



Dimensions of household food waste focused on family and consumers

R. A. González-Santana , J. Blesa , A. Frígola & M. J. Esteve

To cite this article: R. A. González-Santana , J. Blesa , A. Frígola & M. J. Esteve (2020): Dimensions of household food waste focused on family and consumers, Critical Reviews in Food Science and Nutrition, DOI: [10.1080/10408398.2020.1853033](https://doi.org/10.1080/10408398.2020.1853033)

To link to this article: <https://doi.org/10.1080/10408398.2020.1853033>



Published online: 01 Dec 2020.



Submit your article to this journal [↗](#)



View related articles [↗](#)



View Crossmark data [↗](#)

REVIEW



Dimensions of household food waste focused on family and consumers

R. A. González-Santana , J. Blesa , A. Frígola , and M. J. Esteve 

Department of Preventive Medicine and Public Health, Food Sciences, Toxicology and Legal Medicine, University of València, València, Spain

ABSTRACT

Food waste produced in homes represents the largest fraction of food waste generated along the food chain. Therefore, adequate prevention measures based on the quantitative and qualitative dimensions of the problem need to be put in place to reduce waste. The objective of the review was to identify areas of interest in relation to the food waste in households, considering the family unit as a whole as well as individual family members. Quantifying the problem is an important aspect in order to know its scope and dimension, but prevention also involves knowing the causes in a home. This is a complex issue, which, on a family level, is related to socioeconomic status, educational level, composition and number of members of the household as well as culinary and buying food habits. Individual variables such as age, sex, values, awareness, lifestyle and time spent on food preparation were included to characterize consumers. The focus of the problem is also important because most consumers consider food waste from a social perspective, without being aware of the serious environmental and economic problems. Habits and customs of consumers are considered the leading cause of food waste in homes and knowledge of this issue raises consumer awareness as a preventive tool.

KEYWORDS

Household; food waste; quantification; awareness

Introduction

Despite the acceptance of the importance of food waste, there is no consensual definition about the concept. In general, food waste is any edible substance, whether raw, processed or cooked, that ends up being discarded or with the anticipation of being discarded, or otherwise, edible foods produced for human consumption which, for whatever reason, end up not being destined for that purpose (FAO 2011). Among the most commonly used definitions of waste is the one defining it as “healthy and edible material intended for human consumption, originating at any point in the food supply chain, which is discarded, lost, degraded or consumed by pests” (Calderira, Sara, and Serenella 2017).

Food waste can be divided into three categories: avoidable, possible or partially avoidable and inevitable (Beretta et al. 2013). Avoidable waste refers to food and beverages in perfect condition intended for consumption but which are discarded. Potentially avoidable wastes are food and beverages that, despite being edible and in optimal state of consumption, some people consume and others do not, depending on how they are prepared or made. Finally, inevitable residues correspond to the remains of food or beverages that are not edible under normal circumstances (bones, eggshells, skins of some products) (EU 2010). When talking about food waste according to its generation within the food chain, a distinction is made between food loss and food waste. Food loss means the loss of mass or nutritional quality of food originally intended for human consumption, usually caused by inefficiencies in the chain (FAO 2011).

According to Gustavsson et al. (2011) food loss refers to edible foods discarded in the early stages of supply such as production, post-harvest/picking and industrial treatment. However, food waste includes edible food discarded in the final stages of sale and consumption (Figure 1).

According to these definitions, the world generates 1.3 billion tons of food waste every year, which, in turn, generates economic losses equivalent to 940 billion dollars a year (FAO 2015), while paradoxically 870 million people go hungry (FAO 2013). The amount of food waste poses an enormous cost, also from an environmental point of view, resulting in the third largest source of CO₂ emissions in the world, after the US and China (Eurobarometer 2009).

Food waste is generated in immense quantities throughout the life cycle of food, having serious environmental, social and economic consequences (Beretta et al. 2013; Kummur et al. 2012; Stefan et al. 2013; Williams and Wikström 2011).

Food chain

The food supply chain is the system of organizations, people and activities involved in moving food from its producer to the consumer (Beretta et al. 2013), composed of at least three links: production, processing and manufacturing; sale; and (III) consumption (Dou et al. 2016). The food chain is identified as the main contributor to environmental deterioration, and for example, more than a decade ago it already represented between 20% and 30% of the global

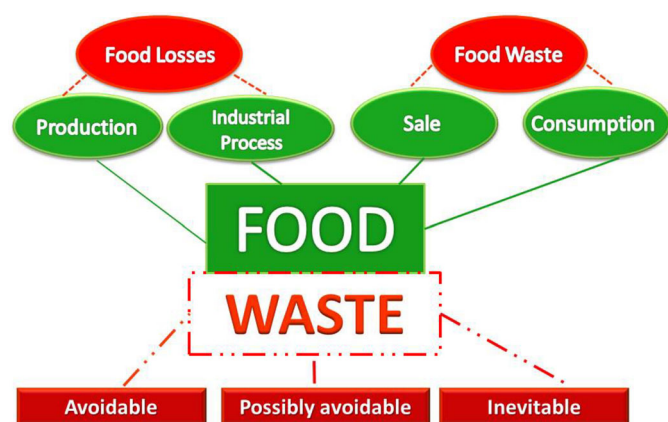


Figure 1. Classification of food waste by categories and according to its generation in the different stages of the food chain.

environmental impact caused by economic activities in Europe (Tukker and Jansen 2006).

In developing countries, during the production stage, which covers both harvest and picking, approximately 40% of food losses occur, while, in the case of industrialized countries, this percentage is significantly lower, 11% (FUSIONS 2016). The main reasons why losses occur are frequently related to damage caused to crops due to extreme weather events and pests (Beretta et al. 2013; Buzby, Farah-Wells, and Hyman 2014; Parfitt, Barthel, and Macnaughton 2010). The use of poor mechanical techniques for harvesting, picking, storage and subsequent transport, low quality seeds and poor harvest planning that generate surpluses can also cause significant food losses (Beretta et al. 2013; Manzocco et al. 2016).

In the industrial processing stage, in general, the use of inadequate machinery for the processing of products, poor storage, handling and packaging, both during the industrial phase and subsequent transport, contribute to the generation of waste (Alexander et al. 2017; Beretta et al. 2013; Manzocco et al. 2016; Olfield, White, and Holden 2016).

To these causes are added the losses corresponding to inedible parts generated during production or caused by changes in production that affect the edible portion, as well as products that do not meet quality standards (Beretta et al. 2013; FUSION 2016; Manzocco et al. 2016).

Compared with the rest of the stages of the food supply chain, food waste from both retail and wholesale sales is the one that generates less food waste, corresponding to 5% of the total generated in the EU (FUSION 2016). As in previous stages, surplus sales, expiration of products and non-compliance with customer standards lead to the discarding of many products (Beretta et al. 2013; Buzby and Hyman 2012; Manzocco et al. 2016).

The responsibilities assigned to agriculture and the later stages of the supply chain vary according to the literature, but the final consumer is considered an important contributor to the problem (FAO 2011; HLPE 2014; Priefer, Jörissen, and Bräutigam 2016; Stenmarck et al. 2016). This is

especially true in more industrialized countries, where final consumers waste up to ten times more food per capita than in developing countries (FAO 2011). A recent study indicates that, in the EU, 53% of food waste occurs at the consumption stage (Stenmark et al. 2016), covering both consumption in catering establishments (12%) and in households (53%); however, reliable data sources are generally scarce (Bräutigam, Jörissen, and Priefer 2014).

Importance of household waste

With the objective of reducing waste in the EU, member states committed themselves to meeting the Sustainable Development Goals (SDGs), adopted in September 2015, together with the objective of halving food waste per capita at the retail and consumer level by 2030, and decrease food waste along food production and supply chains (European Commission 2015). Considering this situation, the European Parliament (2012) determined that the critical point of food waste is waste at consumer level and it has, therefore, focused its efforts on reducing this type of waste. Households, where the final stages of the sale and consumption process occur, represent the largest fraction of waste along the food chain (BIOIS 2011), due to the impact that this waste produces on climate change. Hence, it is crucial to prevent it at this stage (Parfitt, Barthel, and Macnaughton 2010). To be more precise, if food is wasted at the end of the supply chain, that is, in homes, it is a waste of the resources used in its production, processing, transport, refrigeration and preparation, as well as an extra carbon footprint and water footprint generated in vain. At domestic level, food waste is estimated to represent more than 50% of the total food waste in Europe (Kummu et al. 2012) and even up to 60% of total food waste in the US (Griffin, Sobal, and Lyson 2009). In terms of family economy, for a family of 4 members, the waste generated represents a cost equivalent to \$1500 annually in the US and approximately \$1100 per year in the United Kingdom (Buzby et al. 2014; Wrap 2015). Complementary studies show that the total EU food waste averages 123 kg/per capita per year, that is, from 16% of all the food reaching consumers, almost 80%, that is, 97 kg/capita/year is avoidable food waste, categorized as edible food that is not consumed (Vanham et al. 2015). On the other hand, in the United States, families waste almost 15% of the food they buy by adding an additional 10% with liquid waste (Bloom 2011).

Methodology

The objective of the literature search methodology was to establish a database, composed of scientific articles, reports and institutional, governmental or international organizations documents, and press articles inherent to the subject.

The selection of documents was made based on three variables: the choice of a time period for publications collected between 2006 and 2019; the chosen research fields dealing with the environment, agriculture and nutrition; and

the following keywords: food waste, food consumption, waste quantification, and waste management.

The information search was carried out through the Science Direct database and the Research Gate search engine, and also in institutions and programs such as: FAO (Food Agriculture Organization), EUPHA (The European Public Health Association), WRAP (Waste and Resource Action Program), and FUSION (Food use for Social Innovation by optimizing waste prevention strategies). From this search, a limited number of articles were preselected depending on the relationship of the title to the subject of this review and, after reading, the document summary. The most frequently repeated issues were related to food waste, categorization of waste, control of waste, domestic behavior in relation to waste, levels of waste, methodology of quantification of waste, consumer behavior and the purchase of food.

After the preliminary reading that was carried out for the pre-selection of documents, a selection of the documents that would be used as bibliographic references was made, through reading, to verify that the information was really applicable to the subject under study. Also, at this point, references were identified among the bibliography of the selected documents that resulted in primary sources of information. The final inventory of documents consulted and cited was equal to 116 articles. Although the typology of the documents is diverse and in some respects it has many angles of interpretation, set of selected studies allowed us to have a clear view of the literature on household food waste.

Selection of households and means to access families

The methodology for the selection of households can be very diverse and the use of one or the other will depend on the objectives set in the research and on the available means.

Several dimensions can be considered in relation to the standard of living of people in the country or area of residence. Cultural, governmental, technological, economic and industrial variables have been identified as potential characteristics that may influence food residues in a home (Quested et al. 2013).

One of these methods could be a random selection based on a list of households stratified by socioeconomic and demographic variables, whose final number will depend on the population density of an area. It is necessary to verify that the behavior of households with respect to the problematic topic of study coincides with socioeconomic levels, the composition and the number of members making up the family unit, and the educational level of the person responsible for the household. There must be a pre-established routine that selects the homes to be interviewed and the follow-up of these procedures will be recorded for contact-by-contact verification by a supervisor (FAO 2016).

Another way to make the selection of households may be based on the response to a survey distributed by social networks, freely accessible and without registration. The data can be segregated by including questions regarding gender,

age, urban or rural environment, household conformation, educational level or type of employment in the survey. The response can be massive, although adequacy cannot be ensured. Also, a good information and awareness campaign will improve the number of surveys collected. The study “Household food waste in Greece” (Ponis et al. 2017) is an example with a final sample of 500 households; the design of the questionnaire was based on information from similar studies, and the final questionnaire was outlined as a result of a meeting with experts in different disciplines such as food supply chains, marketing, psychologists, sociologists and nutritionists. It contained five sections or dimensions with a total of 35 items: demographic and socioeconomic information; how to buy food and food preparation habits; identification of consumers’ food; type and amount of waste with the reasons why food was decided to be discarded; and awareness of waste with positive, neutral or negative positioning regarding the phenomenon of waste.

Once the households have been selected by the most appropriate method for the investigation to be carried out, with the location and establishment of the sample to be evaluated, appropriate collection instruments must be used, which can be validated through online and self-administered surveys on paper, records such as the purchase, consumption or waste diary, structured interviews or telephone surveys through pollsters trained in household and/or business surveys, trained personnel for weighing and waste sorting, as well as optical readers that expedite the purchase record in addition to taking into account other information such as socio-economic and demographic statistics of local authorities. The studies can be carried out in several periods, complementing each other, determining the daily per-capita waste, to the identification, classification and qualification at a personal level and in homes, as well as the identification of the social causes and behavior of the consumer who motivate waste, adding to this the possible changes over time in waste habits evaluated in quantity and type. The most recurring questions in the investigations are: amount of waste generated; fate of food waste; and division of food waste by categories (Alvarez 2010; Ministerio de Agricultura 2013; Vidal 2012; Wrap 2009).

Methodology for quantifying household food waste

Different methods, quantitative and qualitative, have been used to gather the necessary information when acting on food waste (Schanes, Dobernig, and Gozet 2018). According to FAO (2017), the methods used to estimate waste at the household consumption stage were the following (Figure 2):

Among quantitative methods were the Waste Composition Analysis, the Municipal Solid Waste Analysis (MSW) and Food Waste Diaries.

The Waste Composition Analysis approach consists of the separation and classification of food waste generated at home by the team conducting the study (Wrap 2015). This method can be performed with a high degree of detail by classifying waste into categories and subcategories (FUSION 2016). For small-scale sample studies, the classification



Figure 2. Methods used to estimate waste at the household consumption stage (Source: FAO 2017).

consists of delivering duly identified bags to the participating households. For larger-scale samples, work is done in coordination with the MSW collection system. These methods of garbage collection involve a lot of personnel and high costs. After obtaining the informed consent of the households involved, the wasted food is separated from the remaining waste, classified and weighed. This information is used along with household socioeconomic data to obtain national estimates of food waste (Wrap 2009).

Food Waste Diaries are one of the best ways to obtain information on the reasons why food is discarded (Wrap 2011). They can also be used to quantify waste and are especially useful when direct analysis of MSW is not feasible such as with food thrown into the kitchen sink. The period of time used to carry out this type of study is between 4 and 7 days and households receive some compensation for the time spent (FAO 2017).

However, there are methodological problems around the lack of information and the possibility that the diary influences behavior in addition to being a method that may be subjective since it is the person in charge of the food who is also responsible for registration. For example, the published WRAP analysis indicates that the amounts of waste recorded in diaries are approximately 40% lower than those obtained from the MSW analysis. These problems are parallel to the lack of information in dietary diaries (Macdiarmid and Blundell 1998). The questionnaires reach a large and representative sample of the population to determine the attitudes and behaviors under study. Preliminary or pilot schemes are useful for developing a set of precise questions and for the appropriateness of the language used, so that they allow the validation of the questionnaire. The food waste diary, in spite of being an expensive tool of control, has been used frequently.

Interviews and questionnaires are usually complementary processes to other methods of valuation of waste, being very useful since they allow gathering specific information on many aspects related to food waste, both quantitative aspects and qualitative aspects. Interviews are usually an exceptional complement since data extraction can be directed by the interviewer toward the aspects that are of interest in the investigation. In some studies, interviews have been used,

the questions of which were specific, and which included comparison with existing statistical data on the amount of food waste (FAO 2017).

Other qualitative contributions are also of great importance, thus, ethnographic and domestic research allow a more profound understanding than other simple quantitative methods of how and why food waste is generated in a home, including the respective context. Whoever buys, prepares and eats food has some kind of impact on the waste. For economic reasons, this type of research can generally only be done in a relatively small number of households (Evans 2012; Wrap 2011).

Baquero (2017) observed that although there are methods to determine the amount of waste, the lack of data at some stages of the process where waste is generated prevents more complete results from being calculated, which in many cases leads to estimates on these stages of the process. Economic reasons are also an impediment to obtaining data from practical quantifications, since, either the assessment is not profitable or the budget is insufficient for it, which leads to the calculation of estimates (Mena, Adenso-Diaz, and Yurt 2011).

It is common to combine research methods to gain a complete understanding of a particular topic. For example, in a project aimed at finding out why such a large amount of bread is wasted and how to address this problem, multiple research methods were applied: kitchen diaries and consumer questionnaires together in target groups and brainstorming sessions (Wrap 2011).

The quantification of waste is determined by evaluations, with a more detailed and valid option based on collecting all solid and liquid waste produced in a household, assessing quantities and the quality of food in this kind of waste (Wrap 2015). However, these evaluations are rarely carried out due to their high cost, and once they have been carried out, not all types of waste can be evaluated, for example, food used as fertilizer. Surveys are another option of evaluation, asking about the amount of food that is wasted, for which a verbal response scale is used to assess how much food is discarded. In different studies using this method, the majority of respondents stated that they discarded little or nothing, for example 87% in a Greek sample (Abeliotis, Lasaridi, and Chroni 2014) and 70% in a sample from the United Kingdom (Wrap 2006).

More detailed questions about the amounts of different types of discarded food revealed that the inedible parts of food cannot be considered waste as they constitute inevitable, most frequently discarded, waste (for example, shells and bones), followed by fruits, vegetables, bread and cakes (Wrap 2006). Stefan asked Romanian consumers to report on the amount of four different food groups they wasted per week (Stefan et al. 2013). His evaluation was easier to quantify, since he asked for the amount discarded in relation to the amount of food grown or purchased.

In general, for reliable assessments of the actual amount of wasted food in a home, the assessment period should represent a standard average week; a special occasion during this period, such as a birthday, will distort the results. In

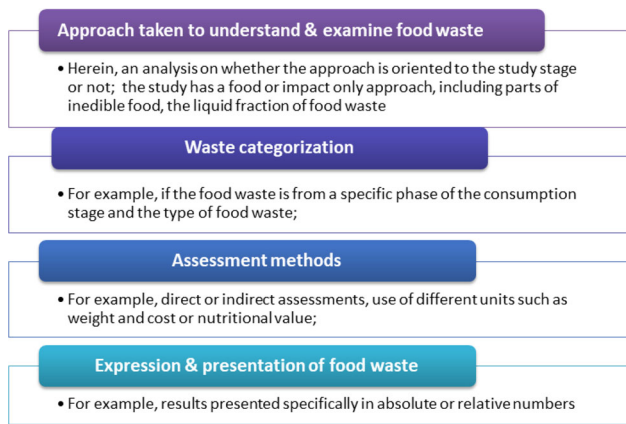


Figure 3. Dimensions used for food waste (Source: Roodhuyzen et al. 2017).

addition, all participants must have the same definition of food waste (Vischers, Wickli, and Siegrist 2016).

Whatever the methodology used to measure food waste, it must include what sector should be covered, what the original destination of the food lost is, what type of material should be considered, what destinations count and what indicator should be used. Within the analysis of the scope of the study, Fusions experts (FUSION 2016) recommend defining the method according to the following questions: which stages of the food chain will be studied? and what types of companies/households/organizations are within and outside the scope? The indicator that will be used to monitor the performance of countries should be "loss of food and waste per capita" (based on the population of each country), measured in kilograms/person/year. It would be based on two indices; one is the "Food Loss Index" presented by FAO (2017), and the other focuses on retail sector waste up to the point of consumption, a "Food Waste Index" still to be developed by FAO.

Baquero (2017) also mentions mathematical and statistical methods as an option to measure the amount of food waste, with the advantage that the software may include factors such as climate variations, agricultural parameters, etc. (FUSION 2016). In households, it must be taken into account that this constant of raw materials or products is not available, and purchases may vary and differ from day to day.

To measure food waste, there are two types of assessments: direct and indirect:

- Direct assessment includes the weighing of garbage, the collection of daily surveys, and records or observation;
- The indirect method includes the modeling or schematization of food, food balance, statistical data or bibliographic consultation.

These methods have advantages and disadvantages related to the cost for the time required, accuracy, and reliability. The selection of the method has a great influence on the results and depends on the objectives of the study or research, in particular, the level of depth, accuracy and reliability of the available sources.

Within the direct method, the collection of garbage, in spite of being cumbersome, provides accuracy, objectivity and reliability of information, but it is expensive as well as time-consuming. On the other hand, observation requires less time and money, but the information is less accurate and depends on the perception of the people involved, the way the information is collected and the subjectivity of the observers. Surveys and daily data logs provide a better balance between the source and content of the information. The indirect method, through the weighing of the food and the adequate treatment of these data, is most frequently used as it is neither time-consuming nor cost-intensive in comparison to the direct method, but its accuracy depends largely on the quality and representativeness of the origin of the data.

The quantification approaches used to determine food waste are variable and are related, in part, to the different definitions used. For example, food waste can be defined as fractions that include edible parts or not, or based on disposal routes with different alternatives (for example, sink or spillage). In addition, it may include food left unconsumed, also including edible organic matter that can be sent to waste-management treatment plants to be reused as compost or biomass. Roodhuyzen reviewed 59 articles that address food waste (Roodhuyzen et al. 2017) in which the dimensions used for food waste research were (Figure 3):

As part of the dimensions in the quantification of waste, the waste should be determined according to the following variables: person/year, economic level, food group, calories and nutrient level.

Socio-economic aspects of household waste

Díaz-Ruiz et al. (2015) established six different factors that affect the waste of food: environmental awareness, materialism, purchasing behavior, choice of diet, waste recycling and waste prevention. In an extension to his work, three additional factors of incidence were added: knowledge of food waste (awareness), religion and personality traits (Díaz-Ruiz, Costa-Font and Gil 2015).

Although the first studies on the relationship between income and food waste found little or no correlation (Dowler 1977; Wenlock et al. 1980), subsequent studies focusing on socioeconomic status and standard of living found that people with a high level of education (Wrap 2009) and higher income families waste more than households with a lower income (Brook 2007; Buzby and Guthrie 2002; Koivupuro et al. 2012). Paradoxically, low-income households implement purchasing strategies to save money; however, when cooking from scratch, they end up generating more food waste (Porpino, Parente, and Wansink 2015).

Recently, Setti et al. (2016) argued that the economic level of people influences food waste, but the relationship between per capita income and behavior on household food waste is very complex. Therefore, certain behavior cannot be ignored or taken for granted.

In the same order, due to the increase in the world population and, therefore, the increase in the middle classes of

developing countries, rapid growth in size and volume of consumption is expected, which according to Nixon will lead to an increase of around 50% in the global generation of food waste, projecting for 2030 a cost of 600 billion dollars (Nixon 2015).

Gender and age

Food and the tendency to waste it is a social and cultural phenomenon. It configures a scenario of interaction between the subjects, around circumstances that intertwine cultural valuations, subjective meanings and social relations, in particular times and dynamics considering generations as well as gender and age, especially in relation to experience and environmental characteristics integrating eating behavior. Experimental evidence suggests that sex, age and social interaction are important factors for food consumption and hence the generation of food waste (Buzby and Hyman 2012).

Based on studies conducted and based on specific personal attitudes that contribute to food waste and, in addition, adding representative characteristics in terms of economic, social and cultural levels, it was found that age and gender are two personal characteristics relevant to food waste. Thus, it was observed that although women waste more than men (Buzby and Guthrie 2002; Gallo 1980), they are more predisposed to reduce food waste when compared to the latter. Young people waste more than older people, especially the postwar generation (Hamilton, Denniss, and Baker 2005), and age has an influence on purchasing decisions and behavior in the face of food waste (Farr-Wharton, Foth, and Choi 2014).

Ethnicity

Ethnicity can be a factor to take into account in studies aimed at specific populations or population groups, since ethnic customs in the type and consumption of food along with the use of these and culinary techniques have an important impact on the generation of waste and its effects on the environment.

The food consumption of blacks, latinos and whites was evaluated to determine their consumption trend and similarities or differences according to racial type.

The results established that ethnicity is a significant factor in food consumption standards in the U.S. The study reveals that the white community consume and waste more food. Their waste affects the environment more than the waste generated by the black and latino communities. When comparing the food consumption of the white community with the latino community, it is observed that whites consume more food with an intense environmental impact at the rate of 5 out of 7 food products within this category, i.e., potatoes, apples, meat, wheat, milk, oil, water. In this same order of comparison, whites consume more environmental effect food than blacks at a rate of 6 out of 7 products of difference. However, they have the same level of consumption in

terms of oils. The comparison between black and latino communities shows a non-statistical difference with respect to the consumption of apples, meat in general, beef in particular, wheat and a marginal difference in water (Bozeman et al., 2020).

White community food consumption patterns produce the highest per capita impact rates on greenhouse gases and water footprint, while black community food consumption patterns produce the highest per-capita impact rate in land use.

Consumer behavior

Consumer habits and customs are considered as the main cause of food waste. In developed countries, the majority of average consumers consider food waste to be a problem of social focus rather than as an environmental or economic problem (Parizeau, von Massow, and Martin 2015). Environmental damage is not only caused by production but also by food waste since part of this waste is related to various environmental aspects such as the emission of greenhouse gases (Eberle and Fels 2016; Kummur et al. 2012; FAO 2013; Grizzetti et al. 2013; Noleppa 2014) and, in turn, the prevention of food waste depends on consumer behavior (Quested et al. 2013). Therefore, a change in consumer attitude could have an effect on the amount of food waste (Stefan et al. 2013). The management of food waste at domestic level is an emotional and cultural issue of idiosyncrasy, affected by social, cultural, economic and institutional factors, which have varying impacts on each household (Parizeau, von Massow, and Martin 2015).

Contrary to the aforementioned behavior, it is the consumer's aversion to the unused portion or proportion of a food or package, i.e., the unused amount, which generates a change in the preferences of the consumer and leads to waste reduction by preferring to buy individualized portions although they cost more but avoid waste (Bolton and Alba 2012). In this sense, economic aspects can become a motivator leading to a reduction in food waste (Baker, Fear, and Denniss 2009; Graham-Rowe, Jessop, and Sparks 2014). This economic aspect should be underlined as consumers give more importance to this dimension than to environmental damage (Baker, Fear, and Denniss 2009; Cox and Downing 2007; Graham-Rowe, Jessop, and Sparks 2014), as consumers are not aware of the connection between food waste and environmental deterioration (Cox and Downing 2007).

Food waste is associated with negative emotions since useless consumption generates guilt (Graham-Rowe, Jessop, and Sparks 2014). However, there are still consumers who do not develop any sensation of wasting food (Baker, Fear, and Denniss 2009; Graham-Rowe, Jessop, and Sparks 2014; Hamilton, Denniss, and Baker 2005). Once consumers are aware, they display positive attitudes and behaviors regarding the prevention of food waste. Thus, they become organized, using shopping lists and meal planning, when storing, buying, preparing and consuming food (Abeliotis, Lasaridi, and Chron 2014). That is, a large number of consumers are knowledgeable about how they can reduce food waste at

home, but do not apply their knowledge (Baker, Fear, and Denniss 2009). Large families and large groups, in general, purchase abundant and healthy food, but its consumption often leads to large quantities of food waste (Graham-Rowe, Jessop, and Sparks 2014). It is difficult to convince all household members to change their behavior and reduce food waste. This type of behavior is very common in the homes of families with children, but not so common in the homes of older or single people (Wrap 2006). Therefore, reducing household food waste could be carried out by generating a sense of guilt, using campaigns to emphasize good environmental behavior (Graham-Rowe, Jessop, and Sparks 2014), thus well-defined strategies could be more efficient than fiscal measures (Chalak et al. 2016).

In previous studies, consumers were divided based on the type of behavior concerning the level of food waste (Cox and Downing 2007), i.e., they were categorized according to their amount of food waste: high, medium and low. The highest level of food waste was dominated by young professionals or young families. In another study, (Hamilton, Denniss, and Baker 2005), consumers were classified according to their attitudes: those conscious of minimizing waste; those who waste and feel guilty, those who give importance to waste; and those unconsciously wasteful or unimportant.

Under this classification, waste is minimized by conscientious people who dispose food in minimal quantities and are careful in managing food, and by wasteful people who feel guilty about wasting food and are likely to improve their attitude. The opposite behavior to the previous ones is that of those who do not mind wasting as they do not mind buying food they do not use, causing large amounts of food waste and usually end up buying food they do not need or use, whilst not being aware of the waste or even denying doing to do so. These classifications of behaviors show that consumers consider waste a social problem rather than an environmental or economic problem (Parizeau, von Massow, and Martin 2015).

Religious beliefs are expected to exert a positive effect on food waste, functioning as an ethical reason related to fairness (e.g. in light of worldwide hunger), values or environmental concerns. Given that food loss and waste are an environmental problem, beliefs provide an ethical motive that strengthens the active attitude against food waste. Aschemann considers religion a critical factor, representing a degree of motivation to avoid food waste (Aschemann-Witze et al. 2015).

Temporality or seasonality

As for temporality, consumption and waste of food tends to vary depending on the season of the year studied (Kantar 2015). Thus, the highest consumption of garden products occurs in the spring-summer season, while the consumption of meat proteins decreases in that season, but increases in autumn-winter. Dairy and bakery products have very similar consumption levels, but dairy products are consumed more frequently in summer, while fewer bakery products are consumed in winter.

Regarding the preference of prepared dishes, salads reach a higher consumption level in summer-spring (21.1%) than in the autumn-winter season (16.8%). For example, Spanish omelet consumption increases in the autumn-winter season (6.8%) compared to the spring-summer season (4.3%). Hence, it is clear that the season influences consumption according to the type of raw material and its origin or classification within the food range. Therefore, it can be deduced that the type of waste also varies, so that of the total annual waste, 52.2% is produced in spring-summer, while 47.8% is generated in autumn-winter. Regarding food purchases, the study revealed that in summer more food is bought in supermarkets and other places of supplies (50.2%) than in autumn-winter (49.8%). Regarding waste, 4.71% of purchase volume is wasted in summer-spring and 4.34% of purchase volume in winter-autumn. Regarding food processed in homes, the total waste in autumn-winter is 47.7%, of the total volume wasted and 52.3% in the spring-summer season.

Waste from unprocessed products stored in the refrigerator or pantry (85.6%) is higher than that of the same food, whether cooked or processed (14.4%). These percentages are practically the same in autumn-winter than in spring-summer which indicates two peculiarities: first, people buy more than they really need, and second, this trend is the same at any season of the year.

Main causes of food waste in households

Secondi, Principato, and Laureti (2015) proposed the following classification of food waste determinants divided into two main categories of variables: contextual and individual (Secondi, Principato, and Laureti 2015). The contextual variable category encompasses political, socioeconomic and cultural factors, as well as the technological and industrial context. It is considered that the concurrence of an increasingly smaller proportion of the budget allocated to food combined with its availability and apparent abundance in the food market affects the value and importance that consumers attribute to food causing food waste to be something that happens easily (Aschemann-Witze et al. 2015; Canali 2014; Eurostat 2015b; FAO 2011; Williams et al. 2012). For instance, bulk or bulk pack discounts - the more you buy, the higher the discount, which is one of the most prominent contextual drivers of waste (Koivupuro et al. 2012; Mallinson, Russell, and Barker 2016; Porpino, Parente, and Wansink 2015; Williams et al. 2012). Also, labeling systems with numerous data tend to confuse the consumer, leading to waste. Another factor is that the labels do not contain relevant information on how to minimize waste, such as the clear specification that food is safe for consumption after the expiration date, thus reducing potential waste. The standardization of expiration labels, (Abeliotis, Lasaridi, and Chron 2014; Monier et al. 2010; Williams et al. 2012) and a dietary guide that promotes the consumption of fruits and vegetables (Canali 2014; Evans 2012; Wrap 2011) are other significant factors.

As part of the individual variables, demographic characteristics, values, attitudes and concerns, the time allocated to the purchase, preparation and storage of food, and lack of knowledge are included (Canali 2014; Farr-Wharton, Foth, and Choi 2014; Koivupuro et al. 2012; Monier et al. 2010; Wrap 2015), carelessness, (Aschemann-Witze et al. 2015; Fonseca 2013; Watson and Meah 2012) and busy and unpredictable lifestyles (Aschemann-Witze et al. 2015; Fonseca 2013; Ganglbauer, Fitzpatrick, and Comber 2013; Kranert et al. 2012; Mallinson, Russell, and Barker 2016; Watson and Meah 2012), constitute the main individual drivers. The tendency to buy, cook and serve in excess, sometimes called the “good identity of the supplier”, combined with a picky or meticulous diet, is another context that favors the generation of food waste, and all these characteristics are based on idiosyncrasy of the population studied (Aschemann-Witze et al. 2015; Evans 2012; Graham-Rowe, Jessop, and Sparks 2014; Koivupuro et al. 2012; Wansink, Brasel, and Amjad 2000; Wrap 2015). Finally, the lack of awareness about the financial, ecological and social consequences (Graham-Rowe, Jessop, and Sparks 2014; Kranert et al. 2012; Monier et al. 2010; Quested et al. 2013; Stefan et al. 2013) and the lack of knowledge and education about the responsibility that should be assumed by individual households also explains the low priority that consumers assign to the reduction of food waste (Aschemann-Witze et al. 2015; Graham-Rowe, Jessop, and Sparks 2014).

Actions that minimize household food waste

The findings imply that waste management activities are the most relevant approach to explain the reality of food waste. Thus, education campaigns should focus on developing and reinforcing waste management skills since these measures can help reduce food waste. In addition, food prices and choice are also considered main factors to explain how food waste occurs (Stefan et al. 2013), with planning and purchasing routines being important factors. This can be attributed to the push effect of companies that use advanced marketing as a technique to sell their products. For this reason, opening the dialogue for cooperation between the actors in the agricultural food chain could help motivate consumers to reduce food waste (Vanham et al. 2015).

Considerable research is still needed to better understand the current food waste landscape (Katajajuuri et al. 2014). Future research ought to be done in two directions: one direction is to extend the current concept by incorporating the theory of planned behavior and relating food waste with obesity in the sense that eating food beyond what is necessary is considered waste as well; the second direction is to investigate the loss and waste of food at the level where the problem is greatest and focusing on the main food products affected by waste.

Food is wasted for multiple reasons and various actors are involved in the supply chain, which makes it difficult to find a quick and complete solution. Food is wasted as a result of higher quantities per package or unit of purchase to achieve higher profits. In many countries, food waste

itself causes problems when dumped or thrown on illegal sites (Eriksson 2015). In general, therefore, food waste is a consequence of unnecessary overproduction, which should be considered of concern.

To reduce food waste, it is first necessary to understand what the problem really is. According to Erickson (Eriksson 2012; Eriksson 2015), a detailed quantification is the essential first step in this process, even more accurate food quantification is necessary to assess the effect of any food waste reduction measures that have been taken. However, waste quantification studies are often short-term and limited, making comparisons between different studies difficult, so it is not easy to generalize or standardize the results obtained by a specific study. In Switzerland, for example, many municipalities have started to quantify their waste, but the information they reveal does not have a standard format for quantification and reporting of food waste, which makes it difficult to compare and evaluate whether or not progress has been made. The most common practice today is to quantify the waste of dishes and lunches served at school for two weeks a year (Hebrok and Boks 2017). Waste data are compiled and compared with those of the dishes used to present the result in grams per serving served. The many similarities between municipalities provide the potential to introduce a common standard that many municipalities already meet or could make small adjustments (Eriksson, Lindgren, and Osowski 2018).

In short, food waste is the result of multiple and complex behavioral factors; therefore, it is difficult to find a single factor that encompasses the whole problem (Wrap 2011; Quested et al. 2013). In fact, there are many factors that motivate people to reduce food waste, be it personal or family group motivation in households and considering variables related to attitude, values, motivation, habits perceived as social norm, knowledge and skills related to handling waste, along with the predisposition to take advantage of available facilities and resources (Ostrom 1998; Evans 2012). (Soon and Manning, 2019) has considered the role of the intelligent applications such as intelligent packaging, intelligent fridges and wider IoT solutions to reduce household food waste.

Awareness about waste

Food becomes wasteful as a result of a series of events and decisions separated by time. This process occurs, initially, unconsciously, which leads to an underestimation of the personal contribution to general waste that each individual has; for that reason, the change should begin with the implementation of measures that motivate people to reconsider their daily practices and routines (Evans 2012). Raising awareness about the problem is crucial, but not enough to cause changes in behavior in favor of the environment. On the other hand, personality traits and awareness as a general characteristic are negatively associated with the production of food waste. Thus, the more awareness, less food waste occurs. FUSION, determined three social factors that affect waste: lifestyle, socio-demographic factors, and the

expectations of the individual (FUSION 2014). Swami, on the other hand, found a positive relationship between personality traits such as kindness and awareness with managing waste reduction and recycling behaviors (Swami et al. 2011).

Desirable behavior must first comply with the moral and social norms of consumers, who must also be convinced that they have an important responsibility and that their personal behavior has a direct impact on waste (Bamberg and Möser 2007; Liobikien and Juknys 2016). Negative group behavior generates negative consequences on individual behavior; therefore, influencing behavior is one of the most effective means of sustainably changing the behavior of a large proportion of the population and thus minimizing waste (Ahn, Bailenson, and Park 2014).

In order to modify behavior and, therefore, sensitize the consumer, realistic simulations in video games can be used for this purpose. Through these simulations, the adoption of desirable behavior can be encouraged, transmitting a message that influences the normative scheme of consumer habits. The message should emphasize how to adopt the desirable behavior, which will allow the consumer to behave as most do and, thus, comply with the social norm (Groot et al. 2013).

Another way to raise awareness and sensitize the consumer is by means of awareness campaigns through which behavior related to food waste can be modified. However, these campaigns must be carefully designed both in the content and the media used. Starting from the content first, two options can be considered: first, the development of a slogan to maintain a certain consistency in communication; and second, a strong focus on a few selected, concrete and effective measures that can be easily adopted by the target audience (DEFRA 2008; Liobikien and Juknys 2016). These campaigns should be aimed at strengthening the awareness of the target groups regarding the protection of the environment, since the consumer in general has no feeling of environmental protection (Gust 2004).

The variety of media is an additional determinant of the success of a campaign. The multiplication of the media helps to reach a wider range of the population and expose them repeatedly to the message through brochures, newspapers and personalized messages. Letters have been cited as preferred sources of communication, while newsletters show the greatest impact on behavior change (Mee et al. 2004). Personal recommendation and personal contact are also recognized as a very effective means of motivation (Bräutigam, Jörissen, and Priefer 2014; Bloodhart, Swim, and Zawadzki 2013; DEFRA 2008). In addition to the information provided, the adoption of new behaviors should be promoted through participatory instruments (Gust 2004). The combination of various interventions, such as awareness campaigns should involve a wide range of actors, incentives and participants. These instruments have proven to be more effective than the sum of individual interventions (Stern 2000) and will contribute to increasing the visibility and credibility of the message (DEFRA 2008; Gust 2004).

In this sense, Young et al. (2017) stated that the provision of information through social networks does not lead to major changes in the behavior concerning food waste in contrast to other information channels. The communication of various reasons, which are compelling for different stakeholders and consumers, is crucial to achieve the commitment of a wide range of organizations and individuals (Aschemann-Witze et al. 2015).

Negative emotions could be addressed to sensitize the consumer and thus try to minimize food waste, as several studies concluded that consumers often feel guilty when they waste food (Hamilton, Denniss, and Baker 2005; Baker, Fear, and Denniss 2009; Graham-Rowe, Jessop, and Sparks 2014). Graham-Rowe, Jessop, and Sparks (2014) also mentioned that lower waste rates could be achieved if information campaigns address the issue of food waste in relation to the feeling of guilt it generates. In this context, it must be demonstrated to what extent the evocation of guilt can, in fact, minimize food waste in households.

The vision of waste as a social or environmental problem

The lack of well-directed communication to raise consumer awareness means that the problem of food waste tends to be considered a social problem rather than an environmental problem (Parizeau, von Massow, and Martin 2015), i.e., consumers fail to detect the connection between environmental problems and food waste (Cox and Downing 2007; Quedsted et al. 2011). If food waste were approached from an environmental viewpoint, a reduction could be achieved since these aspects are important for consumers and their purchasing decisions (Eurobarometer 2009; Moser 2016). Yet, saving money is a more powerful motivator to reduce food waste than environmental protection (Baker, Fear, and Denniss 2009; Cox and Downing 2007; Graham-Rowe, Jessop, and Sparks 2014).

Based on these criteria, it may be sensible and important to provide the consumer with information on the environmental consequences of food waste, with the aim of minimizing it at home. However, most common consumers believe that only a small amount of food is wasted (Wrap 2006). All this lack of conception of waste is due to the difficulty in defining food waste, since it is often not considered as food waste and is categorized as unavoidable. Therefore, much of the waste is not considered a cost in the consumer's account (Wrap 2006). The lack of knowledge of consumers about these economic and environmental aspects, together with a lack of knowledge of all aspects that influence the final amount of food waste, suggests that this process does not constitute a problem and, therefore, the consumer does not feel responsible for wasting food, making the waste, in some way, socially acceptable.

Reduction of household food waste

The reduction of food waste is an important preliminary step in fighting world hunger. There are several factors that

encourage people to reduce food waste, both at the individual and family level, considering the variables related to attitude, values, motivation, habits, customs, knowledge and behavior (Quested et al. 2013). Raising people's awareness of the environmental impact of food waste does not seem to reduce it, while some studies indicate that people who are highly conscious and committed to the environment waste less food (Williams et al. 2012; Parfitt, Barthel, and Macnaughton 2010; Principato 2015).

A study by Farr-Wharton (Farr-Wharton, Foth, and Choi 2014) determined that the use of shopping lists is a mitigating factor of household food waste, with a strong and positive correlation with two other closely related pre-store planning behaviors: planning meals in advance and checking the amount of food before making purchases (Quested et al. 2013). The susceptibility of consumers to "over-shop" is a catalyst for the creation of household food waste; it is reduced with planned purchase activities and the use of a shopping list, which is understood as physical planning of the purchase event, making it a planned and non-impulsive activity (Buckley, Cowan, and McCarthy 2007).

On the other hand, the European Parliament (2012) proposes the following solutions at consumer and household level as mechanisms to reduce waste: regulate the size of the packaging to volumes more in line with the consumption standard; create consumer awareness about waste; develop education programs or campaigns; distribute programs for discarded but healthy food among the European population that needs it; and create better handling of the preferential consumption, respectively the expiry date.

Taking as reference works such as that of Kantor et al. (1997) and more recently that of Gascon (2014), the analysis of strategies that are considered appropriate to minimize waste indicates three lines of action: a system of unconsumed foods that can be used in the fight against hunger; the design of a logistic and technical structure that allows the recycling of discarded food to be converted into animal feed or compost; and educational policies aimed at the consumer with an awareness effect to achieve waste reduction. These points concern public policy, technology and logistics as well as awareness and sensitization of the consumer.

A solution that encompasses all stages of the food process is complicated, and as long as this control is not along the entire food chain, it will only serve to control or adjust to the most obvious stages of waste generation: retailers and consumers.

Final considerations

Households are the places where the resources used throughout the food chain are largely wasted when consumers prepare food for consumption. On a family level, this problem is due to both the behavior and lack of knowledge and awareness of the consumer, such as the format in which food is sold in the market and also to culinary customs. It is important to unravel and understand the role all these elements to reduce food waste at home and monitor progress. Given its high economic cost, research quantifying food

waste can only be carried out in a relatively small number of households. Thus, other qualitative contributions are also of great importance, and, therefore, race, gender, age, socio-economic status and the number of family members are research factors that allow understanding how and why food waste is generated in a home. Information on the subject is limited and more studies would be needed to address the problem in all its dimensions.




Disclosure statement

No potential conflict of interest was reported by the authors.

Funding

This research was supported by the Universitat de València (UV-18-INV_AE18).

ORCID

R. A. González-Santana  <http://orcid.org/0000-0002-6196-6904>
J. Blesa  <http://orcid.org/0000-0002-1690-2418>
A. Frígola  <http://orcid.org/0000-0002-8413-5046>
M. J. Esteve  <http://orcid.org/0000-0002-4468-7233>

References

- Abeliotis, K., Lasaridi, K., and Chroni, C. 2014. Attitudes and behaviour of Greek households regarding food waste prevention. *Waste Management & Research* 32(3): 237–40. doi: 10.1177/0734242X14521681
- Ahn, S. J. G., J. N. Bailenson, and D. Park. 2014. Short-and long-term effects of embodied experiences in immersive virtual environments on environmental locus of control and behavior. *Computers in Human Behavior* 39:235–45. doi: 10.1016/j.chb.2014.07.025.
- Alexander, P., C. Brown, A. Arneth, J. Finnigan, D. Moran, and M. D. Rounsevell. 2017. Losses, inefficiencies and waste in the global food system. *Agricultural Systems* 153:190–200. doi: 10.1016/j.agsy.2017.01.014.
- Alvarez, R. N. 2010. Relaciones políticas en el terreno de la basura: el caso de los quemeros y los emprendimientos sociales en el Relleno Norte III del CEAMSE.
- Aschemann-Witzel, J., I. E. De Hooge, H. Rohm, A. Normann, M. B. Bossle, A. Grønhoj, and M. Oostindjer. 2015. Consumer-related food waste: Causes and potential for action. *Sustainability* 7 (6): 6457–77. doi: 10.3390/su7066457.
- Baker, D., J. Fear, and R. Denniss. 2009. What a waste-An analysis of household expenditure on food. *Policy Brief No. 6*, 2009. Accessed September 16, 2017. <http://www.tai.org.au/node/1580>
- Bamberg, S., and G. Möser. 2007. Twenty years after Hines, Hungerford, and Tomera: A new meta-analysis of psycho-social determinants of pro-environmental behaviour. *Journal of Environmental Psychology* 27 (1):14–25. doi: 10.1016/j.jenvp.2006.12.002.
- Baquero, M. 2017. Residuos alimentarios: Analisis y propuesta de metodología de cuantificación. Universidad de Cantabria, Tesis de Maestría, 64.
- Beretta, C., F. Stoessel, U. Baier, and S. Hellweg. 2013. Quantifying food losses and the potential for reduction in Switzerland. *Waste Management* 33 (3):764–73. doi: 10.1016/j.wasman.2012.11.007.
- Bio Intelligence Service (BIOIS). 2011. *Guidelines on the preparation of food waste prevention programmes*. European Commission DG ENV.

- Bloodhart, B., J. K. Swim, and M. J. Zawadzki. 2013. Spreading the eco-message: Using proactive coping to aid eco-rep behavior change programming. *Sustainability* 5 (4):1661–79. doi: [10.3390/su5041661](https://doi.org/10.3390/su5041661).
- Bloom, J. 2011. *American wasteland: How America throws away nearly half of its food (and what we can do about it)*. Philadelphia: Da Capo Press.
- Bolton, L. E., and J. W. Alba. 2012. When less is more: Consumer aversion to unused utility. *Journal of Consumer Psychology* 22 (3): 369–83. doi: [10.1016/j.jcps.2011.09.002](https://doi.org/10.1016/j.jcps.2011.09.002).
- Bozeman, J. F., S. Springfield, and T. L. Theis. 2020. Meeting EAT-Lancet Food Consumption, Nutritional, and Environmental Health Standards: A U.S. Case Study across Racial and Ethnic Subgroups. *Environmental Justice* 13 (5):160–72. doi:[10.1089/env.2020.0018](https://doi.org/10.1089/env.2020.0018).
- Bräutigam, K. R., J. Jörissen, and C. Priefer. 2014. The extent of food waste generation across EU-27: Different calculation methods and the reliability of their results. *Waste Management & Research: The Journal of the International Solid Wastes and Public Cleansing Association, ISWA* 32 (8):683–94. doi: [10.1177/0734242X14545374](https://doi.org/10.1177/0734242X14545374).
- Brook, L. 2007. Food behaviour consumer research-findings from the quantitative survey. *Briefing Paper*. UK: WRAP. Project code: RWM005-001.
- Buckley, M., C. Cowan, and M. McCarthy. 2007. The convenience food market in Great Britain: Convenience food lifestyle (CFL) segments. *Appetite* 49 (3):600–17. doi: [10.1016/j.appet.2007.03.226](https://doi.org/10.1016/j.appet.2007.03.226).
- Buzby, J. C., and J. F. Guthrie. 2002. *Plate waste in school nutrition programs: Final report to Congress*. Economic Research Service, US Department of Agriculture. (usda.gov)
- Buzby, J. C., H. Farah-Wells, and J. Hyman. 2014. The estimated amount, value, and calories of postharvest food losses at the retail and consumer levels in the United States. *USDA-ERS Economic Information Bulletin*, 121. doi: [10.2139/ssrn.2501659](https://doi.org/10.2139/ssrn.2501659).
- Buzby, J. C., and J. Hyman. 2012. Total and per capita value of food loss in the United States. *Food Policy* 37 (5):561–70. doi: [10.1016/j.foodpol.2012.06.002](https://doi.org/10.1016/j.foodpol.2012.06.002).
- Calderira, C., C. Sara, and S. Serenella. 2017. *Food waste accounting. Methodologies, challenges and opportunities*. Luxembourg: Publications Office of the European Union 2017. Technical report ISBN978-92-79-77221-4 ISSN1831-9424. doi: [10.2760/957031](https://doi.org/10.2760/957031).
- Canali, M. O. 2014. *Drivers of current food waste generation, threats of future increase and opportunities for reduction*. In FUSIONS Reducing Food Waste Trough Social Innovation. Università di Bologna, Bologna N FP7-KBBE-2012-6-311972.
- Chalak, A., C. Abou-Daheer, J. Chaaban, and M. G. Abiad. 2016. The global economic and regulatory determinants of household food waste generation: A cross-country analysis. *Waste Management (New York, N.Y.)* 48:418–22. doi: [10.1016/j.wasman.2015.11.040](https://doi.org/10.1016/j.wasman.2015.11.040).
- Cox, J., and P. Downing. 2007. *Food behaviour consumer research: Quantitative phase*. Banbury UK: Waste & Resources Action Programme.
- Delley, M., and T. A. Brunner. 2017. Foodwaste within Swiss households: A segmentation of the population and suggestions for preventive measures. *Resources, Conservation and Recycling* 122:172–84. doi: [10.1016/j.resconrec.2017.02.008](https://doi.org/10.1016/j.resconrec.2017.02.008).
- DEFRA. 2008. *A Framework for Pro-Environmental Behaviours*. Department for Environment food and rural affairs, British Government, London, 76.
- Díaz-Ruiz, R., M. Costa-Font, G. Costa-Font, and M. José. 2015. Are households feeding habits and waste management practices determinant in order to swing over food waste behaviours? The case of Barcelona Metropolitan Area. In *International conference of Agricultural Economists* (pp. 1–28).
- Dou, Z., J. D. Ferguson, D. T. Galligan, A. M. Kelly, S. M. Finn, and R. Giegengack. 2016. Assessing US food wastage and opportunities for reduction. *Global Food Security* 8:19–26. doi: [10.1016/j.gfs.2016.02.001](https://doi.org/10.1016/j.gfs.2016.02.001).
- Dowler, E. A. 1977. A pilot survey of domestic food wastage. *Journal of Human Nutrition* 31 (3):17–180.
- Eberle, U., and J. Fels. 2016. Environmental impacts of German food consumption and food losses. *The International Journal of Life Cycle Assessment* 21 (5):759–72. doi: [10.1007/s11367-015-0983-7](https://doi.org/10.1007/s11367-015-0983-7).
- Eriksson, M. 2012. Retail food Wastage: A case study approach to quantities and causes. Licentiate Thesis. Faculty of Natural Resources and Agricultural Sciences. Department of energy and Technology. Uppsala. Disponível em: <https://core.ac.uk/download/pdf/11698347.pdf>.
- Eriksson, M. 2015. *Supermarket food waste* (Vol. 2015, No. 119).
- Eriksson, M., S. Lindgren, and C. P. Osowski. 2018. Mapping of food waste quantification methodologies in the food services of Swedish municipalities. *Resources, Conservation and Recycling* 137:191–9. doi: [10.1016/j.resconrec.2018.06.013](https://doi.org/10.1016/j.resconrec.2018.06.013).
- Eurobarometer, F. 2009. Europeans' attitudes towards the issue of sustainable consumption and production. *Flash Eurobarometer* 256: 1–18.
- European Commission. 2010. *Being wise with waste: The EU's approach to waste management*. Environment Directorate-General. Publication Office of the European Union.
- European Commission. 2015. EU actions against food waste Accessed February 18, 2020. https://ec.europa.eu/food/safety/food_waste/eu_actions_en
- EU. 2010. *Estudio Elaborado por y BIO Intelligence Service Preparatory study on food waste across EU27*. Madrid: Resolucion del Parlamento Europeo.
- Eurostat. 2015b.. Dépense de consommation des ménages par fonction deconsommationconsommation -. Eurostat. Accessed March 8, 2016. <http://ec.europa.eu/eurostat/web/products-datasets/-/tsdpc520>.
- Eurostat. 2015a. Household composition statistics. Accessed May 15, 2016. ec.europa.eu/eurostat/statistics-explained/index.php/Household_composition_.
- Eurostat2016. *Bussiness economy by sector-NACE rev.2*Retrieved August. ec.europa.eu/eurostat/stadistic-explained/index.phd/business_economy-By-sector.
- Evans, D. 2012. Beyond the throwaway society: Ordinary domestic practice and asociological approach to household food waste. *Sociology* 46 (1):41–56. doi: [10.1177/0038038511416150](https://doi.org/10.1177/0038038511416150).
- Evans, D., H. Campbell, and A. Murcott. 2012. A brief pre-history of food waste and the social sciences. *The Sociological Review* 60 (2_suppl):5–26. doi: [10.1111/1467-954X.12035](https://doi.org/10.1111/1467-954X.12035).
- FAO. 2011. Global food losses and food waste – Extent, causes and prevention. Accessed 25, 2020. <http://www.fao.org/docrep/014/mb060e/mb060e00.pdf>
- FAO. 2012. Save food: Global initiative on food losses and waste reduction. Accessed 25, 2020. <http://www.fao.org/save-food/en/>
- FAO. 2013. Food wastage footprint, impact on natural resources. Accessed 25, 2020. <http://www.fao.org/docrep/018/i3347e/i3347e.pdf>
- FAO. 2017. *Food loss and food waste*. Accessed 25, 2020. <http://www.fao.org/food-loss-and-food-waste/en>.
- FAOSTAT. 2016. Food and Agriculture Organization of the United Nations FAOSTAT Statistics Database.
- Farr-Wharton, G., M. Foth, and J. H. J. Choi. 2014. Identifying factors that promote consumer behaviours causing expired domestic food waste. *Journal of Consumer Behaviour* 13 (6):393–402. doi: [10.1002/cb.1488](https://doi.org/10.1002/cb.1488).
- Fonseca, J. R. 2013. A latent class model to discover household food waste patterns in Lisbon city in support of food security, public health and environmental protection. *International Journal on Food System Dynamics* 4 (3):184–97.
- FUSION. 2014. *FUSIONS Definitional framework for food waste*. Accessed February 26, 2020. eufusions.org/phocadownload/Publications/Food%20waste%20quantification%20manual%20to%20monitor%20food%20waste%20amounts%20and%20progression.pdf
- FUSION. 2016. Food waste quantification manual to monitor food waste amounts and progression. Accessed February 24, 2019. https://www2.deloitte.com/content/dam/Deloitte/fr/Documents/sustainability-services/fusions_food-waste-quantification-manual-to-monitor-food-waste-amounts-and-progression.pdf
- Gallo, A. 1980. Consumer food waste in the U.S. Consumer research. Fall: 13–6.

- Ganglbauer, E., G. Fitzpatrick, and R. Comber. 2013. Negotiating food waste: Using a practice lens to inform design. *ACM Transactions on Computer-Human Interaction* 20 (2):1–11:25. doi: [10.1145/2463579.2463582](https://doi.org/10.1145/2463579.2463582).
- Gascon, J. 2014. Alimentos desperdiciados. Un análisis del derroche alimentario desde la soberanía alimentaria. *Research Gate* 163.
- Graham-Rowe, E., D. C. Jessop, and P. Sparks. 2014. Identifying motivations and barriers to minimising household food waste. *Resources, Conservation and Recycling* 84:15–23. doi: [10.1016/j.resconrec.2013.12.005](https://doi.org/10.1016/j.resconrec.2013.12.005).
- Griffin, M., J. Sobal, and T. A. Lyson. 2009. An analysis of a community food waste stream. *Agriculture and Human Values* 26 (1–2): 67–81. doi: [10.1007/s10460-008-9178-1](https://doi.org/10.1007/s10460-008-9178-1).
- Grizzetti, B., U. Pretato, L. Lassaletta, G. Billen, and J. Garnier. 2013. The contribution of food waste to global and European nitrogen pollution. *Environmental Science & Policy* 33:186–95.
- Groot, R. S., J. Blignaut, S. Van der Ploeg, J. Aronson, T. Elmqvist, and J. Farley. 2013. Benefits of investing in ecosystem restoration. *Conservation Biology* 27 (6):1286–93.
- Gustavsson, J., C. Cederberg, U. Sonesson, R. Van Otterdijk, and A. Meybeck. 2011. Global food losses and food waste. Accessed 25, 2020. https://www.madr.ro/docs/ind-alimentara/risipa_alimentara/presentation_food_waste.pdf
- Gust, I. 2004. Strategies to promote sustainable consumer behaviour—The use of the lifestyle approach. Lund University International Masters Programme in Environmental Science (LUMES), Lund, Sweden.
- Hamilton, C., R. Denniss, and D. Baker. 2005. Wasteful Consumption in Australia. *The Australian Institute*. Accessed May 20, 2018. http://www.tai.org.au/documents/dp_fulltext/DP77.pdf.
- Hebrok, M., and C. Boks. 2017. Household food waste: Drivers and potential intervention points for design—An extensive review. *Journal of Cleaner Production* 151:380–92. doi: [10.1016/j.jclepro.2017.03.069](https://doi.org/10.1016/j.jclepro.2017.03.069).
- HLPE. 2014. Food losses and waste in the context of sustainable food systems. A report by the high level panel of experts on food security and nutrition of the committee on world food security. Rome: FAO.
- Kantar, W. 2015. Desperdicio de alimentos de los hogares en España: otoño - invierno, Primavera-verano. *Ministerio de Agricultura Alimentación y Medioambiente*.
- Kantor, L. S., K. Lipton, A. Manchester, and V. Oliveira. 1997. Estimating and addressing America's food losses. *Food Review/National Food Review* 20 :2–12.
- Katajajuuri, J. M., K. Silvennoinen, H. Hartikainen, L. Heikkilä, and A. Reinikainen. 2014. Food waste in the Finnish food chain. *Journal of Cleaner Production* 73:322–9. doi: [10.1016/j.jclepro.2013.12.057](https://doi.org/10.1016/j.jclepro.2013.12.057).
- Koivupuro, H. K., H. Hartikainen, K. Silvennoinen, J. M. Katajajuuri, N. Heikintalo, A. Reinikainen, and L. Jalkanen. 2012. Influence of socio-demographical, behavioural and attitudinal factors on the amount of avoidable food waste generated in Finnish households. *International Journal of Consumer Studies* 36 (2):183–91. doi: [10.1111/j.1470-6431.2011.01080.x](https://doi.org/10.1111/j.1470-6431.2011.01080.x).
- Kranert, M., G. Hafner, J. Barabosz, H. Schuller, D. Leverenz, and A. und Kölbig. 2012. Ermittlung der weggeworfenen Lebensmittelmengen und Vorschläge zur Verminderung der Wegwerfrate bei Lebensmitteln in Deutschland. Universität Stuttgart Institut für Siedlungswasserbau, Wassergüte- und Abfallwirtschaft, Stuttgart.
- Kummu, M., H. De Moel, M. Porkka, S. Siebert, O. Varis, and P. J. Ward. 2012. Lost food, wasted resources: Global food supply chain losses and their impacts on freshwater, cropland, and fertiliser use. *Science of the Total Environment* 438:477–89. doi: [10.1016/j.scitotenv.2012.08.092](https://doi.org/10.1016/j.scitotenv.2012.08.092).
- Liobikien, G., and R. Juknys. 2016. The role of values, environmental risk perception, awareness of consequences, and willingness to assume responsibility for environmentally-friendly behaviour: The Lithuanian case. *J. Clean. Prod* 112 (Part 4):3413–342.
- Macdiarmid, J., and J. Blundell. 1998. Assessing dietary intake: Who, what and why of under-reporting. *Nutrition Research Reviews* 11 (2):231–53. doi: [10.1079/NRR19980017](https://doi.org/10.1079/NRR19980017).
- Mallinson, L., J. Russell, and M. Barker. 2016. Attitudes and behaviour towards convenience food and food waste in the United Kingdom. *Appetite* 103:17–28. doi: [10.1016/j.appet.2016.03.017](https://doi.org/10.1016/j.appet.2016.03.017).
- Manzocco, L., M. Alongi, S. Sillani, and M. Nicoli. 2016. Technological and consumer strategies to tackle food wasting. *Food Engineering Reviews* 8 (4):457–67. doi: [10.1007/s12393-016-9149-z](https://doi.org/10.1007/s12393-016-9149-z).
- Mee, N., D. Clewes, P. Phillips, and A. Read. 2004. Effective implementation of a marketing communications strategy for kerbside recycling: A case study from Rushcliffe. *Resources, Conservation and Recycling*. 42 (1):1–26. UK. doi: [10.1016/j.resconrec.2003.12.003](https://doi.org/10.1016/j.resconrec.2003.12.003).
- Mena, C., B. Adenso-Díaz, and O. Yurt. 2011. The causes of food waste in the supplier–retailer interface: Evidences from the UK and Spain. *Resources, Conservation and Recycling* 55 (6):648–58. doi: [10.1016/j.resconrec.2010.09.006](https://doi.org/10.1016/j.resconrec.2010.09.006).
- Ministerio de Agricultura. 2013. *Estrategia: "Mas alimento, menos desperdicio"*. Madrid: Ministerio de agricultura, alimentación y medio ambiente. Accessed February 24, 2020. <https://www.mapa.gob.es/es/alimentacion/temas/estrategia-mas-alimento-menos-desperdicio/>
- Monier, V., S. Mudgal, V. Escalon, C. O'Connor, T. Gibon, G. Anderson, and G. Morton. 2010. Final report—Preparatory study on food waste across EU 27; European Commission [DG ENV—Directorate C]. Paris: BIO Intelligence Service, 1–205.
- Moser, A. 2016. Consumers' purchasing decisions regarding environmentally friendly products: An empirical analysis of German consumers. *Journal of Retailing and Consumer Services* 31:389–97. doi: [10.1016/j.jretconser.2016.05.006](https://doi.org/10.1016/j.jretconser.2016.05.006).
- Nixon, R. 2015. Food waste is becoming serious economic and environmental issue. *Report Says. New York Times*. Accessed February 3, 2016. <https://www.nytimes.com/2015/02/26/us/food-waste-is-becoming-serious-economic-and-environmental-issue-report-says.html>
- Noleppa, S. 2014. Klimawandel auf dem Teller. WWF Deutschland, Berlin, 2. unveränderte Auflage. Accessed February 3, 2015. http://www.wwf.de/fileadmin/fm-wwf/Publikationen-PDF/Klimawandel_auf_dem_Teller.pdf
- Olfield, T., E. White, and N. Holden. 2016. An environmental analysis of options for utilizing wasted food and food residue. *Journal of Environmental Management* 183:826–35.
- Ostrom, E. 1998. The institutional analysis and development approach. In *Designing Institutions for environmental and resources management*, eds. E.T. Loehman and D. M.. UK: Edward Elgar, Cheltenham,.
- Parfitt, J., M. Barthel, and S. Macnaughton. 2010. Food waste within food supply chains: Quantification and potential for change to 2050. *Philosophical Transactions of the Royal Society B: Biological Sciences* 365 (1554):3065–81. doi: [10.1098/rstb.2010.0126](https://doi.org/10.1098/rstb.2010.0126).
- Parizeau, K., M. von Massow, and R. Martin. 2015. Household-level dynamics of food waste production and related beliefs, attitudes, and behaviours in Guelph, Ontario. *Waste Manag* 35:017.
- European Parliament. 2012. Directiva 2012/27/UE, del Parlamento Europeo y del Consejo, de 19 de Enero de 2012, relativa a la cómo evitar el desperdicio de alimentos. *Diario Oficial de la Unión Europea*. Accessed February 3, 2019. de <http://www.europarl.europa.eu/sides/getDoc.do?pubRef=-//EP//TEXT+TA+P7-TA-2012-0014+0+DOC+XML+V0/ES>
- Ponis, S. T., P. A. Papanikolaou, P. Katimertzoglou, A. C. Ntalla, and K. I. Xenos. 2017. Household food waste in Greece: A questionnaire survey. *Journal of Cleaner Production* 149:1268–77. doi: [10.1016/j.jclepro.2017.02.165](https://doi.org/10.1016/j.jclepro.2017.02.165).
- Porpino, G., J. Parente, and B. Wansink. 2015. Food waste paradox: Antecedents of food disposal in low income households. *International Journal of Consumer Studies* 39 (6):619–29. doi: [10.1111/ijcs.12207](https://doi.org/10.1111/ijcs.12207).
- Priefer, C., J. Jörissen, and K. R. Bräutigam. 2016. Food waste prevention in Europe—A cause-driven approach to identify the most

- relevant leverage points for action. *Resources, Conservation and Recycling* 109:155–65. doi: [10.1016/j.resconrec.2016.03.004](https://doi.org/10.1016/j.resconrec.2016.03.004).
- Principato, L. S. 2015. Reducing food waste: An investigation on the behaviour of Italian youths. *British Food Journal* 117 (2).
- Quested, T. E., E. Marsh, D. Stunell, and A. D. Parry. 2013. Spaghetti soup: The complex world of food waste behaviours. *Resources, Conservation and Recycling* 79:43–51. doi: [10.1016/j.resconrec.2013.04.011](https://doi.org/10.1016/j.resconrec.2013.04.011).
- Quested, T. E., A. D. Parry, S. Easteal, and R. Swannell. 2011. Food and drink waste from households in the UK. *Nutrition Bulletin* 36 (4):460–7. doi: [10.1111/j.1467-3010.2011.01924.x](https://doi.org/10.1111/j.1467-3010.2011.01924.x).
- Roodhuyzen, D. M. A., P. A. Luning, V. Fogliano, and L. P. A. Steenbekkers. 2017. Putting together the puzzle of consumer food waste. Towards an integral perspective. *Trends in Food Science & Technology* 68:37–50. doi: [10.1016/j.tifs.2017.07.009](https://doi.org/10.1016/j.tifs.2017.07.009).
- Schanes, K., K. Dobernig, and B. Gozet. 2018. Food waste matters-A systematic review of household food waste practices and their policy implications. *Journal of Cleaner Production* 182:978–91. doi: [10.1016/j.jclepro.2018.02.030](https://doi.org/10.1016/j.jclepro.2018.02.030).
- Secondi, L., L. Principato, and T. Laureti. 2015. Household food waste behaviour in EU-27 countries: A multilevel analysis. *Food Policy* 56: 25–40. doi: [10.1016/j.foodpol.2015.07.007](https://doi.org/10.1016/j.foodpol.2015.07.007).
- Soon, J. M., and L. Manning. 2019. Developing anti-counterfeiting measures: The role of smart packaging. *Food Research International (Ottawa, Ont.)* 123:135–43. doi: [10.1016/j.foodres.2019.04.049](https://doi.org/10.1016/j.foodres.2019.04.049). PMC: 31284961
- Setti, M., F. Banchelli, L. Falasconi, A. Segrè, and M. Vittuari. 2018. Consumers' food cycle and household waste. When behaviors matter. *Journal of Cleaner Production* 185: 694–706. doi: [10.1016/j.jclepro.2018.03.024](https://doi.org/10.1016/j.jclepro.2018.03.024).
- Stefan, V., E. van Herpen, A. A. Tudoran, and L. Lähdenmäki. 2013. Avoiding food waste by Romanian consumers: The importance of planning and shopping routines. *Food Quality and Preference* 28 (1): 375–81. doi: [10.1016/j.foodqual.2012.11.001](https://doi.org/10.1016/j.foodqual.2012.11.001).
- Stenmarck, Å., C. Jensen, T. Quested, and G. Moates. 2016. *Estimates of European food waste*. FUSIONS: Reducing Food Waste Through Social Innovation. ISBN 978-91-88319-01-2- Estimates of European food waste levels final report_ 210316 (eu-fusions.org)
- Stern, P. C. 2000. New environmental theories: Toward a coherent theory of environmentally significant behavior. *Journal of Social Issues* 56 (3):407–24. doi: [10.1111/0022-4537.00175](https://doi.org/10.1111/0022-4537.00175).
- Swami, V., T. Chamorro-Premuzic, R. Snelgar, and A. Furnham. 2011. Personality, individual differences, and demographic antecedents of self-reported household waste management behaviours. *Journal of Environmental Psychology* 31 (1):21–6. doi: [10.1016/j.jenvp.2010.08.001](https://doi.org/10.1016/j.jenvp.2010.08.001).
- Tukker, A., and B. Jansen. 2006. Environmental impacts of products: A detailed review of studies. *Journal of Industrial Ecology* 10 (3): 159–82. doi: [10.1162/jiec.2006.10.3.159](https://doi.org/10.1162/jiec.2006.10.3.159).
- Vanham, D., F. Bouraoui, A. Leip, B. Grizzetti, and G. Bidoglio. 2015. Lost water and nitrogen resources due to EU consumer food waste. *Environmental Research Letters* 10 (8):084008. doi: [10.1088/1748-9326/10/8/084008](https://doi.org/10.1088/1748-9326/10/8/084008).
- Visschers, V. H. M., N. Wickli, and M. Siegrist. 2016. Sorting out food waste behaviour. A survey on the motivators and barriers of self-reported amount of food waste in households. *Journal of Environmental Psychology* 45 :66–78. doi: [10.1016/j.jenvp.2015.11.007](https://doi.org/10.1016/j.jenvp.2015.11.007).
- Wansink, B., S. A. Brasel, and S. Amjad. 2000. The mystery of the cabinet castaway: Why we buy products we never use. *Journal of Family and Consumer Sciences* 92 (1):104–8.
- Watson, M., and A. Meah. 2012. Food, waste and safety: Negotiating conflicting social anxieties into the practices of domestic provisioning. *The Sociological Review* 60 (2_suppl):102–20. doi: [10.1111/1467-954X.12040](https://doi.org/10.1111/1467-954X.12040).
- Wenlock, R. W., D. H. Buss, B. J. Derry, and E. J. Dixon. 1980. Household food wastage in Britain. *The British Journal of Nutrition* 43 (1):53–70. doi: [10.1079/bjn19800064](https://doi.org/10.1079/bjn19800064).
- Williams, H., F. Wikström, T. Otterbring, M. Löfgren, and A. Gustafsson. 2012. Reasons for household food waste with special attention to packaging. *Journal of Cleaner Production* 24:141–8. doi: [10.1016/j.jclepro.2011.11.044](https://doi.org/10.1016/j.jclepro.2011.11.044).
- Williams, H., and F. Wikström. 2011. Environmental impact of packaging and food losses in a life cycle perspective: A comparative analysis of five food items. *Journal of Cleaner Production* 19 (1):43–8. doi: [10.1016/j.jclepro.2010.08.008](https://doi.org/10.1016/j.jclepro.2010.08.008).
- Wrap. 2015. *Estimate of food and packing waste in the UK grocery retail and Hospitality supply chain*. Banbury, UK: WRAP.
- Wrap. 2011. *Reducing household bakery waste*. Obtenido de WRAP: Banbury. Accessed 25, 2020. http://www.wrap.org.uk/retail_supply-chain/research_tools/research/report_reducing.htm
- Wrap, W. 2009. *Household food and drink waste in the UK*. Accessed 25, 2020. http://www.wrap.org.uk/sites/files/wrap/Household_food_and_drink_waste_
- Wrap, W. 2006. *We don't waste food! A house holder survey. retails programme food waste, final report*. <http://www.wrap.org.uk/sites/files/wrap/wedontwastefood.Ahouseholdsurvey.mar07.db6802f9.6397.pdf>.
- Young, W., S. V. Russell, C. A. Robinson, and R. Barkemeyer. 2017. Can social media be a tool for reducing consumers' food waste? A behaviour change experiment by a UK retailer. *Resources, Conservation and Recycling* 117:195–203. doi: [10.1016/j.resconrec.2016.10.016](https://doi.org/10.1016/j.resconrec.2016.10.016).