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Attitudes and Behaviours of Young Consumers towards Wasting Food: Case Study Based on Polish Students

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Abstract: Civilisation changes affect the attitudes and behaviour of consumers related to food waste. Most food is wasted by households. The purpose of this study was to assess the behaviour and attitudes of Polish students related to food waste and to determine the amount and type of food waste, as well as to indicate the causes of this problem. The analysis of attitudes and behaviours of individual groups of society directs actions to be taken in order to reduce food waste. For 14 days, a questionnaire was completed by Polish students from two universities. It concerned the frequency of throwing away food products and the type and amount of wasted products, as well as the reasons for throwing food away and the ways of counteracting this situation. Descriptive statistics, a Pareto–Lorenz analysis and a cluster analysis were used to analyse the obtained data. In this study, the level of food waste by Polish students was determined, and the study group was segmented into three clusters. The three clusters defining the attitudes of Polish students were (1) "aware students", (2) "disengaged students" and (3) "aware but disengaged". The largest number of respondents were classified into cluster 2. Polish students are aware of the problems of food waste, but do not contribute to reducing it. In most cases, students' behaviour was not differentiated by socio-demographic characteristics.

Keywords: food waste; consumer behaviour; consumer attitudes; students

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1. Introduction

The ongoing civilisation changes and the globalisation of food markets have caused many changes in food production and consumption. The positive aspects of globalisation include new markets and access to new raw materials, products and processing technologies, as well as an increase in the availability of food products with various quality characteristics [1]. However, the agri-food trade and physical access to some raw materials have been limited by the COVID-19 pandemic [2] and ongoing military conflicts [3]. These crises have resulted in the instability of supply chains, driving up food prices and consequently weakening the ability of countries and households to secure their food needs. Global food prices have been rising since mid-2020 and are now at an all-time high. Based on EUROSTAT data from 2022, the annual inflation in Europe was 9.2% in December 2022. The main components of inflation in Europe are energy (25.7%), food, alcohol and tobacco (13.8%), non-energy industrial goods (6.4%) and services (4.4%) [4]. In just two years, the number of people facing acute food insecurity or who were at high risk increased by more than 200 million; from 135 million in 53 countries pre-pandemic to 345 million in 82 countries today [5]. According to WHO estimates, more than 1 billion people worldwide are obese—650 million adults, 340 million adolescents and 39 million children— and this number is still increasing [6].

Unsustainable production and consumption inevitably lead to food waste. Food waste is a global issue for all countries in all stages of the food chain. Wasted food is "food produced for human consumption that has not been consumed" [7]. In the

opinion of several authors, food waste is related to the final consumption phase (household, restaurants, retail and transport) and is a consequence of consumer behaviour [8–11]. Food waste is caused by irrational shopping, food exceeding the expiry date, improper storage, unfinished meals, etc. [12–14]. Monier et al. (2010) estimated the average annual food waste per EU inhabitant to be 179 kg; in terms of the household it was 76 kg per household member [15]. At the EU level, the total food waste measured in 2020 nearly reached 57 million tonnes. Household food waste represented more than 31 million tonnes of fresh mass, with a 55% share of the total. The remaining shares of total food waste were from the processing and manufacturing stages (18%), primary production sector (11%), restaurants and food services (9%) and retail and other distribution of food sectors (7%). In 2020 in the EU, around 127 kg of food per inhabitant was wasted. Households generated about 70 kg per inhabitant/per year. The largest amount of food wasted by households was in Portugal (124 kg per person/per year), Italy (107 kg per person/per year) and Luxembourg (91 kg per person/per year), while in Bulgaria it was 26 kg per person/per year. In Poland, there was 60 kg of food waste per person/per year [16]. Several studies analysed the behaviour and the awareness level of young people and university students towards the issue of food waste [17–20]. A study conducted by Nikolaus showed that people aged 18–24 tend to waste more food compared to people in different age groups [21]. Globally, approximately one-third of all food produced for human consumption is lost or wasted [10]. FAO's Food Loss Index (FLI) estimates that globally, around 14 percent of all food produced is lost. As was pointed out in the SDGs Report, around 17% of total food available to consumers (931 million metric tons) is wasted at the household, food service and retail levels, translating to 121 kg per person each year, with about 60% of this waste occurring in households. Food waste at the consumer level in industrialised counties (222 million tons) is almost as high as the total net food production in Sub Saharan Africa. Reducing food loss and food waste is hindered by the lack of data at the national and international level, and still little is known about how much food is wasted by consumers [22]. Amicarelli and Bux [23] stated that it is necessary to coordinate studies and research toward a well-organised measurement of food waste. They indicated that each methodology seems to have its own strengths and weaknesses, but a mix of a mass balance approach and kitchen diaries could be helpful towards food waste minimisation.

The aim of the study was to assess the behaviour and attitudes of the Polish students related to food waste and to determine the amount and type of food waste, as well as to indicate the causes of this phenomenon. The following research hypotheses were formulated in this work:

H1. *The amount of food waste generated by Polish student households is below the Polish households' average.*

H2. *The structure of food wasted by Polish students is similar to other households.*

H3. *Students take action to reduce the amount of food waste in their households.*

2. Literature Review

Food loss and food waste have substantial environmental (e.g., energy, soil, water, greenhouse gas emissions, non-productive use of natural resources, such as agricultural land and water and waste from non-renewable energy), social (e.g., failure to secure food for a wider population, increasing food prices and negative effect on nutrition levels) and economic (e.g., direct loss for all actors along the supply chain, profit reduction, disposal and treatment costs and negative impact on financial resources for other investments) consequences [10,24–27]. Nowadays, sustainably meeting the food demands of a growing population based on finite resources while protecting the environment is one of the great challenges [28]. Reducing food waste and preventing it is becoming one of the key issues of the 21st century in the context of food supply chain management [7]. FLW affects food

security and food nutrition, the sustainability of food systems [29] and undermines the long-term resilience of the global food system by aggravating ecosystem damage [30].

One of the United Nations 17 Sustainable Development Goals, SDG 12 (Responsible consumption and production, target 3) aims to halve global food waste per capita at the retail and consumer levels and reduce food losses along production and supply chains, including post-harvest losses, by 2030 [31–33]. Moreover, to achieve this aim, the European Commission enacted the "Closing the loop–An EU action plan for the Circular Economy", defining food waste as a priority area. Food waste is one of the ten circular economy indicators which must be monitored and reported on by Member States. Furthermore, a main objective of the European Green Deal is the Farm to Fork Strategy, which aims to create a fair, healthy and environmentally friendly food system by reducing environmental impacts, mitigating climate change, reversing biodiversity loss and pursuing food security, nutrition and public health, thereby ensuring access to healthy, nutritious and sustainable food [34]. The concept of sustainable degrowth is emerging, aiming to promote inclusive societies, new social values and new policies, capable of satisfying human requirements whilst reducing environmental impacts and consumption of resources. Circular economy strategies for food production and FLW management systems, following the Sustainable Development Goals agenda, are being developed [35]. Circular economy (CE) is a concept aimed at rationalising the use of resources and reducing the negative environmental impact of manufactured products. A CE aims to minimise the consumption of raw materials and the generation of waste, and thus reduce emissions and energy use levels by creating a closed process loop in which waste generated is treated as a raw material in subsequent production stages [36]. Food waste reduction is one of the top priorities under the recent European Union's CE Package. It also contributes to achieving the SDG 12.3.

The occurrence of food losses and waste generates a burden on the environment. The first element relates to expenditure incurred during food production, and the second relates to utilisation of the resulting losses and waste including, e.g., greenhouse gas emissions (N_2O, CH_4, CO_2), which have a negative impact on the environment [36]. As pointed out by Hoehn et al. [37], the energy consumption of food systems is estimated to be about 30% of the final energy use, 70% of the world's freshwater withdrawals are used for agriculture and food systems produce around 26% of the anthropogenic greenhouse gas emissions. As a consequence, food that ends up in landfills generates 8 to 10 percent of global greenhouse gas emissions [32,36].

According to Conrad et al., the causes of food waste are increasing due to a higher quality of living [38,39], stating that single-person households or young professionals often buy more than they need. Bilska et al. [40] and Tomaszewska et al. [41] found that more food was wasted often by young people in Poland, both in households and in meals ordered in food establishments. The authors showed that people with a university-level education wasted food more often. Actually, food is an essential factor in many SDGs, such as no poverty (SDG 1), zero hunger (SDG 2), good health and wellbeing (SDG 3), clean water and sanitation (SDG 6), affordable and clean energy (SDG 7), responsible consumption and production (SDG 12), climate action (SDG 13) and life on land (SDG 15) [26,42–44].

A number of studies have focused on consumer segmentation in terms of attitudes towards food waste. Islam [45] divided Korean students into three clusters: (1) considerate food wasters, (2) unwitting food wasters and (3) ruthless food wasters. Cluster 1 is the largest cluster and it contains around 50% of the collected sample. There were more females than in the other clusters, so gender could be considered to have an effect on food waste. Unwitting and ruthless food wasters do not have enough knowledge about the effects of food waste and ways to prevent it. Aschemann-Witzel et al. [46] divided consumers into five clusters related to the food-lifestyle: (1) uninvolved young man waster, (2) convenience and price oriented low income, (3) well-planning cook and frugal food avoider, (4) young foodies and (5) established. Respondents belonging to cluster 1 are young, male respondents who assess food waste as relatively less important. Cluster 2 consists of respondents who are uninvolved or less involved with food, who focus on

price, have a preference for convenience foods and often correlate with lower income customers. Cluster 3 includes older respondents, females, sometimes with a fairly high income, who are characterised by a certain involvement with food, planning meals, using less convenience food and who report the lowest amount of food waste. The fourth cluster consists mainly of young people or females. It is characterised by high involvement with food and high importance given to the issue of food waste, who consider meals as an opportunity for social events and sometimes do not pay attention to meal planning or food prices. The fifth profile includes respondents with certain food involvements, in particular a culinary interest, who give less importance to price and use convenience food less, they are more highly educated, have a higher income or are elderly consumers. Bilska et al. [47] also performed consumer segmentation. They divided households into three groups: (1) saving food, (2) wasting vegetables and fruits and (3) wasting food. Respondents in cluster 1 declared a good financial situation and a low share of food expenditure in their budget. Cluster 2 was formed mostly by couples with one child who preferred large stores; they were the once who threw away fresh fruits and vegetables most often. Cluster 3 consisted of single and double households without children.

As Stancu et al. [48] claim, consumers' food waste behaviour is significantly correlated with household size, income and age. Older consumers or households with fewer members and a lower income waste less food. Awareness of food waste consequences was also significantly related to the amount of food waste, with awareness of economic impact having a stronger negative association compared to awareness of the environmental and social consequences. The authors drew attention to two routes to food waste behaviour: the intentional one and the routinised one. Food-related routines, such as planning, shopping and leftover reuse were the main drivers of limiting food waste. Lockdowns during the COVID-19 pandemic, the war in Ukraine and high inflation, as well as awareness of climate change significantly affected the change in consumer behaviours [49,50].

Vidal-Monez et al. [51] estimated the level of food waste in Spanish households after the first COVID-19 lockdown. They stated that one household generated 234.72 g per week on average, which was equal to 88.42 g per capita. Most of the respondents indicated that they wasted the same amount as before the lockdown. Bread (7.5%), fruit (7.6%) and vegetables (4.5%) were wasted more than before the lockdown. The authors of the study showed that age, gender and household size had a significant effect on the amount of food wasted in a household. The total food waste increased with age. However, this tendency was different among participants older than 65 years, who wasted significantly less food than the other age categories, except for the youngest one. Females reported lower food waste levels than males and those not declaring their gender. The more inhabitants, the less food wasted per capita. Some changes in consumer behaviour have been observed, which has resulted in more responsible consumption, for example, consumers planned their shopping better, planned their meals and optimised food storage and conservation. Theodoridis and Zacharatos [52] classified Greek consumers into seven clusters: (1) 20s to 40s—food waste fighters, (2) 20s to 40s—food wasters, (3) unaware consumers—food wasters, (4) total food waste fighters, (5) typical young female food wasters, (6) aware consumers—food waste fighters and (7) typical young male food wasters. They showed that the increase in the purchase of food products during lockdown affected food waste. The age of consumers appeared to be related to food waste. Clusters 4 and 6, with higher rates of people over 40 years, present high levels of awareness, a more extensive use of shopping lists and planning of meals, as well as reduced quantities of food wasted due to understanding information on the food labels. Young people in the age range 18–29 mainly belong to the category of "Food Wasters" (clusters 3 and 5). Shopping lists were recognised as an easier and more widely used measure for household organisation compared to meal planning by "Food Waste Fighters" (clusters 1, 4 and 6). Similar studies were conducted by Macková et al. in the Czech Republic [53]. The authors stated that food wastage was most common among well-off households, which is a typical feature of today's consumerist society. They also categorised consumers into clusters: (1) unintentional food

economisers, who do not waste food because they need to be frugal, (2) consumers affected by systematic education since primary school, this includes consumers who are aware of all the negative consequences of food waste but they waste food because they have sufficient financial resources and (3) re-education, the typical food-wasters whose consumer behaviour is determined by sufficient or surplus income. As Jribi et al. [54] showed, in a study conducted in Tunisia on consumer awareness, attitudes and behaviours during the pandemic, respondents planned their purchases better. However, the authors found an increase in overcooking, inappropriate storage and overbuying of food that affected the food waste. Dou et al. [55] pointed out that people in the USA and China have changed their food purchase behaviour in favour of more takeout and delivery orders, wasting less food during the pandemic.

The research presented above clearly shows that young people living in single and double households contribute to large amounts of food waste. According to data of the Polish Central Statistical Office [56], in the academic year 2021/2022, 1218 thousand students were educated at universities in Poland. This is 2.9 thousand more than in the previous year. Over 58% of the students were women.

3. Materials and Methods

3.1. Data Collection

The survey was conducted from February to June 2022 at two Polish universities: University of Warmia and Mazury in Olsztyn (UWM) and University of Gdańsk (UG). Students participating in the research studied in various fields, related and unrelated to food. Respondents were asked to complete a questionnaire about their food waste for 14 days. The questionnaire was sent electronically to the students who agreed to participate in the study. Completed questionnaires were collected in the same way. A total of 136 questionnaires were obtained, but 44 of them were rejected due to incompleteness or incorrectness in indicating data on the amount of wasted food. Respondents were supposed to indicate the amount of food thrown away in grams or millilitres, but unfortunately some of them used usual terms, such as a slice, a portion, a piece, half a pack or one fruit. Therefore, 92 correctly completed questionnaires were qualified for the analysis. After the analysis of properly completed questionnaires, additional interviews with students were conducted. Participation in the study was voluntary. Everyone was informed about the confidentiality rules.

Before the actual research, a pilot study was carried out in 2019 and 2020 [57]. The pilot study involved 20 students who completed the questionnaire for 7 days. Students noted that one week does not represent the actual level of food waste in their households. Therefore, the time was extended to two weeks.

Detailed sociodemographic characteristics of the respondents are presented in Table 1.

Table 1. Sociodemographic characteristics of respondents.

Variable	Characteristics	*n*	%
Gender	Female (F)	71	77
	Male (M)	21	23
Age	20 years old	3	3
	21 years old	13	14
	22 years old	13	14
	23 years old	36	39
	24 years old	11	12
	25 years old	12	13
	Over 25 years old	4	4

Table 1. *Cont.*

Variable	Characteristics	*n*	%
Place of living	Dormitory	6	7
	Rented flat/room	45	49
	Family house	24	26
	Own household	17	18
Financial situation	Very good	7	8
	Good	55	60
	Average	27	29
	Bad	2	2
	Very bad	1	1
Number of persons in the household	One	8	9
	Two	37	40
	Three	23	25
	Four	8	9
	Five	11	12
	Six or more	5	5
Type of household	Family	25	27
	Partner	22	24
	Friends	37	40
	Single	8	9
Shared kitchen	Yes	65	78
	No	18	22
University	UWM	48	52
	UG	44	48

3.2. Questionnaire

The questionnaire consisted of two sections. The first part contained eight questions, which the respondents answered every day. A catalog of answers was provided for each question. In addition, the respondents could choose the answer "other" if they felt that the list of answers was insufficient. The second section of the questionnaire contained questions concerning the respondents' sociodemographic information which were relevant to the study, i.e., gender, age, place of living, number of people and relationships between people living together, as well as whether those living together have common kitchen. The structure of the questionnaire is shown in Table 2.

Table 2. Structure of the questionnaire.

Number	Question
	Section 1
1	Have you thrown away food today?
2	What were the products?
3	What was the reason for throwing away the products?
4	How much food have you thrown away (in grams or milliliters)?
5	Where did you eat your meals today?
6	When eating a meal away from home, did you eat everything?
7	If you did not eat everything today, what did you do with the leftovers?
8	What do you do not to throw food away?

Table 2. *Cont.*

Number	Question
	Section 2
1	Gender
2	Age
3	Place of living
4	Financial situation
5	Number of persons living with you
6	I live with
7	If you live with someone, do you run a shared kitchen?

3.3. Statistical Analysis

The obtained data were binary coded and compiled in contingency tables. The answers to the questions about the amount of food thrown away were summed up over the 14 days and the numbers were entered into the spreadsheet. A descriptive method with elements of descriptive statistics was used to analyse the obtained results. The coded data were compiled into contingency tables, which allowed to analyse the frequency of responses and the relationships between the variables. After analysing the contingency tables, the hypothesis about the independence of the examined qualitative variables was verified. A non-parametric test, the χ^2 test of independence, was used ($p = 0.05$).

The obtained data were also analysed using the Pareto–Lorenz analysis. Pareto–Lorenz analysis (also known as the 80/20 rule) is a statistical technique in decision-making used to select a limited number of tasks that produce a significant overall effect. It uses the concept based on identifying the top 20% of causes that need to be addressed in order to resolve 80% of the problems. The 80/20 rule has been applied in many fields, e.g., manufacturing, reliability, root cause investigation, risk analysis, quality management, cost analysis and supply chain management [58]. The 80/20 principle can be successfully applied in assessing food waste, making people aware of which products are thrown away the most.

In order to group variables, cluster analysis was used. Cluster analysis is a tool in exploratory data analysis, aimed at arranging objects into groups in such a way that the degree of linking objects within the group is as large as possible and with objects belonging to other groups as little as possible. For this purpose, the agglomeration method was used, in which each object is a separate cluster initially and it is combined with other objects lying closest to each other to form new clusters. Binding was performed by the Ward method with a Euclidean distance measure. This method uses analysis of variance approaches to estimate the distance between clusters. On the basis of the agglomeration course and dendrogram, clusters were separated.

All tests were performed using Statistica software version 13.3 Pl (StatSoft, Cracow, Poland).

4. Results

4.1. Behaviour of Polish Students Related to Food Waste

Food was thrown away on average four times per week. The largest number of respondents declared that they waste food on Tuesdays (57%) and Wednesdays (58%), and least frequently on Saturdays (48%) and Sundays (42%). Food was thrown away least often on the weekend. On those days, students most often indicated that they ate meals at family home or restaurants. The most frequently discarded products were bread (63% of responses), vegetables (58.7%), cheese and cottage cheese (44.6%), fruit (43.5%) and cold cuts (43.5%). There were no statistically significant differences between the frequency of throwing food away and sociodemographic characteristics. In quantitative terms, vegetables (16.3%), bread (12.8%) and fruits (9.9%) were thrown away the most. Additionally, in this case, sociodemographic characteristics did not significantly differentiate the respondents. Referring to the Pareto principle (80/20), it could be stated that 80% of wasted food were

products from 11 groups, which is presented in Figure 1. The vast majority of these products belong to so-called perishable food. Perishable food means any food that may spoil or otherwise become unsafe to consume because of its nature, type or physical condition. Most of these products are temperature sensitive and must be kept refrigerated [59–61].

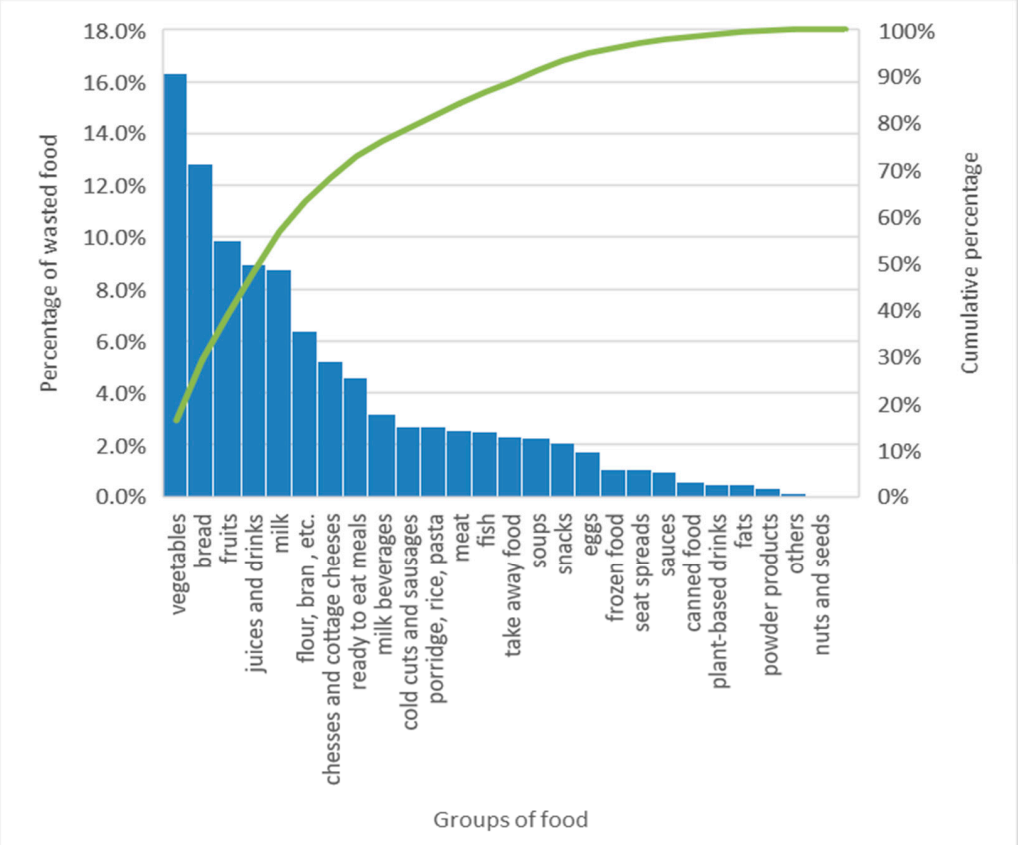

Figure 1. Pareto diagram—type of food wasted by Polish students.

During the two week measurement period, 254 kg of food was wasted from 92 respondents. On this basis, the amount of food wasted per year by a student household was calculated. A year was assumed to have 52 weeks. It was estimated that on average, 72 kg of food is thrown away by student households per year.

Students declared that spoilage (30%) was the most common reason for throwing away food, as well as loss of freshness (16%), expiry date (14.9%), too big a portion (11.3%) and loss of visual appeal (7.5%). These five reasons caused 80% of food to be thrown away (Figure 2). At the same time, respondents declared that they were taking part in thoughtful shopping (67.4%) and storing food correctly (35.9%). However, most students (72.8%) tried to eat everything to avoid wasting food. More than half of the respondents declared that they planned meals (57.6%) and shopped with a list (51.1%). During the interviews, 63% of the students admitted that they rarely managed to strictly stick to their shopping list.

Most meals were eaten by students mainly in the place of residence (96.7%). Eating meals with the family (once or twice a week) was indicated by 43.5% of the respondents, and with friends by 23.9% of the respondents. Students willingly used the catering services. More than half declared that they ate a meal in a restaurant or bar at least once a week (55.4%). Buying takeaway food was popular among students; 27.2% of students consumed this form of meal at least twice a week. Slightly more than one-third of the respondents prepared meals at home and took them to the university or to work (39.1%). This group consisted mainly of people who paid special attention to the composition and energy value of meals. It was not related to the financial situation of the respondents, but to a special diet (reduction or elimination or related to practiced sport). Half of the students using dining

establishments stated that they ate the whole dish. However, only 20.6% of students who did not eat the whole dish took home an unfinished meal.

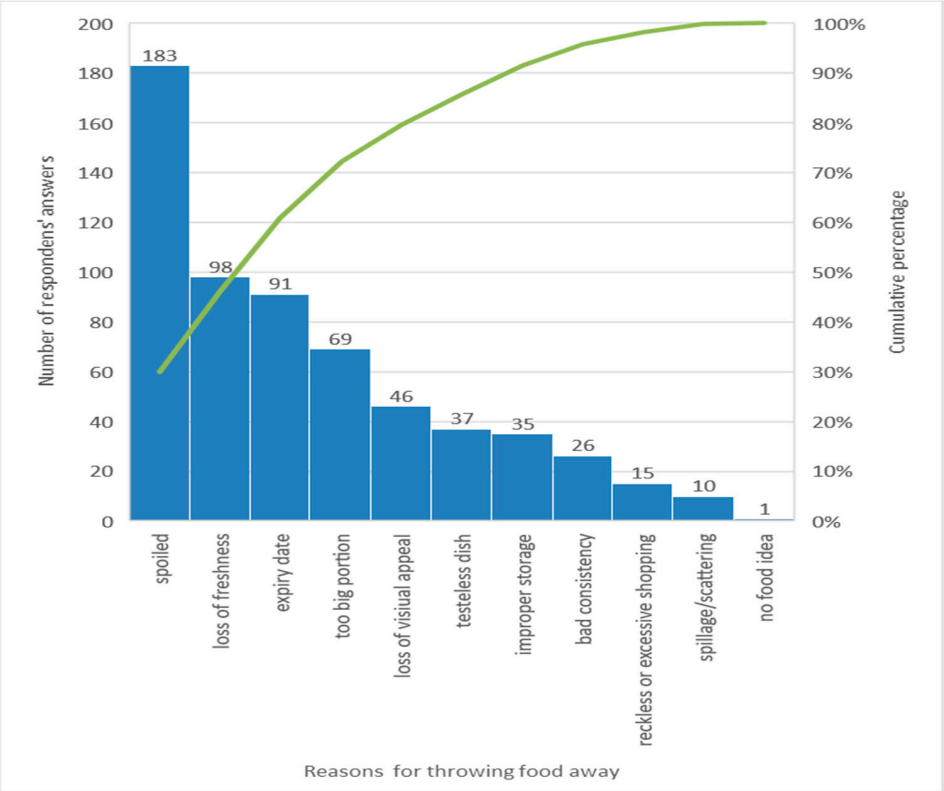

Figure 2. Pareto diagram—reasons for wasting food by Polish students.

4.2. Attitudes of Polish Students Related to Food Waste

Based on the interviews, it was found that Polish students are aware of the problems related to food waste. However, they did not realise how much they themselves contribute to this. Completing the questionnaire made them realise how much food they waste. Students tried to rationalise food shopping by preparing for it by planning meals, developing a shopping list, buying smaller amounts of food and not going to the store hungry. The remaining answers of students regarding the methods they use to avoid food waste are presented in Figure 3.

Unfortunately, the awareness of food waste problems does not go hand in hand with student behaviour and attitudes. Over 60% of respondents said that they throw away unfinished meals (32.6%) or leave them on the plate (30.4%). Only one-quarter of the respondents used leftovers from an uneaten meal to prepare another dish. A total of 40% of students lived with friends and half of them used a shared kitchen. Students living with friends most often indicated that they shared food with their friends so as not to waste it. Who the students lived with significantly differentiated the answers ($p = 0.0072$). Only 10.9% of the respondents used physical methods of food preservation (freezing and pasteurisation). During the interviews, they stated that they did not have time or did not want to devote time to food preservation. As mentioned above, only 35.9% of students tried to store food properly. A total of 67.4% of respondents assessed their financial situation as good or very good, and 29.3% as average. This means that they have access to the necessary equipment. Students do not transfer food to community fridges (no indication), do not provide information about their willingness to share food on dedicated social media (no indication) and very rarely share food with those in need. The distribution of respondents' answers regarding the handling of food leftovers is shown in Figure 4.

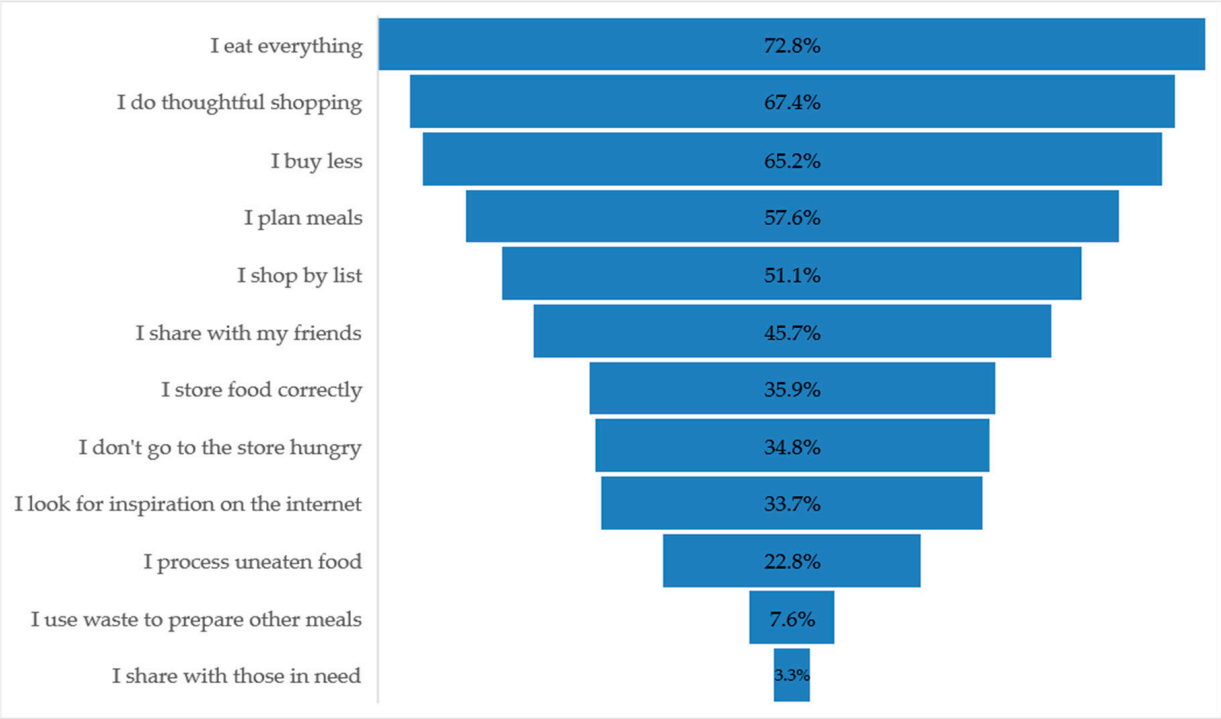

Figure 3. Ways to reduce of food waste used by Polish students.

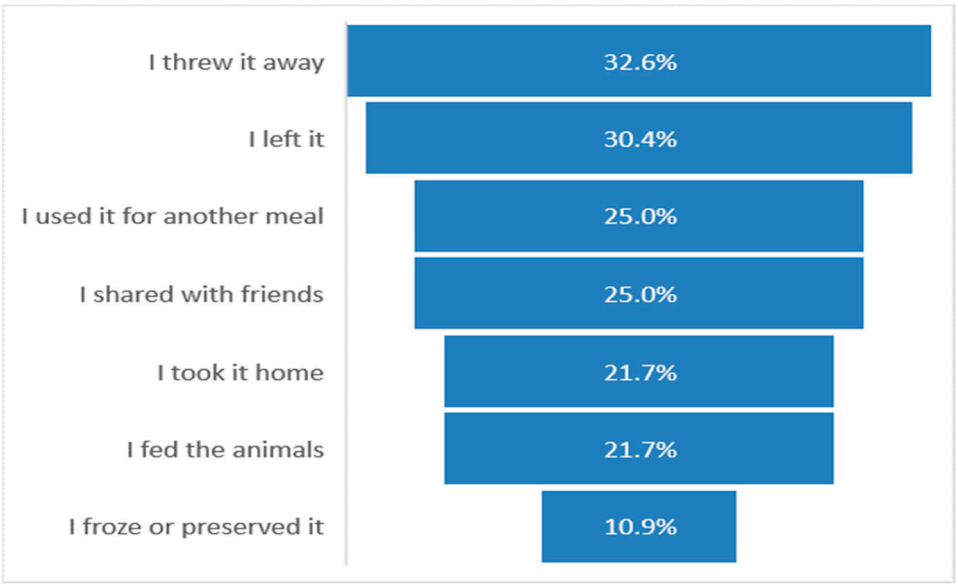

Figure 4. Students' handling of food leftovers.

Cluster analysis was used to determine the links between student behaviours and attitudes regarding food waste. The results of the analysis are presented as a tree diagram in Figure 5.

The first cluster consists of people who throw away food because of spoilage, exceeding the expiry date and loss of freshness. At the same time, they try to reduce food waste by eating whole meals, thoughtfully shopping, buying less food, shopping by list and planning meals. Cluster 1 is made up of "aware students".

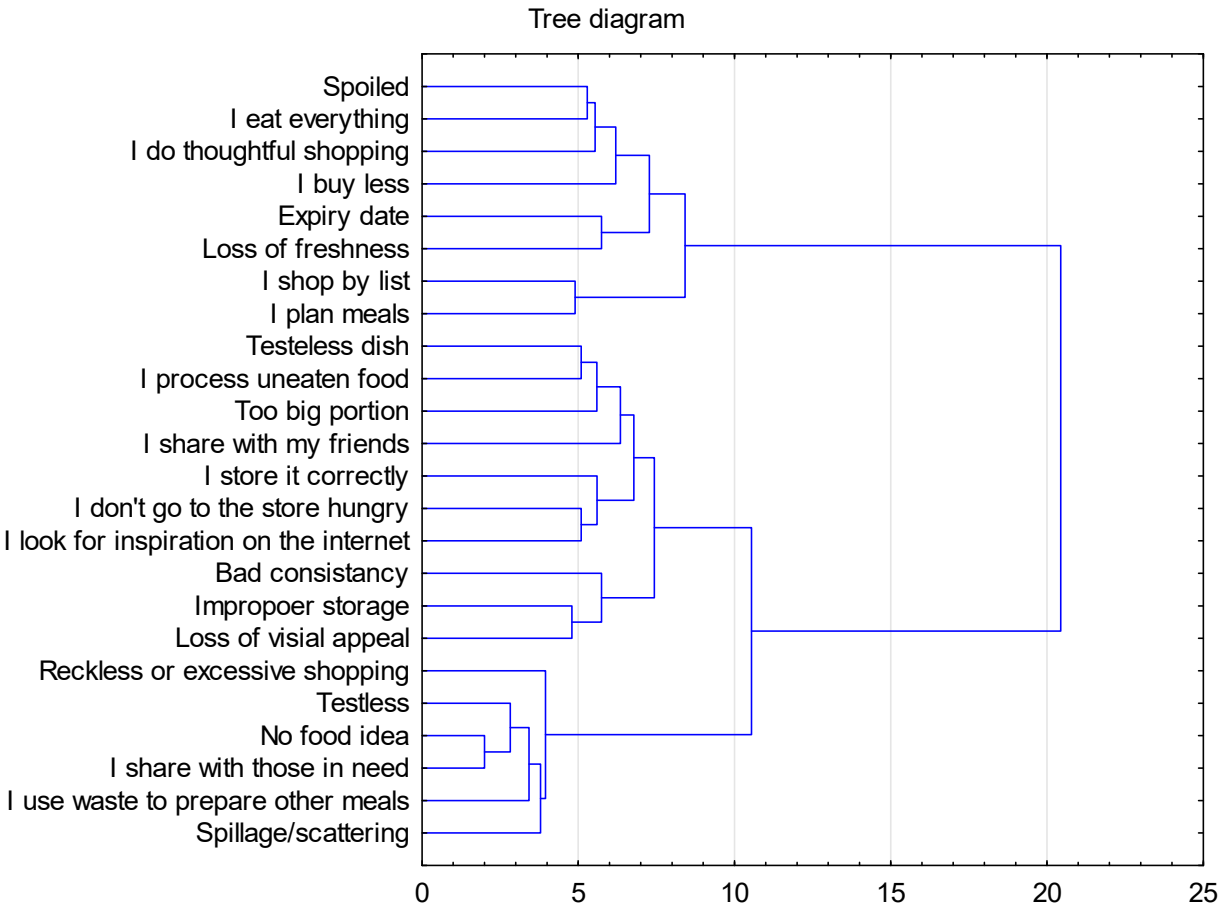

Figure 5. Tree diagram—segmentation of Polish students taking into account food waste.

In the second cluster, there are respondents who throw away food for sensory reasons, such as not a tasty dish, bad consistency and loss of visual appeal. In addition, they throw food away because the portions are too large and they store food incorrectly. However, on the other hand, they declared that they try to store food correctly as well as freeze or can food. They also do not go to the store hungry and they are share food with friends. Some of them look for ideas for preparing meals on the internet. Respondents gathered in cluster 2 were called "disengaged students".

The third cluster aggregates people who have no idea how to prepare a meal, often do not like a meal, are careless and they spill or scatter food products. These are the people who most often recklessly or excessively shop. At the same time, they declare sharing with those in need and using waste to prepare other meals. The students gathered in this cluster are called "aware but disengaged".

5. Discussion

There is a general consensus on the fact that reducing food waste on the household level has great potential for enhancing food security and strengthening the sustainability of food systems. Wilarino et al. [62] indicated that FLW research should be more holistic. FLW should be treated as part of the circular economy, particularly on the socio-economic and environmental impacts on regional policies, taking into account, among others, infrastructure, energy, markets and education. However, in order to effectively prevent this phenomenon, it is necessary to obtain information about the amount and type of food waste generated by different stakeholders of the food chain, as well as the causes of this phenomenon. Research conducted by Łaba et al. [12] showed that households are responsible for 60% of food wasted in Poland. Looking ahead, we should focus on young people who, in the near future, will face the consequences of food waste and will be co-responsible for achieving

the SDGs. As was shown in Section 2, most food is wasted by young people. In this study, it was found that 72 kg of food is wasted by student households per year. Nováková et al. [63] estimated that Czech households wasted 135.68 kg per year. Łaba et al. [12] showed that an average of 3.9 kg of food was thrown away per week in a Polish household, which gives around 203 kg per year. Probably the reason for such differences is the fact that most of them do not have children and have a limited budget, despite the fact that they assessed their financial situation as good or average. The first hypothesis, that students waste less food than the household average, has been confirmed.

According to the Pareto analysis, among the most frequently thrown away products, the majority were perishable food products. Bread was the most frequently thrown away, which was ranked second in terms of quantity. On the one hand, the waste of bread is easy to eliminate because it is a group of products highly diverse in terms of size, shape and weight. On the other hand, retailers' practices such as discounts, i.e., "3 for 2" or similar, as well as requiring the purchase of a whole loaf of bread in most stores, result in over-purchasing and hence food waste. Vegetables had the largest quantitative share in the total products thrown away, and in terms of the frequency of throwing them away, they were ranked in second place. The most common reasons for discarding vegetables were loss of freshness and visual appeal, not spoilage. This may be due to the lack of knowledge on how to store different types of vegetables and how to use them to prepare meals, as well as a lack of willingness to use them rationally. It was the same in the case of fruits. Cheese and cottage cheese were thrown away very often; they were indicated as the third group of the most frequently thrown away products, but they were ranked 7th in terms of quantity. These products are sold in individual packages of various weights, which allows for rational purchases. In addition, in many stores, it is possible to buy a specific amount or number of slices of cheese. Despite this, the frequency of these products being thrown away is worrying. A similar situation is found with cold cuts and sausages. This may be related to incorrect storage conditions for temperature-sensitive products. Among the 20% most discarded products were flour and bran, as well as porridge, rice and pasta, which are dry products with a long shelf life, which are not considered perishable foods. Flour, bran, etc., in terms of quantity were in the 6th position with a quantitative share of 3.38% of the total food thrown away, but in the 20th position in terms of the frequency. The indicated reasons were spillage or missing the expiry date, which most often resulted in throwing away the entire package (usually 1 kg), hence such a large quantitative share. The opposite situation was found in the case of porridge, rice and pasta. This group of products was indicated more often, it was the 8th in the ranking of the most frequently thrown away products, but with a smaller quantitative share (2.68%) (11th position). The indicated reasons for throwing away were preparing too large a portion or a distasteful dish. The results of the research related to the structure of wasted food products are comparable with the results of surveys conducted by other authors in different countries, e.g., Czech Republic [63], Canada [64], Germany [65], Morocco [66], Poland [7,40,41], Hungary [67], Italy [23,65,68], Saudi Arabia [69] and multi-level analysis [70]. Regarding the research conducted in Poland on the types of discarded products, Tomaszewska et al. [41] showed that the most frequently discarded products were vegetables and meat. A slightly different structure of wasted products was obtained in this study. Vegetables and fruits were most often and in the largest amount thrown away by students. Meat was ranked 12th with a quantitative share of 2.6%. Students who did not live in the family home usually bought portioned meat for one or two meals. The second hypothesis that the structure of food wasted by Polish students is similar to other households has been confirmed. In our opinion, a comparison of the amount of products thrown away with their amount and reasons can be useful when developing a food waste prevention strategy. Such analysis may direct educational programs to reduce the waste of particular groups of food products.

Three indicated clusters of student attitudes can be compared with the segmentation developed by other researchers, which was presented in the Literature Review section. All studies identified a group of respondents who treated the problem of food waste

disrespectfully. At the same time, in each study there was a group of "saving food" consumers and an "in the middle" group, which included other respondents. Other consumer groups identified in the research could probably be included in one of the three indicated in this research, if the conditions of the agglomeration were changed.

Cluster 1 was named "aware students", but that does not mean this group does not contribute to food waste. An educational program addressed to this group should concern the possibility of developing additional skills and habits leading to the reduction in food waste. This group of students planned meals and tried shopping with a list, but at the same time they threw away products because of spoilage, the expiry date was exceeded or loss of freshness. The reason for this may be, e.g., not checking their household inventory. In addition, this group should be given ideas to implement a zero-waste policy in the household. This could include meal recipes with a shopping list. It is important that the shopping list includes commercially available quantities of individual products. If the recipe contains, e.g., half an avocado, it should indicate what to do with the second part, how to store it or provide a link to another recipe which also uses half of this fruit. Programs addressed to this group should develop skills and should be implemented under the slogan "what else can I do?".

Cluster 2 "disengaged students" includes the largest number of respondents, which indicates the necessity to take action to change students' habits regarding food handling. Students aggregated in this cluster mostly did not plan their meals and did not prepare a shopping list. Their shopping and eating behaviours seem to be quite spontaneous. This group is probably the most vulnerable to retailer practices such as discounts and favourable prices for large packages (such as XXL or economy size). This contributes to over-purchasing, which results in food waste, especially in small households, which are mostly run by students. This group seems to be the least aware of food waste problems. Therefore, educational programs should be developed. These programs should cover two aspects. First of all, there should be educational campaigns to increase student awareness on how food waste affects the environment, as well as to highlight the economic issues. Students usually do not realise how much throwing food away costs them. Secondly, education should concern the improvement in consumer knowledge and skills in the field of proper food storage and the possibility of managing food raw materials that do not meet sensory expectations. Students aggregated in this cluster indicated that they threw away food due to improper storage conditions, while at the same time indicated that they were trying to store it properly. Similar conclusions were drawn by Tomaszewska et al. [61], who stated that a significant number of Polish customers showed an insufficient level of knowledge, and that their practices dealing with food were unsatisfactory, mainly in terms of its safety and hygiene. This confirms the need to educate consumers on the correct handling of food, despite the mandatory information on the intended use and storage conditions on the food packaging.

Cluster 3 is the smallest cluster. It includes respondents, as we can assume, who are empathetic, with high demands on the sensory features, but at the same time who do not pay attention to the problem of food waste. They are the ones who most often recklessly or excessively shop. Interviews conducted with students who indicated using waste to prepare other meals showed that it was not an action aimed to reduce food waste, but to look for new flavours, as well as following trends observed on social media. Educational programs aimed at this group should primarily promote tools to prevent reckless or excessive shopping, such as a shopping lists, checking the condition of products before shopping, etc., with simultaneous indication of adverse environmental changes caused by food waste. Quested et al. [71] stated that that there is a strong positive correlation between making a shopping list and planning meals. This correlation has not been confirmed in our study. Planning of food shopping is recognised as an effective tool to prevent food waste. The majority of Polish students declared that they prepared a shopping list but did not always follow it. In most cases, socio-demographic factors did not differentiate students' behaviours and attitudes, which may be determined by the similar lifestyles of the surveyed students.

The obtained results are consistent with the research conducted by Tomaszewska et al. [72]. The authors pointed out that consumers aggregated in all clusters with a similar frequency threw away food products due to spoilage and passed expiration dates. Similar consumer behaviour has been identified by other researchers [40,64,65,70,73,74].

Campaigns for clusters 1 and 2 could additionally include an encouragement to share food. Educational programs for clusters 2 and 3 should indicate what influences excessive purchases. As Messnner et al. [75] pointed out, food waste creation at the household level cannot be explained by consumer behaviour solely, but has to be regarded within the structural context of the whole food supply chain. In studies conducted by Butler and Dixon [76], Evans [77], Lorenz-Walther et al. [78] and Schmidt and Matthies [79], it has been shown that practices used earlier in the food chain, such as packaging, promotional offers, restaurant portions sizes, fast food consumption habits and food marketing contribute to food waste. Based on the cluster analysis, the third hypothesis has been confirmed that students take action to reduce the amount of food waste in their households. At the same time, it has been shown that the actions they take are insufficient. This indicates that most Polish students are aware of the problems of food waste, but do not contribute to reducing it.

Taking into account the recommendations for developing educational programs indicated above, it is also important to promote the SDGs and the principles of circular economy in preventing and managing FLW. Educational programs should be run on social media and at universities. This is a research gap open for sociologists, social communication and marketing specialists to determine effective and attractive methods of communication.

Similar to other research papers, this paper also has several limitations. First, the samples were taken from two universities. A bigger sample size could give us a better insight into the attitudes and behaviours of the group under study. Furthermore, this type of research is burdened with a high risk related to incorrectly completed questionnaires, which results in excluding them from further analysis. It should be noted that socio-demographic characteristics did not differentiate the answers to the questions included in the questionnaire. As mention above, 44 obtained questionnaires were not included in the analysis. They were rejected mainly for pointing to items (portion and slice) not weight or volume. In other studies [23,63], such questionnaires were qualified for further analysis, and the researchers converted the indicated items and customary measures (tablespoons and cups) into weight. This was to reduce the burden of diary-keeping and gave some flexibility to diary holders. In this study, we wanted to measure the amount of food thrown away as accurately as possible, even if it resulted in a reduction in the research sample. There are publications in the international literature that use kitchen diaries as a research method, similar to those used in this study, based on much smaller research sample (15 and 20 surveys) [23,67]. It should be noted that the use of a mix of a mass balance approach and a food diary has double meaning. On the one hand, it provides researchers with the valuable material for the analysis of consumer behaviours, and on the other hand, it raises consumer awareness of their contribution to food waste and how much money they could save by making rational purchases. As Tomaszewska et al. [61] pointed out, respondents did not always report their real reactions to the discussed problem. In the case of kitchen diaries, the result may be influenced by social desirability bias whereby people change their waste-discarding habits or underreport their waste in order to present themselves in a positive light [34,63]. However, the received results are in agreement with the results obtained by other researchers.

6. Conclusions

This paper investigated the current attitudes and behaviours of Polish students related to food waste. In the near future, current students will create their own households, and their behaviour will have a significant impact on the level of food waste. The products thrown away, both most often and in the largest quantities were bread, vegetables and fruits. The most common causes of food waste include food being spoiled, loss of freshness,

a passed expiry date and preparing or buying portions that were too big. Knowing the key factors impacting consumer behaviour that cause food waste is essential for the development of effective educational programs to reduce this negative phenomenon. Adequacy in purchasing and cooking quantities is an important prerequisite for sustainable food management in households. Summing up the cluster analysis, it should be stated that, apart from awareness, improving consumers' knowledge and skills is of key importance to efficiently reduce food waste. The skills of young consumers, regarding the preparation and planning of meals, are usually low; they are just starting to manage their household. In addition, they repeat the habits learned from family homes. Therefore, educational activities and social campaigns to raise awareness of how much food is wasted by a single household should be intensified. Based on the above findings, all research hypotheses were confirmed. However, limiting food losses only at the household level is not sufficient to effectively prevent this phenomenon. Apart from consumer behaviours, food business stakeholders can play a huge role in reducing food waste by offering products in various weight standards, date labelling and retail marketing.

To conclude, it should be stated that students' awareness of food waste does not go hand in hand with their behaviour. This is evidenced by the amount and type of food they waste and the "light approach" to the problem. The results of our study should be used by organisations to prepare personalised education programs and in the development of regional strategies for reducing food waste.

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