
Attitudes and Behaviour of Polish Consumers Regarding Food Waste in the Food Chain

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Abstract:

Purpose: The article raises consumer behaviour regarding food waste, which is a current and multidimensional problem with many economic, environmental, and social consequences. The main objective of the research was to learn the behaviour and attitudes of young Polish consumers to food waste and the opinions about the causes of food waste, awareness of the places in the food chain with the most incredible food waste, and to study whether this awareness was associated with food waste behaviour.

Design/Methodology/Approach: The research was conducted among 1,078 Polish consumers aged 18-35 (representatives of the X and Y generations). In order to verify which socio-demographic factors influenced the assessment of the impact of changes in consumer behaviour on the reduction of food waste, a regression analysis was performed. Furthermore, relationships between the socio-demographic profiles determined in the cluster analysis and food waste behaviour were examined.

Findings: The conducted research confirmed that women are more aware of the impact of introducing appropriate consumer behaviour on reducing the scale of food waste (due to their more direct contact with food during shopping and cooking) and young age and higher education contributed to the higher awareness of waste as a significant socio-economic and environmental problem. On the other hand, consumers aware of the highest share of households in food waste did not behave in a manner intending to reduce food waste.

Practical Implications: The obtained results may be helpful for institutions and organizations responsible for shaping the policy of reducing food waste.

Originality/Value: Getting to know the opinions of young consumers is essential from the point of view of analyzing consumer behaviour, because these people are starting their careers and families, set specific trends in market behaviour, and it is their behaviour that will determine the scale of food waste in the future.

Keywords: Food waste, food chain, consumer behaviour, young consumers.

JEL codes: D10, Q18, Q58.

Paper Type: Research Paper.

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1. Introduction

The problem of food waste appeared in the public debate. It became the subject of interest of scientists only at the beginning of the second decade of the 21st century, after the publication of a report entitled *Global food losses and food waste - Extent, causes, and prevention* by the Food and Agriculture Organization of the United Nations in 2011. This report was the first one to state that globally, roughly one-third of food produced for human consumption is lost or wasted, which amounts to about 1.3 billion tons per year. Since then, the interest in this issue has been growing, and it is emphasized that food waste is a multidimensional problem with enormous negative environmental consequences, e.g., greenhouse gas emissions (Kummu *et al.*, 2012), economic consequences (waste of raw materials needed to produce food, including water, soil, person-hours, energy) and social consequences. Therefore, food waste consumes global resources (Cuellar and Webber, 2010; Liu *et al.*, 2013; Venkat, 2011) and contributes to severe resource and environmental pressures (Cheng *et al.*, 2012; Song *et al.*, 2015; Zhang *et al.*, 2016).

Additionally, financial losses incurred in the food trade increase its prices. The problem of wasted food is also connected with the subsequent handling of waste, as the increase in the total mass of food being thrown away determines the need to manage more organic and inorganic waste. Overconsumption in developed countries contributes to food waste because it is the unmanageable consumption that leads to environmental degradation by excessive exploitation of natural resources, contributes to the waste of goods and human labour, and causes significant economic disproportions between people. In some countries, dozens of tons of food are wasted, while at the same time, more than 820 million people in the world are still hungry (FAO, 2019).

The main research objective was to learn the behaviour and attitudes of young Polish consumers towards food waste. The detailed objectives were:

1. learning about the opinions of the respondents on the causes of food waste and their awareness of the places in the food chain with the most incredible food waste;
2. identification of socio-demographic factors influencing the perception of waste as a multidimensional socio-economic and environmental problem;
3. identification of differing socio-demographic profiles of respondents and examining their association with food waste behaviour.

As part of the research, four research hypotheses were verified (primary hypothesis H1 and three detailed hypotheses): H1: Poles' awareness of food waste in households is insufficient; H2: Women are more aware that food waste is a significant socio-economic and environmental problem; H3: Young age, higher education of Poles, as well as the knowledge of various initiatives, such as food collection, resulted in higher awareness of the impact of changes in consumer behaviour on reducing the scale of food waste; H4: Awareness of the highest share of households in food waste in the scale of the entire supply chain is related to the reduction of food waste.

2. Literature Review

Due to the complexity of the food chain - its multi-stage and complicated organizational structure, the process of managing the logical flow and management of food constitutes a big challenge. Errors, the increase in the mass of goods on the market, and the elongation of distribution channels result in the increasing scale of food loss and waste. This phenomenon applies to all stages of the food chain “from farm to fork,” starting from primary production, through processing, trade, gastronomy, distribution, and ending with households. At the same time, food losses occur mainly in the initial stages of the chain, and food waste is mainly a reflection of consumer behaviour, often associated with informed decisions related to throwing away edible food products (HLPE, 2014).

There is no harmonized definition of food waste at the European Union level, and Member States use different definitions for their research. The European Parliament, in its Resolution of 2012, proposed its definition of food waste. They are food products removed from the agri-food supply chain for economic or aesthetic reasons, or due to an impending use-by date, but still perfectly fit for human consumption, and which due to the lack of possible alternative use, are destined for liquidation or disposal, which has adverse external effects in terms of environmental impact, economic costs and lack of income for businesses (Resolution..., 2012). The Food and Agriculture Organization of the United Nations - FAO, also uses its definition of food loss and waste.

According to the FAO, food losses mean a reduction in the quantity or quality of food resulting from the decisions and actions of food suppliers in the agri-food chain, excluding retailers, catering service providers, and consumers. In contrast, *food waste* was defined as a reduction in the quantity or quality of food resulting from retailers, catering services, and consumers (FAO, 2019). In international literature, we can also find various definitions of irrational food management (Gustavsson *et al.*, 2011; Griffin *et al.*, 2009; Hodges *et al.*, 2011; Schneider, 2013), but most often, these definitions are based on the FAO definition.

In the case of developing countries, most losses were observed in the early stages of production. This mainly results from the lack of advanced agricultural techniques, adequate transport infrastructure, e.g., proper cooling and storage options ensuring product durability. In developed regions, i.e., in Europe, North America, and the industrialized part of Asia, the link in which food is wasted most is consumption. Losses at the level of production and storage occur mainly in South and South-East Asia. In developed countries, cereal products have the largest share of wasted products. Within the Europe 2020 strategy, the European Commission, in communication on resource efficiency, devoted one paragraph to the need to reduce food waste, and the European Parliament adopted a resolution on a strategy to increase the efficiency of the food chain and asked the European Commission to adopt specific measures towards halving food waste by 2025.

Growing attention to food loss and waste is also reflected in the Sustainable Development Goals (SDGs). SDGs call for halving per capita global food waste at the retail and consumer levels and reducing food loss along production and supply chains (including post-harvest losses) by 2030.

In agriculture, food waste is related to its production, cultivation, harvesting, or storage. The food industry wastes food already at the stage of receiving the raw material and at the stage of transport, as it is often transported over long distances. In households, we also observe various causes of food waste. Table 1 shows phases of the food chain and possible causes of food loss and waste.

Table 1. *Phases of the food chain and possible causes of food loss and waste*

| Phases of the food chain | Causes of food loss and waste |
|---|---|
| Agricultural production and harvest, slaughter or catch | Natural disasters Left in the fields due to quality standards Machine and labourer damage Overproduction Too low purchase price Mechanical failure of the raw material Poor harvest scheduling |
| Storage and transportation | Lack of proper storage or transportation facilities (e.g. refrigerated trucks) Mechanical failure of the raw material Poor management of temperature and humidity Logistical mismanagement (poor handling of delicate produce) |
| Processing and packaging | Inadequate processing capacity for seasonal production gluts Errors during production processes and storage (e.g. wrong size or damaged packaging) Equipment failures Interruption of the cold chain Overproduction |
| Wholesale and retail | Overstimation the order Short shelf life Mechanical damages of packaging Inadequate storage and exposure conditions |
| Consumption: households and food services | Oversized portions Confusion between expiration and preferred consumption date labels Poor storage or stock management in the home Too large purchases |

Source: Lipinski et al. 2013, Bliska et al. 2015.

Consumers play a crucial role in food waste. Food waste among consumers has been studied in different countries, among others, in the United States (Venkat, 2011; Thyberg *et al.*, 2015), Germany (Schmidt, 2016), Switzerland (Berretta *et al.*, 2013), Finland (Katajajuuri *et al.*, 2014; Silvennoinen *et al.*, 2014), Spain (Gracia and Gomez, 2020; Mondéjar-Jiménez *et al.*, 2016), Greece (Abeliotis *et al.*, 2013; 2016), Czech Republic (Mackova *et al.*, 2019), Romania (Stefan *et al.*, 2013; Iorga *et al.*, 2017), China (Zhang *et al.*, 2020), Poland (Kołozyn-Krajewska *et al.*, 2014; Bliska *et al.*, 2020).

According to the report “Estimates of European food waste levels,” the 28 EU countries generated ca. 87.6 million tons of food waste, of which households are responsible for approximately 53% (Stenmarck *et al.*, 2016). In highly developed western countries, consumers' scale of food waste is even more significant, in Germany, it is 74% of the total amount, in France and Great Britain, it is 58%.

According to the literature review, there is tremendous variability in estimating food waste and loss because of the different methodologies used in collecting data (Van der Werf and Gilliland, 2017). Studies carried out in Finnish households show that the amount of food waste generated each year is around 23 kg per capita and 63 kg per household (Katajajuuri *et al.*, 2014, Silvennoinen *et al.*, 2014). A study carried out in Germany shows that household food waste adds up to 89.5 kg/year, and per capita, food waste amounts to 44.6 kg/year (Herzberg *et al.*, 2020). Based on a report made within the Bioregio project (Interreg Europe, 2019), the amount of food waste varies from 186 kg/capita/year in Spain to 129 kg/capita/year in Romania. Poles waste 9 million tons of food annually, which means that the average Pole wastes 236 kg of food (Business Insider, 2017).

3. Material and Methods

The research was conducted among 1,078 respondents aged 18-35. The empirical method was a research survey involving a standardized questionnaire, which supplied data necessary to achieve the research goals. The research technique was an internet survey. The survey was carried out in 2020. The selection of the sample was random - the respondents expressed their willingness and consent to participate in the research by filling in a questionnaire, but the inclusion criterion was age up to 35 (18-35). By introducing this restriction, the researchers wanted to know the opinions of young consumers, the so-called representatives of the Y and Z generations (Millennials and Post-Millennials). Knowing the awareness and opinions of these consumers about food waste is particularly important because these people are entering the labor market, starting a family, often setting behavioural trends, creating their households, or will do so shortly.

The entire group of respondents was $N = 1,078$ people, of which 82.6% were women, while in terms of age, people aged 18-25 (71.4%) prevailed. The predominant group in the studied sample were studying (43.4%) or with higher education (36.4%), while the minority were people with secondary education (16.5%) or less. In terms of

residence, most people lived in huge cities, with over 500,000 inhabitants (43.2%) or people from small towns up to 50,000 inhabitants (39%). The distribution of indicative net income per capita in the household varied. In the study group, there were both people with high and low income per capita in the household, and the largest group were people with an income of EUR 251-500 (36.9%). The respondents usually came from households of 3-4 persons (43.4%) or single-person households (28.2%), less frequently from households consisting of 2 persons (10.8%) and households more significant than four persons (17.6%).

Table 2. Characteristics of the respondents in terms of socio-demographic features

| Characteristic | N | % | Characteristic | N | % |
|---|-----|--------|--|-----|--------|
| Sex | | | Age | | |
| Female | 890 | 82.56% | 18-25 | 770 | 71.43% |
| Male | 188 | 17.44% | 26-35 | 308 | 28.57% |
| Education | | | Place of residence | | |
| Less than secondary | 40 | 3.71% | Town up to 50,000 inhabitants | 420 | 38.96% |
| Secondary | 178 | 16.51% | City from 50,000 to 200,000 inhabitants | 168 | 15.58% |
| Student | 468 | 43.41% | City from 200,000 to 500,000 inhabitants | 44 | 4.08% |
| Higher | 392 | 36.36% | City above 500,000 inhabitants | 466 | 43.23% |
| Monthly net income per capita in the household | | | Professional status | | |
| Up to 250 EUR | 182 | 16.88% | Unemployed | 40 | 3.71% |
| 251-500 EUR | 398 | 36.92% | Student | 514 | 47.68% |
| 501-750 EUR | 254 | 23.56% | Employed (employment contract) or running a business | 524 | 48.61% |
| Above 750 EUR | 244 | 22.63% | | | |

Source: Authors' survey.

To verify which socio-demographic factors and factors related to the knowledge of food waste influenced the assessment of the perception of food waste as a significant socio-economic and environmental problem and the assessment of the impact of changes in consumer behaviour that may contribute to the reduction of the scale of waste, a regression analysis was performed. Two regression models were created for the newly acquired latent variables in the factor analysis. The independent variables were, sex (female/male), age (18-25/26-35), education (up to secondary/higher, incomplete and whole), income (up to EUR 500/over EUR 500), place of residence (town/city of up to 200,000 inhabitants/more than 200,000 inhabitants), number of people in the household (up to 2 people/more than two people), professional status (not working/working), awareness of the largest share of households in wasting food in the supply chain (no/yes), knowledge of initiatives organized, among others, by food banks (no/yes), donating food as part of actions conducted by organizations, including food banks (no/yes). To obtain models best suited to the data and having

only statistically significant variables, a regression analysis was performed using the primary elimination method.

Another method used in the analysis of the results was cluster analysis, which was aimed at distinguishing possibly different profiles of people in terms of socio-demographic variables. The hierarchical cluster analysis using Ward's method was used for the analysis. The formula gives the measure of variation known as the error of the sum of squares:

$$ESS = \sum_{i=1}^k (x_i - \bar{x})^2 \quad (1)$$

where: x_i - value of the variable that is used for segmentation, k - number of items in a cluster.

Subsequently, the relationships between socio-demographic profiles determined in the cluster analysis and food waste behaviour were examined. It was verified whether the awareness of the highest share of households in food waste in the supply chain was related to food waste behaviour. Due to the nominal values of the analyzed variables, a series of analyses using Pearson's χ^2 tests were used to verify the relationship.

4. Results

As many as 97.8% of people admitted to wasting food in their households. Several times a week, 6.8% of people threw food away, and 49.5% a few times a month, while 22.4% admitted to throwing food away once a month, and 20.5% less frequently than once a month. Food in households was usually thrown away because the use-by date was missed (83.7%), and then much less often because of too large portions of prepared meals (43.3%), too many purchased products (27.7%), and improper storage of products (18.2 %). The number of products thrown away per person estimated by the respondents was up to 1 kg (52%) or 1-2 kg (35.9%) a month. A smaller proportion of respondents stated that they throw away between 2-3 kg (8.7%) or more than 3 kg (3.4%) a month. The most frequently wasted food in the study group was bread (51.8%), followed by fruit, cold cuts, vegetables, and yogurts (about 35% each).

A large proportion of the respondents took some measures to prevent throwing away too much food. These mainly included freezing food before it expires (64.7%), making a shopping list (53.3%), and planning meals for several days (40.4%). A small proportion of people created their composter (13.7%) or home food processing (20.5%). According to some of the respondents, in the entire supply chain, food is wasted in the household link in the most significant quantity, but only 31.1% of the respondents were aware of it. A large group consisted of people who believed that food is wasted chiefly in retail and wholesale (37.8%) or the case of food services (22.4%). Only 1.9% of people believed that most food is wasted at the stage of agriculture. As many as 90.1% of the respondents heard about food collections

organized by various organizations, e.g., food banks, but only 44.8% ever donated food to food banks or as part of other campaigns, e.g., Christmas food collection.

Before verifying what socio-demographic factors and factors related to the knowledge of food waste influenced the assessment of the perception of food waste as a significant socio-economic and environmental problem, and the assessment of the impact of changes in consumer behaviour that may contribute to the reduction of the scale of waste, factor analysis was performed for the questions measured on the Likert scale. The factor analysis performed using the principal components method gave a statistically significant result in the Bartlett sphericity test $\chi^2(15) = 907.22$; $p < .001$, which means that there were statistically significant correlations between the variables used in the analysis. The Kaiser-Meyer-Olkin coefficient was $KMO = .72$, which means that the factor analysis was justified and resulted in the actual reduction of factors. In the analysis of factors using Ward's primary components method, two components were distinguished: I - Assessment of the impact of changes in consumer behaviour on the reduction of the scale of waste, and component II - Assessment of the perception of waste by consumers as a significant socio-economic and environmental problem. Then, two regression models were built for the components separated in the factor analysis.

The first regression analysis showed that sex $t = -4.68$; $p < .001$; $\beta = -.20$, age $t = -3.08$; $p < .01$; $\beta = -.13$, knowledge of initiatives organised, among others, by food banks $t = 2.49$; $p < .05$; $\beta = .11$, and donating food as part of actions carried out by various organisations, including food banks, $t = -2.31$; $p < .05$; $\beta = -.10$, turned out to be statistically significant predictors of the assessment of the impact of consumer behaviour that may contribute to the reduction of the scale of waste in the study group. It has been shown that the above mentioned actions of consumers aimed at reducing the scale of food waste (planning meals in advance, distinguishing between the determinations on the labels "best before ..." and "use by ..", reducing excessive expectations about food, etc.), were assessed by women, people in the age group up to 25 and people who had knowledge of collections organised by food banks, but at the same time never donated food to such institutions. This model turned out to be statistically significant $F(4,516) = 12.44$; $p < .001$; $R^2 = .08$.

The second model examined the predictors of the assessment of consumer perception of waste as an important and multidimensional problem. This model also fits the data well $F(5,515) = 9.41$; $p < .001$; $R^2 = .08$. Statistically significant predictors of this assessment in the study group included sex $t = -2.07$; $p < .05$; $\beta = -.09$, age $t = -3.31$; $p < .01$; $\beta = -.14$, education $t = 2.92$; $p < .01$; $\beta = .12$, awareness of the highest share of households in food waste in the supply chain $t = 3.14$; $p < .01$; $\beta = .13$ and $t = 2.60$; $p < .05$; $\beta = .11$. Women, people up to 25 years of age, with higher education, who were aware that the greatest amount of food is wasted in households and had knowledge about collections of food organised, among others, by food banks were more aware of the perception of waste as a multidimensional problem of economic, social, and environmental importance.

The cluster analysis performed using Ward's method allowed for identifying two different profiles of people in the study group in terms of socio-demographic factors. The separate clusters consisted of 364 and 714 people. Based on the results of the analyses performed using Pearson's χ^2 tests, it can be concluded that the separate clusters of people differed statistically significantly in terms of age, education, place of residence, professional status, income per capita, and household size.

However, there were no differences between the groups in terms of sex. Cluster I was dominated by people over 25, with higher education, large cities, working, high earnings, and small households. In the group of people from cluster II, the opposite socio-demographic profile prevailed: there were more people before 25 years of age, from smaller cities, not working, earning less, and from larger households.

Table 3. *Distribution of socio-demographic characteristics with the division into clusters*

| Socio-demographic characteristics of the respondents | Cluster 1 | Cluster 2 | <i>p</i> * | |
|--|--------------------------------|------------|------------|-------|
| Sex | Female | 308 34.61% | 582 65.39% | 0.369 |
| | Male | 56 29.79% | 132 70.21% | |
| Age | 18-25 | 236 30.65% | 534 69.35% | 0.016 |
| | 26-35 | 128 41.56% | 180 58.44% | |
| Education | Up to secondary | 0 0% | 218 100% | 0.000 |
| | Higher incomplete and full | 364 42.33% | 496 57.67% | |
| Place of residence | City up to 200,000 inhabitants | 88 14.97% | 500 85.03% | 0.000 |
| | City above 200,000 inhabitants | 276 56.33% | 214 43.67% | |
| Professional status | Not working | 140 25.27% | 414 74.73% | 0.000 |
| | Working | 224 42.75% | 300 57.25% | |
| Net income per capital in the household | Up to 500 EUR | 160 27.59% | 420 72.41% | 0.001 |
| | Above 500 EUR | 204 40.96% | 294 59.04% | |
| Number of people in the household | Up to 2 people | 364 86.67% | 56 13.33% | 0.000 |
| | More than 2 people | 0 0% | 658 100% | |

Note: * *p*- statistical significance in the Pearson's χ^2 tests

Source: Authors' survey.

The relationships of the profiles mentioned above determined in the cluster analysis with behaviour related to food waste (among others, the frequency of throwing food away, the amount of food thrown away, giving food to, e.g., food banks) were studied. In the group of people from the profile I, all respondents admitted that they throw away food in their households, while in profile II, 3.4% of people admitted that food is not thrown away in their households. No more statistically significant associations between socio-demographic profiles and food waste behaviour were found.

The study also verified whether the awareness of the highest share of households in food waste in the food chain was associated with behaviour related to throwing food

away. The analyses showed that this awareness was statistically significantly associated with the frequency of throwing food away $\chi^2(1) = 24.64$; $p < .001$; $V = 0.22$, amount of food thrown away $\chi^2(1) = 6.24$; $p < .05$; $V = 0.11$, and with the knowledge of organised food collections $\chi^2(1) = 6.66$; $p < .05$; $V = 0.11$. Contingency Table 4 presents food waste awareness in the supply chain crossed with food waste behaviour.

Table 4. Contingency table for the relationship between awareness of places of food waste in the supply chain and food waste behaviour

| | | Lack of awareness of the highest share of households in food waste in the supply chain | | Awareness of the highest share of households in food waste in the supply chain | |
|--|------------------------|--|-------|--|-------|
| Frequency of throwing food away in the household | Once a month or less | 364 | 50.4% | 88 | 27.2% |
| | More than once a month | 358 | 49.6% | 236 | 72.8% |
| Amount of food thrown away in the household per month/per person | Up to 1kg | 404 | 55.6% | 144 | 43.9% |
| | Above 1kg | 322 | 44.4% | 184 | 56.1% |
| Knowledge of food collections organised by e.g., food banks | No | 88 | 12.1% | 16 | 4.9% |
| | Yes | 638 | 87.9% | 312 | 95.1% |
| Donating food to food banks or as part of other actions, e.g., Christmas food collection | No | 394 | 54.3% | 188 | 57.3% |
| | Yes | 332 | 45.7% | 140 | 42.7% |

Source: Authors' survey.

People who were aware that the most significant amount of food in the supply chain is wasted in households threw food away more often and did it in more significant amounts, despite being aware of the organization of, for example, food collections. This proves that the respondents are aware that their behaviour related to irrational food-management contributes to the fact that most food waste occurs in households, as they correctly indicated this link as the one where most food is wasted in the supply chain.

5. Conclusions

The study's objective was to learn the opinions and attitudes of young Polish consumers towards the problem of food waste. An essential aspect of the research was to verify the respondents' awareness of the links in the supply chain, in which most food is wasted, to find out the causes and scale of food waste in the respondents' households. As many as 97.8% of people in the study group admitted to wasting food in their household, and they usually threw food away several times a month in an amount not exceeding 1 kg/person/month. The main reason for wasting food was

missing the use-by date, even though most of the respondents reported trying to freeze food before it expires. According to the respondents, the most significant amount of food is wasted in retail and wholesale, and then in households.

The conducted research confirmed that women are more aware of the impact of introducing appropriate consumer behaviour on reducing the scale of food waste due to their more direct contact with food during shopping and cooking. The hypothesis that young age and higher education of Poles and the knowledge of initiatives such as food collection contributed to a higher awareness of perceiving food waste as a significant socio-economic and environmental problem was also confirmed. It is also worth noting that people who donated food to Food Banks assessed consumers' actions to reduce food waste as having a less significant effect.

However, the fourth hypothesis, assuming that the awareness of the highest share of households in food waste in the food chain is related to Poles' reduction of food waste, was not confirmed. In the group of people aware that most food is wasted in households, there was a more significant percentage of people throwing away more food.

The conducted research aimed to find out the opinions and attitudes of young consumers towards food waste. In the future, similar research will be carried out among older consumers, which will allow for comparative analyses to be performed and differences in the perception of this problem by different generations of consumers to be indicated.

References:

- Abeliotis, K., Lasaridi, K., Chroni, C. 2016. Food waste prevention in Athens, Greece: The effect of family characteristics. *Waste Management & Research*, 34(12), 1210-1216.
- Abeliotis, K., Lasaridi, K., Chroni, C. 2014. Attitudes and behaviour of Greek households regarding food waste prevention. *Waste Management & Research*, 32(3), 237-240.
- Beretta, C., Stoessel, F., Baier, U., Hellweg, S. 2013. Quantifying food losses and the potential for reduction in Switzerland. *Waste Management*, 33, 764-773.
- Bilska, B., Wrzosek, M., Kołozyn-Krajewska, D., Krajewski K. 2015. Food losses and food waste in the context of sustainable development of the food sector. *Chinese Business Review*, 14(9), 452-462.
- Bilska, B., Tomaszewska, M., Krajewska, K.D. 2020. Analysis of the behaviors of Polish consumers in relation to food waste. *Sustainability*, 12, 304.
- Business Insider. 2017. Poles waste 9 million tons of food annually. Retrieved from: <https://businessinsider.com.pl/lifestyle/jedzenie/marnowanie-zywnosci-ileton-jedzenia-wyrzucaja-polacy/5wnn8yt>.
- European Parliament Resolution of 19 January 2012 on how to avoid food wastage: strategies for a more efficient food chain in the EU. Retrieved from: https://www.europarl.europa.eu/doceo/document/TA-7-2012-0014_EN.html.
- FAO. 2011. Global food losses and food waste - Extent, causes and prevention. Available at <http://www.fao.org/3/a-i2697e.pdf>.

- FAO. 2019. Moving forward on food loss and waste reduction. Rome. Retrieved from: <http://www.fao.org/3/ca6030en/ca6030en.pdf>.
- Giordano, C., Alboni, F., Falasconi, L. 2019. Quantities, determinants, and awareness of households' food waste in Italy: A comparison between diary and questionnaires quantities. *Sustainability*, 11, 3381.
- Gracia, A., Gómez, M.I. 2020. Food Sustainability and Waste Reduction in Spain: Consumer Preferences for Local, Suboptimal, And/Or Unwashed Fresh Food Products. *Sustainability*, 12(10), 4148.
- Griffin, M., Sobal, J., Lyson, T.A. 2009. An analysis of a community food waste stream. *Agriculture and Human Values*, 26(1), 67-81.
- Gustavsson, J., Cederberg, C., Sonesson, U., van-Otterdijk, R., Meybeck, A. 2011. Global Food Losses and Food Waste: Extent, Causes and Prevention. FAO, Rome, Italy.
- Herzberg, R., Schmidt, T.G., Schneider, F. 2020. Characteristics and determinants of domestic food waste: A representative diary study across Germany. *Sustainability*, 12, 4702.
- HLPE. 2014. Report 8. Food losses and waste in the context of sustainable food systems. A report by the High Level Panel of Experts of Food Security and Nutrition. Retrieved from: <http://www.fao.org/3/a-i3901e.pdf>.
- Hodges, R.J., Buzby, J.C., Benenett, B. 2011. Postharvest losses and waste in developed and less developed countries: opportunities to improve resource use. *Journal of Agricultural Science*, 149, 37-45.
- Interreg Europe. 2019. BIOREGIO Regional circular economy models and best available technologies for biological streams. Available at www.interregeurope.eu/bioregio/.
- Iorga, S.C., Apostol, L., Belc, N., Mosoiu, C.E., Berca, L.M., Niculae, O.M., Popa, M.E. 2017. Profile of high risk wasting food consumer in Romania. *Scientific Bulletin. Series F. Biotechnologies*, 21, 301-307.
- Katajajuuri, J.M., Silvennoinen, K., Hartikainen, H., Heikkilä, L., Reinikainen, A. 2014. Food waste in the Finnish food chain. *Journal of Cleaner Production*, 73, 322-329.
- Kolozyn-Krajewska, D., Wrzosek, M., Bliska, B., Krajewski, K. 2014. Rzyzyko powstawania strat i marnotrawstwa żywności a możliwość ich ograniczenia. In: Tarko, T., Duda-Chodak, A., Witczak, M., Najgebauer-Lejko, D. (eds): *Technologia produkcji i bezpieczeństwo żywności*, Polish Society of Food Technologists: Cracow: 5-16.
- Kummu, M., de Moel, H., Porkka, M., Siebert, S., Varis, O., Ward, P.J. 2012. Lost food, wasted resources: Global food supply chain losses and their impacts on freshwater, cropland, and fertiliser use. *Science of the Total Environment*, 438, 477-489.
- Lipinski, B., Hanson, C., Lomax, J., Kitinoja, L., Waite, R., Searchinger, T. 2013. Reducing food loss and waste. Installment two of creating a sustainable food future. Working Paper. Washington, DC, World Resources.
- Macková, M., Hazuchová, N., Stávková, J. 2019. Czech consumers' attitudes to food waste. *Agricultural Economics - Czech*, 65(7), 314-321.
- Mondéjar-Jiménez, J.A., Ferrari, G., Secondi, L., Principato, L. 2016. From the table to waste: An exploratory study on behaviour towards food waste of Spanish and Italian youths. *Journal of Cleaner Production*, 138, 8-18.
- Schmidt, K. 2016. Explaining and promoting household food waste-prevention by an environment psychological based intervention study. *Resources Conservation and Recycling*, 111, 53-66.
- Silvennoinen, K., Katajajuuri, J.M., Hartikainen, H., Heikkilä, L., Reinikainen, A. 2014. Food waste volume and composition in Finnish households. *British Food Journal*, 116, 1058-1068.

- Stefan, V., Van Herpen, E., Tudoran, A.A., Lähteenmäki, L. 2013. Avoiding food waste by Romanian consumers: The importance of planning and shopping routines. *Food Quality and Preference*, 28, 375-381.
- Stenmarck, A., Jensen, C., Quedsted, T., Moates, G. 2016. Estimates of European food waste levels, Stockholm. Retrieved from: <https://www.eu-fusions.org/phocadownload/Publications/Estimates%20of%20European%20food%20waste%20levels.pdf>.
- Timmermans, A.J.M. 2015. Fusions Food waste data set for EU-28: New Estimates and Environmental Impact; European Commission: Brussels, Belgium. Retrieved from: <https://www.eu-fusions.org>.
- Thyberg, K.L., Tonjes, D.J., Gurevitch, J. 2015. Quantification of Food Waste Disposal in the United States: A Meta-Analysis. *Environmental Science & Technology*, 49, 13946-13953.
- Van der Werf, P., Gilliland, J.A. 2017. A systematic review of food losses and food waste generation in developed countries. In: *Proceedings of the Institution of Civil Engineers-Waste and Resource Management*, Thomas Telford Ltd.: London, UK, 170, 66-77.
- Venkat, K. 2011. The climate change and economic impacts of food waste in the United States. *International Journal of Food System Dynamics*, 2, 431-446.
- Zhang, P., Zhang, D., Cheng, S. 2020. The Effect of Consumer Perception on Food Waste Behavior of Urban Households in China. *Sustainability*, 12, 5676.