



Article

Towards a More Sustainable Food Supply Chain: Opening up Invisible Waste in Food Service

Belén Derqui ^{1,*}, Teresa Fayos ² and Vicenc Fernandez ³

¹ Department of Business Administration, Universitat de Barcelona, Barcelona 08034, Spain

² Department of Marketing and Market Research, Universidad de Valencia, Valencia 46022, Spain; teresa.fayos@uv.es

³ Department of Management, Universitat Politècnica de Catalunya, Barcelona 08028, Spain; vicenc.fernandez@upc.edu

* Correspondence: belenderqui@ub.edu; Tel.: +34-600-230-090

Academic Editor: Giuseppe Ioppolo

Received: 2 May 2016; Accepted: 29 June 2016; Published: 20 July 2016

Abstract: Future challenges to the global food supply chain are complex. In order to embrace sustainability, companies should change their management practices towards more efficient resource use. Food waste being a misuse of resources, we identify its causes and possible ways of minimising it. To achieve this goal, we conducted explorative research with qualitative and quantitative data through in-depth semi-structured interviews and an open questionnaire with top Spanish food service companies. Results show that most businesses mainly tend to minimise food waste according to economic criteria, without taking into account the social, ethical or environmental factors. As a consequence, just “visible” food waste that has an economic impact on the results is minimised. Nevertheless, visibility of real waste is often low. At the same time, awareness of (and therefore initiatives to reduce) food waste that does not directly affect a firm’s profit can be increased through multi-stakeholder collaboration. Opportunities for reducing food waste therefore arise from increasing the visibility of food that is discarded as well as addressing plate waste. We identify best practices that could lead to a reduction of the amount of food waste generated in the out of home channel in Spain.

Keywords: sustainability; food waste; sustainable development; food supply chain; food service; food surplus

1. Introduction

Sustainable development has been defined by the World Commission on Environment and Development as “meeting the needs of the present without compromising the ability of future generations to meet their own needs” [1]. Under this context, the food system is closely related to sustainability as production must be augmented to meet the needs of a future increased and more affluent population demand [2] resulting in increased competition for more and more scarce resources. According to FAO (Food and Agriculture Organisation) Food Wastage Footprint study (cited in [3]), we waste roughly one-third of the food produced for human consumption, which amounts to over 1.3 billion tons a year globally. A sustainable food system should be based on resource use efficiency [4] in order to minimise its impact on the environment [5,6] and of course, waste has a crucial role to play here. Reducing food waste can represent part of the solution to food security and environmental challenges, namely the need to feed more people while making the food value chain more environmentally sustainable and resilient [7].

Food waste has increased over the last few years and if nothing is done will continue increasing in the near future [8]. For this reason, as observed by Warshawsky [9], it has emerged as a critical issue attributable to unsustainable production and consumption. Both institutions and scholars (e.g., [2,10]) agree that food produced for human consumption but finally discarded means an overspending of natural resources. Having in mind the need to guarantee food security globally, and food demand being a major driver for the global environmental footprint [11], increasing the efficiency of the whole food chain becomes a high priority for sustainable development [12]. According to FAO, the environmental cost of food waste is huge. It comprises natural resources such as land, water and energy used across the food chain, the impact of food waste disposal as well as the impact of GHG emissions on the atmosphere [13]. The loss of land, water and biodiversity, as well as the negative impacts of climate change, represent huge costs to society that are yet to be quantified. FAO estimates direct economic cost of food wastage of agricultural products, based on producer prices only, in about USD 750 billion, an impressive figure, equivalent to the GDP of Switzerland [14].

Under this context, the objective of our research is to identify food waste causes and describe best practices to reduce it in Spain, through an explorative study in which managers of 12 corporations and two institutions were interviewed. Moreover, we have developed a questionnaire to quantify food waste that was then filled in by 20 corporations. With regard to our scope, we focus the research on food waste management from a broad perspective in the food service sector, which, as described by the European Commission, comprises the “preparation of ready-to-eat food for sale to individuals and communities including catering and restoration activities in the hospitality industry, schools, hospitals and businesses” [15].

1.1. The Concept of Food Waste

There is no consensus among scholars on the definition of food waste [16], making it difficult to compare the findings of studies on the management of surplus food between different countries [17]. Numerous terms are often used as synonymous, such as food waste, food loss, bio-waste [18] and kitchen waste while at the same time the same word is often used with different meanings [19]. One of the most widely accepted definitions of food waste was given by the FAO as edible products aimed for human consumption but which by chance leave the human food chain, being discarded, lost, degraded or consumed by pests instead [2].

Parfitt [20] discriminates three food waste definitions from this former one. He recalls Stuart [21], adding to this former definition of food waste all edible material intentionally used to feed animals or used as a by-product of food processing diverted away from human food [21]. This approach distinguishes “planned” non-food uses from “unplanned” non-food uses [2].

Recently, the European Union’s project FUSIONS [22] defined food waste as “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 into the sea)”.

Table 1 shows different conceptualisations and terms found in the literature relative to food waste in addition to the above-mentioned.

From the review of the different concepts and definitions, we consider that the 1981 FAO definition still seems current as most researchers reference it; however, the definition of Food Waste has evolved and matured at the same time, while new related terms have appeared, although authors have not reached a consensus. Buzby and Hyman [8] point out that there is a trend to use wider definitions of food waste.

Table 1. Concepts related or included in Food Waste (FW).

Reference	Concept	Definition
[23]	Food loss	Food losses usually refer to edible food, lost at any stage of the supply chain, such as meats, bread, discarded or unserved restaurant-prepared food, or products that are unmarketable for aesthetic reasons, but otherwise edible and safe.
[24]	Food loss	Food loss refers to the decrease in food quantity or quality, which makes it unfit for human consumption.
[20]	Food loss vs. FW	Food losses: Waste produced at the beginning of the FSC: production, postharvest and processing stages.
		FW: When appearing at the end, retail and final consumption.
		Post-Consumer Waste: FW produced at households.
[25]	FW	FW: Any edible food that is lost during any phase of the food system.
[26]	FW	FW occurs when edible items go unconsumed as a result of human action or inaction, often result of a decision made by business, governments or consumers.
[27]	Avoidable vs. Unavoidable	Avoidable FW: Foods or parts considered edible by the vast majority of people) and Unavoidable FW: Waste arising from food that is not edible under normal circumstances, fruit skin, apple cores and meat bones. He recalls this classification is subjective in a way as depends on factors such as culture, religion, etc.
[17]	Food surplus vs. FW	Surplus Food: The edible food that is produced, manufactured, retailed or served but for various reasons is not sold to or consumed by the intended customer.
		FW: The surplus food that is not recovered to feed people, to feed animals, to produce new products (e.g., jams or juices), new materials (e.g., fertilizers) or energy.
[17]	FW perspectives	FW from a social perspective: surplus food that is not used for feeding people. FW from a zootechnical perspective: surplus food that is not used for feeding humans or animals. FW from an environmental perspective: surplus food that is not re-used or recovered in any form and is disposed of.
[28]	FW	All the products discarded from the food chain while still preserving their nutritional value and complying with safety standards.
[29]	FW unavoidable vs. avoidable	Unavoidable FW: Food that was never intended for human consumption.
		Avoidable FW: Food that can no longer be consumed because of quality requirements, shelf life issues, hygiene rules or consumption habits.
[30]	FW	The final destination of all food, and inedible parts of food, removed from the food supply chain.

1.2. Food Waste as a Global Issue

Mena et al. [5] highlight that food waste is a global issue not only for ethical reasons, because reducing food waste would help feed the hungry [21]; but also for the environmental consequences of inefficient use of natural resources [21,31,32], and the production of methane and pollution [21,33,34]; and for its economic impact throughout the supply chain [35]. Food waste arises as a problem that must be tackled appropriately in order to guarantee sustainable growth on our planet.

Slightly over 50% of global Food loss and waste is generated in developed countries where we waste more at the consumption and distribution stages rather than at the first steps of the food supply chain [3]. In the European Union (EU), 89 million tons of food are wasted annually, and this figure is projected to increase to 120 million by 2020; Spain was, with 7.7 million tons, the sixth highest country in the EU for waste, with fish, fruit and cereals being the categories with a stronger level of waste [15]. Recently, Canali et al. [30] estimate that the EU-28 countries annually produce about 100 M tons of food waste.

Several researchers have estimated the food service industry as being responsible for between 10% and 20% of the total food wastages in the EU countries, claiming that over two-thirds of this amount are avoidable [36,37]. Hafner et al. [38] attribute the food service industry as the second highest source of food wastage after households along the value-added chain in Germany [38]. Engström and Carlsson-Kanyama [37] went further measuring food waste at the different stages of the food service process, certifying that 4% to 10% of the amount delivered was wasted on handling of the food,

storage, preparation and serving, and more relevantly plate waste accounted for 11% to 13% of the amount delivered.

Different categorisations make quantifying food waste difficult [8], and on top of that, comparing research results is difficult as we verify in the literature that each researcher uses his own classifications and measurement processes. For instance, FAO figures have been considered unreliable [39,40] although Lipinski et al. [3] think they are the most comprehensive global numbers available. Canali and co-worker's [30] quantification on food waste is estimated with data only obtained for up to a quarter of the EU-28 members (where data from Spain appear as "non-available").

This said, researches measuring food waste in the Food Service industry show striking data such as a range between 19% and 66% food waste in Welsh hospitals under study [41]. Nevertheless, scholars agree on the necessity to perform more solid quantification and in more countries (e.g., [29,37]).

1.3. Food Waste Drivers

Comprehending food waste drivers in an integrated perspective through the food supply chain is essential to find solutions and consequently prioritise initiatives for action [17,30,42]. Canali et al. [30] suggest a classification based on seven groups, from production to food service and household. At this point, researchers agree that food waste is produced by diverse causes [30] and at different stages of the process [25]. In fact, every process in the food supply chain—production, transport, storage, and cooking—is embraced in the waste produced [41].

Accurately predicting demand is highlighted as a significant factor that may contribute to food waste generation while rigid food procurement specifications is also mentioned as a cause of food waste such as when products—notably fruit and vegetables—do not meet standards, meaning they cannot be put to their intended use [10]. In fact, Göbel et al. [10] reveal different main reasons for waste depending on the food category: Quality standards for vegetables, freshness for bread and bakery, production process for milk and dairy and health and cost pressure for meat products. He finally summarises seven central potential causes for food waste, namely: Quality standards, Legal requirements, Market conventions, Human errors, Technical issues, Logistic issues and Cultural influences. They strongly emphasise the inter-dependency between the different stages stating that demands on products at a specific stage can create waste at stages that differ from the ones in which waste is created [10].

At the final stages of the food supply chain, the lack of concepts for subsequent use and insufficiently utilised ways of disposal are also linked to the generation of food waste [10]. Nevertheless, Bernstad and Canovas consider that waste varies significantly depending on the type of food served [43,44]. Thus, vegetables/fruit, bread, cheese and other dairy products, fish and meat should be differentiated when studying drivers for food waste. Natural product characteristics such as shelf life, demand fluctuation, and storage requirements have a significant influence on the level of waste [5].

In the food service sector side dishes and accompaniments are significantly often left by diners in restaurants; for this reason, vegetables and starch are top food waste categories [29] seemingly because they are low-cost items [45]. Furthermore, Wansink [46] did research on the influence of dinnerware size on self-serving food waste concluding that diners with large plates wasted a lot more food than those with smaller plates. Related to the influence of dinnerware on food waste, Kim and Morawski [47] suggested that the removal of trays in universities resulted in reduced food waste. Excess quantity was found by Collison and Colwill [48] to be more relevant than poor quality as a cause of food waste when dining in restaurants, and that women and younger customers were more likely to leave food uneaten. Women are more likely to produce plate waste than men [29] and portion size is also significant, because when women serve themselves, food waste is significantly lower than when the quantity served is determined by staff.

In order to shed light on the complexity of food waste drivers, the FAO in its High Level Panel of Experts (HLPE) report [42] classifies causes of food waste into three groups: (1) Causes which result from actions—or inactions—of individual actors at a specific stage of the food supply chain; (2) causes which can result from the way different actors in the food supply chain are organised together or relationships along the food supply chain, i.e., lack of communication, coordination and organisation between food chain actors; and (3) causes which respond to more root causes, those that favour the emergence of all the other causes, such as the absence of an enabling environment to support coordination between actors.

Nonetheless, the lack of awareness on food waste is one of the reasons for the slow progress in reducing food waste, few people understand the scope of the problem [49].

To conclude, we find the analysis proposed by FUSIONS [30] interesting, where among the causes of food waste in the Food Service channel, our research object, they mention five which are related to technology, storage, equipment and containers and lack of good practice, opposed to business related drivers such as the difficulty to estimate and calculate the right amount of food to cook, consumer expectations, prediction and demand forecasting, inflexibility in portioning, food being prepared but not served, food being served but not eaten, contracts imposing caterers to provide a wide assortment, prioritise turnover and consumer satisfaction, and variety in choices offered [30].

1.4. Tackling the Food Waste Issue

Finn [49] argues that an urgent switch is needed to reduce food waste globally on the grounds that we cannot afford to waste 30% to 50% of our food nor can we afford the environmental consequences of it. He supports that institutions, corporations and consumers must unite efforts on behalf of their responsibility to feed nine billion people by 2050. Furthermore, Seuring states that research should not merely observe and explain the empirical phenomena but aim to help change the status quo [50].

Waste at the distribution and consumption stages is relevant because food has been through all the previous value chain stages, accumulating costs and use of resources. Nevertheless, it is a very difficult issue to address for managers, as its costs remain “hidden” [5] most of the time and they are often undervalued and underreported [51]. With the objective of uncovering this hidden cost, researchers like Lipinski [3] highly recommend the development of a food loss and waste measurement protocol, linked to setting reduction targets and the support of collaborative initiatives to reduce food waste. Other best practices for the Food Service sector suggested by researchers include increasing awareness of the importance of reducing food waste among food service customers together with temperature control issues and speed in reception of deliveries together with a First in First Out method (FIFO) storage system [37]. Furthermore, Betz [29] underlines the optimisation of storage management, stock minimising, training of employees, fast cooling down of food to avoid microorganism growth, adaption of portion sizes to customer needs, attractive presentation of meals, use of small serving bowls at the buffet, as well as sensitisation of customers regarding food waste and the use of feedback sheets among the recommended initiatives to reduce food waste [29]. Moreover, Falasconi et al. [28] mention the importance of increasing flexibility in portions of different food types, menu planning and information campaigns aiming to increase dietary habits among students in order to reduce food waste in school catering. Finally, we must not forget the role of technology improvement and innovation in long-term approaches to reduce food waste [22,36].

Thyberg and Tonjes [18] group food waste prevention under three key areas: Values: providing people with knowledge on food waste so that they want to change their behaviour; Skills: increasing abilities to be able to reduce it (e.g., through training); and Logistics: including better forecasting practices or improved packaging storage facilities and donations. They suggest that holistic approaches across the food system are ideal solutions [18].

Due to the fact that food waste is produced at all stages of the food supply chain solutions to the reduction should include multi-stakeholder collaboration [52], taking into account that initiatives for reducing food waste in one stage could negatively affect another stage [37]. Such complexity in the relations among different stages of the food supply chain puts forward the need to mobilise all actors around a shared vision for sustainable development [41] and the relevance of innovation through cross-sectorial approaches [4]. Nevertheless, as Pirani and Arafat [44] state, setting up a collaboration culture among supply chain members and even between food service staff and the guests could lead to food waste reduction. Also interesting is Garrone and co-worker's [53] reflection on the fact that companies should work on their processes to reduce food waste while legislators, companies, and food banks should collaborate to find innovative solutions to tackle food waste [53].

Göbel et al. [10] recommend an optimisation of value-added chains, focused on waste avoidance. They also defend the need to develop a new appreciation for food among people who act along the whole food supply chain through informing and educating actors and consumers on the topic of food waste. In this sense, Strasser [54] interestingly underlines that this is of special relevance in the food service sector as we tend to undervalue food that is not prepared by ourselves or by our loved ones.

Finally, legislation is also relevant on inducing corporate responsiveness and could lead to reducing food waste. On the other hand, stakeholders can also encourage corporations to consider sustainability impacts in decision making. Economic opportunities also drive sustainability initiatives in firms [55].

1.5. Spanish Research on Food Waste

Food waste research results are often based on rough estimates and are likely to have a high degree of error [5]. If we take the current publications about food waste, scholars mention multiple gaps in food waste research and suggest that more research should be conducted on the amount of food wasted at each level of the food supply chain [52], and on its social and environmental implications [41]. On top of that, Tielens [56] mentions the need for research on the impact of food waste reduction on food prices and he sees the need for research to improve the effectiveness of value chains or food systems including food waste analysis as a part of it. Finally, there are also several gaps on distribution management [45], and food service institutions, as research showed that levels of food waste were significant, recommending further research to better quantify losses, devise prevention and identify policy implications [37].

On the contrary, as there are different attitudes and insights with respect to food waste in different countries [5] as well as socio-cultural differences [27], wastage patterns differ from region to region and country to country, further research is needed to analyse food waste in different geographical areas [18].

For Spain, the object of this research, data on food waste in the Food Service sector are lacking. Although Spanish Administration is promoting the campaign: "More food, less waste" to which our research belongs, aiming to engage society and all food supply chain stakeholders [57] very few researches have been found based in Spain in the literature review (e.g., SCOPUS, PROQUEST, DIALNET, and Google Scholar), and most of them are related to recycling or with students eating habits [58]. Two studies about food waste in Spain are interesting though: qualitative research by Mena et al. [5], and González Vaqué [57] who analyse different initiatives performed in Spain to reduce waste highlighting the lack of legal initiatives. Mena and co-worker's [5] results, although focused only on supplier-retailer interface show that food waste drivers in Spain are, among others, the short shelf life of bread, the wide range of products in stock, defective products, products damaged during logistics, as well as poor temperature control. In his study, he suggests better practices and finally recommends further research on the topic, widening the scope and range of products under research.

In order to contribute towards filling this gap, we have planned research in the Food Service channel in Spain. The aim of this study is to shed light on the opportunities for food service businesses to reduce the amount of food wasted in the food supply chain. According to the previous review and

development, a main research question shows up: Which business practices could lead to reducing food waste in the food service channel in Spain? In order to answer this research question, we defined the following objectives:

- O1: To identify what is considered as food waste by Spanish Food Service companies.
- O2: To explore how to quantify food waste in Spain.
- O3: To classify and prioritise top Spanish food waste categories.
- O4: To explain the causes which lead to food waste throughout the Spanish Food Supply Chain.
- O5: To explore Spanish management initiatives that can lead to food waste reduction.
- O6: To assess multi-stakeholder collaboration as a necessary condition to reduce food waste.

2. Materials and Methods

The study of the business practices that can lead to reducing food waste in the food service channel in Spain includes a set of complex social phenomena. To analyse this complexity, we designed a research with an explorative/inductive approach through primarily qualitative data [59]. The research had two parts: the first one includes the most researched objectives of the study, while the aim of the second part was to quantify how much is wasted by product category and where it occurs in the process.

The method of data collection of the first part of the study was semi-structured individual interviews from different companies. The sample selection followed a strategy of quotas according to the type of the company (non-commercial food service, commercial food service, not for profit international organisations, and others such as bakery industries). Due to the nature of the research, all companies should have satisfied the following criteria: Revenue in Spain of at least €10 million in the last year and a significant market share in the areas where they compete. To identify these companies, we explored their web sites and existing reports. Moreover, this research helped us to obtain a great amount of information about their activities, the services they provide, and the profile of the companies they serve. The final sample consists of 14 companies (see more detail in the table in the Appendixes). More specifically, the final sample is made up of nine food service companies, market leaders in their sector. We also selected two food production corporations, both in the bakery sector, and a fresh food wholesaler that distributes mainly fruits, vegetables, meat and fish to the food service channel. Additionally, two institutions were included, due to their relevance in the topic: a not for profit organisation was included because they are informed through privileged access to many suppliers and retailers at the same time and they assess their associate companies on food waste; finally, a food bank was included as their mission is closely related to food waste reduction.

The interviewees were representatives of the companies from management level. In addition to the interviews, in most companies, the statements were supported by company tours and informal interviews with employees. Due to the complexity of an analysis of this kind of process, we developed a protocol as a conceptual and practical guide on data collection during interviews. The protocol is based primarily on the works of Canali et al. [30] about the reasons of food waste and their classification based on seven groups; on the FAO [42] with classification into three groups of causes of food waste; on Göbel et al. [10] regarding the classification of food and its causes; on Gustavsson and Stage [25] with different stages where food waste appears in the process; and, finally, on Thyberg [18] regarding the prevention of food waste according to three key areas (values, skills and logistics). The protocol proposes a semi-structured interview design with open questions and unlimited time in order to capture possible unexpected results and redirect the interview according to the responses of the interviewee. The interviews lasted an average of 60 min and all of them were conducted in places suggested by the interviewees to maintain their comfort and privacy. In addition, the interviews were recorded using an audio recorder. The protocol also suggests the annotation of interviewees' reactions (e.g., behaviours or non-verbal communication) when they are responding to questions. The transcript of the interviews was conducted by means of the Transcriber software following a process of double review.

The next step was the codification of the interviews through the methodological proposals of Bogdan and Biklen [60] with the qualitative data analysis software called MaxQDA. The first step of interview coding was to identify the blocks or paragraphs where the interviewees spoke about one of the elements suggested by Bogdan and Biklen [60], such as Setting, Definition, Process, and Method. This first coding allowed defining the starting point from which we analysed the structure of each interview. The second step of coding consisted in assigning to paragraphs (or a part of them) a list of preconceived codes from the theoretical framework of the research. The initial list of codes contained 11 codes (Terminology, Demand and Planning, Procurement, Menu planning, Storage, Cooking, Service, Measuring and Control, Awareness, Collaboration and Type of Food). The third and final step consisted in coding the paragraphs with a more inductive approach (encoding *in vivo*), recoding some of the interviews as new codes emerged. The final code book contains a total of 56 codes that classify data into the following blocks: Concepts (e.g., food waste), Stage of the process (e.g., cooking), Type of food (e.g., bakery), Management (e.g., sales forecast), Food Waste Drivers (e.g., shelf life), Collaboration (e.g., Food Banks), and Control and Measurement (e.g., Quantification).

After the encoding process in the 14 interviews transcribed, we analysed each interview and later we analysed them all in block following the suggestions of Miles and Huberman [61] and Jurgenson [62] with the goal of obtaining a specific vision of each case and a final conclusion for all cases. The first step of this part of the analysis was to build a checklist matrix to coherently organise several components for every case. These matrices showed the different sources of data (interviews) in rows and the topics or codes (both the codes from the second and the third step of the coding process) in columns. The matrices allowed us to display the interviews of the codified elements and their reliability and importance according to the number of sources that corroborated them. Moreover, we identified some gaps in the interviews, as well as some inconsistencies. With the goal to achieve a complete view of each case, we decided to interview more managers of some cases. More specifically, we needed more individual interviews with two other managers in case C1 (see more detail in Table A1 of the Appendix) and one more manager in case C8. This extra information allowed us to conduct triangulation according to source which is useful for improving the validity and credibility of information [63].

From each case, we generated a Time-Ordered Matrix that showed the several processes throughout the study period. Based on the matrices, we re-analysed the strategies and initiatives of food waste that we had previously identified in Spanish companies. As a result of the former analysis, the causes and the strategies in each part of the supply chain are identified (see results for more information). After the analysis of each case, we carried out a Cross-Case Analysis in order to enhance generalisability and to deepen understanding and explanation of the food waste in Spain. Following a code-oriented strategy, we developed a Case-Ordered Effects Matrix (based on [61]), which placed the strategies in each stage of the supply chain we had identified before in rows and the consequences and the rest of the coded data related to these processes (participants, settings, relationships, etc.) in columns. Clustering the strategies and initiatives according to similar or equivalent consequences, we analysed the rest of the data from these processes (e.g., types of companies, types of food, and quantification) in order to identify shared elements. To achieve this goal, the analysis was performed by means of successive attempts of trial and error from the data gathered.

As we have mentioned, the research consisted of two parts. From the results of the first part, we tried to quantify food waste by product category in Spanish companies. The method of data collection of the second part of the study was the survey from different companies. The sample selection followed a strategy similar to that in the first part of the study. The final sample includes 20 firms (10 from the first part of the study and 10 additional firms to which we had posterior access). We elaborated a questionnaire with semi-open questions in order to gather terminology and definitions used and closed questions aiming to quantify how much is wasted by product category and where in the process wastage occurs. The questionnaire was divided into four parts, related to the above-mentioned codes. Part 1 was about terminology and classifications; Part 2 about food waste quantification; Part 3

about food waste causes; and Part 4 about current initiatives implemented to reduce food waste. The quantitative results obtained allowed us to get an estimation of the amount of food wasted as the questionnaire included a table to be filled in by the companies with kilos wasted as well as per cent of overall kilos consumed according to food category and production stage. These questionnaires allowed us to additionally interpret and complete qualitative results formerly obtained.

3. Results and Discussion

3.1. Definition and Typologies of Food Waste

The results of our research confirm that there is neither a clear nor homogeneous definition of food waste across the organisations interviewed:

C8.1: "There is great confusion nowadays about the terminology related to food waste."

M1: "Food waste is simply food that cannot be commercialised anymore."

In fact, a great number of terms were used to address food waste, many of which even had different meanings in different organisations or even among different persons in the same organisation. We listed up to 20 different terms; some of which could be translated as waste, wastage, loss, leftovers, residue, rubbish, organic products, rubbish, production loss, shrinkage, stale food, leftovers, breakages, spoiled food, etc. Therefore, the lack of common terminology when speaking about food waste across the sector is an important research limitation.

We concluded from our exploratory research that food waste definitions can be classified in three different ways (summarised in Table 2): (a) Attending to when and where waste is generated; (b) attending to its grade of avoidance; and (c) from a business perspective and relative to who produces the waste and on how relevant it is perceived to be by business managers. This latter definition is not found in the literature and noted by C1.

1. Firstly, we can classify food waste attending to when and where it is produced, akin to Engstrom [38] and Betz [29], although as described in Table 3, our definition emphasises the place (kitchen vs. service) and moment when waste is produced, in order to ease correction initiatives.

C6: "There are three types of losses: out of date products, production losses and service losses."

D3: "We are focused on production losses. What is sold is not our responsibility any more."

Table 2. Typologies of food waste found in Spanish food service and its relationships.

	I	II		III
	Attending to Where Waste Is Generated and Produced	Attending to Where It Ends		Attending to Who Originates It/How Relevant Is for the Company
Kitchen	Damaged and out of date ingredients	Animal feed Industry derivatives	Avoided Waste	Pre-Consumer Waste
	Kitchen Waste	Bones, Skins, Shells, peels, etc.	Unavoidable	
Service	Cooked but not served	Display excess, self-service, leftovers, etc. that go to Trash bin, dumpster, landfills, compost	Avoidable/Partially avoidable	Post-Consumer Waste
	Served but not eaten			

Table 3. Proposal of actions to reduce food waste in Spanish food service sector.

Group	Actions
Improved management processes	Demand planning using ICT
	Regular Waste Audits
Raising awareness about food waste and Training among all stake holders	Diners (to reduce plate waste)
	Food Service companies on the importance of measuring food wasted, fixing reduction objectives and doing follow up.
	Employees
	Contractors
Collaboration among different players in the food supply chain	Collaboration with logistic partners in order to reduce safety stocks
	Collaboration with suppliers in order to adapt formats to the real kitchen needs
	Look over contractual obligations having FW in mind
	Collaboration with NGOs to increase donations

2. A second classification of waste identified in our research, similar to Papargyropoulou et al. [27] is to distinguish between avoidable waste, that is food that might not have ended up as waste with better management, partially avoidable waste, which is food that is finally diverted to uses other than human nutrition, and finally unavoidable waste, such as peels, bones, etc.

O1: "Fresh products all have losses, commonly because of their natural shelf life or for economic reasons. For example, 30% of the bananas sold in supermarkets end up thrown away. But this is life, you cannot change it."

D2: "We usually throw away stale bread. We could sell it as animal feed, but then you need to take the packaging away and this costs more than what you can get from it."

- Under this context, we concluded from our research that it would be easier to reach a consensus on the terminology if we classified waste based on where it ends up. Firstly waste that has a final utility would be included under the concept of avoided waste and would include for example donations, recycled food or food sent to secondary markets. This concept would include food that, although not having received the use for which it was produced, does not end up discarded. Opposed to this concept would be real food waste, meaning food that ends in landfills, compost, etc. This classification could well have reduced the reluctance of corporations to answer our questionnaire, as some of them felt that giving waste figures meant they recognised not being efficient and therefore a likely reason why we had such a low response rate to our questionnaire.
3. From a strictly business/management view our research suggests a new additional way of classifying food waste, not found in previous literature. Based on who gives origin to the waste and on how relevant this is perceived to be by business managers, it seems critical to distinguish two additional food waste categories: (A) Pre-consumer waste (or waste produced before food is served on diners' plates or trays) is considered by food service companies as directly related to their P&L (Profit and Loss statement) and, consequently, managers tend to naturally minimise it. Whenever no effort is made by operators to minimise this is due to its low visibility or to marketing reasons. Pre-consumer waste would include damaged and out-of-date ingredients, kitchen waste, plates displayed but not sold, etc. (B) Post-consumer waste (or food left uneaten by diners) is not considered an economic burden for the business. We give this term a slightly different meaning to Parfitt et al. [20] who use it to address household waste. From our standpoint it would include plate waste and food surplus caused by the need to accomplish contract obligations (e.g., when catering companies must offer a specific number of alternatives to diners in a buffet until the end of the service or a specific portion size, for example, of bread).

Most managers interviewed consider post-consumer waste a decision of the consumer/client opposed to a business indicator to be managed:

C2: *“Plate leftovers are the consumers’ responsibility.”*

C7: *“I do not measure what consumers leave on their plates, I only measure my inefficiencies.”*

C4: *“You cannot consider what consumers decide to leave uneaten as waste.”*

C6: *“We are very good at cost control and therefore we produce very little waste.”*

Summarising the three above-mentioned classifications resulting from our research (Table 2) we can conclude that causes of food waste and adequate solutions to reduce it must be understood under this perspective of when and where in the process food waste has been produced (Classification I), where food waste ends up (Classification II) combined with how relevant it is to business managers (Classification I). In the next section we shall analyse in detail food waste causes and will suggest best practices in order to minimise waste in each step of the process.

3.2. Is It Possible to Quantify and Classify Food Waste in the Spanish Food Service (FS) Channel?

Our research shows that not only the lack of consensus in food waste definition is a hindrance, but also quantifying food waste is abnormally difficult as its visibility is normally very low. Many businesses in the sector are not aware of the waste they produce. Low visibility of waste produced is, therefore, a key factor.

C4: *“We produce no waste. If we did, it would mean that we are managing inefficiently.”*

C8: *“Efficiency implies close to zero losses or shrinkages.”*

O1: *“Existing statistics are all wrong, most measures are not properly done.”*

Through the results of our survey, we estimate that 13.5% of the volume of food ingredients managed by the companies included in the sample is wasted in the food service sector. This figure includes plate leftovers, although, as said before, it is very rarely measured by operators. Our survey showed the following estimated quantitative results per category (per cent of total kilos used or bought): Plant-based food: Bakery (15%, SD = 5.29, min = 9.20, max = 20.50), Fruits and vegetables (25%, SD = 4.56, min = 18.80, max = 29.60); Animal food: Dairy (6%, SD = 0.54, min = 7.75, max = 7.00), Meat (9%, SD = 5.84, min = 3.00, max = 16.22) and other (20%, SD = 17.70, min = 0.50, max = 22.50). Plate waste resulted to be 30% of the total kilos wasted. The biggest losses come from fruits and cooked dishes.

The questionnaire was designed with the main purpose of quantifying the amount of food wasted in each of the different stages of the process, emphasizing the differentiation among product categories and taking note of outstanding product types. Although the final destination of waste was asked separately, only a few responses specified waste disposal method. We infer from this fact, combined with our qualitative findings, that in most cases food waste in food service outlets in Spain is not recovered (at the most thrown to organic containers). Recycling initiatives such as animal feed were not mentioned in the interviews; this lead us to assuming that recycling food waste was a secondary issue for food service managers in Spain.

3.3. Drivers of Food Waste and Practices for Its Reduction

Similar to Gunders’ [64] report, our research confirms that causes of waste vary depending on the stage of the channel and therefore, solutions to reduce it must be developed ad-hoc. Food waste causes and best practices suggested by our interviewees are grouped according to process stages.

At the procurement process, mistakes in demand planning are responsible for an important part of food waste in Spanish food service business as it is acknowledged as a difficult task, affected by many factors out of management control. Deep historical data analysis and the use of advanced demand

planning software were mentioned as best practices. So-called “Kilometre Zero” procurement practices (local products) were also mentioned as possible food waste reduction drivers mainly because of the higher distribution flexibility usually offered by close-by suppliers.

C4: “We only buy lettuce from local suppliers as they can deliver based on daily needs.”

Menu management was mentioned as another key issue: the wider the menu offered, the more difficult it becomes to minimise waste. It is recommended to plan menus in creative ways, such as including dishes that use ingredients that would otherwise be discarded, for example, for being leftovers of other plates on the menu. In the case of catering companies, smart menu planning means using ingredients left from one day in the menu of the following day. Respondents also mentioned the lack of adequate formats offered by suppliers (e.g., 5 kg cans of a specific sauce was the standard food service format, meaning that it often expired before it could be used). Collaboration with suppliers with the objective to adapt formats to customer needs, as well as the use of packaged portions or frozen solutions, were suggested as best practices to address this issue. Another recommendation was to concentrate procurement responsibilities to one single person as this facilitates detecting errors due to the fact that one person can have a global view and will be able to optimise the whole process more easily.

In the storage stage, stock management and permanent control were mentioned as critical areas. The FIFO system should always be used, best before dates should systematically be revised and technology-related issues such as the availability of vacuum packaging equipment to better preserve food leftovers. Expiry dates being controlled on a regular basis would reduce raw materials having to be discarded. At this point, it is important to recall the relevance of controlling both primary and secondary (once primary packaging has been opened) expiry dates. The use of pre-prepared food was also mentioned as a driver of low food waste.

With regard to transport, the most critical issue is considered to be supplier flexibility on distribution and the frequency of their delivery calls. This is critical for short shelf life products.

In the cooking process, training and consciousness of employees on waste is alleged to make a huge difference. Raising awareness of how much food is wasted daily was mentioned as a key issue. Business with a top-down focus on reducing waste includes waste management in personnel meetings and even daily calculating avoidable waste and following its progression. On this point, it is mentioned as relevant to share the results of this measurement with employees and benchmarking with similar centres. Increasing the visibility of what is thrown away during the cooking process can be achieved for example by simple measures such as using transparent rubbish bags.

C4: “Training kitchen personnel is key, fundamental to help them organise what they prepare based on demand planning.”

C9: “After we started using transparent rubbish bags at sites, waste was reduced as managers became more aware of the amount wasted.”

At the service stage, offering half portions and child menus was mentioned as a best practice to be considered. As side dishes, as well as bread, were top waste categories in post-consumer waste, offering them as optional is highly recommended. In the specific case of self-service restaurants (such as hotel buffets), reducing the range of products offered at the end of the service, while offering alternative dishes to diners was mentioned as a best practice too. Suggested sales by waiters is another tool that is frequently used by restaurants, meaning that waiters get instructions to recommend specific dishes when there is risk of high pre-consumer waste.

Raising awareness on food waste among consumers can also lead to waste reduction. One interviewee (C1) mentioned that some consumers acknowledged they “serve themselves to bread automatically” without caring about finally eating it or not. This fact was of strong relevance in catering facilities with a self-service bar as in most cases bread was offered at the beginning of the line

meaning that consumers grab it before they know what they are going to eat. Take away containers, though seldom offered in Spanish food service outlets, could help reduce importantly plate waste. Interviewed consumers mentioned that they felt shy to ask for such containers (“doggy bag”), but when proactively offered by waiters, the rate of acceptance was very high.

C5: “Since we decided that our waiters would offer all our customers the availability of take away containers, 85% of them used them, significantly reducing plate waste.”

Food service managers that regularly control plate waste can figure out dishes that generate too much waste or portion sizes that are too big and act in consequence resulting in improvements not only for food waste management but also for consumer satisfaction. Nevertheless, as already stated, Food Service operators in our research considered plate waste as the consumers’ decision and thus they do not measure it as they consider it has no effect on their financial results: it is “already sold” produce. In fact, only one firm in our sample occasionally measured plate waste. However, managers in companies that made efforts towards reducing plate waste mentioned they were motivated mainly by their managers’ orientation towards sustainability in general or mere marketing policies rather than by specifically reducing food waste.

3.4. Management Initiatives to Address Food Waste in Spanish Food Service Channel

Without failing to recall the opportunities for food waste reduction described in the literature for this sector (e.g., [34]), our research findings suggest that Best Practices addressing food waste reduction in Spain (summarised in Table 3) can be categorised into three groups:

A. Improved Management Processes

In order to embrace sustainability, companies must change their management practices [65], and this will be achieved by adopting the 3R “Reduce, Reuse, Recycle” [66] design mind-set in products and services. As described before, certain management related issues such as demand planning, improved purchasing models, best before dates control, adapting new technologies and pre-prepared food, among others, are key in food waste management.

We concluded from our research that implementing best practices is usually related to the interest of corporations in reducing food waste. Our study shows a relationship between such interest and economic issues, together with top management interest on sustainability issues. Whenever managers see the opportunity of improving their P&L they will apply measures and improve their processes. This does not always occur mainly due to two reasons: waste may not be visible to them and it may collide with marketing objectives. Business managers interviewed in our research agreed on the fact that fulfilling their business positioning objective (in terms of image) would always be prioritised on the reduction of food waste or other secondary objectives. Manager’s understandable priority is to focus on their positioning strategy as it differentiates their offer from their competitors guaranteeing sustainable economic profits. For this reason, certain merchandising issues such as the amount of product to have on display is also prioritised over reducing food waste. Therefore, they are prioritising the economic pillar of sustainability over social and environmental issues.

C4: “Our customers come for the size of our hamburgers, we are not going to change this.”

D2: “We assume stale bread as a cost in our P&L, it accounts for over 6% of our revenue. Assuming this cost is needed in order to offer the freshest product in the market.”

C10: “Merchandising is important: we need to have products on display until closure time. It is more expensive not to sell than to throw away some produce. Raw material cost is low while personnel is a fixed cost.”

Waste produced is thus only considered a low relevancy secondary issue. We can infer from this that improved management processes and economic drivers, although important in food waste management, cannot be the only solution to the problem.

B. Raising visibility and awareness about food waste among all stake holders

Binyon [51] mentioned that one major problem associated with food waste is that its costs are often undervalued and underreported so they remain “hidden”. Raising awareness of these “hidden” costs could be a catalyst for resolving the problem as businesses will realise the scale of the predicament and its impact, we propose raising awareness as the core of the second best practice for food waste reduction. Most importantly, increasing waste visibility usually results in waste reduction. Corporations that had implemented waste audits or other plans to emerge waste have since reported important improvements. Such firms even reported surprise from operational managers and the fact that once waste was made evident, they naturally applied corrective measures. Simple initiatives such as the use of transparent plastic rubbish bags proved to be effective. Regular waste audits are consequently highly recommended as we can infer that once managers are aware of the waste produced, they automatically apply measures to reduce it.

C1: “We launched an initiative to reduce waste at the production stage and the key issue was to force people to recognise they were throwing food away. What we did to deal with this is to create three-member teams in each production centre to measure waste daily.”

We propose in line with results obtained, that raising awareness must be implemented through communication, training and improved processes at different levels: (a) Diners, to reduce plate waste; (b) Food Service companies on the importance of measuring food wasted, fixing reduction objectives and following up on all this; (c) Employees, on kitchen and service best practices; and (d) Contractors, on the relevance of contract clauses on food waste.

C9: “We significantly reduced waste through a training programme for managers. We trained them on daily orders based on historical sales and weekly sales forecast.”

C. Collaboration among different players in the food supply chain

Food waste can also be reduced by multi-stakeholder collaboration. Practices suggested by our interviewees lead to the need for collaboration with logistic partners (in order to reduce safety stocks), collaboration with suppliers (in order to adapt formats to real kitchen needs), as well as the need for looking over customer–supplier contractual obligations having food waste in mind, and private-public cooperation aiming to reduce food waste through regulations and public contract conditions.

C7: “We have significantly reduced waste by reducing safety stocks in trains and by increasing communication with suppliers.”

C6: “Contractual obligations often produce waste in Food Buffets because you are usually obliged to offer the last person to enter the buffet the same dining alternatives as the first one.”

Collaboration with NGOs to increase donations was mentioned by most of the firms interviewed and they all agreed that Spanish legislation does not facilitate donations due to the fact that responsibilities are not limited to donors as occurs in the US or Italy. Finally, related to the public sector, there are tax-related policies as well as public contract requirements.

C1: “In Spain we lack a law similar to the Good Samaritan Act. We can only donate packaged food which is a minority in our business. We have an agreement with an NGO which collects surplus packaged food in specific events.”

C1: “I would suggest public contractors to require waste management policies to their suppliers.”

O2: “Throwing away food is cheaper than donating for corporations in Spain.”

With this in mind, we must agree with Garnett [7] that food supply chains should be considered to be a complex system of inter-related stages in which initiatives taken in one step are dependent on and

part of the whole food supply chain. The synergies between these parts and stages deserve a much more careful consideration in our efforts to understand and enhance the sustainability of a food system [7]. Moreover, external stakeholders increasingly put pressure on companies requiring them to accomplish sustainability commitments exceeding regulatory requirements [67], while in order to reach their sustainability standards and commitments, corporations often need to force their upstream suppliers to adapt sustainable practices [68]. On the other hand, facilitating collaboration with NGOs can be a driver to increase non-economically driven sustainable initiatives in corporations. Collaboration among stakeholders is, therefore, mandatory to achieve a more sustainable food supply chain.

4. Conclusions

Our paper provides new contributions to the literature on Food Waste: firstly, a new conceptualisation on food waste based on business reality; secondly, our quantitative analysis shows that the problem is relevant in the Food Service channel in Spain; and, thirdly, we identify specific best practices for Spain.

Each country and each company are at different levels of awareness about the issue as well as about practices to face it. We agree with food waste researchers (e.g., [10]) on the fact that further in-depth research is needed and it should focus on exploring and understanding particular food waste context and interactions. As acknowledged by EU research FUSION [22], due to the complexity of the food supply chain, there is no way of applying easy solutions to all circumstances.

As for contributions to Food Service management for food waste reduction, our research confirms that Spain is, among developed countries, at an intermediate stage regarding food waste management, and far from approaches in countries such as the UK, Germany or Denmark as shown by the fact that there is not even a common language when speaking about food waste across the sector. With regard to measures carried out by different Spanish players to reduce food waste, results show that these are closely related to their interest in minimising it. Only by looking for opportunities that make food waste management “profitable” for firms will waste be reduced. In those cases in which initiatives to reduce food waste would not be profitable in economic terms, they will most probably not be put into force. Consequently, due to the fact that the main motivation for Food Service companies in Spain is economically based, we can conclude that the higher the cost of food waste is for firms, the higher their interest will be in reducing it. Whenever measures are not taken, it is usually due to: (1) its low visibility or low real awareness of waste; (2) marketing issues also related with economic results—expected sales decrease when reducing waste; or (3) because waste is produced once food has been sold (post-consumer waste). These conclusions are aligned with Canali et al. [30] who argued that changes are potentially more feasible when depending on improvements in manufacturing or production efficiency along the food supply chain.

This research shows that Spanish corporations give medium relevance to social consequences of food waste. They usually acknowledge the ethic perspective of food waste although this is rarely translated into initiatives or programmes due to economic or legal issues. Finally, with regard to the environmental perspective of food waste, their concern can be graded as low due to the low awareness or credibility of the negative consequences of food waste for the environment.

The application of best practices mentioned in this paper can help reduce food waste in the Food Service channel in Spain, and they can also mean a starting point for reflection and study for researchers and corporations in other countries. As underlined by Seuring [50], researchers should not limit themselves to observe and explain the empirical phenomena but aim to help change the status quo. EU administration should try to achieve a unique definition and communicate it to all stakeholders. Spanish Administration should address a double fold strategy, as suggested by EU Fusion, firstly to “measure food waste robustly at all sector levels” [30], and secondly, “to create a framework to enable society to undertake the necessary engagement to prevent and reduce a largely avoidable wastage of resources” [30].

As with most research in food waste, this study could be improved by performing direct measurement of wasted food. We have to take into account that the conclusions come from a sample that includes commercial and collective Food Service operators, which account for 25% of the out of home market in Spain, but does not include independent bars and restaurants.

Acknowledgments: This research was partly funded by the Spanish Ministry of Food and Agriculture. The authors want to thank the Ministry for their initiative “More Food, Less Waste”, under which framework this research was done. We are extremely thankful to Antonio Agustín, founder and CEO of El Índice K for his support and helpful ideas. Finally, we thank all organisations and contact people for sharing information.

Author Contributions: Belen Derqui and Teresa Fayos conceived the framework of the research. Vicenc Fernandez defined the method and Teresa Fayos designed the empirical study. Belen Derqui performed the data gathering. Next, Teresa Fayos and Vicenc Fernandez analysed the data, however, all authors participated in the discussion of the results. Finally, Belen Derqui wrote the first draft of the paper; afterwards all authors re-wrote the paper in an iterative way until its final version.

Conflicts of Interest: The authors declare no conflict of interest.

Abbreviations

The following abbreviations are used in this manuscript:

EU	European Union
FAO	Food and Agriculture Organisation of the United Nations
FIFO	First in First Out inventory method
FS	Food Service
FSC	Food Supply Chain
FW	Food Waste
GHG	Greenhouse Gas
HLPE	High Level Panel of Experts
ICT	Information and Communication Technologies
NGO	Non-Governmental Organisation
P & L	Profit and Loss statement

Appendix A. Tables

Table A1. Sample Characteristics.

Interview Code	Position in the Company	Type of Company	Characteristics	Revenue in Spain/ Outlet Number
C1.1	Communication and External Relations Director	Non-commercial Food Service	Food Service for companies, institutions, hospitals, schools, universities, etc.	207 M €
C1.2	Operational Excellence Spain Project Leader			
C1.3	Brand Manager and Strategy Support			
C2	CEO	Non-commercial Food Service	Food Service for companies, institutions, hospitals, schools, universities, etc.	55 M €
C3	Marketing Director	Non-commercial Food Service	Food Service for companies, institutions, hospitals, schools, universities, etc.	150 M €
C4	CEO	Commercial Food Service	Fast food restaurant chain (Burgers)	15 M €/65 outlets
C5	Master Franchise	Commercial Food Service	Fast food restaurant chain	160 M €
C6	Quality control manager	Commercial Food Service	Restaurants at airports, train stations and Highways	410 M €/1000 outlets
C7	CEO	Travel Retail and Food Service	Catering on board trains	109 M €
C8.1	External Communication Director	Wholesaler	Public Company Wholesaler	26.5 M €
C8.2	Communication assistant			

Table A1. Cont.

Interview Code	Position in the Company	Type of Company	Characteristics	Revenue in Spain/ Outlet Number
C9	CEO	Commercial Food Service	Restaurants at airports, train stations and Highways	9,000 M €
C10	CEO	Catering and retailing	Food Retail/Catering	40 M €
D2	Commercial Director	Industrial Bakery	Bakery Producer	360 M€
D3	CEO	Industrial Bakery	Frozen Dough Producer	50 M €
M1	Vice-President	NGO	Food Bank	
M2	Food waste Project Manager	Not for profit international organization	Over 25,000 member companies from both supplier and retailer sectors	

Table A2. Food waste drivers in Spain and recommendations for its reduction.

Stage	Drivers	Reduction Drivers
Procurement	Demand planning errors	Demand Planning using historical data analysis Demand Planning using ICT specific software Kilometre Zero procurement Procurement responsibility concentrated on one individual Collaboration culture
	Poor Menu Management	Smart Menu Planning Collaboration with suppliers regarding product formats and new product development Use of pre-prepared portioned food
Storage	Discarded raw materials	Minimise Stocks FIFO inventory method Permanent stock control and regular revision of best before dates. Control of expiry dates on a regular basis Control both primary and secondary expiry dates Use of fourth or fifth range products (packaged prepared or pre-cooked products)
Transport	Short shelf life products	Reduce safety stocks Collaboration culture with suppliers Supplier flexibility Smaller orders, more frequent deliveries
Kitchen	Cooking process	Training and awareness building of employees on waste Track the issue in personnel meetings Waste audits measuring daily avoidable waste Share audit results with employees Benchmarking among centres Increase visibility Use transparent rubbish bags
Service	Size of portions	Offer half portions and children's menus Observe leftovers and reduce portions when a lot is often left
	Side dishes and bread	Leave them as optional
	Self-service and buffets	Reduce the range of products offered near closing time and offer Alternative dishes to diners Availability of take away containers Private-public cooperation in collective food service contracts: agreements with waste in mind
	Plate waste	Employee training and information campaigns Waiters suggesting menu options is another tool Raise awareness on FW among consumers Collaboration culture among waiters and guests Remove dishes that generate too much waste from menus

Table A2. Cont.

Stage	Drivers	Reduction Drivers
Waste Management	Waste recovery	Collaboration with related businesses and NGOs
	Waste disposal	Regular waste audits Set reduction objectives Separate waste collection facilities Safe disposal of waste to landfill

References

1. Brundtland, G. World Commission on Environment and Development. In *Our Common Future*; Oxford University Press: Oxford, UK, 1987.
2. FAO (Food and Agriculture Organization of the United Nations). *Global Food Losses and Food Waste: Extent, Causes and Prevention*; FAO: Rome, Italy, 2011.
3. Lipinski, B.; Hanson, C.; Lomax, J.; Kitinoja, L.; Waite, R.; Searchinger, T. *Reducing Food Loss and Waste*; World Resource Institute: Washington, DC, USA, 2013; pp. 1–40.
4. Sustainable Food Consumption and Production in a Resource-Constrained World. Available online: <http://www.scp-knowledge.eu/knowledge/sustainable-food-consumption-and-production-resource-constrained-world-full-report> (accessed on 28 January 2016).
5. Mena, C.; Adenso-Diaz, B.; Yurt, O. The causes of food waste in the supplier–retailer interface: Evidences from the UK and Spain. *Resour. Conserv. Recycl.* **2011**, *55*, 648–658.
6. Deutz, P.; Ioppolo, G. From Theory to practice: Enhancing the potential policy impact of industrial ecology. *Sustainability* **2015**, *7*, 2259–2273. [[CrossRef](#)]
7. Cooking up a Storm: Food, greenhouse gas emissions and our changing climate. Available online: http://www.fcrn.org.uk/sites/default/files/CuaS_web.pdf (accessed on 19 April 2016).
8. Buzby, J.C.; Hyman, J. Total and per capita value of food loss in the United States. *Food Policy* **2012**, *37*, 561–570. [[CrossRef](#)]
9. Warshawsky, D.N. Food waste, sustainability, and the corporate sector: Case study of a US food company. *Geogr. J.* **2015**. [[CrossRef](#)]
10. Göbel, C.; Langen, N.; Blumenthal, A.; Teitscheid, P.; Ritter, G. Cutting food waste through cooperation along the food supply chain. *Sustainability* **2015**, *7*, 1429–1445. [[CrossRef](#)]
11. Tilman, D.; Fargione, J.; Wolff, B.; D’Antonio, C.; Dobson, A.; Howarth, R.; Schindler, D.; Schlesinger, W.H.; Simberloff, D.; Swackhamer, D. Forecasting agriculturally driven global environmental change. *Science* **2001**, *292*, 281–284. [[CrossRef](#)] [[PubMed](#)]
12. Cappelletti, G.; Ioppolo, G.; Nicoletti, G.; Russo, C. Energy requirement of extra virgin olive oil production. *Sustainability* **2014**, *6*, 4966–4974. [[CrossRef](#)]
13. Reducing the Food Wastage Footprint. Available online: <http://www.fao.org/docrep/018/i3342e/i3342e.pdf> (accessed on 19 June 2016).
14. Fao Food Wastage Footprint: Impacts on Natural Resources. Available online: <http://www.fao.org/docrep/018/i3347e/i3347e.pdf> (accessed on 19 June 2016).
15. European Commission. *Preparatory Study on Food Waste Across EU 27*; European Commission: Brussels, Belgium; Luxembourg, Luxembourg, 2010.
16. Lebersorger, S.; Schneider, F. Discussion on the methodology for determining food waste in household waste composition studies. *Waste Manag.* **2011**, *31*, 1924–1933. [[CrossRef](#)] [[PubMed](#)]
17. Garrone, P.; Melacini, M.; Perego, A. Opening the black box of food waste reduction. *Food Policy* **2014**, *46*, 129–139. [[CrossRef](#)]
18. Thyberg, K.L.; Tonjes, D.J. Drivers of food waste and their implications for sustainable policy development. *Resour. Conserv. Recycl.* **2016**, *106*, 110–123. [[CrossRef](#)]
19. Gjerris, M.; Gaiani, S. Household food waste in Nordic countries: Estimations and ethical implications. *Etikk Praksis* **2013**. [[CrossRef](#)]
20. Parfitt, J.; Barthel, M.; Macnaughton, S. Food waste within food supply chains: Quantification and potential for change to 2050. *Philos. Trans. R. Soc. Lond. B Biol. Sci.* **2010**, *365*, 3065–3081. [[CrossRef](#)] [[PubMed](#)]

21. Stuart, T. *Waste: Uncovering the Global Food Scandal*; Penguin Books Limited: London, UK, 2009.
22. Östergen, K.; Gustavsson, J.; Al, E. FUSIONS Definitional Framework for Food Waste. Available online: <http://www.eu-fusions.org/phocadownload/Publications/FUSIONS%20Definitional%20Framework%20for%20Food%20Waste%202014.pdf> (accessed on 19 July 2016).
23. Kantor, L.S.; Lipton, K.; Manchester, A.; Oliveira, V. Estimating and addressing America's food losses. *Foodreview* **1997**, *20*, 2–12.
24. Grolleaud, M. *Post-harvest Losses: Discovering the Full Story. Overview of the Phenomenon of Losses during the Post-Harvest System*; FAO: Rome, Italy, 2002.
25. Gustavsson, J.; Stage, J. Retail waste of horticultural products in Sweden. *Resour. Conserv. Recycl.* **2011**, *55*, 554–556. [[CrossRef](#)]
26. Bloom, J. *American Wasteland: How America Throws away Nearly Half of Its Food (and What We Can Do about It)*; Da Capo Press: Cambridge, MA, USA, 2011.
27. Papargyropoulou, E.; Lozano, R.; Steinberger, J.K.; Wright, N.; bin Ujang, Z. The food waste hierarchy as a framework for the management of food surplus and food waste. *J. Clean. Prod.* **2014**, *76*, 106–115. [[CrossRef](#)]
28. Falasconi, L.; Vittuari, M.; Politano, A.; Segrè, A. Food waste in school catering: An Italian case study. *Sustainability* **2015**, *7*, 14745–14760. [[CrossRef](#)]
29. Betz, A.; Buchli, J.J.; Göbel, C.; Müller, C.; Göbel, C.; Müller, C. Food waste in the Swiss food service industry—Magnitude and potential for reduction. *Waste Manag.* **2015**, *35*, 218–226. [[CrossRef](#)] [[PubMed](#)]
30. Drivers of Current Food Waste Generation, Threats of Future Increase and Opportunities for Reduction. Available online: <http://jukuri.luke.fi/handle/10024/485040> (accessed on 19 February 2016).
31. Lundqvist, J.; de Fraiture, C.; Molden, D. *Saving Water: From Field to Fork: Curbing Losses and Wastage in the Food Chain*; Stockholm International Water Institute: Stockholm, Sweden, 2008.
32. The Environmental Food Crisis: The Environment's Role in Averting Future Food Crises: A UNEP Rapid Response Assessment. Available online: http://www.grida.no/files/publications/FoodCrisis_lores.pdf (accessed on 19 April 2016).
33. Griffin, M.; Sobal, J.; Lyson, T. An analysis of a community food waste stream. *Agric. Hum. Values* **2009**, *26*, 67–81. [[CrossRef](#)]
34. Dealing with Food Waste in the UK. Available online: http://www.wrapcymru.org.uk/sites/files/wrap/Dealing_with_Food_Waste_-_Final_-_2_March_07.pdf (accessed on 19 April 2016).
35. The Food We Waste. Available online: <http://www.ifr.ac.uk/waste/Reports/WRAP%20The%20Food%20We%20Waste.pdf> (accessed on 19 April 2016).
36. Beretta, C.; Stoessel, F.; Baier, U.; Hellweg, S. Quantifying food losses and the potential for reduction in Switzerland. *Waste Manag.* **2013**, *33*, 764–773. [[CrossRef](#)] [[PubMed](#)]
37. Engström, R.; Carlsson-Kanyama, A. Food losses in food service institutions Examples from Sweden. *Food Policy* **2004**, *29*, 203–213. [[CrossRef](#)]
38. Hafner, G.; Barabosz, J.; Schneider, F.; Scherhauser, S.; Schuller, H.; Leverenz, D. *Vorschläge zur Verminderung der Wegwerfrate bei Lebensmitteln in Deutschland—Kurzfassung*; Institut für Siedlungswasserbau, Wassergüte und Abfallwirtschaft: Stuttgart, Germany, 2012. (In German)
39. Bender, W.H. Seventh annual hunger research briefing and exchange. *Food Policy* **1994**, *19*, 483–485. [[CrossRef](#)]
40. Smil, V. *Feeding the World: A Challenge for the Twenty-First Century*; The MIT Press: Cambridge, UK, 2001.
41. Sonnino, R.; McWilliam, S. Food waste, catering practices and public procurement: A case study of hospital food systems in Wales. *Food Policy* **2011**, *36*, 823–829. [[CrossRef](#)]
42. Las Pérdidas y el Desperdicio de Alimentos en el Contexto de Sistemas Alimentarios Sostenibles. Available online: <http://www.fao.org/3/a-i3901s.pdf> (accessed on 21 February 16). (In Spanish).
43. Bernstad Saraiva Schott, A.; Cánovas, A. Current practice, challenges and potential methodological improvements in environmental evaluations of food waste prevention—A discussion paper. *Resour. Conserv. Recycl.* **2015**, *101*, 132–142. [[CrossRef](#)]
44. Pirani, S.I.; Arafat, H.A. Reduction of Food Waste Generation in the Hospitality Industry. *J. Clean. Prod.* **2015**. [[CrossRef](#)]
45. Charlebois, S.; Creedy, A.; von Massow, M. “Back of house”—Focused study on food waste in fine dining: The case of Delish restaurants. *Int. J. Cult. Tour. Hosp. Res.* **2015**, *9*, 278–291. [[CrossRef](#)]

46. Wansink, B.; van Ittersum, K. Portion size me: Plate-size induced consumption norms and win-win solutions for reducing food intake and waste. *J. Exp. Psychol. Appl.* **2013**, *19*, 320–332. [[CrossRef](#)] [[PubMed](#)]
47. Kim, K.; Morawski, S. Quantifying the Impact of Going Trayless in a University Dining Hall. *J. Hunger Environ. Nutr.* **2012**, *7*, 482–486. [[CrossRef](#)]
48. Collison, R.; Colwill, J.S. Food waste in public houses and restaurants and customer attitudes. *Int. J. Hosp. Manag.* **1987**, *6*, 163–167. [[CrossRef](#)]
49. Finn, S.M. Valuing our food: Minimizing waste and optimizing resources. *Zygon* **2014**, *49*, 992–1008. [[CrossRef](#)]
50. Seuring, S.; Gold, S. Sustainability management beyond corporate boundaries: From stakeholders to performance. *J. Clean. Prod.* **2013**, *56*, 1–6. [[CrossRef](#)]
51. Binyon, S. *Reducing and Managing Waste in the Food Industry: Food Industry Sustainability Best Practice Workshop*; Food & Drink Federation: London, UK, 2007.
52. Halloran, A.; Clement, J.; Kornum, N.; Bucatariu, C.; Magid, J. Addressing food waste reduction in Denmark. *Food Policy* **2014**, *49*, 294–301. [[CrossRef](#)]
53. Garrone, P.; Melacini, M. Food Waste Reduction: Empirical Findings from the Italian Food Supply Chain. 2012. Available online: <http://ssrn.com/abstract=2109587> (accessed on 20 February 2016).
54. Strasser, S. *Waste and Want: A Social History of Trash*; Henry Holt and Company: New York, NY, USA, 2014.
55. Bansal, P.; Roth, K. Why companies go green: A model of ecological responsiveness. *Acad. Manag. J.* **2000**, *43*, 717–736. [[CrossRef](#)]
56. Reducing Food Wastage, Improving Food Security. Available online: http://knowledge4food.net/wp-content/uploads/2014/07/140702_fbkp_report-foodwastage_DEF.pdf (accessed on 19 April 2016).
57. Vaqué, L.G. El insostenible desperdicio de alimentos: ¿Qué podemos hacer los consumidores. *Rev. CESCO Derecho Consumo* **2015**, *14*, 203–216. (In Spanish)
58. Alejandra, R.T.; Begoña, P.V.; Jesus, P.C.M.; Gaspar, R.B.; Eduardo, G.M.L. Evaluando la aceptación de alimentos en escolares; registro visual cualitativo frente a análisis de residuos de alimentos. *Nutr. Hosp.* **2014**, *29*, 1054–1061. (In Spanish)
59. Pratt, M. From the editors: For the lack of a boilerplate: Tips on writing up (and reviewing) qualitative research. *Acad. Manag. J.* **2009**, *52*, 856–862. [[CrossRef](#)]
60. Bogdan, R.; Biklen, S.K. *Qualitative Research for Education: An Introduction to Theory and Methods*; Allyn & Bacon: Boston, MA, USA, 1997.
61. Miles, M.B.; Huberman, A.M. *Qualitative Data Analysis: An Expanded Sourcebook*; SAGE Publications: Thousand Oaks, CA, USA, 1994.
62. Cómo Hacer Investigación Cualitativa. Available online: <https://mayestra.files.wordpress.com/2013/03/bibliografica3ada-de-referencia-investigacion3b3n-cualitativa-juan-luis-alvarez-gayou-jurgenson.pdf> (accessed on 23 April 2016). (In Spanish)
63. Doherty, A.M. Market and partner selection processes in international retail franchising. *J. Bus. Res.* **2009**, *62*, 528–534. [[CrossRef](#)]
64. Wasted: How America Is Losing up to 40 Percent of Its Food from Farm to Fork to Landfill. Available online: <https://www.nrdc.org/sites/default/files/wasted-food-IP.pdf> (accessed on 19 April 2016).
65. Kotler, P. Reinventing marketing to manage the environmental imperative. *J. Mark.* **2011**, *75*, 132–135. [[CrossRef](#)]
66. Sustainable Operations Management: An Enduring Stream or a Passing Fancy? Available online: https://www.hks.harvard.edu/m-rcbg/heap/papers/Drake-Spinler_DP49.pdf (accessed on 19 April 2016).
67. Grimm, J.H.; Hofstetter, J.S.; Sarkis, J. Critical factors for sub-supplier management: A sustainable food supply chains perspective. *Int. J. Prod. Econ.* **2014**, *152*, 159–173. [[CrossRef](#)]
68. Hassini, E.; Surti, C.; Searcy, C. A literature review and a case study of sustainable supply chains with a focus on metrics. *Int. J. Prod. Econ.* **2012**, *140*, 69–82. [[CrossRef](#)]

