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# Sustainable food policy tools: a deposit for PET bottles and a charge for wasted food – a study in Poland

Narzędzia polityki zrównoważonej żywności: opłata za butelki PET oraz kaucja za marnowaną żywność – przykład Polski

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**Abstract**

This article assesses the social acceptability of two food policy tools, viz. a polyethylene terephthalate (PET) bottle deposit scheme, and a wasted food charge. First, a systematic literature review on regulatory and market tools was conducted. Next, a quantitative survey was carried out among food consumers residing in the municipality of Poznań Poland in 2022. To deepen the analysis, the quantitative survey was supplemented with interviews with experts. The analysis of the quantitative data revealed that women have a statistically significantly higher acceptance for both instruments than men. Acceptance for the PET bottle deposit is highest among younger respondents and those with higher education, while acceptance for the introduction of a wasted food charge was highest among older respondents and rural dwellers. The experts pointed out both the benefits and the risks associated with implementing these instruments, and emphasised the need to adapt educational and regulatory strategies to diverse demographic and socio-economic groups.

**Keywords:** Poland, market-based food policy tools, sustainable and environmentally friendly food consumption, deposit for PET bottles, charge for wasted food.

**JEL:** E61, H41, O44, Q56

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**Streszczenie**

Celem artykułu jest ocena społecznej akceptacji dwóch narzędzi polityki żywnościowej, tj. opłaty za politereftalan etylenu (PET) oraz kaucji za marnowaną żywność przez konsumentów. W pierwszej kolejności przeprowadzono systematyczny przegląd literatury z zakresu narzędzi regulacyjnych i rynkowych. Następnie, wykonano badanie ilościowe wśród konsumentów żywności zamieszkałych w Powiecie poznańskim w 2022 roku. W celu pogłębienia analizy, badanie ilościowe zostało uzupełnione wywiadami z ekspertami. Analiza uzyskanych danych ilościowych pokazała, że kobiety charakteryzują się statystycznie istotnie większą akceptacją dla obu instrumentów w porównaniu do mężczyzn. Akceptacja dla kaucji za butelki PET jest najwyższa wśród młodszych respondentów i osób z wyższym wykształceniem. Z kolei, najwyższą akceptacją dla wprowadzenia opłaty za marnowaną żywność zgłosiły osoby najstarsze i mieszkańcy obszarów wiejskich. Eksperti wskazali na korzyści, jak i zagrożenia związane z wdrożeniem analizowanych instrumentów, podkreślając konieczność dostosowania strategii edukacyjnych i regulacyjnych do zróżnicowanych grup demograficznych i społeczno-ekonomicznych.

**Słowa kluczowe:** Polska, narzędzia polityki żywnościowej, zrównoważona i przyjazna środowisku konsumpcja żywności, kaucja za butelki PET, opłata za marnowaną żywność.

**JEL:** E61, H41, O44, Q56



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## 1. Introduction

Food economy is one of the most important sectors of the national economy (Carlsson-Kanyama et al., 2003; Gorynia & Kuczevska, 2023). The European Commission (EC) advocates for positive changes in the food system through initiatives such as reusable plastics (*Plastics, the circular economy and Europe's environment*, 2021), replacing plastics with biodegradable materials (Heidbreder et al., 2020), increasing public awareness of the negative environmental impact of food waste (Cattaneo et al., 2021; Zielińska-Chmielewska et al., 2021), formulating sustainable tax collection strategies (Gombár et al., 2022), and promoting sustainable food consumption (FAO, 2018). Priority is given to changing consumption profiles by increasing public awareness of a healthy diet (Galli et al., 2020). The long-term aims include an increase in the share of plant-based foods in the human diet, a rise in prices for certain less sustainable food categories, a higher share of green public procurement, the dissemination of fiscal measures, and a reduction in food waste (Zaharia et al., 2021). These changes in the food system are expected to boost population levels in depopulated rural areas and improve the economic situation of farmers in those parts of the world (FAO, 2020).

One of the primary motivations for implementing economic policy tools for sustainable food consumption is their ability to influence both the supply and demand of food products (Wielicka-Regulska & Sołtysik, 2021). Several food policy tools intended to stimulate more sustainable food choice are currently being considered. These include higher tax rates on junk food, green public procurement, plastic bottle deposit schemes, value-added tax (VAT) exemptions for food donated to charitable institutions, and waste charges on food consumed in retail outlets (coffee shops, bars, restaurants, etc.). Implementing sustainable food policy tools can yield substantial economic, social and environmental benefits (Sojkin et al., 2012). Furthermore, these tools can enhance public awareness, induce salutary decisions on the part of consumers and producers, and lead to sustainable lifestyles (Sojkin et al., 2009).

Approximately 20–30% of the food we produce is wasted, according to the UN (2023). If global food waste and loss were a country, it would rank as the world's third-largest emitter of greenhouse gases (GHG). The energy expended in growing food, the fuel and energy used in maintaining supply chains, and the greenhouse gases emitted from rotting food are key contributors to this alarming statistic. Somewhat counter-intuitively, life cycle assessments of single-use plastics and food waste show that the impact of wasting food on the climate can dwarf that of packaging (Lockrey, 2022).

Food waste depletes natural resources, including land, water, energy, labour, capital, and emits GHG (FAO, 2013). Corrado and Sala (2018) reported that, on average, 158–298 kg of food per person per year was wasted in the EU in 2010–2017. Food waste is both irrational and environmentally harmful. The reasons for food waste vary between sectors (*Sustainable consumption and production*). The highest proportion of food waste in developed countries occurs at the consumption and retail levels (Łaba, 2020). Devin & Richards (2018) proved that, from the supply side, food is wasted due to difficulties in predicting demand and inefficiencies in managing supply chains. Moreover, they claim that, from the demand side, food is

wasted due to inappropriate consumer behaviour, confusion about food labelling, or the appearance of food (Košičiarová et al., 2022). Cerciello et al. (2018) state that Good Samaritan Food Donation laws, which provide civil and criminal liability protection for food donors who, in good faith, donate wholesome food to charities and non-profit organizations that distribute it to the needy, as demonstrated in Italy, are effective in reducing food waste. Consumers hold varying opinions as to whether they or retailers are responsible for food waste (Aschemann-Witzel et al., 2023). Research indicates that consumers perceive themselves as knowledgeable and engaged in waste reduction efforts, as they are motivated by desires to save money, protect nature, and set examples for their children (Aschemann-Witzel et al., 2023). However, consumer behaviour towards suboptimal food, influenced by such factors as social influence and purchase context, can lead to food waste at the consumer-retailer interface (Aschemann-Witzel et al., 2019). Consumers are primarily driven by a desire to economize on food shopping, e.g. by looking for products that are marked down on account of impending expiration dates (Neff et al., 2015). This suggests that consumers may respond to initiatives such as imposing a wasted food charge on large retailers, especially if these initiatives are conducive to saving money and reducing waste (Aschemann-Witzel et al., 2016). Such a fee could motivate retailers to offer larger discounts on food that is suboptimal, nearing expiration, or which would otherwise be thrown away. The policy of imposing a penalty for food wastage generated at the retail level could benefit price-sensitive consumers by lowering prices of particular foodstuffs – mainly perishable food items. This policy might not necessarily limit the scope of food waste, but it would certainly shift the responsibility for it.

Food policy tools such as a PET bottle deposit scheme and a wasted food charge would generate revenue that the government could allocate to e.g. education, health, social and environmental actions. The revenue from these taxes could also be used to support organizations involved in food recycling and disposal. A charge on PET bottles would incentivize the use of reusable packaging and stimulate the design of innovative packaging solutions, thereby contributing to the development of eco-friendly alternatives. Reducing the number of PET bottles decreases the use of raw materials, lowers disposal costs, and increases savings at the local level. A wasted food charge, in turn, could reduce waste by encouraging producers to manage food more responsibly and consumers to plan their purchases more efficiently. It would be an incentive to make conscious food choices, plan meals, monitor expiration dates, and minimize food waste. Understanding the reasons for consumer resistance or support for these sorts of tools would enable policymakers to take optimal fiscal decisions.

A deposit scheme involves adding a surcharge (i.e. a 'deposit') to beverages. This amount is refunded when the packaging is returned to an authorised retailer (Siwkowska, 2022). The aim is to encourage consumers to return empty plastic and glass bottles and cans so that they can be recycled. The deposit system for food packaging is an important component of the closed-loop economy and the zero-waste movement, whose main goal is to achieve zero harmful emissions into the atmosphere, and zero deposits of materials, products and waste into water and land (Zero Waste International Alliance). A closed-loop economy assumes that all

discarded materials are resources, and resources should not be burned or buried. The European Commission (2018) has mandated that all new plastics be fully recyclable (*EU sets 2030 recycling target for all plastic packaging*, 2018) by 2030. This will be made possible by introducing the Extended Producer Responsibility Program (EPR), which will fund educational activities and deposit schemes for beverage packaging.

Having analysed the extensive and diverse literature on the topic, the present authors concluded that there is a lack of research on the social acceptability of food policy tools in Poland. This justifies their efforts to determine the level of social acceptability of the subject food policy tools with a view to having them effectively implemented and widely accepted by all stakeholders.

Additionally, imposing a wasted food charge is justified by the fact that Poland generates approximately 5 million tonnes of food waste per year while more than 1.6 million people live below the poverty line (*Benefits of donating food products for social purposes*, 2023).

This study assesses the social acceptability a PET bottle deposit scheme and a wasted food charge in Poland. It was vital to gauge the extent to which consumers are willing to accept state interference in their purchasing habits. Both primary and secondary research materials were used. The primary materials included a survey questionnaire with data and an expert study. The sample was structured to be representative in terms of gender, age, education, place of residence, household size, and household financial situation. Raw data from both sources were collected, cleaned, coded and subjected to statistical processing. The results are presented below in the form of tables and charts. Descriptive, comparative, deductive and synthesis methods were used.

The results can assist government institutions in implementing a closed-loop economy in various production activities and in addressing health issues such as obesity and diabetes. Moreover, a new tax on single-use packaging is being introduced in Poland in 2024. The changes in the product fee system represent the transposition into Polish law of Directive (EU) 2019/904 of the European Parliament and of the Council of 5 June 2019, on reducing the environmental impact of certain plastic products (Official Journal L 155 of 12 June 2019).

The present study makes two contributions to the topic of sustainable food policy. First, by assessing the level of social acceptability of PET bottle deposit scheme and a wasted food charge, it can suggest tax rates that encourage certain pro-environmental activities without overburdening consumers to the point of discouragement. Second, the outcomes can inform education and outreach campaigns designed to promote more sustainable and pro-environmental behaviour and encourage more sustainable consumption practices.

## 2. Literature review

Research on the essential characteristics of the subject food policy tools has examined their effectiveness (Nissinen et al., 2015), fairness (Vermeir et al., 2020), and

advisability (Testa et al., 2016). Baker et al. (2018) show that the adequacy of these tools varies depending on cultural and economic circumstances.

Economic policy tools for a sustainable and closed-loop economy are defined by Vedung (Bemelmans-Videc et al., 1998, p. 21) as a set of techniques that government authorities apply to effectuate or prevent social change with public support. Bemelmans-Videc et al. (1998) and Vedung (2020) categorized these tools into three groups: regulative, economic and informative. With reference to these tools, Reisch et al. (2013) classified tools for sustainable food consumption as policy instruments intended to promote sustainable food systems and categorised them as information-based, market-based, regulatory, and/or self-committing. Acciai & Capano (2021) in turn reviewed the most frequently used typologies of economic policy tools, and conducted a meta-analysis to demonstrate how these tools have been applied differentially to explain real-world phenomena. The results are highly diversified due to the nature of the economic policy tools under consideration and the division between typologies focused on governmental resources and those focused on expected consumer behaviour.

Although sustainable food policy tools are necessary and desirable, factors such as implementation and maintenance costs (Vermeir et al., 2020; Hendriks et al., 2021), the low uptake of tools to stimulate sustainable consumption (Dawkins et al., 2019), and potential public resistance to actions and measures that restrict consumers' buying and retailers' selling behaviour (Jürkenbeck et al., 2020), all pose serious obstacles. The increasing importance of public institutions and policies at the local (Doernberg et al., 2019), national (Mozaffarian et al., 2018) and international (Sonnino & Coulson, 2021; Saviolidis et al., 2020) levels plays a vital role in overcoming these challenges in implementing sustainable food policy tools.

Regardless of the reasons, research addressing the issues involved in implementing PET bottle deposit schemes and imposing food waste charges mainly focus on the influence of the public (Macková et al., 2019), who require a high accuracy of interventions and social control of the process (Spadło & Grotowska, 2022). The use of market-based food policy tools promotes societal inclusiveness and facilitates better perception of food policy programs by all stakeholders (Erokhin et al., 2022).

Jadayil & Aqil (2023) state that a deposit scheme exerts a positive impact on the local economy because it allows savings to be made due to reduced production of plastic bottles and decreased storage of unreturned bottles. Konstantoglou et al. (2023) indicate that consumers in Greece are willing to participate in refundable recycling initiatives due to their environmental concerns, and they regard it as an easy and simple process. Meanwhile, independent polls conducted in France in 2023 and in Scotland in 2024 (Public support for deposit return systems, 2024) showed that more than 90% of the population supported the introduction of a deposit scheme. Italy developed a National Plan for Food Waste Prevention (PINPAS) and, in 2016, it passed the Gadda Law to reduce food waste. However, the Gadda Law is controversial because it is predicated on 'educating the consumer', thus indirectly blaming consumers for food waste. A distinct advantage of the Gadda Law is the increase in the pool of donors, an aspect that was neglected in the Buon Samaritano [Good Samaritan] Law that it superseded (Berti et al., 2021). Moreover, this

legislation highlights the important role assigned to local government authorities, as they are tasked with promoting the use of doggy bags in restaurants and have the authority to grant a waste tax rebate policy to retailers who donate. Similarly, French supermarkets have been required to donate food that would otherwise be discarded to charities since 2016 (Garske et al., 2020).

In Poland, wasted food has been taxed at the retail level and distributors who donate food to public benefit organizations have been entitled to a VAT deduction since March 2020 (Act of 19 July 2019 on counteracting food waste; Preventing food waste – what are the obligations of food sellers, 2022; Charity without VAT, 2018). Moreover, VAT tax relief in Poland includes the free donation of food products (excluding alcoholic beverages) to public benefit organizations for charitable purposes. Large-area shops and wholesalers that have a sales area of over 250 square metres, and which derive at least 50% of their revenue from food sales, are required to donate food to a selected NGO (Act of 11 March 2004, on tax on goods and services; the amended Act on not wasting food came into force – entrepreneurs can now lose their VAT exemption, 2019). The regulations mentioned above do not affect consumers directly, although they may have an indirect impact on food prices if distributors pass on some of the economic costs associated with these new regulations to consumers. Poland has not implemented a deposit system because of the cost involved, which the Polish Ministry of Environment estimated in 2017 to range from PLN 19 billion to PLN 24 billion (Bodirsky et al., 2022). Broniewicz et al. (2023) point out that implementing a deposit scheme in other countries has proven to be a successful instrument for achieving the objectives of the SUP Directive. The presented forecast of the economic effects of introducing a deposit scheme for selected packaging in Poland indicates that the implementation costs will be lower than those in a business-as-usual scenario.

The revised Waste Directive (EU and EU Council Directive 2018/851, 2018) and the Directive on the Reduction of the Environmental Impact of Certain Plastic Products (European Parliament and Council Directive (EU) 2019/904, 2019) specify the recycling rate targets for municipal waste. The municipal waste recycling rate was set at a minimum of 50% in 2020 and is expected to reach a minimum of 65% by 2035. The recycling rate for packaging waste is set to be a minimum of 65% by 2025, and a minimum of 70% by 2030. For plastic bottles, at least 77% of the raw material is required to be separately collected by 2025 and 90% by 2030. Furthermore, plastic bottles are required to contain 25% recycled material by 2025 and 30% by 2030 (Polish Zero Waste Association, 2020). In Poland, the level of plastic recycling in 2022 was 21.2% (Plastics Europe, 2024), which was below the EU-27 average (European Parliament, 2019). According to EUROSTAT, an estimated 41.5% of plastic packaging waste was recycled across the EU in 2018 (More than 40% of EU plastic packaging waste was recycled in 2021).

The main environmental problems resulting from production activities (in the broad sense of the term) include the use of plastics (Moore, 2023), production waste (Fortunati et al., 2020), food waste (Oláh et al., 2022), atmospheric emissions of pollutants, wastewater discharge, the use of agricultural and forest land for production, soil devastation and degradation, electromagnetic radiation, and environmental

changes due to the extraction of raw materials from deep underground (Filho et al., 2021), changes in the landscape and other aesthetic qualities, and even the final product during its use and its packaging at the disposal and storage stages (Wrzosek & Kisała, 2019).

### 3. Methods

Previous studies (Picuno et al., 2021; Pinter et al., 2021; Boros et al., 2021; Friman & Hyytiä, 2022; Zhou et al., 2023, Jadayil & Aqil, 2023) reveal that consumers exhibit varying levels of social acceptance of a PET bottle deposit scheme and a wasted food charge. The present study similarly assesses the social acceptance of these tools. The study was conducted from 1 January to 31 March 2022, and residents of the municipality of Poznań, Poland, comprised the sample (N = 150). The primary sources consist of questionnaire data and interviews. The secondary sources comprise a literature review to introduce and lead the discussion on the characteristics of selected regulatory and market-based policy tools using databases, market reports, newsletters, and information services. The results of literature review were used to identify relevant areas related to the acceptance of sustainable food consumption and interventions in food systems. The secondary research sources were identified and screened. The article concludes with descriptive and comparative data analyses, supplemented with a tabular presentation of the results.

Both a quantitative (CAWI questionnaires) and a qualitative (IDI interviews) method were employed to assess the social acceptance of the subject food policy tools in Poland. The quantitative approach addresses the second and third research questions on demographic and socio-economic features, while the qualitative approach addresses the first research question on the practical implementation of a PET bottle deposit scheme and a wasted food charge. The quantitative method was utilized in the first stage. The Likert scale was used (1 – Strongly disagree; 2 – Disagree; 3 – Neither agree nor disagree / difficult to say; 4 – Agree; 5 – Strongly agree) to assess the responses to the following statements:

- 1) Stores should pay a fee for the amount of food wasted;
- 2) A refundable deposit for plastic bottles should be introduced.

These questions are fundamental to the analyses and the presentation of the results.

The study targeted the population of the municipality of Poznań (the capital city of the Wielkopolskie Voivodship, Poland). The representativeness of the sample (N = 150) was ensured by employing a quota sampling method that maintained the structure of the key characteristics of the subject population. The sampling was done by quota according to place of residence, gender, age, education, household size, number of children in the household, and source of income.

Data were collected via an electronic Google form and the traditional paper questionnaire method. The data from both sources were then processed in a spreadsheet using a statistical analysis package. The data were cleaned, coded, and subjected to both one-dimensional and two-dimensional analyses. The results were presented in the form of tables and interpreted descriptively. The basic criteria for

selecting a research sample included: municipality (Poznań); gender (female/male); age (20–34; 35–49; 50–64, 65+); education level (vocational, secondary, secondary with matriculation, and higher); household size; and household financial situation.

The analysis of the literature and the empirical evidence showed that the social acceptability of the subject food policy tools varies by gender. Dupont (2004) indicates that women are more concerned about deteriorating environmental quality. Davidson & Freudenburg (1996) find that women are more concerned about the environment than men. Moreover, many scholars (Zelezny et al., 2000; Meneses & Palacio, 2005; Keuschnigg & Kratz, 2018; Steg & Vlek, 2009; Echavarren, 2023; Dhenge et al., 2022; Tien & Huang, 2023) have found that women possess greater environmental awareness, exhibit more pro-environmental attitudes and behaviours, and are more likely to take pro-environmental actions than men. Stern et al. (1993) indicated that women are more convinced that environmental degradation has serious consequences and are therefore more likely to take pro-environmental actions. Hunter et al. (2004) found that women appear to be more engaged in household (private) oriented pro-environmental activities (e.g. recycling) and that men are more involved in community/society (public) oriented pro-environmental activities (e.g. protesting).

The following three research questions were formulated on the basis of the literature review:

1. Does the social acceptability of a PET bottle deposit scheme in a household and a wasted food charge vary?
2. Are demographic (gender, age) and socio-economic features (education, residence, household size, household financial situation) relevant to the degree of social acceptability of a PET bottle deposit scheme?
3. Are demographic features (gender, age) and socio-economic features (education, residence, household size, household financial situation) related to the degree of social acceptability of a wasted food charge?

In the second stage, the qualitative method, viz. IDI interviews (N = 6) with experts, was employed. The questions for the experts consisted of three main themes: the impact of the particular tool, the practicalities of implementation, and good practices. The collected data were transcribed and coded using QDA Miner software, LITE v2.0.8 to create a database and code the responses. The analysis of the in-depth interviews encompassed the 5 stages posited by Yin (2015), viz.: (i) Collecting data for the database – transcribing the interviews; (ii) Disassembly – coding the respondents' answers; (iii) Reassembly – tabulating the data; (iv) Interpretation – presenting the frequency of reasons cited; and (v) Conclusion. The substantive reason for employing this method was the need for expert analysis of the qualitative data.

## 4. Results and discussion

The sample of 150 respondents aged 20+ was divided six ways. First, it was divided into females (N f = 46%) and males (N m = 54%). Second, it was divided into four



age categories: 20–34 years old (N = 28%), 35–49 years old (N = 28%), 50–64 years old (N = 24%), and 65+ years old (N = 20%). Third, it was divided by education level: vocational (13%), secondary (23%), post-secondary/baccalaureate (20%), and higher (44%). Fourth, it was divided by place of residence: rural area (20%), city with a population of 50K or less (28%), city with a population between 50K and 200K (27%), city with a population between 201K and 500K (14%), and city with a population of more than 500K (11%). Fifth, it was divided by household size: 1-person (11%), 2-person (28%), 3-person (23%), 4-person (25%), 5-person or more (13%). Sixth, it was divided by financial situation: modest (10%), average (54%), good (31%), and very good (5%).

**Table 1.**

*The social acceptability of a PET bottle deposit scheme in terms of demographic and socio-economic features*

Variable	N	Mean	Median	SD	Min.	Max.	
Gender	female	81	4.14	4.00	1.09	4.00	5.00
	male	69	3.60	4.00	1.32	3.00	5.00
	overall	150	3.90	4.00	1.22	4.00	5.00
Age	20-34	44	4.29	4.00	0.87	4.00	5.00
	35-49	37	4.05	4.00	1.27	4.00	5.00
	50-64	40	3.57	4.00	1.45	2.00	5.00
	65 or older	29	3.63	4.00	1.20	3.00	4.00
	overall	150	3.90	4.00	1.24	4.00	5.00
Education	vocational education	19	3.37	4.00	1.60	2.00	5.00
	secondary education	34	3.89	4.00	1.21	4.00	4.00
	secondary education with matriculation	32	3.80	4.00	1.20	3.00	5.00
	higher education	65	4.20	4.00	1.14	4.00	5.00
	overall	150	3.88	4.00	1.23	4.00	5.00
Residence	rural areas	30	3.87	4.00	1.22	4.00	5.00
	city with a population up to 50K inhabitants	42	4.05	4.00	1.08	4.00	5.00
	city with a population between 50K and 200K inhabitants	41	4.00	4.00	1.19	4.00	5.00
	city with a population between 201K and 500K inhabitants	21	3.35	4.00	1.20	2.00	5.00
	city with a population of more than 500K inhabitants	16	3.91	4.00	1.32	4.00	5.00
	overall	150	3.89	4.00	1.22	4.00	5.00

Variable		N	Mean	Median	SD	Min.	Max.
Household Size	1-person	15	3.67	4.00	1.23	3.00	5.00
	2-person	44	3.86	4.00	1.30	3.00	5.00
	3-person	34	3.91	4.00	1.24	4.00	5.00
	4-person	37	3.94	4.00	1.20	4.00	5.00
	5-person or more	20	4.27	4.34	0.41	4.17	4.67
	overall	150	3.89	3.00	1.22	4.00	5.00
Financial situation	modest	15	3.54	4.00	1.41	2.00	5.00
	average	81	3.84	4.00	1.17	4.00	5.00
	good	46	4.04	4.00	1.25	4.00	5.00
	very good	8	4.12	4.50	1.36	4.00	5.00
	overall	150	3.89	4.00	1.22	4.00	5.00

Source: own calculations based on collected primary data.

**Table 2.**

*The social acceptability of a wasted food charge in terms of demographic and socio-economic features*

Variable		N	Mean	Median	SD	Min.	Max.
Gender	female	81	3.86	4.00	1.26	3.00	5.00
	male	69	3.16	3.00	1.30	2.00	4.00
	overall	150	3.54	4.00	1.32	2.00	5.00
Age	20–34	44	3.41	4.00	1.35	2.00	4.00
	35–49	37	3.81	4.00	1.31	3.00	5.00
	50–64	40	3.22	3.50	1.30	2.00	4.00
	65 or older	29	3.82	4.00	1.28	3.00	5.00
	overall	150	3.54	4.00	1.32	2.00	4.00
Education	vocational education	19	3.42	4.00	1.35	2.00	5.00
	secondary education	34	3.32	4.00	1.45	2.00	5.00
	secondary education with matriculation	32	3.62	4.00	1.31	2.00	5.00
	higher education	65	3.65	4.00	1.27	2.00	5.00
	overall	150	3.54	4.00	1.32	2.00	5.00

Variable	N	Mean	Median	SD	Min.	Max.	
Residence	rural areas	30	3.90	4.00	1.12	3.00	5.00
	city with a population up to 50K inhabitants	42	3.45	4.00	1.45	2.00	5.00
	city with a population between 50K and 200K inhabitants	41	3.34	4.00	1.54	2.00	5.00
	city with a population between 201K and 500K inhabitants	21	3.25	3.50	1.16	2.00	5.00
	city with a population of more than 500K inhabitants	16	3.53	4.00	1.32	2.00	5.00
	overall	150	3.54	4.00	1.32	2.00	5.00
Household Size	1-person	15	2.67	2.00	1.50	2.00	4.00
	2-person	44	3.75	4.00	1.25	3.00	5.00
	3-person	34	3.65	4.00	1.23	2.00	5.00
	4-person	37	3.68	4.00	1.36	2.00	5.00
	5-person or more	20	2.97	3.20	0.69	2.34	3.34
	overall	150	3.54	4.00	1.32	2.00	4.00
Financial situation	modest	15	3.54	4.00	1.35	2.00	5.00
	average	81	3.50	4.00	1.40	2.00	5.00
	good	46	3.60	4.00	1.30	4.00	5.00
	very good	8	4.12	4.00	0.99	4.00	4.00
	overall	150	3.54	4.00	1.32	2.00	5.00

Source: own calculations based on collected primary data.

From Table 1 and Table 2, it can be concluded that women are more accepting of both initiatives than men. As such, they are probably more inclined to support pro-environmental actions. Younger individuals (20–34 years) are more likely to accept a PET bottle deposit scheme, while older individuals (65 years and over) show greater acceptance of a wasted food charge. Individuals aged 50–64 have the lowest acceptance for both instruments. This aligns with the findings of Zelezny et al. (2000) and Konstantoglou et al. (2023), who observed similar demographic trends. However, the lower acceptance among older individuals contrasts with some studies (e.g. Jürkenbeck et al., 2020), suggesting the need for targeted educational campaigns. Higher education is associated with greater acceptance of both a PET bottle deposit scheme and a wasted food charge, whereas vocational education is associated with the lowest acceptance for both initiatives. Large households (5-person or more) are most accepting of a PET bottle deposit scheme, while 2-person households are most accepting of a wasted food charge. Single-person households are least accepting of both tools.

To verify the existence of possible relationships between demographic and socio-economic features with the subject food policy tools and to verify the rese-

arch questions (Q1; Q2; Q3), the correlation coefficients were calculated for both demographic and socio-economic features (Table 3). Neither the socio-economic features of a PET bottle deposit scheme nor of a wasted food charge were linearly related to the degree of social acceptability.

**Table 3.**

*Correlation between the demographic and socio-economic features of the social acceptability of a PET bottle deposit scheme and a wasted food charge*

Variable	Gender	Age	Education	Residence	Household Size	Financial situation
A deposit for PET bottles	0.241*	0.106	0.111	-0.101	0.043	0.151
A charge for wasted food	0.287*	-0.101	0.082	0.000	0.038	0.054

Note: Spearman rank-correlation-order; Correlation coefficient is significant with  $p < 0.05$

Source: own calculations based on collected primary data.

The correlation analysis between the demographic and socio-economic features of the social acceptability of a PET bottle deposit scheme and a wasted food charge revealed a linear correlation (Table 3). Women’s acceptance of a PET bottle deposit was 0.241, and their acceptance of a wasted food charge was 0.287 ( $p < 0.05$ ).

The authors’ empirical studies have led to the formulation of the following hypotheses:

- H<sub>0</sub>: There is a statistically significant relationship between the social acceptability of implementing a PET bottle deposit scheme and gender;
- H<sub>1</sub>: There is no statistically significant relationship between the social acceptability of implementing a PET bottle deposit scheme and gender;
- H<sub>0</sub>: There is a statistically significant relationship between the social acceptability of imposing a wasted food charge on large retailers and gender;
- H<sub>1</sub>: There is no statistically significant relationship between the social acceptability of imposing a wasted food charge on large retailers and gender.

Table 4 and Table 5 present the results of the social acceptability of a PET bottle deposit scheme and a wasted food charge.

**Table 4.**

*The social acceptability of a PET bottle deposit scheme by gender*

Variable	N = 150	Mean Rank	Median (±quartile deviation)	Mean
Females	81	65.30	4 (0,5)	4.135802
Males	69	62.99	4 (1)	3.594203

Kruskal-Wallis test = 7.984, critical significance level = 0.005

H1: Gender significantly differentiates the social acceptability of a PET bottle deposit scheme

Variable	N = 150	Mean Rank	Median (±quartile deviation)	Mean
Decision on H1	Do not reject			
Interpretation	The social acceptability of a PET bottle deposit scheme was significantly higher for women. Women voted 4 ±1.5 and men 4 ±2			

Source: own calculations based on collected primary data.

Table 4 shows that gender statistically differentiated the social acceptability of a PET bottle deposit scheme in Poland in 2022. Women are more positive about a PET bottle deposit scheme than the more sceptical men. Zelezny et al. (2000) also found that women exhibit stronger environmental attitudes than men. Moreover, women take more responsibility for recycling than men (Meneses & Palacio, 2005). Women also recycle more glass and plastic waste (Keuschnigg & Kratz, 2018). Other research (Picuno et al., 2021; Pinter et al., 2021) has uncovered a growing interest in deposit-refund schemes among Central-Eastern Europe consumers as these countries adopt circular economy practices. Boros et al. (2021) note that the deposit fee for one-way bottles adopted in Hungary has stronger support among women. Since 2020, many European countries, including Germany, the Netherlands, Denmark, Sweden, Norway, Finland, Estonia, Iceland and Croatia, have implemented plastic bottle deposit schemes. Zhou et al. (2020) conclude that the deposit return system for beverage packaging in Israel, Latvia, and Belgium is economically beneficial. Nikiema & Asiedu (2022) demonstrate that a refundable deposit on PET bottles is highly effective in reducing plastic waste and that the rate of return in both Sweden and Germany is around 90%.

Women and men may have different perceptions of hard policy interventions against wasteful retail practices, and different views on whether such measures are related to opportunities to economise and/or save the natural environment when shopping for food. Women appear to be more aware of the potential to save money and/or reduce their household’s environmental footprint by purchasing marked down food that would otherwise be discarded. The present research confirms this.

**Table 5.**  
*The social acceptability of imposing a wasted food charge on large retailers by gender*

Variable	N = 150	Mean Rank	Median (±quarter deviation)	Mean
Females	81	86.15	4 (1)	3.864198
Males	69	62.99	3 (1)	3.159420
Kruskal-Wallis test = 11.39, critical significance level = 0.001				
H2:	Gender significantly differentiates the level of support for imposing a wasted food charge on large retailers			
Decision on H2	Do not reject			
Interpretation	The acceptability of imposing a wasted food charge on large retailers was significantly higher for women than men. Women voted with a median of 4 and men with a median of 3.			

Source: own calculations based on collected primary data.

Table 5 shows that gender significantly differentiates social support for imposing a wasted food charge on large retailers. Wasted food is understood as any loss or waste of food at any link in the food supply chain, from the farm through processing, and includes consumption outlets (restaurants, canteens and homes) (*About Food Waste*, 2023). Women's greater support for imposing a wasted food charge on large retailers may be explained by the fact that they make most of the household food purchasing decisions. These results are in line with studies conducted by Jungowska et al. (2021), which found that women are more concerned about the adverse effects of food waste on the environment, as they are the dominant food providers. On the other hand, there is a running debate on the extent, if any, to which household food wastage is gender-dependent. Some studies have found that women produce less food waste (Cecere et al., 2014; Secondi et al., 2015). Principato et al. (2015), however, contend that gender does not have a significant effect on household food waste. For their part, Visschers et al. (2016) found that more food is wasted when a woman is responsible for the household grocery shopping (Schanes et al., 2018).

The analysis of the subject tools was deepened during the qualitative study, which consisted of in-depth interviews, conducted individually, with six experts. Four of them were from the Poznań University of Economics and Business and the Poznań University of Life Sciences, and the other two business practitioners from the food industry. These consultations focused on the impact of PET bottles and food waste. In particular, topics such as food pricing, waste management practices, and changes in the behaviour of producers, retailers and consumers were explored. The experts pointed out that charges imposed for wasted food would probably be passed on to consumers in the long run. Nevertheless, it can be concluded that the fierce competition between large food retailers would incentivise them to reduce the amount of wasted food by distributing it to charities, as has happened in Italy. A wasted food charge can help reduce the financial losses associated with disposal costs and waste management, and translate into increased operational efficiency and business profitability for producers.

The experts advised that consumers from different backgrounds (urban vs. rural, age, or education) might have varying opinions on introducing a PET bottle deposit scheme in Poland. Moreover, the high upfront costs and operational challenges could delay its nationwide implementation. However, the EU's stringent requirements and expectations for a high percentage of recycled packaging could serve as an effective incentive to convince producers to support the initiative. Undoubtedly, a deposit system would contribute to reducing the amount of plastic waste and increasing its recovery. It would also be an effective tool for raising public awareness of the problem of plastic pollution and the need to take action to protect the environment.

The experts unanimously claimed that introducing a deposit scheme would require significant investment in infrastructure for collecting and processing PET bottles, and that this would generate additional costs for retailers and/or consumers. The introduction of a deposit scheme would also involve additional logistical and administrative challenges for retailers, such as the need to manage deposit returns. In summary, these expert opinions are a valuable source of knowledge and play a supporting role in the discussion on introducing the subject food policy tools.

## 5. Conclusions

The main aim of this study was to assess the social acceptance of environmentally friendly food policy tools in Poland, specifically a PET bottle deposit scheme and a wasted food charge. It reveals significant insights into the social acceptance of environmental food policy tools in Poland. From the results, it can be concluded that the choice and rationalization of food purchases primarily depend on women, who favour various financial and non-financial incentives to make the food system more sustainable. The acceptability of a PET bottle deposit scheme and a wasted food charge is greater among women. This is probably due to their greater environmental awareness and responsibility for household food purchases. Younger individuals are more supportive of a refundable PET bottle deposit, while older individuals are in favour of a charge on wasted food. This highlights generational differences in environmental priorities. Higher education levels correlate with greater acceptance of both food policy tools, indicating the role of education in fostering pro-environmental attitudes. Larger households are more supportive of a PET bottle deposit scheme, while 2-person households are more in favour of a wasted food charge. These findings prove that gender statistically significantly influences the acceptance of the subject policy tools. The expert interviews underscore the importance of competitive pressures and regulatory frameworks in encouraging retailers to reduce food waste and support recycling initiatives. They also confirm that policy makers must take gender into account when designing and implementing these sorts of initiatives.

Moreover, implementing new technological solutions and new production methods as part of a closed-loop economy is going to require new regulations and government support. The subject food policy tools are examples of measures that are intended to deal with multi-level economic and environmental issues and which are subject to multifactor motivations. These economic instruments trigger actions to avoid emissions and improve the environment at a relatively low cost, leaving the means of achieving the environmental goals to individuals. A PET bottle deposit can shape attitudes towards environmentally friendly solutions that have been created by the local population and which are associated with a closed-loop economy. In addition, household participation in waste collection and segregation can be increased in both regulatory and applicative ways. The first method involves regulations that impose financial consequences, while the second provides access to containers that facilitate separate waste collection. Notably, a PET bottle deposit scheme can lead to more recycled PET bottles. Recycling PET bottles requires less energy than producing new ones from raw materials and reduces the amount of plastic waste in landfills. A reduction in demand for energy-intensive products can influence energy consumption and associated greenhouse gas emissions. Furthermore, wasted food charges can encourage more conscious food purchases, which would deliver savings in terms of the energy needed to grow, transport and process food. Lastly, introducing a PET bottle deposit scheme and imposing wasted food charges can encourage more sustainable consumption patterns and reduce the amount of waste produced.

However, this study has a few limitations that may spur further research. Although the research was conducted on a limited group, it still provides valuable information

and allows the authors to formulate more complex hypotheses for further research. Nevertheless, the results should be interpreted with caution. Studies on larger research samples are definitely in order. It is obviously more difficult to discern patterns and detect differences in a small sample. That is because small sample may fail to encapsulate the full social, economic, and political context likely to shape public opinion and influence how the subject food policy tools are assessed. In addition, a small-group survey conducted in a single municipality may fail to consider the demographic, regional and cultural differences that can potentially affect the acceptability of introducing a PET bottle deposit scheme and/or imposing a wasted food charge. These are crucial when establishing nationwide regulations.

As for future research directions, researchers would be advised to explore other types of entities in the food supply chain, e.g. producers, processors, distributors and retailers. The limitations of the present research set a potential direction for future research. One of the findings highlights some difficulties in accurately measuring and monitoring the food waste that lingers in bottles and packaging. Scholars may wish to look for ways of reducing leftover food in bottles and returnable packaging.

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