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WASTE FOR YOU, FOOD FOR OTHERS

**Exploring the Interplay of Country-Level Factors and Consumer Attitudes
in Addressing Food Waste: A Multi-Method Approach**

*Országspecifikus tényezők és fogyasztói attitűdök kölcsönhatásának vizsgálata az
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Abstract

Sustainability is determined not only at the consumer level but also significantly at the corporate and even governmental levels. Food waste has been a widely discussed topic since the 1987 Brundtland Report, academic research and policy-makers also raise awareness on the constantly increasing issue. Which participants in the supply chain can play a key role in reducing waste emissions? What role does the government and consumer decisions industry play in this? The broad scope of the research focuses on analyzing the relationship between country-level food wastage and other factors affecting it using a linear regression method. Then consumer attitudes will be investigated through a semi-qualitative Q-methodology analysis.

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I. Introduction

According to Eurostat, 58.4 million tonnes of food waste is generated annually in the European Union in 2021 (Eurostat, 2022). The substantial production of food that goes unconsumed by humans has significant adverse effects on the environment, society, and the economy. It is estimated that approximately 8-10% of global greenhouse gas emissions are linked to unconsumed food (UNEP, 2021).

The Food Waste Index report from the United Nations Environment Programme (UNEP, 2021) states that in 2019, the total amount of food waste generated globally was around 1.3 billion tonnes (\$931 billion each year), with 26 kg/capita coming from the hospitality sector, 13 from the commercial sector, and 79 from households on annual basis only in high-income countries, while upper- and lower-middle-income countries waste 76 and 91 kg/habitant/year on household level (other levels are not measured). More than 800 million people suffer from hunger (WHO, 2022), 2 billion people are moderately or severely food insecure by recent calculations (SOFI, 2022), while 31% of food is wasted until it is finally used by end-consumers, with 12% out of that accounting for the waste generated by the hospitality sector. The waste generated in the food supply chain (FSC) could feed 1.26 billion hungry people (FAO, 2019). Food security and its sustainable considerations have been a core issue since the Brundtland Report published by the United Nations in 1987. The study drew attention to the problem of unequal sharing and proportion of food, yet agriculture had and has the potential to supply all but is often unavailable where it is really needed (UN, 1987). Economies of scale enabled developed countries to create surplus and to exploit their technological advancements while developing countries suffer from the deficiency of food. Sustainable action-taking incorporates a set of elements that aim to adjust activities in a way that social, industrial, and environmental well-being and welfare are ensured. This mindset has been applied by several global organizations, institutions, and governments as well since then. That is why the European Commission undertakes actions to move forward to a circular economy, climate-neutral economy, and stands for different sectorial initiatives and strategies to establish a comfortable place and environment to live for future generations.

There are 2 main research questions, one focusing on macro-level and analyzing the predictive ability of different variables regarding country-level food wastage globally and in the European region and what government interventions are influential. We hypothesize that income and national policies on waste management will affect the amount of food wastage generated. A linear regression analysis is used to analyze the relationship. Secondly, the issue will be put in

a micro-level framework, we will examine different consumer attitudes towards food consumption habits, and the main drivers of them to explore their behavior towards food saving. For that Q-methodology will be used, with which we can examine consumers' views as a whole in relation to each others' responses. The study also aims to summarize the various definitions and concepts used in the literature regarding food waste.

The structure of this paper is the following: Section II reviews the literature about food waste while presenting different theoretical backgrounds in terms of definitions, stage differentiation, and legislation while giving an overview of food waste in the hospitality sector. Section III describes the methodologies used in the analysis. Section IV contains the results and their analysis. Section V concludes, and explores ideas for future research.

II. Literature review

Several EU projects have been advocated in recent years in the field of food waste, however, the focal point of these initiatives is mainly the identification of key drivers and measuring the extent of waste production coming from food. Although the data-driven initiative has been an important aspect to highlight the relevance of its phenomenon, disposable methods, and waste patterns, it did not bring comprehensive and comparable knowledge on how to deal with the issues, and consequences at any level and did not focus on educational aspects. (Manfredi et al., 2015).

II.1. Definition and conceptual overview

Food waste (FW) and food loss (FL) have different definitions in the literature, there is no integrated determination in literature as researchers use these terms as required by the research methodology and reflect different problems associated with the topic. Betz et al. (2014) use them as a synonym as they refer to all the losses occurring during the value chain until it finally reaches the end consumer. Gustavsson et al. (2011) differentiate the two terms based on where and when they are produced in the value chain: food loss is created at the beginning, and food waste is generated at the end of the value chain (Gustavsson et al., 2011; Parfitt et al., 2010). According to the interpretation of the Food and Agriculture Organization (FAO), food loss is the decrease in dry matter or quality that was intended for human consumption; food waste refers to “the food appropriate for human consumption being discarded, whether after it is left to spoil or kept beyond its expiry date” and there is also a third definition under FAO’s framework, food wastage which incorporates both waste and loss in its determination (FAO, 2013). The European Commission (Eurostat, 2019) and the EU FUSIONS (2014) states that “Food waste is any food, and inedible parts of food, removed from the food supply chain to be recovered or disposed (including composted, crops ploughed in/not harvested, anaerobic digestion, bio-energy production, co-generation, incineration, disposal to sewer, landfill or discarded to sea)”. The SOFA report (2019) gives a comprehensive definition based on empirical considerations by defining FL occurring in the upstream (excluding the retail level) while FW occurs during the downstream processes of the supply chain, thus on the retail and consumer level. Food loss and waste therefore is the decrease in the quantity or quality of food resulting from decisions and actions made on all levels of the SC (SOFA, 2019) and is referred to as food wastage or FLW (food loss and waste) in the following research.

During this research, the differentiated approach is followed, and food loss is considered as the loss arising from the pre-consumer stage, and the loss occurring in the consumer stage – including hospitality – is referred to as food waste. As this study is intended to analyze the aspects of FW in the hospitality sector, other levels and stages have to be excluded.

II.2. Different levels of FSC and stages of FW

As anticipated in this paper, food wastage is generated on all levels of the FSC. FAO determined 5 stages where it is produced:

1. Agricultural production: harvesting, breeding, fishing, sorting;
2. Storage and handling: packaging, transportation;
3. Processing: eliminating the non-usable parts of food (peeling, slicing, boiling, etc.);
4. Distribution: how the product gets for sale (e.g. transportation), including all the market system;
5. Consumption: the end-user decides what part of the product will be used. (FAO, 2011)

Liu (2014) uses only three stages, agricultural production, post-harvest, and consumer level. However, the SOFA report (2019) argues that FW should not contain the economic loss and those diverted to other economic uses (e.g. feeding), thus are not considered as wastage. Similarly, inedible parts are not considered food loss or waste (SOFA, 2019). Arguably, packaging and other garbage arising from foodstuff is considered as waste in this paper, because of the narrow perspective used for the analysis.

Determining and analyzing the amount of waste generated during the given process, the consumption stage is the least measurable of the above-mentioned stages as it cannot be analyzed by exact and accurate quantitative measurements (European Commission, 2015) because the usage of products can differ from consumer to consumer.

FUSIONS project (2014) analyzed the key drivers leading to FW: current causes, future threats, and future opportunities and categorized them contextually, from technological, institutional – by differentiating business management and legislative – and social aspects. The project also collected the main reasons for creating FW, these are collected and listed in Table 1.

Table 1. Distinguished clusters recognized by referring to the current causes of FW generation

A. Characteristics of food products and production/consumption processes	• Perishability of food. • Limited predictability of supply and demand. • Limited capacity to quickly adapt the supply to evolving demand. • Limited ability of consumers to accumulate individual stocks of food.
B. Social factors and habits	• Non-readily changeable habits and lifestyles. • Factors such as single-person households, the young age of household members, young couples with small children, and increased consumption of meals outside the home.
C. Individual consumer preferences	• Non-readily changeable preferences, including expectations regarding food aesthetics, freshness, and the ability to access a variety of food regardless of location, season, or time.
D. Choices of private and public stakeholders	• Prioritization of concerns by private companies, where profit may take precedence over minimizing food waste. • Public authorities may prioritize food safety, food security, consumer information, and animal welfare over addressing food waste.
E. Technological, organizational, and legislative factors	• Non-use or sub-optimal use of available technologies. • Organizational inefficiencies in supply chain operations. • Inefficient legislation. • Consumer behaviors are influenced by unawareness, limited information, and inadequate food skills.

Source: FUSIONS, 2014

II.2.1. Food waste in the hospitality sector

Based on the findings of the Food Waste Index Report the average FW in high-income countries generated by the food service sector is 26 kg/capita/year which is twice more than those produced by the retail sector (UNEP, 2021). As reported by NACE rev.2 restaurants generate 12 kg/inhabitant/year food waste, while the retail sector accounts for only 9 kg/inhabitant/year (Eurostat, 2022); although the average total food waste generated by one European citizen is 130 kg annually. However, the food service sector is subdivided into various divisions and sectors. Filimonau and Coteau (2019) argue that FW in hospitality is under-researched from economic and societal point-of-view, however is part of the common topics in management. Dhir et al. (2020) argue that governments by intervening in waste generation and NGOs by the reuse of leftovers and disposal play a crucial role in reducing FW. Some researchers say that

the insufficient amount of quantitative statistics of quality (Wang et al., 2017) is the issue in understanding the reasons behind and exact effects of food waste, while others state that the absence of comprehensive studies (Betz et al. 2014) social theories (Munir, 2022), and theoretical frameworks (Dhir et al., 2020) is an obstacle to reaching goals and achieving visible results.

Research on FW in hospitality is limited by five main reasons, encompassing the restricted and narrow scope of previous research, undervaluation of waste quantity (or none at all), constrained geographical coverage, limited depth of analysis concerning mediating and moderating variables, and absence of theoretical frameworks (Dhir et al. 2016). Conclusively, there is no unified solution for prevention or proper waste management. The lack of a comprehensive set of effective business practices to serve as a universally applicable management framework hinders the implementation of global food waste mitigation and reduction measures by hospitality enterprises (Filimonau and Coteau, 2019).

Literature has analyzed and straightened out the actuality of FW restaurants, hotels, cafes, canteens, kindergartens, etc. Restaurants from the different operators of the hospitality sector account for the largest amount, being the main target for interventions preventing FW (Filimonau et al., 2023). On the other hand, quantification of FW generated by restaurants is hard because of the different research methods and the varying definitions and categories (Pirani and Arafat, 2014). Finnish studies found that approximately 18-20 thousand tonnes (Silvennionen et al., 2012) of waste were generated in licensed restaurants annually, while 20% of all food is wasted (Silvennionen et al., 2015), from which most account for leftovers in restaurants and diners.

II.2.2. Causes of FW in restaurants and recommendations for reduction

Restaurant food waste can be categorized into 3 groups: kitchen waste, serving waste, and leftover (Silvennionen et al., 2015). Kitchen waste can occur in the preparation and cooking stage, however, saved food thrown away is considered as waste generated in the kitchen. Serving waste arises from already cooked food and meals (left from the buffet, from pots and bowls). In high-end catering establishments, the kitchen serves as the primary operational zone where substantial food waste occurs, highlighting chefs as the primary contributors to food waste generation; therefore, it is crucial to enhance our understanding of how chefs can be more actively involved in preventing food waste and identify the necessary actions to facilitate their engagement in this regard (Filimonau et al., 2023).

According to Betz et al (2015) serving losses however almost completely avoidable, and by using smaller serving balls and estimating and adapting the right portion size, can be minimized. Their findings suggest the importance of the awareness of staff as well so that they could sensitize customers towards a more sustainable mindset and draw attention to food waste problems.

There are several factors contributing to food waste production. Silvenninen et al. (2015) identify two divisions of food waste: originally edible and originally inedible (peelings, bones, coffee grounds). Poor stock rotation may cause the deterioration of perishable products and lead to unnecessary amounts of waste. The same applies to inappropriate storage (improper temperature, damp or dark room, etc.) that can make food unusable (Mackenzie et al., 2011). Excessive production, insufficient preparation, and inadequate portion control methods may also result in the wastage of food (Drysdale and Galipeau, 2009). Portion size can differ based on the type of the restaurant and may determine both the serving and leftover wastage. Using a short supply chain and 1 or 2 local or national suppliers reduces kitchen waste but could make delivery frequency less by causing bulk purchases of materials and ingredients and greater waste, while retail-originated food is more frequently delivered, thus reducing the possibility of waste creation.

The variety of the menu also influences food waste, when more serving dishes are offered, less part of the ingredients are used, making larger amounts of waste. One theoretical example is when one customer orders broth a day, however, the chef cannot cook only one bowl of broth, and all the other 4 liters of soup will be wasted. This is the reason why some restaurants have a narrower, but frequently changing menu and items can differ by season as well.

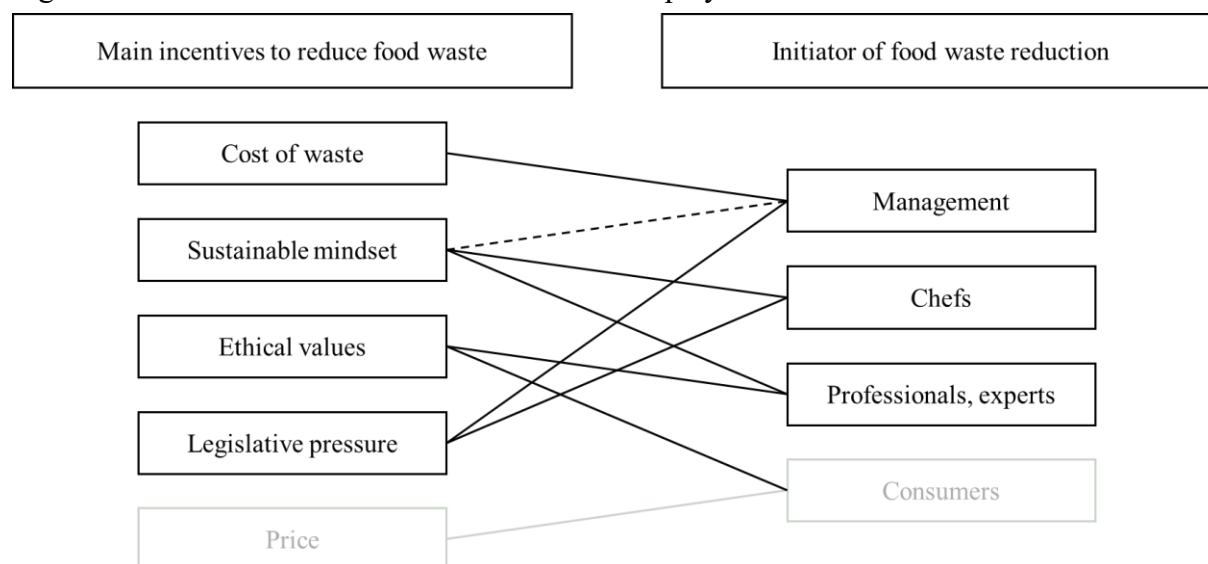
Another factor could be the quality of food. Upscale dining establishments may offer smaller servings of premium food to minimize food waste. However, these outlets often engage in on-site cooking from raw ingredients, resulting in a higher amount of preparation waste compared to scenarios where partially prepared food is procured (Pirani and Arafat, 2014). On the other hand, buffet-style restaurants offer lower-quality meals (cheap materials and ingredients and oily food) on a higher scale, but much more leftovers remain.

An inevitable aspect of FW in restaurants is based on the style or type of the restaurant. Buffet-style restaurants create the most waste as the amount of food cooked a day is prepared in advance, while fine-dine establishments cook food based on customer orders directly. Hotels face the challenge of striking a balance in serving sizes, aiming to satisfy customer preferences without providing portions so large that leftovers lead to unnecessary waste, considering the

diverse appetites among guests. Achieving the perfect portion size to cater to the varying appetites of guests is a complex task for hotels and restaurants, as it is practically impossible to cook precisely enough to please every individual, necessitating thoughtful consideration to minimize food waste (Pirani and Arafat, 2014).

Based on different research findings we developed a framework of what main incentives can drive restaurants to reduce food waste and who are the possible initiators of that. Figure 1 shows how they are connected to each other. We highlighted consumers with lighter because they are only indirectly connected with the restaurant's views, thus cannot be called 'initiators', but are affected by the issue. Hence, price increase or decrease as an incentive attributed to consumers is only an indirect factor. The dashed line means that a sustainable mindset would not be a main decisive factor considering food waste reduction (only applicable to management).

Figure 1. Connection of incentives that drive main players to reduce food waste



Source: Own table based on literature

Most researchers agree on the fact that a sustainable mindset and the practices to avoid and prevent waste within one establishment mostly come from the management's holistic approach (Heikkilä et al., 2016) or the head of the staff, mainly the chef (Filimonau et al., 2023). Hennchen (2019) emphasizes the role of experts and suggests that professionals in the food industry possess valuable practical knowledge, ethical values, and experiences that can effectively address the issue of food waste and states that the potential is only achievable if a cooperative top-down approach is used.

Table 2 gives an overview of the different types of food waste and their determinative aspects from the generation until the reduction of food waste, including where they are present mainly and who are the players able to influence solving food waste problems.

Table 2. Specificities of kitchen, serving, and leftover waste

Food waste	Kitchen waste	Serving waste	Leftover waste
Definition	Waste coming from preparation, cooking stage	Waste generated from cooked food	Leftovers from consumers and non-consumed food
Crucial players	Chefs, kitchen staff	Kitchen staff, waiters	Consumers, chefs
Causing factors	Poor stock rotation, storage problems, variety	Human mistakes, low awareness	Excess production, lack of or inefficient predictions, quality
Significance	Fine dines, upscale restaurants	Everywhere	Canteens, hotels, buffet-style restaurants
Avoidability	Totally avoidable	Totally avoidable	Partially avoidable

Source: Own table based on literature

II.3. Consumers' aspects and perspectives towards food waste

A recently used method to reduce food waste is food surplus donations, which have significantly grown in the EU in recent years. Újhelyi and Cseh (2016) analyzed the foodbank framework in Hungary. The study indicated promising potential and existing interest from both the donor (the producer having surplus) and recipient (who gets the food) sides. Redistribution appears feasible, considering both logistical aspects and EU-level food safety considerations, however, the EU has not developed a common EU policy on donations yet and has no aggregated data on Member State level food donations (FUSIONS, 2015). Similarly, with the appearance of *Too Good To Go* (Austria, Belgium, Canada, Denmark, the Faroe Islands, France, Germany, Ireland, Italy, the Netherlands, Norway, Poland, Portugal, Spain, Sweden, Switzerland, the United Kingdom, and the United States), *Munch* (Hungary) and other variations of services connect customers and restaurants (and lately stores as well) that have unsold food. This is a very good way to reduce the amount of leftover waste, and becoming more and more popular, for instance as of March 2023, Too Good To Go reported that 200 million meals were saved by the application globally, and half of it is under 1.5 years. When talking about food saving we mainly focus on these companies, instead if otherwise explained.

The motives to use these kinds of services can be different across consumers. One of the most visible advantages of food saving is that it is significantly cheaper as opposed to eating out in a restaurant, meals are offered with a 50% or more discount compared to their original price. Another advantage could be – staying from the customer's point of view – that they are easily accessible, restaurants (and lately grocery store chains, like Spar or CBA in Hungary) join the service not only from the city centers but suburbs and other cities as well. However, in a broader scope, they are very location-specific, these apps are not present in villages or smaller towns, so even though Munch is very popular in Hungary, a significant part of the population does not have the opportunity to access it, simply because they do not live in Budapest or other larger cities of Hungary.

According to the study performed by Van der Haar and Zienstra (2019) users of Too Good To Go are motivated to use the service by 3 factors: a desire to reduce food waste, saving money, and having a surprise experience. They analyzed a focus group of 66 people and then surveyed 611 respondents. The research found that 35% of the respondents chose food waste reduction as the main reason, while surprise effects and money-saving were the most important factors for 26% and 20% of the participants. They also revealed that although on a very low level, some part of the saved food will be discarded. 12% of the respondents indicated that they discard some food from their boxes in more than 10% of the occasions. The primary reasons for discarding food from the magic box included concerns about spoilage, dislike of the food, or it is a type that is not typically consumed. Additionally, some people discard food because of the lack of storage space, however, most of the respondents chose to share food or store it in the freezer in case of problems (Van der Haar and Zienstra, 2019).

There are different reasons for consumer food waste. It can be generated because of special manners: attitudes (Newton and Meyer, 2013) and behaviors (Setti et al, 2018). People tend to acquire conscious and unconscious consumption habits that influence their lifestyle. Some attitudes can be explained by multiple factors, price, and perceptions of quality, as such. However, for sustainable consumers green purchases and the attitude toward remanufactured or reused products have more effect on switching intentions. (Perez-Castillo and Vera-Martinez, 2021); on the other hand, green purchasing is also influenced by personal feelings and morals (Liu, et al. 2020).

Food safety concerns are also an important issue when considering food waste, however, there is only a little information for consumers about expiry dates. Perishable products that have a shelf-life of 1 or 2 weeks require ‘use-by date’ labeling on their packaging. Shelf life is called

the time elapsed between production and the use-by date. It is crucial for maintaining both food quality and safety, as microbial activity can lead to spoilage and potential health risks. To ensure safety, producers often set conservative shelf lives for highly perishable items. Based on the definition of USDA FOOD Safety and Inspection Service ‘use-by date’ is the last date recommended for the use of the product, while ‘best if used by’ or ‘best before’ dates indicate when a product will be of the best flavor or quality, but it is not a purchase or safety date – most often used for frozen dried or tinned foods, sometimes fruit and cheese. There is also a term called ‘freeze-by date’ that indicates when a product should be frozen to maintain peak quality. These terms are important because when known and highlighted they can contribute to the reduction of consumer food waste, considering especially health- and quality-conscious people. However, overly conservative shelf-life practices can result in unnecessary waste at the retail level, for example, if consumers prioritize products with the longest use-by dates. Additionally, consumers' preference for products with longer use-by dates can contribute to older items being left on shelves, exacerbating waste at retail stores (Tromp et al., 2016). Strategies such as discounting and dynamic shelf-life adjustments have been identified as effective means to mitigate food waste (Buisman et al., 2019). Wilson et al (2017) have highlighted that consumer confusion regarding expiry dates often leads to the premature discarding of safe food.

Segmentation of consumers is an often-used method to analyze and examine behavior patterns and is common in this research field (e.g.: EU FUSIONS and Refresh projects). Demographics are indeed an important factor in food waste. Di Talia et al. (201) found that gender, household size, and level of education influence food waste, but the level of awareness of the surrounding environment is also a determinant factor. Romani et al. identified 3 segments: “virtuous”, “waster” and “moderate” consumers based on their demographics, intentions, and food-related behaviors. Consciousness towards eating can be also related to diet or high attention on when and what to eat. People who plan their meals ahead can generate less food waste because they do not purchase bulk amounts of food. Actively taking efforts towards food waste reduction, worry about the cost of food waste, frequency of eating out, income, and the presence of one or more children affect the amount of food waste; variables such as income, presence of young children, frequency of eating out and waste consciousness are positively related to food waste; hence increasing it, while efforts made to reduce food waste and worry about the cost of food waste are negatively related to food waste (Liu and McCarthy, 2023). Findings on food waste intensities showed 3 types of consumers: food savers, light wasters, and medium wasters that relation with the different variables and predictors can be seen in Table 3.

Table 3. The predictors of different food waste intensities

Food waste intensity	Food savers	Light food wasters	Medium food wasters	Heavy food wasters
Predictors	Efforts to reduce food waste Worry about the cost of FW	Eating out High-income Young children Waste consciousness	Eating out High-income Young children Waste consciousness	No predictors found

Source: Liu and McCarthy, 2023

II.4. Legislative framework

There are only a few steps taken toward the reduction of food waste on the legislative level, most actions are rather projects following an informative approach and rather focus on drawing attention to the problem than pushing Member States to implement determined solutions into practice. Most decisions leave open-ended questions on how to implement ideas in order to achieve EU goals, for instance, SDGs.

The Sustainable Development Goals (SDG) were adopted by the United Nations Development Program (UNDP) in 2015 to protect the planet, terminate poverty and hunger, and ensure the well-being of humans by 2030. SDG Target 12.3 states that *“By 2030, halve per capita global food waste at the retail and consumer levels and reduce food losses along production and supply chains, including post-harvest losses”*. In order to achieve the SDG goals, the European Commission set legally binding food wastage reduction targets through the Waste Framework Directive. This was adopted on 5 July 2023 and is to be achieved by Member States by 2030. More specifically, Member States are obligated to undertake measures to reduce food waste by the end of 2030:

- A 10% reduction in processing and manufacturing,
- A 30% reduction (per capita) collectively in the retail sector and at the consumption level, encompassing restaurants, food services, and households.

Similar considerations are suggested in the European Green Deal (2020), under the Farm to Fork program the EU pursues the issue of food sustainability and includes the target of reducing food waste by 50% by 2030.

Since 2016, the Commission has instituted a collaborative forum known as the EU Platform on Food Losses and Food Waste (FLW). This platform aims to assist various stakeholders in devising strategies to mitigate food waste, exchange successful approaches, and assess

advancements. The RESTwithEU pilot project calls specifically for the restaurant sector to action and assesses and suggests digital tools for minimizing food waste.

National strategies for preventing food waste are overarching initiatives comprising a comprehensive array of policy measures tailored specifically to address the issue of food waste. These plans typically encompass various sectors, including local authorities, households, the hospitality industry, the retail supply chain, and institutions such as schools and hospitals. This approach aligns with the recommendations outlined in the EU Guidelines for formulating food waste prevention programs, as presented by the BIO Intelligence Service in 2012 (Azzuro, Gaiani and Vittuari, 2016).

II.4.1. Solid waste management

Food waste is part of solid waste which refers to any garbage or refuse, sludge from a wastewater treatment plant, water supply treatment plant, or air pollution control facility, and other discarded material, resulting from industrial, commercial, mining, and agricultural operations, and from community activities based on the definition of the US Environmental Protection Agency. In the U.S. food waste is the largest component of landfill waste, accounting for nearly 24% of disposed municipal solid waste (FDA, 2020). While in other countries, food waste becomes part of agricultural waste because of the lack of modernized technologies. The first part of this research study will measure how much solid waste management reduces the amount of food waste by country.

III. Methodology

III.1. Analyzing country-level food wastage

This part of the study analyzes how much the different aspects of policies (national and international), laws, and information available influence the amount of FLW on a national level. The above-mentioned approaches gave a broader scope on the various fields of FLW management, however the literature on comparative methodologies between them is limited.

Using country-level data retrieved from the World Bank, a linear regression analysis was built to assess the following:

- How does the income level of the country affect FLW?
- Do national laws, or regulations of national and international agencies have an impact on FW? Does the fact of raising awareness of food waste and the sharing of information collected have an effect on FLW?
- How much do different approaches influence the amount of country-level FLW?

III.1.1. Linear regression methodology

First, we wanted to see, if there is a relationship between income level and food waste. For income level, we used GDP per capita, and for measuring food waste the percentage of composition of organic food wastage was included in the models. All country-level data was retrieved from the World Bank, from 2023. The number of observations was reduced to 166, as there was no information for several countries about food waste. Originally, the dataset had 4 levels for income level classification: low-income (LIC), lower-middle-income (LMC), upper-middle-income (UMC), and high-income (HIC), however as LIC and LMC were less represented in the narrowed dataset, the two factor levels were merged (LIC_LMC) in order to achieve a similar number of observations in each group.

The strength and direction of the relationship between two random variables is measured by the linear correlation coefficient. The value of the linear correlation coefficient always falls between -1 and 1. Its absolute value measures the strength of the relationship, while its sign indicates the direction of the relationship. If its value is -1 or 1, one variable is a linear function of the other; if its value is 0, there is no linear relationship between the two variables.

In order to ascertain how much GDP per capita and different policies reduce the amount of food waste generated in a country; an Ordinary Least Squares (OLS) linear regression method was

used. With this statistical analysis technique, the relationship between the response (the variable to be explained) and one or more independent variables (to make predictions) is defined, and a linear equation is fitted to the observed data. The aim of conducting linear regression is to quantify the strength of the connection between the variables and forecast both the value of Y and the values of X . We use R^2 as the coefficient of determination, which shows the explanatory power of the model. It shows how much of all independent variables explain the variance of the dependent variable.

First, several models were built for a global estimate where Y is the composition of organic food wastage (%) and $X_1, X_2, X_3, \dots, X_k$ variables note GDP per capita (in logarithmized form), different national laws, regulations, information availability of waste management; but we also checked how much the total amount of food waste impacts food waste. The final model was selected to assess the extent of influence of independent variables on the dependent variable either partially or collectively. The multiple linear regression equation for a population can be shown as follows:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_n X_n + e,$$

After estimating several models, we concluded that the best model was obtained by using 3 independent variables:

X_1 : natural logarithm of GDP per capita in US dollars (numeric)

X_2 : whether a national law exists on solid waste management in the country (dummy)

X_3 : whether there is national agency enforcement in the country other than national law (dummy)

III.2. Analyzing consumers' attitudes

We also wanted to analyze personal motives towards food consumption and beliefs about the problems of food waste. As presented, there are several papers analyzing consumer food waste, however, findings can only be projected on specific groups (based on location for example), because they are mostly based on questionnaires with at most a thousand participants, which hardly represent global perspectives. We wanted to analyze young adults' drivers towards food consumption and their relationship with food waste consciousness with Q methodology. Based on the existing literature, we wanted to observe the different drivers for people choosing to save

food. With the given statements, we hypothesize that we can assess 4 groups based on what kind of motivation someone has/would have for doing so if they were to use Munch in Hungary:

- Sustainable behavior
- Price sensitivity
- Curiosity
- Convenience (not used to cooking, etc.)

We also expect that some groups can overlap with negative drivers, such as concerns about reliability or uncertainty regarding the liking of the food (surprise food boxes).

Research found that loyalty can only happen if users are satisfied with the delivery service (Chang et al., 2014), but food quality also matters besides service (Suhartanto et al., 2018). Based on this, we applied 2 statements about why people use or do not use based on the quality of service and reliability. Regarding loyalty, habits are also important, some people only choose places that they know, because quality is important to them (Mattila, 2001; Namkung and Jang, 2007; Jaehang et al., 2023). Chandrasekhar et al. (2019) revealed that considering food service, fastness is a decisive effect to turn to food delivery rather than cooking or preparing a meal on their own. This can also be important when choosing between restaurants or food saving, because in this case eating in is an even faster choice, as food saving happens mostly in the evening hours. Other than eating out or cooking, people can be described as curious and indifferent or people of habit (Nezlek et al.), some are more open to new things, and others are more likely to choose things that they are used to. Regarding curiosity, we will analyze how much consumers are attracted to exotic food, in some cases people tend to purchase regional food than the ones not regionally produced (Zinoubi and Toukabri, 2019, Lorenz, Hartmann and Simons, 2015). For young adults, price can also be a decisive factor, we will analyze whether there is a relationship or not between motives of using food-saving apps and price sensitivity (Mathisen and Johansen 2022). Silva (2021) found that consumers believe that food-saver companies tend to shape consumers' minds and not only seek profit, thus they are able to reduce food waste. We also wanted to analyze how sustainable consumers are and how much they think that individual-level actions can contribute to the reduction of food waste. According to Jeżewska-Zychowicz and Jeznach (2015), most consumers care about packaging waste and disposables.

III.2.1. Q methodology

The main research was conducted by utilizing Q methodology, which is similar to factor analysis and builds on different perspectives of participants. The methodology was developed in 1935 by William Stephenson, initially for psychological studies, but it became more and more popular in other research areas, such as political science (Brown, 1980; Balch, 1982), sociology, tourism (Stergiou and Airey, 2011; Hunter, 2011), and other disciplines as well. Several studies used this method in environmental science to measure people's attitudes toward environmental policies and considerations (Addams and Proops, 2000; Kamal et al., 2014).

It is often considered as a semi-quantitative method. The basis of the approach is that it measures individual responses and then evaluates them in the whole dataset of responses instead of looking for patterns among people, hence the variables are not tests or criteria but the participants themselves categorized by their individual preferences. As statements are not rated separately but respondents' choices are evaluated in relation to each other it could give better results considering the similarities of people rather than questions (Zabala, Sandbrook and Mukherjee, 2018) and more nuanced opinions (Kamal et al. 2014) compared to other factor analysis methods (e.g. Likert scale). According to Brown (1980), even though opinions are subjective, they are not random but follow certain patterns or structures that can be evaluated by Q. The methodology has been used primarily on small samples with 25-50 participants.

The analysis was run in PQMethod 2.35. software, which is a program tailored for Q-methodology. It enables factor analysis, using mathematical techniques with built-in centroid analysis (Q-Cent) to extract factors, varimax rotation (Q-Varimax) for the extracted factors, and automatized and optional factor flagging. In order to enter data, all surveys have to be uploaded into the program manually.

Data was collected between February 2024 and April 2024. The sample had been compiled of 21-26-year-old young adults in Budapest, with different social backgrounds. All of them were university students in the capital. Originally 40 surveys were sent out, we got back 29 of them, but only 26 of them were filled out sufficiently. Despite we provided clear instructions on how the survey should be filled out (first the statements are to be read, then grouped and placed in a table presented in Table 4), some mistakes can occur due to the misunderstanding of the guidelines.

We excluded the surveys where some statements were excluded and the sort was not filled up and surveys that had repeating statements (one statement was placed in more boxes, and another

was missing out from the sort). These surveys are considered errored sorts, as the program cannot interpret sorts with missing or recurrent data.

Not typical for me

Typical for me

-3 (3)	-2 (4)	-1 (5)	0 (6)	+1 (5)	+2 (4)	+3 (3)

Statements were determined based on existing literature and own intuitions about the interests of consumers' behavior and are paired in contrast to each other to observe opposite patterns if exist; pairings can be followed in Table 5. When filling out the questionnaire, 30 statements must be placed on a +3 – 0 – -3 scale and this filled table becomes the unit of the analysis (Table 4). Each statement can only be assigned to one value and each statement must be classified. The value +3 means: it is completely typical of me; the value of -3 means: it is not at all characteristic of me. Survey participants are given that at first, they have to read all statements and divide them into 3 groups:

- Statements with which I rather disagree (-)
- Statements that are indifferent to me (0)
- Statements with which I tend to agree (+)

Then, they have to place all statements accordingly. More statements may be placed in one of the three groups, but that is not a problem, the point is to sort them according to the table afterward, even if the person completing the questionnaire still agrees with the given statement, it can only be placed in the indifferent category because the essence of the method is the examination of order of preference.

The completed Q-sorts will be correlated with other participants and factor-analyzed. The factor analysis will show similarities between how the participants sorted their statements. Participants who rank statements similarly will be on the same factor as each other, indicating a pattern of statements reflecting their subjective perspectives (Coogan and Herrington, 2011).

Participants who are found to have similar views with more than one group may not be significant for any factor.

The factors were defined based on the distinguishing statements, the statements that can be considered decisive, for which the Z-value is greater than 1 or less than -1. For the determination number of factors, we built on the Eigenvalue, the correlation between factors, and the number of Q-sorts per factor. Eigenvalue is a measure of the amount of variance accounted for by a factor. Any factor with an Eigenvalue ≥ 1 explains more variance than a single observed variable, so for a factor to be significant, the value has to be above 1. The correlation coefficients between the factors have to be a maximum of 0.5 so that there should be no relationship between the separated groups (no overlap between the factors). We defined the minimum number of Q-sort per factor for 2.

Table 5. Statements of Q-methodology with their corresponding pairs.

1. I often use food-saving apps, since I don't usually cook.
2. I often eat at restaurants or order from Foodora, Wolt.
3. I consciously plan my meals in advance, so I don't like it when what I eat comes as a surprise.
4. I am open to new things; I am always excited and curious to see what surprise awaits me in the food rescue package.
5. I don't use food rescue services because I don't think they are reliable.
6. I had a good experience, I was never disappointed in the quality of the services.
7. I order from food rescue apps because it is much cheaper than ordering from other places.
8. Price doesn't matter when it comes to my meal.
9. I consider quality important, so I only order from places I know.
10. I trust the services and the quality they convey, so I order with confidence.
11. I don't like it when leftover food ends up in the bin, so I prefer to eat food that lasts for several days.
12. I don't usually store food for days because it spoils quickly.
13. I constantly check the expiry date of food.
14. Regarding the spoilage of food, I prefer to find out from the Internet or intuition (smell, color, texture, etc.) than from the label.
15. I do not like to eat food that is not aesthetically pleasing to me.
16. It doesn't matter if the food looks a little worse, as long as I know there's nothing wrong with it.
17. I usually order food because I get it quickly.
18. It doesn't bother me that I can only go for food in the evening, after closing time.

19. I am a conscious consumer, so I rarely use disposable boxes, plastic bags, or cutlery.
20. Grease cans are hard to wash, so I reuse them at most once before getting rid of them.
21. It bothers me when too much packaging material is used.
22. Hygiene is important to me, so I prefer my food/beverage to be wrapped in foil, boxes, or bags.
23. When I cook, I mostly choose cheap products.
24. I consider it very important to work with quality raw materials.
25. I like exotic food.
26. I much prefer to buy products marked “domestic product”, I look for them in stores.
27. If I'm used to something, it's hard for me to try new things.
28. I like to experiment with recipes and food.
29. I use food rescue services to help reduce food waste.
30. I do not believe that it is possible to make a large contribution to stopping the food waste crisis on an individual level.

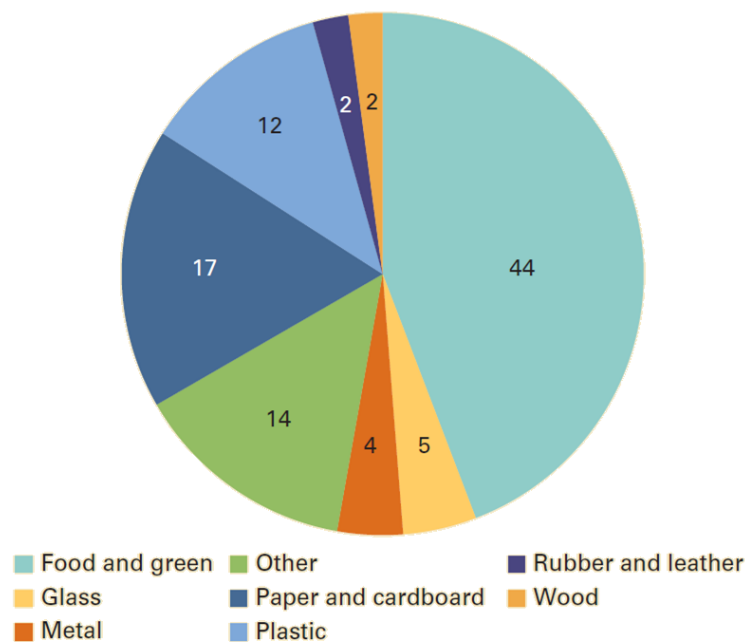
Note: When these statements are presented to the participants in the survey, they have to be separated from each other so that the opposite relationship of the respective statements are not noticeable for filler. Additionally, respondents do not see these in a table of rows presented here, but in a different way.

IV. Results

IV.1. Measuring the influencing factors of country-level food wastage globally

In this section, the results of the linear regression analyses will be presented, first globally, then in the European region. Based on World Bank data, Figure 2 shows that food and green waste make up 44% of all waste generated globally. According to the World Bank, the composition of waste varies depending on income levels, reflecting different consumption patterns. In high-income countries, 32% of waste consists of food (and green) waste. Conversely, middle- and low-income countries produce more food and green waste, accounting for 53% and 57% respectively, with the proportion of organic waste rising as economic development decreases. Generally, most regions produce around 50% or more organic waste, except for Europe and Central Asia, and North America, which generate higher proportions of dry waste. Beyond income levels, there is little variation in waste composition across regions (World Bank, 2023).

Figure 2. Global waste composition (*percent*)



Source: World Bank (2023)

As can be seen in Figure 3, we found a moderate negative correlation between the two variables, supporting our hypothesis. Both outliers included or dropped out of the Pearson correlation coefficient accounted for -0.42. Conclusively, countries with higher GDP per capita generate less food wastage compared to lower-income countries, the more money a country and its citizens have, the more is not spent on basic needs, thus, where more capital remains, people are more educated, more sensitive on environmental issues and aspects as well, and are able to

spend on reducing ecological footprint, including food waste as well. Interestingly, we also see some deviations, some high-income countries show much more amount of food waste generated than countries having lower GDP per capita, and we can find some low-income countries that have less food waste than any other country, however, this can be explained by the fact that these countries suffer from hunger mostly.

Figure 3. Scatter plot of GDP per capita and composition of organic food wastage



Source: World Bank (2023)

On the other hand, LIC countries having high levels of food waste suffer from hunger as well, for instance, Burundi has one of the highest hunger rates, having 50% of the population suffering from food insecurity, while the economy is heavily reliant on agriculture, but is so underdeveloped that significant part of edible products are damaged and lost before it could get to consumer phase, resulting in a food waste rate of 81% as of 2023 (World Bank, 2023). In Africa, farmers lose up to 40% of their crops because of post-harvest loss (WFP, 2019).

We found that a one percent increase in income reduces the amount of organic food wastage by 6.73% (either analyzed in simple or in multiple regression), supporting the previous results of the negative correlation between GDP per capita and organic food waste. The -0.42

correlation implies that 17.83% of the variance in food waste across countries can be explained by differences in income level.

Table 6 illustrates the results, confirming that GDP per capita and the presence of national law is a good basis for forecasting the composition of organic food wastage. The regression equation of the chosen model is the following:

$$Y = 115.52 - 6.73X_1 - 9.95X_2 + \varepsilon$$

Regarding the influencing factors of policies in the final model X_2 was significant at 5% as well, with a beta estimate of -9.95% (-11.28 when analyzed individually in a simple linear regression model), hence, the presence of national law on solid waste management reduces the amount of food waste by around 10%. This is even more remarkable when running the model only in high-income and upper-middle-income countries with a beta of -16.29%. Other variables were not significant. The final model was accepted with a p-value lower than 5%. The independent variables in the model are able to account for 20.82% of the variance of the composition of food waste across countries.

Table 6. Multiple linear regression summary table

	<i>Estimate</i>	<i>Std. Error</i>	<i>t-value</i>	<i>p-value</i>	
(Intercept)	115.5248	12.9777	8.902	4.11E-15	***
log(gdp)	-6.7266	1.3134	-5.121	1.07E-06	***
National law governing solid waste management (yes)	-9.9502	4.7993	-2.073	0.0401	*
National agency enforcing solid waste laws and regulations (yes)	0.5269	4.6809	0.113	0.9106	
Note: Signif. codes: * p<0.1; ** p<0.05; *** p<0.01					

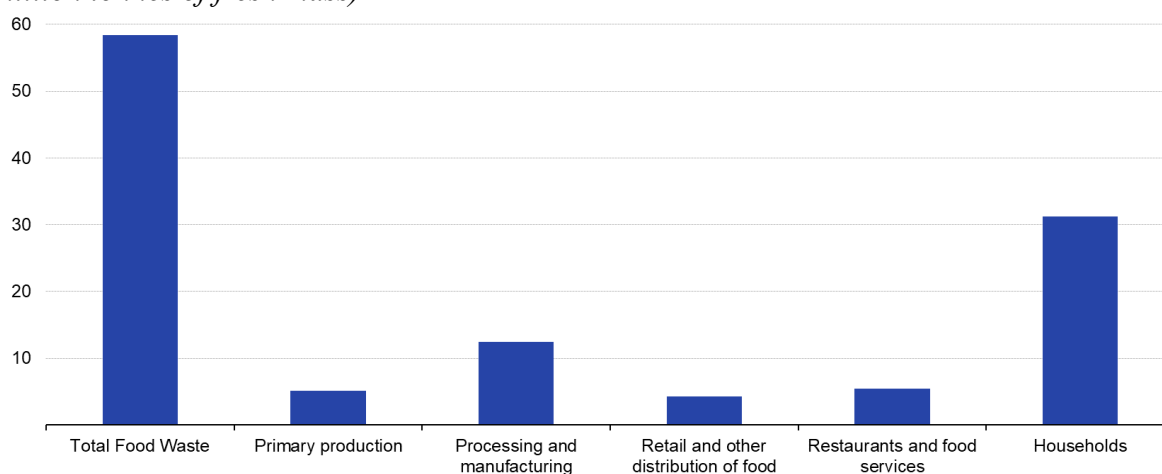
However, X_3 was neither significant in the multiple regression analysis, nor when used as a single regressor on a global scale, but we found that by narrowing the dataset to UMCs and HICs, similarly to X_2 the presence of national agency enforcement has a significant effect on the composition of organic food wastage with a beta value of -15.33%, conclusively it reduces the amount by 15% in upper-middle and high-income countries.

Interestingly, while the variable marking whether there is a system of collected information about waste management was not significant when used in the multiple regression model, individually analyzed it was significant with a beta of -7.33%, however, it has a very low R-squared value (5%).

The assumptions of OLS regression were tested. As OLS requires normality, we used the Shapiro-Wilk test. It resulted in a p-value of higher than 0.05 (0.35), meaning that the model is normally distributed. Fischer's exact test measures independence; as the p-value was less than 0.05 meaning that the results are statistically significant, hence we can state that all variables are independent in the model. Assuming that residuals have constant variance, heteroscedasticity was also analyzed by the Breusch-Pagan test. With a p-value of 0.33, we can claim that the model is not violated by heteroscedastic standard errors. We used the Variance Inflation Factor (VIF) to detect the presence of multicollinearity in the model. VIF indicator is a measure of the correlation between the independent variables, which correlation is called multicollinearity, that can cause problems in the validity and significance of the regression analysis. We found VIFs in our model consequently 1.04, 1.07, and 1.09 for variables X_1 , X_2 and X_3 , therefore we can conclude that the variables are not significantly correlated, and multicollinearity does not cause problems in the model.

IV.2. Measuring the influencing factors of country-level food wastage in Europe

Figure 4. Food waste estimations in the European Union, 2021
(million tonnes of fresh mass)



Source: Eurostat, 2021

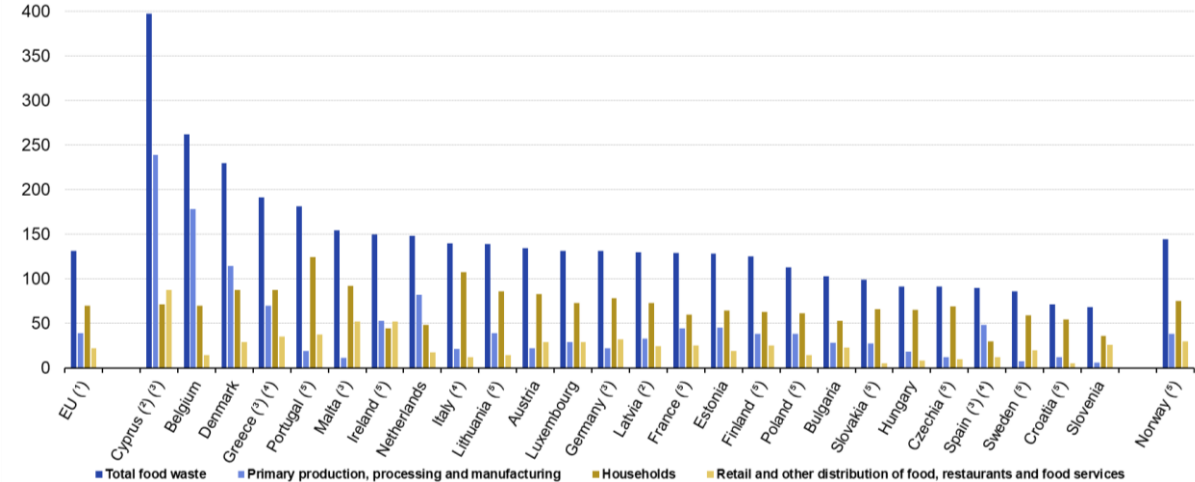
Unfortunately, as quantitative measurements of food waste and loss are very hard, country-level data differ significantly from one dataset to another, however, the European Commission sets out exact measurements for all states. The EU collects data about food waste via Eurostat in million tonnes of fresh mass (Figure 4). Contrary to the World Bank data Eurostat's database collects all food loss and waste data together. As EU Member States have to provide data annually, all measurements are based on the NACE Rev.2 and it includes all stages of all stages of the food supply chain as set out in Annex III of Commission delegated decision (EU)

2019/1597, hence inedible and edible parts as well. Estimations indicate that 9 million tonnes of food waste was produced by the hospitality and retail sector in 2021, which is similar to those generated during processing and manufacturing.

Annex III also defines what type of waste to be included in the different sectors. Retail and other distribution of food contains biodegradable kitchen and canteen waste, edible oil and fat, mixed municipal waste, waste from markets, and non-hazardous organic waste. Restaurant and other distribution of food incorporates biodegradable kitchen and canteen waste, edible oil and fat, and mixed municipal waste as well. Figure 5 and Table 7 show the data on the amount of food waste generated per inhabitant and total in 2020 and 2021 broken down by sector, grouped by country. We can see that the main wasters are Cyprus, Belgium, and Denmark, where more waste comes from primary production – much more than from households –, for which only the Netherlands shows that pattern. Slovenia, Croatia, and Sweden generate the least in the EU, while in Croatia waste is especially low in the manufacturing and retail sectors, but higher in households, in Slovenia, Households and the retail sector are on a similar level. V4 countries, including Hungary, are below the average, but Poland is above the others in total food waste.

Interestingly, however, Cyprus generated only 0.61% of the total of all food waste generated in the EU in 2020, it reported by far the largest kg per inhabitant amount of food waste, with 397 kg, however, their methodology for measurements differs from the other countries. We can also see that Cyprus is the only country, where waste coming from retail and food services surpasses household waste.

Figure 5. Food waste by sector of activities by Member State, 2021
(kilogram per inhabitant)



Source: Eurostat, 2021

Germany and France show similarities, waste is generated more in primary production, processing and manufacturing, and retail and hospitality, while in the primary production sector waste is much more in France, but in Germany, only 1% of the GDP is attributed to agriculture, in France it is 2%. However Italy is around the EU average, and household-level waste is much more than in other countries in the region, similar to Portugal, but Portugal has also a significant amount of food waste that comes from the retail and hospitality sectors.

Table 7. Total food waste by sector of activities, 2021
(kg/year)

	Total food waste	Primary production	Processing and manufacturing	Retail and other distribution of food	Restaurants and food services	Households
Austria	1 201 165	9 555	187 425	84 286	178 428	741 472
Belgium	3 034 977	34 610	2 022 535	69 568	96 369	811 895
Bulgaria	711 844	60 081	131 495	41 211	117 016	362 041
Croatia	280 008	39 248	9 464	4 103	14 797	212 396
Cyprus ⁽¹⁾ ⁽²⁾	354 021	43 564	169 706	50 268	27 145	63 338
Czechia ⁽¹⁾	972 445	27 022	100 339	64 394	37 941	742 749
Denmark	1 344 550	57 985	607 693	99 791	72 081	507 000
Estonia	170 501	18 638	41 302	13 113	12 474	84 975
EU ⁽¹⁾	58 400 000	5 100 000	12 400 000	4 200 000	5 400 000	31 300 000
Finland	693 662	49 950	158 334	57 460	80 991	346 927
France	8 764 000	1 244 000	1 720 000	633 000	1 084 000	4 083 000
Germany ⁽¹⁾	10 922 321	190 203	1 612 505	762 352	1 860 980	6 496 282
Greece ⁽¹⁾ ⁽²⁾	2 048 189	372 204	375 158	150 472	220 032	930 323
Hungary	883 486	12 963	159 309	57 278	19 337	634 598
Ireland	753 081	52 691	215 601	75 019	188 955	220 816
Italy ⁽²⁾	8 291 265	672 971	542 409	474 252	263 013	6 338 620
Latvia ⁽²⁾	245 442	30 592	32 518	16 765	28 617	136 950
Lithuania	390 645	81 202	29 271	33 951	4 651	241 570
Luxembourg	83 622	7 235	11 333	8 861	9 466	46 727
Malta ⁽¹⁾	79 589	759	4 668	3 910	23 016	47 235
Netherlands	2 586 744	315 150	1 131 100	209 805	83 035	847 654
Poland	4 281 212	639 352	809 287	345 514	186 433	2 300 626
Portugal	1 874 832	126 392	75 257	224 838	162 903	1 285 442
Romania	:	:	:	:	:	:
Slovakia	537 486	23 764	125 013	17 630	8 988	362 091
Slovenia	143 254	71	13 428	14 465	39 923	75 368
Spain ⁽¹⁾ ⁽²⁾	4 260 845	845 620	1 419 257	348 219	213 023	1 434 726
Sweden	900 000	22 000	53 000	108 000	98 000	619 000
Norway	777 404	177 958	28 338	69 221	94 556	407 331

(:) not available

Figures in italic are estimates

⁽¹⁾ 2021 data not reported, 2020 data presented; ⁽²⁾ Definition differs in some figures

Source: Eurostat (online data code: env_wasfw)

We also built a model only for the European region, the 27 member states of the EU (except Slovenia where there was no data), the UK and Switzerland included. As the EU regulates waste management strictly and both the United Kingdom and Switzerland have similar policies, measuring the effect of national regulations and laws within this dataset becomes meaningless. On the other hand, we can analyze the relationship of GDP per capita, again.

The regression equation for the reduced model to Europe will look like the following:

$$Y = 192.11 - 14.82X_1 + \varepsilon$$

Table 8: Simple linear regression to European region summary table

	<i>Estimate</i>	<i>Std. Error</i>	<i>t-value</i>	<i>p-value</i>	
(Intercept)	192.11	67.39	2.851	0.00826	**
log(gdp)	-14.82	6.3	-2.353	0.02616	*
Note: Signif. codes: * p<0.1; ** p<0.05; *** p<0.01					

From Table 8, we can conclude that income difference has an even higher effect on the amount of food wastage in the European region, than on a global scale. A 1 percent increase in GDP per capita results in around 15% less organic food wastage.

We also tested some assumptions for the simple linear regression. The Shapiro-Wilk test resulted in a p-value of 0.55, we explored normal distribution in the second model as well. The Breusch-Pagan test resulted in a value of 0.49, thus no heteroscedasticity issue is present.

IV.3. Motivation factors of consumers based on Q methodology

In the following, we will present the results of the Q-methodology-based survey. After running the model several times, 4 different groups could be identified based on their motivations and drivers towards food consumption and their attitude towards food waste: *'hygiene maniacs'*, *'conscious cooks'*, *'neophobes'*, and *'experimenters'*.

1. The hygiene maniacs – 11 participants

In the case of this factor, reducing food waste cannot be considered a decisive motivation when buying food. It doesn't matter to them that the food looks a little worse if they know that there is nothing wrong with it. However, they call for awareness of the perishability of food and are more likely to find out about the spoilage of food from the Internet or intuition (smell, color, texture, etc.) than from the label. Hygiene on the other hand is important to them, so they prefer food and beverages to be wrapped in foil, boxes, or bags. The price of food is important to them, they mostly choose cheap products.

2. The conscious cookers – 5 participants

People belonging to Factor 2 consciously plan their meals in advance, so they are not surprised by what they eat. The expiration date of food is also important to them, so they constantly check the ‘use-by’ and ‘best-by’ dates. At the same time, they do not eat out often, and they do not order from Foodora or Wolt either. For them, the price is especially important when it comes to meals.

3. The neophobes – 4 participants

In the case of Factor 3, neophobia is a defining aspect: if they are used to something, it is difficult for them to try new things. From their point of view, this is also evident from the fact that they do not like to experiment with recipes and new dishes. At the same time, it is not typical for them to consciously plan their meals in advance, so they are not surprised by what they eat.

4. The experimenters – 6 participants

People in this factor consciously plan meals in advance, so they will not be surprised by what they eat. At the same time, they are not people of habit (neophilia): even if they are used to something, they like to try new things.

Two statements were identified among the consensus statements, in the case of which the respondents had the same opinion across the factors. Of these only one of them can be considered significant at a 5% significance level: *“It bothers me when too much packaging material is used.”* In addition, it is important to note that there is also a similarity in opinions about statement 1 – *“I often use food-saving apps, because I don't usually cook”* – from which we could conclude that those who save food often do not do that because of their cooking habits, but for other reasons, or other people do not use Munch as often; on the other hand, this cannot be considered as a significant ($P>0.05$) consensus statement.

V. Conclusions

V.1. Discussion

As stated by World Bank, the composition of waste varies depending on income levels, reflecting different consumption patterns, and middle and low-income countries produce more organic food wastage. We found evidence that income-level of a country indeed influence the amount of food wastage globally and regionally as well. This can be attributed to the fact that high-income countries raise more awareness on environmental protection, because no economic issues effect them highly, EU regulations also play a quite crucial role, and both national and household savings remained can be spent on these issues. In the era of inflation and high consumer prices, people especially with lower average income must spend more on basic needs, while less savings remain if even does. Similarly, more of the government budget will be spend on balancing the economy out and supporting their citizens rather than issues like food waste. Other than that, it is also important to raise awareness to low-income countries, especially Africa, where agriculture is one of the determinant sectors, however the lack of modernized technologies and low awareness on safe storing result in spoiled edible food, huge losses, thus large amounts of food wastage. Solid waste and solid waste management incorporates a lot of types of waste and it is pleasing that the presence of solid waste management regulations or policies influence the amount of food waste.

Hospitality and retail sector also generates a large part of food waste, however almost all part of restaurant food waste could be avoidable if more awareness was raised to the issue. Restaurant managers and chefs are the most important players when attention is paid on food waste issues, but the type of restaurant also influence how food waste is handled. Conclusively, while a holistic top-down approach is needed to reduce food waste in hospitality, the attitude of workers, operational changes in the kitchen, service and consumer nudges are needed to reduce food waste. While consumers just indirectly connected with restaurant food waste, leftover waste is the hardest to influence, however there are existing practices on leftover waste reduction: with the use of smaller plates waste created by consumers, while with joining food saving or food donating chains the leftover waste directly coming from the restaurant can be decreased. Although, it is also important to mention, that first, pre-analysis of the efficiency of restaurants should be made, in order to reach the least possible leftover waste.

Based on literature, consumers have different motivations towards eating out, and food saving.

Regarding consumers' perspectives, we analyzed young university students' motivations and drivers of food consumption habits with respect of food waste and food saving. The study revealed 4 groups based on their routines and attitudes towards food waste, which four we named '*hygiene maniacs*', '*conscious cooks*', '*neophobes*', and '*experimenters*'. Based on our research, we can conclude that people differ in terms of food consumption and their behavior affects their food waste attitudes as well. Despite price was important for some groups, it was not a determinant factor considering food, which aligns with the existing literature. Price-effect can be also attributed to their demographics, as they are university students, they are more conscious about their spending. Significant and decisive factors differentiating participants in terms of food saving were hygiene consciousness, cooking attitudes, habits, and curiosity. Additionally, all participants were bothered by packaging waste regarding food.

V.2. Implications

Food waste being a major problem in the world should be an important topic in everyday life as well. While it has a large interest in the academic world, few people are aware of the contradictory self of food waste. Sustainable Development Goals draw attention to a bunch of issues in today's world, but they do not or slightly reach the public. Policies and directives coming from international organizations should be taken seriously, but national regulations and laws should implement stricter policies regarding both general waste and food waste. If policymakers force businesses to join food-saving campaigns, it would also encourage people to consume due-date products.

Not only policies should be improved, but education as well. Children must be taught from a young age how to take social responsibility, and how to take care of the future of human beings. Food waste should be considered as a global issue in front of children and not connected with the problems of pickiness or parental discipline. Unfortunately, households and consumers are the most difficult to encourage to reduce their food waste. Bad habits often undermine consciousness and that is why people must grow up in a way they do not take on those.

Restaurant managers, kitchen staff, and chefs should be trained on how to reduce restaurant food waste, but as there are several success stories they can build their own system as well. Food saving apps and food donation programs can be tailor-made to locations and in today's world, when the internet is available almost everywhere, no barrier shall halt anyone from that.

Retail sector must improve in terms of storage and placing food while informing customers about important expiry dates. As more and more retailers join food saving and donations, retail-

level food waste could be reduced. In addition, regardless of food waste the amount of plastic these businesses use is enormous and could be reduced by returning to weighed goods instead of portioning.

V.3. Limitations and further research directions

The study addressed several limitations in terms of quantitative data available globally. Measurement methodologies differ from country to country, even among the members of the European Union, which in itself makes it more difficult to oversee the problems and aspects of food waste globally, regardless of country comparisons. Different determinations of food waste, food loss, and food loss and waste or food wastage can also cause issues in interpreting different analyses' results. It is hard to differentiate them and more importantly, measure them separately. Regarding consumer food waste, it is almost impossible to measure, so we can only estimate it. But regardless of estimations consumers are the hardest to influence as they use what they are given, hence food waste on the consumer level can only be reduced if previous stages of the supply chains are also doing so.

We suggest further research on food waste in low-income countries, as there is only little data available from there, especially in Africa. African countries waste a lot, but the Western model hardly fits the specificities of that region. Fieldwork could be done on how food saving works in developing countries, what food donation chains or food banks exist there, and how to improve their technologies to achieve higher efficiency in food waste reduction. Regarding consumer attitudes different demographic characteristics could be measured in more depth in the European region. The relationship between waste and the economic stability of a country would be also an interesting topic to analyze.

Appendix

Table 9. Variables used in the regression analysis

Variables	Type
Country name (country_name)	Categorical
Regional classification of countries (region_id)	Categorical (factor)
GDP/capita (gdp)	Numeric
Income level (income_id)	Categorical (factor)
Food wastage (composition_food_organic_waste_percent)	Numeric (%)
Whether there is a national law governing solid waste management in the country (other_information_national_law_governing_solid_waste_management_in_the_count ry)	Dummy
Whether there is a national national agency enforcing solid waste management laws and regulations (other_information_national_agency_to_enforce_solid_waste_laws_and_regulations)	Dummy
Whether there is an existing information system available for solid waste management (other_information_information_system_for_solid_waste_management)	Dummy

Table 10. Unrotated Factor Matrix of sorts

Factors	1	2	3	4	5	6	7	8
SORTS								
r01	0.7548	-0.0364	-0.0533	-0.3762	0.2266	-0.0627	-0.0154	-0.1621
r02	0.8153	0.1249	0.293	-0.0694	-0.125	0.1773	-0.1593	-0.0507
r03	0.2909	-0.5001	-0.0418	-0.2937	-0.3528	-0.3589	0.2649	0.046
r04	0.5885	0.4815	-0.0003	-0.2497	0.1691	0.1517	0.0348	0.2315
r05	0.525	0.1175	0.4254	0.0679	-0.0592	-0.3267	-0.1152	0.1716
r06	0.3854	0.4518	-0.1647	0.2623	-0.5698	0.0498	-0.0817	-0.2497
r07	0.4686	0.3297	-0.1157	-0.169	0.0022	0.4304	0.0847	-0.3171
r08	0.2494	-0.5957	0.4272	0.1831	0.1781	0.2106	0.0974	-0.0542
r09	0.7547	0.0748	0.1465	0.2233	0.0525	-0.2245	0.1431	0.0989
r10	-0.0142	0.6665	0.2544	-0.3962	-0.093	0.1524	0.2618	-0.0941
r11	0.6703	-0.0359	-0.0862	-0.3736	-0.0966	0.117	0.3906	0.1008
r12	0.7078	-0.0341	-0.1364	0.3791	0.2574	-0.1718	0.1493	-0.1973
r13	-0.0672	0.2929	0.7219	0.1734	0.1536	0.0947	-0.3235	0.2635
r14	0.7918	0.055	-0.1636	0.0118	0.0484	-0.0706	-0.4182	0.033
r15	-0.0463	-0.4187	0.3231	0.2693	-0.21	0.5206	0.2461	0.2307
r16	0.4135	-0.0946	-0.3025	0.6369	-0.0341	-0.1084	0.2458	-0.0003
r17	0.6226	-0.1601	-0.4732	0.2805	-0.0778	0.0826	-0.1426	-0.0239
r18	0.4443	0.2279	-0.3376	0.1133	-0.2819	0.2194	0.1542	0.5524
r19	0.0576	-0.3388	0.6114	-0.1639	-0.1313	0.0039	0.2448	-0.2793

r20	0.4743	-0.0535	-0.3121	-0.3032	0.6483	0.1813	0.1521	0.083
r21	0.5675	0.2061	0.2119	0.5458	0.1296	0.2914	-0.0071	-0.2386
r22	0.6906	-0.1165	0.0593	-0.1834	-0.0296	-0.4172	-0.0272	0.0166
r23	0.4513	-0.5624	-0.0509	-0.3524	0.0721	0.2564	-0.3765	0.016
r24	0.6409	0.3337	0.3399	-0.1959	-0.3428	-0.1306	-0.0429	-0.0071
r25	0.6809	-0.4416	0.311	0.1494	0.0853	-0.0515	0.0354	0.0847
r26	-0.1962	0.5581	0.2221	0.218	0.4745	-0.2679	0.2567	0.0477
Eigenvalues	7.4247	3.0911	2.4722	2.2031	1.6339	1.4437	1.1367	0.9289
% expl.Var.	29	12	10	8	6	6	4	4

Table 11. Factor Matrix with defining sorts indicated

QSORT	1	2	3	4
r01	0.6832 X	0.4811	-0.0288	0.1278
r02	0.8057 X	0.0943	0.2245	0.2501
r03	0.1067	0.6004 X	0.2221	-0.0387
r04	0.7416 X	-0.0143	-0.2838	0.0991
r05	0.5734 X	-0.1204	0.3295	0.1521
r06	0.3422	-0.2376	-0.2725	0.4482 X
r07	0.5202 X	0.0607	-0.2717	0.1488
r08	0.0262	0.2219	0.7542 X	0.1202
r09	0.5896 X	0.0305	0.2186	0.5002
r10	0.4829 X	-0.3815	-0.3191	-0.4307
r11	0.6060 X	0.4654	-0.0632	0.0988
r12	0.3620	0.1360	0.1102	0.7091 X
r13	0.2465	-0.6168 X	0.4018	-0.1973
r14	0.5808 X	0.2912	-0.054	0.4816
r15	-0.1946	0.0044	0.5586 X	0.0674
r16	-0.0347	0.0264	0.0575	0.8196 X
r17	0.1668	0.3859	-0.1028	0.7269 X
r18	0.2898	0.0819	-0.3013	0.4412 X
r19	0.1621	0.0690	0.6189 X	-0.3236
r20	0.3480	0.4749 X	-0.2254	0.1403
r21	0.4094	-0.3056	0.2546	0.6176 X
r22	0.5713 X	0.3737	0.1480	0.1991
r23	0.2230	0.7290 X	0.2561	0.0055
r24	0.8148 X	-0.0668	0.0786	0.0382
r25	0.3986	0.3261	0.6195 X	0.3586
r26	0.0760	-0.6495 X	-0.1317	-0.0426
% expl.Var.	21	13	11	14

Table 12. Factor Characteristics; Table 13. Standard Errors for Differences in Factor Z-Scores

Factors	1	2	3	4
No. Of Defining Variables	11	5	4	6
Average Rel. Coef.	0.8	0.8	0.8	0.8
Composite Reliability	0.978	0.952	0.941	0.96
S.E. of Factor Z-Scores	0.149	0.218	0.243	0.2

	1	2	3	4
1	0.211	0.264	0.285	0.249
2	0.264	0.309	0.326	0.296
3	0.285	0.326	0.343	0.314
4	0.249	0.296	0.314	0.283

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