequent research is necessary in this area, ideally with a united methodology for every country in the European Union.

Keywords: factors; food; wasting; causes; consumer

1. Introduction

Food waste is a publicly discussed issue of society-wide importance. The discussions are led by the effort to decrease the amount of food waste, thus contributing to improving the environment. Food

waste and its quantification is the subject of interest for groups such as farmers, ecologists, technologists, and economists, however, it is also an issue of social and ethical significance. Aside from the interest of the general public, the first scientific studies are emerging and the associated need to define the basic concepts of food waste. The concepts related to food waste and bio-waste are dealt with in European law in Regulation (ES) No. 98/2008 on waste, Article 3. “Bio-waste” is defined as “biologically decomposable waste from gardens or parks, food-processing or kitchen waste from homes, restaurants, the hospitality industry and retail businesses, and comparable waste from facilities of the food-processing industry”. However, this concept is not sufficient in defining the problem of food waste, as a generally valid definition for the concept “food waste” does not exist. FAO considers food waste the amount of edible food originally intended for human consumption, providing the definition “food waste comprises of the waste arising when harvesting crops, when processing food, and waste from food, which occurs when retailers and consumers are involved” [1]. This statement illustrates the great difficulty of quantifying food waste.

This issue needs to be seen primarily as a waste of resources along the entire length of the food chain. Limiting food waste is an important factor for securing nourishment for people on a worldwide scale, the use of limited resources for different purposes, the reduction of financial losses, and finally, environmental risks [2].

As previously mentioned, the issue of food waste is not only a large environmental and economic problem [3,4] but also an issue of ethics and sociology [5]. The consumer continues to vigorously demand society for a healthy environment, however, they subconsciously impact this demand with their decision-making when satisfying their needs, both structurally and in terms of quantity. Production and its adverse effects on the environment are considered to be decisive for the quality of the environment. A more considerate approach by producers to air quality conditions and the carbon footprint they create is required. In the search for measures to reduce waste, the influence of consumer behaviour is increasingly coming to the foreground. Food waste is closely linked to the food industry. It is this sector that produces more than a third of the world’s emissions [6]. [7] suggest a change of strategy for the food industry when producing new products by altering the technologies that cause certain changes in the product in terms of extending and increasing shelf-life and nutritional quality, thus reducing the amount of food waste. It is precisely the reduction in the amount of food waste that is the most anticipated change in consumer behavior.

According to [8] food waste is defined in the literature using a variety of terminology and meanings. To distinguish between the stages of the supply chain where the waste takes place, the phrases “food losses” and “food waste” have been applied. In addition, [9–12] stated that almost 30% of food globally produced is lost or wasted along the food supply chain. The food supply chain includes stages from primary production including pre-harvest and post-harvest, distribution including processing and manufacturing, retail and wholesale to food consumption [8,13]. As a consequence, food losses and food waste at any of these stages mean the inappropriate application of the resources like energy, land or water and other resources which are used for producing food [14].

[15] describe food production as one of the major elements influencing consumption-related environmental effects. When producing food, the usage of several resources is used, for instance, land, water fuels or raw material causing the rise of food production costs and creating an extra, pointless load on the ecosystem, impacting biodiversity, climate, and nutrient losses [5]. Moreover, most of the environmental food waste impacts originated from the primary production stage of the food supply chain. The effect of food waste on the environment includes all emissions produced at various stages

throughout the food supply chain. In fact, products discarded later in the food supply chain have higher environmental implications, due to emissions coming from the first stages of the supply chain [15].

Therefore, it is crucial to reduce food waste in order to increase food security and cut back on unneeded expenses and environmental impacts [16]. According to [17] food losses and food waste are connected with climate change. It is important to point out that extreme weather events are disruptive to both agriculture and supply chain resiliency. Food loss and waste also degrade the climate change crisis with its serious greenhouse gas footprint. Food supply processes including production, transportation, and handling of food create significant Carbon Dioxide (CO₂) emissions. Moreover, when discarded food ends up in landfills, it derives methane, which is an even more potent greenhouse gas. As reported by [18], food waste increases the strain on ecosystems, for instance, desertification, eutrophication, pollution of the air, land, and water, depletion of scarce resources like water and phosphorus, and climate change. According to [19] water footprint, carbon footprint and ecological footprint are environmental effects that are strongly linked to the stages of food consumption and food discard. Furthermore, [20,21] stated that these footprints can be used to evaluate the external environmental implications of international trade on other countries. Additionally, businesses and consumers can use them for consideration to reduce their environmental impacts [22,23]. Studies done by [24,25] demonstrated that the dairy and meat sector generates an extensive environmental effect in the sector of agriculture. [15] stated that livestock farming creates serious environmental emissions in the form of methane derived from the enteric fermentation of animals. As reported by [26] the effects of livestock farming accounted for 10% of the EU's overall GHG emissions in 2011. As reported by [27,28] the biggest waste of food is produced by consumers in the phases of retail and consumption. Finally, [29] reported that the programs for food rescue could decrease the effects of food waste and its treatment on the environment. To conclude, the environmental effect of food waste throughout the food supply chain and following waste disposal is considerable.

As reported by [30] food losses and food waste have received a lot of attention recently and have moved up the political agendas of both the global and national levels. For instance, one of the goals of the 2030 Agenda for Sustainable Development [31] is to ensure sustainable consumption and production patterns (Goal 12, Target 12.3: by 2030, halve per capita global food waste at the retail and consumer levels and reduce food losses along production and supply chains, including post-harvest losses). Furthermore, food losses and waste leads to environmental pollution, natural resource degradation and depletion and food security decrease the contribution of this target includes various dimensions of the 2030 Agenda, for instance, eliminating hunger [32] and food insecurity enhancing the sustainability of both marine and terrestrial ecosystems, increasing sustainable water management, and. By reducing food losses and waste food, the security of vulnerable groups of people can be protected. Moreover, the reduction of food loss and waste can lead to a decrease in the environmental footprint of food production processes [33]. Due to increasing environmental, social and economic concerns, [33,34] claimed that food losses and waste are one of the most crucial concerns that governments and society must deal with. As stated by [35], there is a difference between the terms “food loss” and “food waste” occurring in the distinct stages of the food supply chain. [36] describes “food loss” as the decrease in quality or quantity of food. On the other hand, “food waste” can be defined as a part of food loss that involves throwing away or other (nonfood) use of food that is safe and nutritious for human consumption along the whole stages of the food supply chain, from primary production to the final consumption. Likewise, [37] claimed that “food loss” refers to the amount of food available for human consumption after harvest that is not consumed for whatever reason. It

contains loss from mold, bugs, or poor climate management, as well as natural shrinkage. Food loss includes food waste, which happens when an edible item is not consumed, such as discarded food based on color or appearance from retailers.

[38] considers food waste as an ethical concern. Consumers when deciding to waste food may be faced with an ethical dilemma. When creating food waste, consumers are driven by internal and external motivations [27]. Studies done [39–41], confirmed that younger consumers achieving higher income living in cities with more family members or children incline to give more money on food and discarded more food. As reported by [42] consumers' food waste habits may be influenced by money. Additionally, consumer food waste behaviour is affected by self-identity, guilt [4] and regret [42]. Aspects such as environmental care or obligation and moral attitude straightly influence consumer behaviour intentions [42,43]. A study done by [28,42] reveal the fact that if consumers are aware of issues connected with food waste, their food waste is reduced. Moreover, according to [43] friends, family and social pressure have a great impact on food waste behaviour.

The need remains to recognise that the production process also has a consumer side [44]. The size of consumption, however, considerably varies both between and inside the individual countries. By way of monitoring it, it is appropriate to observe the size of an individual's (household's) income, as a decisive element of the motivation for consumption and consumer preferences. Both companies and consumers are part of the economic system and interact with one another. [45,46] are among the first to link individualization and consumption. Traditional social values, the need to occupy a certain position in society, and to have sufficient funds for the free choice of their allocation leads to ever-increasing consumption. This process is accompanied by ever-increasing demands on material equipment and food security.

Based on the statement given above, the authors agree with the opinion of [47] that, from a theoretical standpoint, the causes of food waste must be searched for in the theory of consumer behaviour. Learning these causes and locating the implements that influence the individual's behaviour may lead to the requested behavioural changes and reduction of overall waste. The individual, their personal attributes, and the environment they live in and are a part of are decisive for their behaviour.

Customer behaviour is impacted by a great number of factors. Some, to a greater extent, function as a reaction to their external environment, while others are a display of their individuality. Monitoring their influence, the mutual interaction of influencing, is particularly problematic [48]. Cultural factors are also connected to food waste behaviour [49]. For instance, according to [50], French consumers like to taste and savor their meals. On the other hand, [51] stated that the American food culture prioritizes quantity over quality, which results in food waste. In a way, cultural influences may be observed [52], which are genetically determined, have a long-term effect, are very slowly subject to change, but their knowledge is quite difficult to quantify. In addition, cultural and ethical influences together form the basis of an individual's value hierarchy. The diversity of cultures to meet the needs of Western cultures, for example, is the prioritisation of the importance of new technologies, the quality of information, the method in which they are used, and usefulness.

Factors influencing food consumption and waste include personal, demographic, the character and size of households, their lifestyle, economic activity, and household income. Food price is also respected as a significant factor. [53] count education and sex amongst the significant factors. In their studies, [54] provide the trust factor as the deciding factor of consumer behaviour in today's modern consumer society. They distinguish trust between organisational and interpersonal relations. Organisational trust is given by the social system, enforceability, law, information quality both in print

and on social media, product quality, brands, etc. The trust of interpersonal relations is given by consumers' behaviour, their communication, both personal and primarily their behaviour on social media. Development and the continuously growing popularity of social media amongst internet users greatly influence the change of shoppers' purchasing decisions; this is a powerful tool for influencing the consumer. The positive benefits include the option of purchasing over the internet in the online environment, easier access to information about the product, consumer reviews, experience with using the product, information regarding individual sellers' behaviour, etc. These positive benefits may become negative if the consumer decides to provide irregular information. A negative impact in relation to waste may be seen in the reality that, to a large extent, social media encourages the consumer to purchase the given product or service, even if they do not need it, leading to waste. Members sharing their purchases on social media contributes to this behaviour, however, this gives sellers the incentive to improve product or service quality and the option to increase their trustworthiness.

Changes taking place in society and evoking changes to consumer behaviour are particularly significant not only for their substance but also the speed at which they are displayed separately for various generations of individuals [55].

[56] show the importance of the subjective perception of the issue of waste, which can lead to a change in stances towards waste and consequently the amount of food waste through the controlled action of appropriate tools.

Food waste can also be influenced by a number of so-called "external factors", the knowledge of which and the choice of appropriate marketing tools can reduce the size and structure of food waste. Such factors include the correctly chosen type and form of packaging. Information on the length of storage and its form is also important, as is the size of the packaging. [57] affirm that the primary component of creating waste is purchasing in too great a quantity (often caused by packaging sizes), ambiguously provided expiration dates, failure to inspect the expiration dates, and making random instead of planned purchases. [3] similarly cite the purchasing of large quantities of food, its poor storage, exceeded expiration dates, and spoiled food as a common cause. These easily remediable causes of waste are greatly important, as the size of waste in households, cafeterias, and restaurants contributes significantly to the size of our carbon footprint. According to [58], 40–60% of food waste is made in consumers' homes, and that it creates up to 20% of the total waste in landfills.

This work aims to monitor the differences in stances towards consumer waste based on surveys in the three countries similar in history, culture, and social institutions, and thus, contribute to the decisions regarding the reasons that contribute significantly to food waste, finally to suggest ways to reduce food waste. Is society-wide consumption equally important as a starting point for waste in all these countries? Do consumers have an equally responsible approach to shopping in terms of consumption or depreciation? Are they also aware of the waste of societal resources when wasting daily?

2. Materials and method

The main source of secondary data are the Eurostat databases [59,60]. To express the economic situation of the individual countries of the Czech Republic, Poland, and Slovakia, data on household income and total consumption was monitored for a 10-year time series between the years 2010–2019. A quintile income ratio is used to express income inequality.

To find out the respondents' behaviour in connection with food waste, an extensive questionnaire

survey was conducted in the month of March–June 2019 with 1,582 respondents from the Czech Republic, 838 from Slovakia, and 1,009 from Poland. The questionnaire was translated from the Czech language into Slovak and Polish in order to ensure the appropriateness of the translation and has the same meaning in the three countries. For this purpose, a cross-check was carried out by language experts.

Before data collection began, the questionnaire was tested and a pilot study was conducted on a sample of 30 respondents from each country in January 2019. The data collection itself was carried out by a combination of personal and online interviewing in order to ensure the representativeness of the data. The questions in the questionnaire were constructed on the basis of free interviews with 10 respondents and subsequent brainstorming by the authors of this paper, who drew on professional sources. The data in Table 1 shows the representativeness of the number in the individual identification groups.

Table 1. Sample composition.

Number of respondents		CZ 1582		PL 1009		SK 838	
		Abs.	Rel. %	Abs.	Rel. %	Abs.	Rel. %
Check digits							
Sex	Male	973	61.5	805	79.8	588	70.2
	Female	609	38.5	204	20.2	250	29.8
Age	18-29	266	16.8	424	42.3	344	41.1
	30-49	735	46.5	440	43.6	210	25.1
	50-64	361	22.8	122	12.2	162	19.3
	65 and over	220	13.9	19	1.9	122	14.5
Education	Primary School	32	2.0	8	0.7	16	1.9
	Secondary School — non-graduate	211	13.4	46	4.6	99	11.8
	Secondary School — graduate	697	44.0	315	31.4	437	52.2
	Higher Vocational School/College	78	4.9	366	36.3	26	3.1
Economic activity	University	564	35.7	274	27.1	260	31.0
	Employee	911	57.5	454	45.0	301	35.9
	Self-employed	153	9.7	131	13.0	74	8.8
	Pensioners	248	15.7	38	3.8	134	16.0
	Student	198	12.5	279	27.6	293	35.0
Perceived income	Other	72	4.6	107	10.6	36	4.3
	Insufficient	11	0.7	32	3.2	15	1.9
	Low	140	8.8	92	9.1	74	8.9
	Average	551	34.9	462	45.8	274	32.7
	Satisfactory	788	49.8	369	36.6	415	49.4
	High	92	5.9	54	5.3	60	7.1

The questionnaire was created with 18 content questions related to the issue of waste, their stances in relation to this issue, the causes of food waste, and their structure. Age, education, economic activity, and perceived income are the identification questions of the respondent, the control features for the

representativeness of the selection.

The results of the questionnaire survey were processed in the SPSS program Statistics Using Descriptive Statistics; Pearson's chi-squared test was used to verify the dependence of the qualitative indicators.

In the next step, logistic regression analysis in its nominal form was performed. The subjective evaluation of the consumers' own food waste (dependent variable) is expressed using 5 levels:

- A. zero waste
- B. small amount of waste
- C. medium amount of waste
- D. large amount of waste
- E. considerable amount of waste

These levels were determined from the question in the questionnaire expressed as follows: 0 g (A), 51–500g (B), 501–1000g (B), 1001–1500g (D) 1501–2000g (E). These 5 levels stem from previous findings from a diary survey among Czech respondents and was compiled on the basis of statistical rules for sorting.

Using the results of logistic regression, the difference in self-assessment in the area of waste in connection with selected statements (independent variables) shall be determined:

- 1) They prefer to buy large packages of food because they are cheaper per piece.
- 2) Planning shopping for food and food preparations in the way so that nothing is thrown out, is very difficult.
- 3) I consume every piece of food I purchase.
- 4) Before I eat, I always cut off the skin/peels from the fruit and throw them away.
- 5) The problem of food waste is a current and ongoing issue.
- 6) Food waste presents a great threat for us in the future.

The observed reference category is the E level of waste-the consumer is rated as "wasting a considerable amount". The work's conclusion and recommendation are formulated as a result of these analyses.

3. Results

The issue of waste, as stated by [45,46] for example, must be looked at in connection with the economic situation of the given country, primarily, how the household income is progressing (Figure 1) and the overall consumption of these countries (Figure 2). To this end, the situation is first approached in the selected countries: The Czech Republic, Poland, and Slovakia, and this is then compared with the average in the European Union.

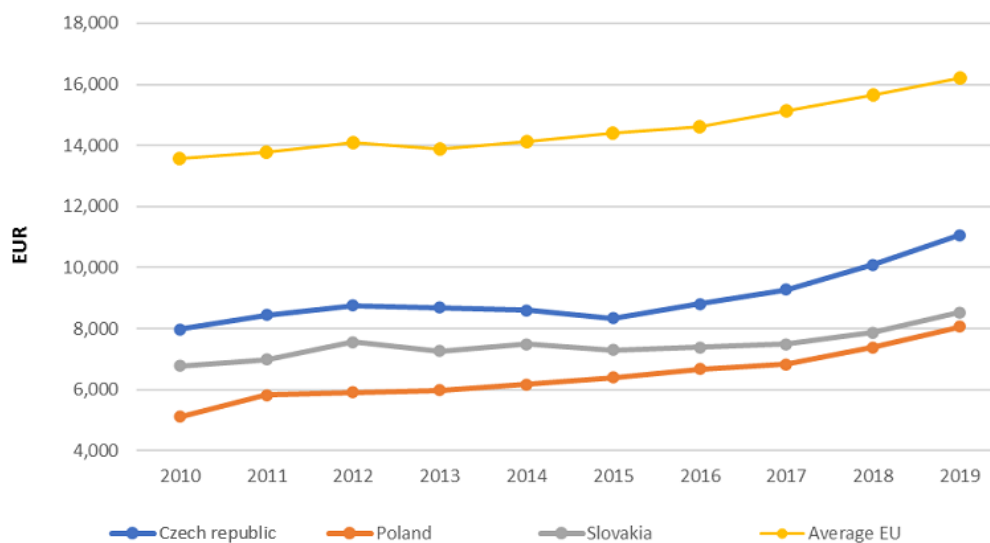


Figure 1. Development of equivalised annual household income. Source: [17,18].

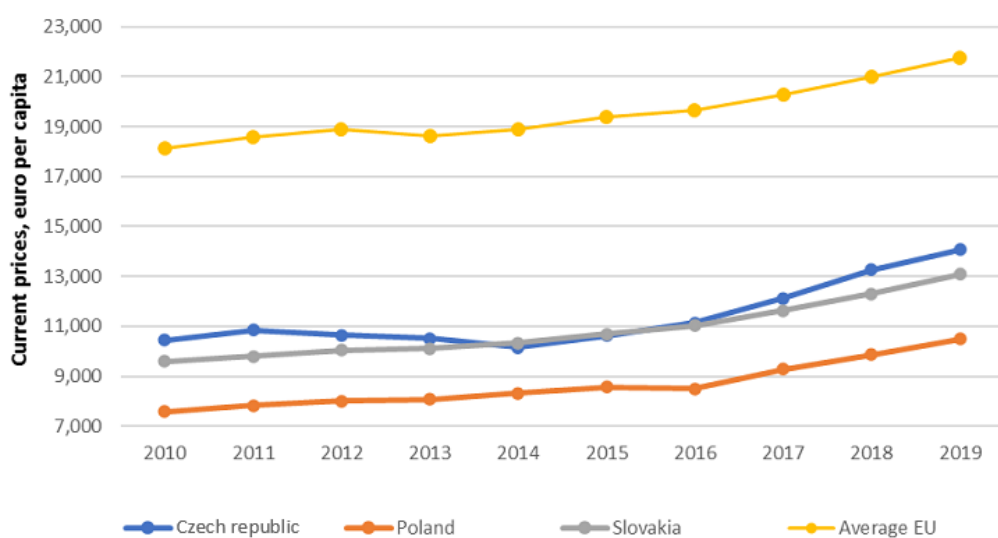


Figure 2. Final yearly consumption expenditure. Source: [17,18].

In Figure 1, the development of the household income via the equivalised annual income is expressed in the three observed countries. The course of development shows the fastest income growth and its achieved level in the Czech Republic; a similar rate of income development was recorded in Poland and a certain stagnation of household income growth was recorded in Slovakia, however, at a higher level than Poland.

A suitable addition to the household income analysis is the income average (Table 2). This indicator is the measuring scale for income inequality. It is calculated from the total income and is the ratio of the highest income quintile to the lowest income quintile. It shows that the largest income inequality is in Poland, the smallest in the Czech Republic. The assumed structure of expenditures may be deduced from the income inequality in society. According to Maslow's pyramid, low-income

households use their expenditures primarily to meet basic needs, i.e., expenditures on food and housing.

Table 2. Average household income. Source: [17,18].

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
CZ	3.47	3.54	3.49	3.40	3.50	3.51	3.50	3.40	3.32	3.34
Poland	4.98	4.95	4.92	4.88	4.91	4.92	4.76	4.56	4.25	4.37
Slovakia	3.80	3.81	3.73	3.58	3.93	3.54	3.63	3.49	3.03	3.34

The largest increase in consumption expenditures for the 10-year period is seen in Poland (38%), followed by Slovakia (36%), and the Czech Republic (34%). The way these countries are ranked is in direct proportion to the achieved level of total consumption expenditure in the observed years. This is in line with the trend of the consumer society. Poland, which has had the lowest consumption expenditure so far, is approaching the remaining countries in question. This overview of the initial economic situation in the EU countries and the countries we monitored also shows a different level of consumption expenditure between individual EU countries, since about a 30% difference remains between the average household expenditure of our countries and the EU average.

It is also clear from Figures 1 and 2 that economic growth is recorded, and household income is still expected to grow faster than the consumption expenditure. This also corresponds to one of the aims of this work, that in all three monitored countries, namely the Czech Republic, Poland, and Slovakia, society-wide consumption as a starting factor for waste does not differ significantly and has an increasing trend of development, with a small deviation of household income in Slovakia. Therefore, the issue of food waste must be addressed in an effort to change the hierarchy of values both in society and its approach to environmental protection, as well as by changing the value orientation of each individual.

The results of the questionnaire survey conducted in 2019 were used to monitor consumer behaviour in the food market, including their stances on food waste. The survey took place in the Czech Republic, Poland, and Slovakia with a total of 3,429 respondents. In the Czech Republic, 1,582 respondents participated, with another 1,009 in Poland, and 838 in Slovakia. As the secondary data showed, it could be stated that the income situation in the given countries and the resulting societal consumption in these countries have a growing trend and do not differ significantly between countries.

In terms of an individual's behaviour, food waste in households has, among other things, its basis in the way people buy and approach shopping. The relationship to consumption and expenditure on food with a predominantly rational way of shopping is shown by the answers to the questions that relate to the method of purchasing food. The strength of their effect on individuals is expressed by determining the value on a 10-point scale. Also from the answers of the respondents here, it can be deduced that the preparation and method of shopping in the observed countries do not significantly differ. Shopping influences Slovak consumers the most according to the state of the given household's provisions and according to whether they prepare a list in advance. Price and discounts are important for the Czech Republic. Poles are the least responsible for buying food. Overall, the price level of purchasing food is given less importance, as well as discount promotions for buying food, even if they do not need it at the moment. These responses to how the importance of prices was viewed must be taken with some caution, as experience from other research shows that consumers believe to have a general knowledge of the price rather than its reality. The approach to purchasing food as needed, so that it is not then thrown away, as well as striving to consume every purchased item is considered a

significant factor in the waste of half of all households.

Knowing the causes of waste is necessary for creating effective measures to reduce food waste. As Figure 3 makes apparent, the causes of food waste and its amount in the observed countries are particularly similar. The most common reason for food waste is its spoilage, past expiration dates, and the fact that consumers prepare more meals (lunch, dinner) than they actually consume. Similarly, they also buy more than they consume; all three causes of food spoilage (expired minimum shelf-life date, exceeding the “use by” date, the food has spoiled while in storage, etc.). Consumers do not buy because they need food and in the correct amount. Rather, they purchase food because they like the offer, either thanks to its appearance or the economic advantage at the time (discount, quantity discount, package size of discounted goods, etc.). More detailed results on the causes of waste in the given countries are shown in Figure 3.

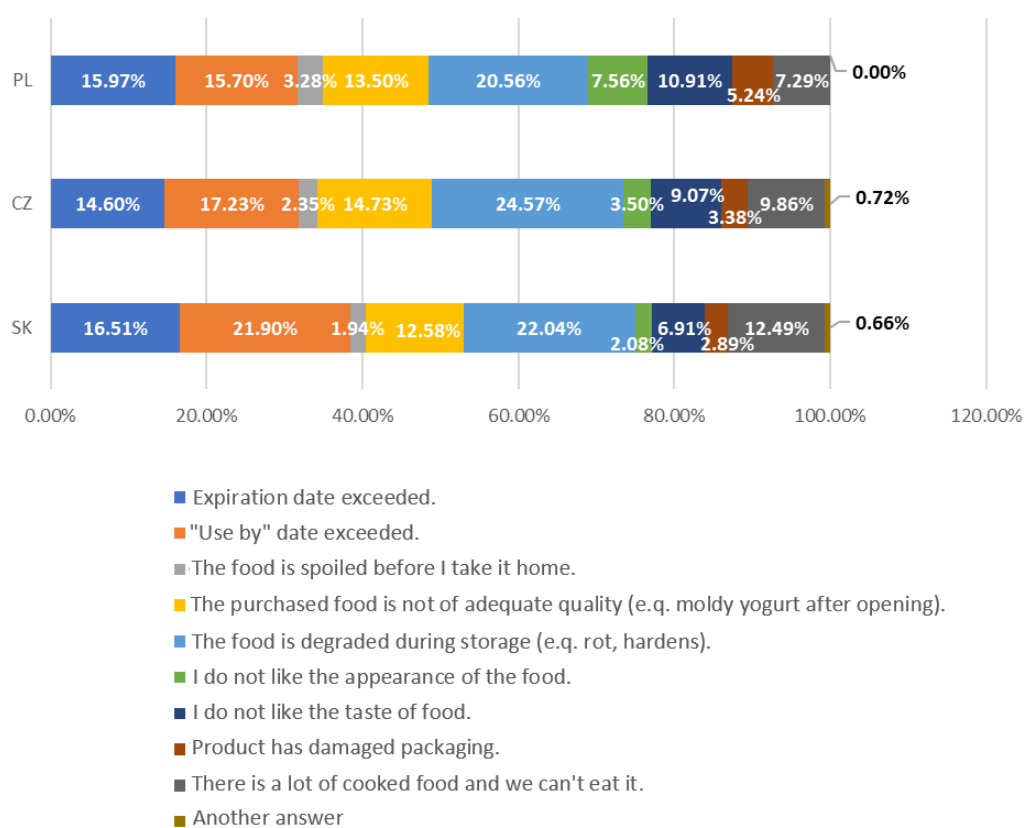


Figure 3. Answers to the question “What is a frequent cause for you throwing away food?”.

Source: questionnaire survey, n = 3429.

Another important factor is the attitude towards wasting, which also happens to be one of the most important factors in consumer behaviour and food waste. Every individual develops an attitude towards wasting during their lifetime via their stance on their quality of life, the environment, commercialization in society, and their given education orientation value. Seniors behave differently as they remember what it means to have food shortages (within their respective cultural conditions), young people approach food waste differently as well, as they are capable of imaging the energy demands for food production and processing as well as the energy intensity of waste disposal,

including spoiled food. People who prefer a healthy lifestyle and protecting the environment have a different approach to consumption, and people who represent the consumer society and prefer consumption quantity, its quality, and opulence have a different relationship to waste. The individual's attitude to waste was monitored through a number of questions on the issue of waste and expressed by their positive or negative stance on waste. This opinion (Table 3) differs for individual groups created according to identification features, i.e., by education, age, economic activity, and income situation. Whether there is a significant relationship between the groups of respondents created by the levels of individual identifiers to their stance on food waste was statistically evaluated. Pearson's chi-square test was used to verify the dependence, where the p-value less than 0.05 verifies the dependence, the contingency coefficient indicates the degree of dependence (in our cases, it reaches the lower values). For this factor in Slovakia, the economic activity expresses the mean strength of dependence. The values in the table marked with a red X indicate independence.

Table 3. Contingency analysis results. Source: questionnaire survey, n = 3429.

	SK		CZ		PL	
	Contingency coefficient	Pearson	Contingency coefficient	Pearson	Contingency coefficient	Pearson
Age	0.2223978	0.02271	0.1993418	0.00019	0.3433109	0.00000
Education	0.2566722	0.00895	0.1591122	0.42255	0.3310958	0.00000
Eco. activity	0.4675452	0.00003	0.2512942	0.00315	0.3434123	0.00000
Income	0.2274798	0.12835	0.1826349	0.06188	0.1973293	0.26469
Sex	0.1571603	0.01170	0.1563638	0.00002	0.2107870	0.00000

Above, Table 3 shows that stances towards food waste, whether positive or negative in nature, are influenced by identifying features such as age, education, economic activity, and perceived income. The results are statistically significant. This is almost identical in every observed country and it does not differ significantly between the countries. Respondents in the Czech Republic, Poland, and Slovakia have a particularly similar stance on waste, although the relationship between the stance on waste and age, stance on waste and economic activity, and stance on waste and gender are weak, however, convincing. The influence of education on the stance on waste was only recorded in Poland and Slovakia. The influence of the income group has not been demonstrated in all countries. This conclusion on the influence of the perceived income is probably influenced by the fact that the objectively achieved income was not monitored, rather the respondents themselves provided whether they considered their perceived income to be sufficient or not.

In order to examine the relationship between the quantity of food waste and the selected consumer stances, a nominal regression was performed, the results of which are shown in the following tables (Tables 4–9).

Table 4. Case processing summary.

		N	Marginal Percentage
Try to estimate how much food you throw out per week.	Less than 50g	848	25.6%
	51–500g	1383	41.8%
	501–1000g	691	20.9%
	1001–1500g	287	8.7%
	1501–2000g	102	3.1%
Country:	CZ	1508	45.5%
	SK	826	24.9%
	PL	977	29.5%
Valid		3311	100.0%
Missing		119	
Total		3430	
Subpopulation		3051	
a. The dependent variable has only one value observed in 2993 (98.1%) subpopulations.			

Table 5 shows that the model is statistically significant (significance of the model verified).

From the test results in Table 6 together with the Pseudo R-Square results in Table 7, it can be stated that the model appears to be of sufficient quality.

Table 5. Model fitting information.

Model	Model Fitting Criteria	Likelihood Ratio Tests		
	-2 Log Likelihood	Chi-Square	df	Sig.
Null	10500.375			
Final	8350.088	2150.287	40	0.000

Table 6. Goodness-of-fit.

	Chi-Square	Df	Sig.
Pearson	12845.334	12164	0.000
Deviance	8246.311	12164	1.000

The model is statistically significant and explains nearly 50% of the dependent variable.

Table 7. Pseudo R-Square.

Cox and Snell	0.478
Nagelkerke	0.498
McFadden	0.202

Every variable listed below is based on the Likelihood Ratio Test for the statistically significant model ($p < 0.05$).

Table 8. Likelihood Ratio Test.

Effect	Model Fitting criteria		Likelihood Ratio Tests	
	-2 Log likelihood of reduced model	Chi-Square	df	Sig.
(1)(2) I go shopping for food regularly.	8360.246	10.158	4	0.038
(1)(8) Planning shopping for food and food preparations so that nothing is thrown out is very difficult.	8398.742	48.655	4	0.000
(1)(9) I consume every piece of food I purchase.	8491.041	140.953	4	0.000
(1)(10) Before I eat, I always cut off the skin/peels from the vegetables and throw them away.	8416.615	66.527	4	0.000
(1)(11) Before I eat, I always cut off the skin/peels from the fruit and throw them away.	8367.232	17.144	4	0.002
(1)(12) The problem of food waste is a current issue.	8360.286	10.199	4	0.037
(1)(13) Food waste presents a great threat for us in the future.	8364.898	14.811	4	0.005
Country:	8580.122	230.034	12	0.000

The chi-square statistic is the difference in -2 log-likelihoods between the final model and a reduced model. The reduced model is formed by omitting an effect from the final model. The null hypothesis is that all parameters of that effect are 0.

The effect on the difference in food waste up to 50 g and over 1500 g affects the planning of purchases, the consumption of all purchased food, and the peeling of vegetable skins/peels. Those who plan purchases have a 0.873× higher chance of wasting quantities up to 50 g than over 1500 g (i.e., less of a chance). Those who consume all purchased food have a 1.303× higher chance of wasting quantities up to 50 g than over 1500 g. Those who peel vegetable skins/peels have a 0.824× higher chance of wasting quantities up to 50 g than over 1500 g (i.e., less of a chance).

Czechs have a 4.9× higher chance of wasting food up to 50 g than over 1500 g. Slovaks have a 3.3× higher chance and Poles have a 10.5× higher chance. Thus, Poles throw out the amount of food up to 50 g most often out of all three countries. This is interesting since, for all other quantities, the Czechs throw out the smallest amount of food (Czechs have the highest chances in the Exp (B) column). For the last compared category of quantity (1001–1500 g), the influence of each country is insignificant. It differs from the wasted amount of 1501–2000 g only in the Czech Republic.

Table 9. Parameter estimates.

Try to estimate how much food you throw out per week ^a .			Std.					
		B	Error	Wald	df	Sig.	Exp(B)	
Less than 50g	(1)(2) I go shopping for food regularly.	0.077	0.043	3.269	1	0.071	1.080	
	(1)(8) Planning shopping for food and food preparations so that nothing is thrown out is very difficult.	-0.136	0.045	9.178	1	0.002	0.873	
	(1)(9) I consume every piece of food I purchase.	0.264	0.047	31.689	1	0.000	1.303	
	(1)(10) Before I eat, I always cut off the skin/peels from the vegetables and throw them away.	-0.194	0.055	12.471	1	0.000	0.824	
	(1)(11) Before I eat, I always cut off the skin/peels from the fruit and throw them away.	0.028	0.052	0.296	1	0.586	1.028	
	(1)(12) The problem of food waste is a current issue.	-0.040	0.068	0.338	1	0.561	0.961	
	(1)(13) Food waste presents a great threat for us in the future.	0.064	0.064	1.000	1	0.317	1.066	
	[Country=1.00] CZ	1.580	0.454	12.105	1	0.001	4.856	
	[Country=2.00] SK	1.194	0.456	6.860	1	0.009	3.300	
	[Country=3.00] PL	2.351	0.405	33.670	1	0.000	10.491	
	51–500g	(1)(2) I go shopping for food regularly.	0.086	0.041	4.394	1	0.036	1.090
		(1)(8) Planning shopping for food and food preparations so that nothing is thrown out is very difficult.	-0.113	0.044	6.719	1	0.010	0.893
		(1)(9) I consume every piece of food I purchase.	0.129	0.045	8.282	1	0.004	1.138
(1)(10) Before I eat, I always cut off the skin/peels from the vegetables and throw them away.		-0.028	0.053	0.281	1	0.596	0.972	
(1)(11) Before I eat, I always cut off the skin/peels from the fruit and throw them away.		-0.059	0.050	1.403	1	0.236	0.943	
(1)(12) The problem of food waste is a current issue.		-0.070	0.067	1.097	1	0.295	0.933	
(1)(13) Food waste presents a great threat for us in the future.		0.159	0.062	6.573	1	0.010	1.172	
[Country=1.00]		2.254	0.444	25.753	1	0.000	9.524	
[Country=2.00]		1.605	0.446	12.947	1	0.000	4.976	
[Country=3.00]		1.641	0.402	16.664	1	0.000	5.160	

Continued on next page

Try to estimate how much food you throw out per week ^a .		B	Std. Error	Wald	df	Sig.	Exp(B)	
501–1000g	(1)(2) I go shopping for food regularly.	0.102	0.042	5.779	1	0.016	1.108	
	(1)(8) Planning shopping for food and food preparations so that nothing is thrown out is very difficult.	-0.048	0.045	1.148	1	0.284	0.953	
	(1)(9) I consume every piece of food I purchase.	0.029	0.046	0.405	1	0.525	1.030	
	(1)(10) Before I eat, I always cut off the skin/peels from the vegetables and throw them away.	-0.014	0.055	0.066	1	0.798	0.986	
	(1)(11) Before I eat, I always cut off the skin/peels from the fruit and throw them away.	-0.011	0.051	0.042	1	0.837	0.989	
	(1)(12) The problem of food waste is a current issue.	-0.112	0.068	2.675	1	0.102	0.894	
	(1)(13) Food waste presents a great threat for us in the future.	0.117	0.064	3.390	1	0.066	1.124	
	[Country=1.00]	1.739	0.456	14.573	1	0.000	5.694	
	[Country=2.00]	1.462	0.457	10.237	1	0.001	4.314	
	[Country=3.00]	1.494	0.412	13.165	1	0.000	4.454	
	1001–1500g	(1)(2) I go shopping for food regularly.	0.137	0.047	8.635	1	0.003	1.147
		(1)(8) Planning shopping for food and food preparations so that nothing is thrown out is very difficult.	0.034	0.049	0.469	1	0.493	1.034
		(1)(9) I consume every piece of food I purchase.	-0.037	0.050	0.540	1	0.462	0.964
(1)(10) Before I eat, I always cut off the skin/peels from the vegetables and throw them away.		-0.056	0.060	0.868	1	0.351	0.946	
(1)(11) Before I eat, I always cut off the skin/peels from the fruit and throw them away.		-0.001	0.056	0.000	1	0.986	0.999	
(1)(12) The problem of food waste is a current issue.		-0.157	0.074	4.512	1	0.034	0.855	
(1)(13) Food waste presents a great threat for us in the future.		0.116	0.069	2.803	1	0.094	1.123	
[Country=1.00]		1.078	0.495	4.744	1	0.029	2.940	
[Country=2.00]		0.712	0.499	2.035	1	0.154	2.037	
[Country=3.00]		0.750	0.450	2.785	1	0.095	2.118	

^aThe reference category is: 1501–2000g.

4. Discussion

Based on the results of the questionnaire survey it can be concluded that shopping decisions in Slovakia are primarily influenced by the state of the household's supplies and by whether a list has been made in advance. Czech consumers prefer discounts and overall prices when shopping. The least responsible people for food purchases are Poles. [61] were evaluating consumer food waste behaviour in Italy. Their findings reveal that approximately 92% of respondents prepare a shopping list and almost all of the respondents claimed that they buy food when special offers are offered. Research by [62] discovered that 16% of young Romanian males (aged between 18–34) are attracted to special offers when shopping. On the other hand, 12% of female respondents claimed that they shop when there is a special offer. Moreover, almost 25% of females claimed that they are not interested in special offers when shopping. According to [63], Italian consumers appear to be sensitive to discounts and are eager to purchase in several shops. Additionally, [64] product discounts can result in a positive consumer reaction in the context of expiration date or damaged product. Based on the results from [65] it can be concluded that more than 47% of respondents in Macedonia prepare a shopping list and 40% of respondents prepare it occasionally. In contrast, only 12% of participants did not prepare a shopping list.

When discovering the causes of the food waste the results showed that in Slovakia almost 22% of respondents claimed that the term „use by“ date was exceeded. Furthermore, 22% of Slovak participants generate food waste due to food degradation during storage. Almost 17% of respondents stated that they create food waste because of the date expiration. Similar results were obtained also in other examined countries. In the Czech Republic, almost 25% of respondents generate food waste because of degradation during storage and in Poland approximately 21% of respondents. The appearance of food was evaluated as a frequent cause of throwing away in Poland by 8% of respondents, 2% of respondents in Slovakia and 4% of participants in the Czech Republic. Results of [66] showed that more than 50% of respondents as the main reason for throwing food away was food spoilage, followed by overrun of the expiration date (33%) and excessive food preparation (21%). Additionally, [67] were discovering the reasons for food waste in Finland. It can be concluded that the most frequent reason for throwing food away was mainly spoilage and mould (29%). The second frequent cause of food waste was that the best before or use by date has expired (19%). Finally, 14% of respondents created food waste due to plate leftovers. [68] highlighted the major causes of food waste. They emphasize that among the main causes of waste was mainly a lack of planning and management of the purchase, storage, preparation, and reuse of food and meals and also the appearance of overall food.

Research by [69] offers an interesting look on the results at the “best before” and “use by” dates in Poland. 1145 respondents conducted the questionnaire survey. Based on the results it can be concluded that 61% of participants were able to correctly answer the meaning of the “best before” date. Furthermore, 5% of respondents did not know what the terms mean. On the other hand, when discovering the term “use by” almost 80% of respondents were able to answer correctly. Only 4% of respondents did not know the answer. A study done in Belgium was discovering the understatement of the dates “use by” and “best before” among 907 participants. Based on the results 30% of participants did not know the difference between use by and best before labels [70]. According to research by [71] consumers were not certain when it comes to the meaning of date labels. Moreover, the results showed that consumers use the dates on food labels to decide what to throw away. More than 37% of

participants always or frequently throw away food because it is approaching or the date expired. Notably, consumers over the age of 65 were the least inclined to throw away food based on the date label, while consumers aged 18 to 34 were the most likely to throw food.

The authors of the paper are trying to find a way to capture food waste so that it can be investigated. However, this effort has its limits. Food waste is a topic that is difficult to grasp in a way due to the ambiguous definition of this term in research circles. Respondents in the questionnaire estimate the amount of food they threw away, which can be misleading. For this purpose, it is necessary to carry out a thorough daily examination. Anyway, the authors are trying to at least approximate this. It would be appropriate to conduct a questionnaire survey on a larger sample of respondents and at the same time supplement this survey with qualitative research.

5. Conclusions

To achieve the societal goal of reducing food waste, it is necessary to know both the process of food waste and subjective customer behaviour. Quantifying the quantity of food waste and its structure for subsequent corrective measures is unrealistic due to the absence of a definition of basic terms, especially the definition of food waste and the absence of a methodology for monitoring the structure and amount of food waste. Therefore, on the issue of food waste, the authors of this work chose the path of understanding subjective customer behaviour. This is about recognizing the conditions under which there is an undesirable increase in the amount of food waste. The basic condition for the growth of consumption is the economic growth of society, especially the income situation of households in the given countries, and thus, the sufficient financial resources to satisfy consumption. From the 10-year period of economic development in the Czech Republic, Poland, and Slovakia, there is clear economic growth (with a similar growth rate) as well as growth in the household income situation. Thus, the conditions for meeting people's needs are met.

The main subject of the authors' interest was to know the factors that are decisive for consumers in relation to waste, i.e., the relationship to consumption and the stance on waste. This work aimed to learn the causes that significantly influence this stance. Opinion polls were conducted in 2019, in the three observed countries – the Czech Republic, Poland, and Slovakia, with 3,429 respondents. Their answers showed that the reason for food waste is its spoilage (exceeding the food's expiration date, change in quality), however, the primary cause is the amount of food purchased and not consumed.

According to the results of the survey, this quantity is mainly influenced by the individual's approach when shopping – whether they shop according to their number of provisions at home, according to their list of needs, or if they shop emotionally according to the current offer/sale. The survey also showed that the stance on waste, or access to consumption, respectively, consists mainly of each individual's identifying features, such as age, economic activity, and education. Whether there is a relationship between these traits and their stances on waste expressed by their attitude and behaviour, Pearson's chi-square test was used, the results of which show that the stance towards food waste, whether positive or negative, is influenced by identifying features such as gender, age, education, economic activity, and perceived income. This is almost identical in every observed country and it does not differ significantly between the countries. Respondents in the Czech Republic, Poland, and Slovakia have a particularly similar stance on waste, although the relationship between the stance on waste and age, stance on waste and economic activity, and stance on waste and gender are weak, however, convincing. In monitoring the relationship between the subjectively perceived amount of

food waste and consumer behaviour, a nominal regression was performed, indicating the expected changes in the future. E.g., those who prefer buying large-package items have a higher chance of not wasting than wasting a lot. Those who think it is difficult to plan their purchases and preparation of food so that nothing is thrown away have a higher chance of not wasting than wasting a lot. Those who consume all the food they buy have a higher chance of not wasting it at all. Those who think that food waste is a threat to the future have a higher chance of not wasting food.

To reduce food waste, consumers need to be made aware of this issue through organisational and government campaigns, something that has already proved effective in the UK, where food waste has fallen by more than 20%, thanks to the “Love Food, Hate Waste” campaign. [3]. The education of young people and the use of digital technologies and social networks prove to be a possible solution. What is necessary from a methodological point of view, however, is the creation of a uniform approach to measuring the amount of food waste, at least within the European Union, and constant research in this area so that developments may be monitored, and the necessary changes highlighted.

Conflict of interest

All authors declare no conflicts of interest in this paper.

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