



UNIVERSITY OF GOTHENBURG
SCHOOL OF BUSINESS, ECONOMICS AND LAW

Getting to Grips With Food Waste

A Case Study of Food Waste Mitigation and Management at a
Swedish Restaurant

Bachelor Thesis in Corporate Sustainability
The School of Business, Economics and Law
University of Gothenburg
Spring Semester 2022
Supervisor: Ove Krafft
Karlotta Backe
Robert Skoog

Abstract

The fact that a large amount of the food produced in the world is wasted is a direct expression of an inefficiency in the way we use our resources. It causes sufferings on a humanitarian level and profitability losses on a financial level. This work will focus on food waste in the hospitality industry and aims to contribute to improved food waste mitigation and management and to contribute to the knowledge generation in the growing academic field of food waste mitigation. This is reflected in the overarching research question of this paper: *Which possible adjustments to Filimonau's & De Coteau's (2018) managerial framework for food waste mitigation in the hospitality industry can be derived from the application of the model to a case study in the Swedish context?*

The work is based on a case study of a Swedish lunch restaurant with food waste mitigation on top of the agenda and an experimental approach to the challenge. We have gathered qualitative data from the restaurant regarding different actions for improved food waste mitigation, as well as quantitative financial data from the case restaurant, another related restaurant and general data from a Swedish hospitality industry organization, with the intention to see if food waste mitigation efforts influence the financial results. The analysis of the financial data shows no clear evidence of correlation between food waste mitigation and improved gross margin. After applying the managerial framework for food waste mitigation to the data of the case study, we derive suggestions for possible adjustments to the theoretical framework and propose areas of future research.

Keywords: food waste mitigation, managerial framework for food waste mitigation, restaurant, management

Contents

1. Introduction	1
1.1 Background.....	1
1.2 Problem Discussion	3
1.3 Purpose	5
1.4 Research Questions.....	5
1.5 Delimitations	6
2. Theory	7
2.1 Defining Food Waste.....	7
2.2 Food Waste in Sweden	8
2.3 Drivers of Food Waste in the Restaurant Industry	10
2.4 Solutions to Food Waste in the Restaurant Industry	13
2.5 Theoretic Framework for Food Waste Management in Hospitality Operations	16
3. Method	22
3.1 Study object.....	22
3.2 Interviewees.....	23
3.3 Data collection.....	23
3.6 Literature Review and Source Criticism	24
4. Result and Analysis	25
4.1 Interview responses	25
4.2 Discrepancies between theory and practice.....	33
4.3 Waste's financial performance in comparison	34
5. Discussion	40
6. Conclusion	43
6.1. Future Research	44
References	i
Appendix 1 - Interview Guide.....	vii

List of Tables

Table 1 <i>Compilation of Drivers and Solutions connected to Food Waste in the Restaurant Industry</i>	11
Table 2 <i>Revenue from Food Redistribution at Waste</i>	39

List of Figures

Figure 1 <i>Origins of Food Waste in Different Food Service Outlets by Slivenoinnen et. al. (2015)</i>	9
Figure 2 <i>The Hospitality food waste transformation framework by Filimonau & De Coteau (2018)</i>	18
Figure 3 <i>The Framework of Critical Evaluation by Filimonau & De Coteau (2018)</i>	19
Figure 4 <i>The Managerial Framework for Hospitality Food Waste Mitigation by Filimonau & De Coteau (2018)</i>	20
Figure 5 <i>Challenges and Opportunities at Waste</i>	27
Figure 6 <i>The Managerial Framework applied to Waste's Food Waste Mitigation Efforts</i>	33
Figure 7 <i>Average Gross Margin in the Hospitality Industry</i>	35
Figure 8 <i>Comparison of Waste's and Ooto's Gross Margins</i>	36
Figure 9 <i>Comparison of Average Gross Margins</i>	37

Glossary

Avoidable food waste	Edible food that could have been eaten but was not, for example spoiled produce.
Food loss	Food lost in the early stages of the food supply chain, excluding retailers, food service providers and consumers.
Food waste	Food lost as a result from decisions and actions by retailers, food service providers and consumers.
Food waste management	Actions associated with handling food waste.
Food waste mitigation	Actions associated with reducing food waste.
Food supply chain	The chain of events of food ingredients from field to fork.
Overproduction	Meals produced but not sold.
Unavoidable food waste	Inedible parts of food associated with food preparation, for example eggshells.
Plate waste	Leftovers from customers' plates going to waste.
Waste hierarchy	A systematic model of priorities for waste mitigation and management.

1. Introduction

Food production stands for a significant part of the resource usage of our planet and poses a stress to our environment. In many parts of the world food is taken for granted, but more than 820 million people are not guaranteed sufficient amounts of food according to the Food and Agriculture Organization of the United Nations (here after: FAO), and disturbing happenings in the world like the Covid-19 pandemic has added to the food insecurity. (FAO, n.d.) The war in Ukraine is on top of the general misery of war, another disturbance to food supply. Ukraine and the Russian Federation are among the world's top exporters of a range of crops and the Russian Federation is also one of the top exporters of fertilizers in the world. The consequences of the war and the bans set on the Russian Federation is predicted to lead to deficits in food supply and an increase of food prices of more than 20%. It will not only affect the conflicting countries but also neighboring regions and economically vulnerable countries normally importing from Ukraine and the Russian Federation in the Asia-Pacific, sub-Saharan Africa, the Near East and North Africa, leading to a further increase in the number of undernourished people.(FAO,2022) At the same time, a significant proportion of the food produced is wasted. According to a statement by the FAO in 2011, one third of the food produced in the world is either lost or wasted every year (FAO, n.d.).

Improvements and changes in the attitude towards the problem are seen and academic research in the subject is increasing. But in a macro perspective, any amount of edible food that never gets eaten represents a waste of resources such as land, water, energy, and other inputs used in food production, packaging, transportation, and processing, as well as outputs of unnecessary greenhouse gas emissions. Considering the misfit of allocation of food in the world described earlier, it is well desired to use the available resources in a more efficient way and thus improve food security, save economic and environmental resources, and reduce the load on the waste management system (Thyberg & Tonjes, 2015). When narrowing down the perspective to a corporate level, wasted food also represents inefficiencies and losses of financial resources in the food production chain.

1.1 Background

In 2015 all the United Nation member states adopted the 2030 Agenda for Sustainable Development consisting of 17 different Sustainable Development Goals, SDGs, which serve as targets by all countries involved in this global partnership (The United Nations Department

of Economic and Social Affairs, n.d.a) SDG 12.3 calls for “halving per capita global food waste at retail and consumer levels by 2030, as well as reducing food losses along the production and supply chains.”(The United Nations Department of Economic and Social Affairs, n.d.b) The private sector plays a part in achieving this goal, and one of the stakeholders is the restaurant business or food service sector, where overproduction of meals and inefficient use of resources are factors to consider. In 2012, 12% of the total food waste in the EU was estimated to come from the food service sector and the total costs associated with the food waste within the EU were estimated at around 143 billion euros. (Stenmarck, Jensen, Quedstedt & Moates, 2016) The estimated total costs of the food waste, even though only a part of it applies to the private food service sector, gives a guidance on the financial implications of the problem.

A forecast of increasing food prices due to external disturbances mentioned above can be expected to further emphasize the importance of improving waste management in the private food service sector to control costs, be efficient with resources and continue being profitable. The severe consequences to the hospitality industry of the Covid-19 pandemic(SCB, 2022), also could turn attention to the importance of efficient handling of resources. Improved food waste monitoring and mitigation management would both assist in reaching SDG 12.3 as well as increase economic profits through better efficiency in the use of resources. A non-financial aspect of reducing food waste for the private sector is the image of the company as a responsible and cautious actor on the market. This could be of benefit for a restaurant by attracting consumers that are aware of the problem and by building long term loyalty to the company. It is even indicated that 70% of the consumers are willing to pay more at a restaurant that practices food waste mitigation. (Filimonau & De Coteau, 2018)

In this paper we will make a case study of a Swedish lunch restaurant with an ambitious approach to sustainability and mitigation of food waste, and we will apply our empirical findings to the existing theories in this field of research. The restaurant that is selected to be the object of study is called WASTE-edible food lab (hereafter: Waste). It was established in 2019 and is located in central Gothenburg, Sweden. The business is run as a “Food waste project with [akademiska hus]” (Waste, n.d.) and was established in 2019 (Jonas, personal communication). From the beginning on this restaurant has been run as a kind of experimental project with a goal to find methods for improved sustainability and healthy eating while being profitable. Possibly, these methods can then serve as a base for further expansion with new similar businesses. (Magnus, personal communication) During their operation, numerous

actions have been taken in order to minimize food waste and improve sustainability. As much as possible of the purchased ingredients consist of goods wasted, discarded or close to expiration date at the wholesale companies cooperating with Waste. The restaurant has a focus on greens and vegetables and are building the menu with this in mind. 3 days a week fish can be added to the greens and vegetables if the guest chooses to and 2 days a week meat is the option while every day there is a vegetarian alternative add on. Over time the goals are to be able to affect customer behavior towards choosing more greens and vegetables and to minimize leftovers from customer plates. Leftovers not served are taken care of as much as possible, recomposed and sold the following days as soups, wraps, bistro dishes or as takeaway at a lower price. Since the beginning, some data on sustainability performance has been collected but never truly analyzed and evaluated (Jonas, personal communication). By looking into the existing collected data and adding further qualitative empirical findings, we find this case interesting and valid as a reference to test some of the now existing academic theories.

To review financial implications of the work with waste mitigation, comparison of financial figures is needed to be able to identify possible differences and draw conclusions about correlation between waste mitigation and profitability. In order to do this, a restaurant with the same owner, located across the street and also based on serving lunch but without the distinct focus on waste mitigation and sustainability (Magnus, personal communication) was chosen as a reference object. The restaurant is named Ooto, and of course since having the same owner it also has a mindset of taking good care of purchased goods and buying raw materials close to expiry date, but more because of financial advantages and a general concern about the consumer society (Magnus, personal communication). Ooto is run as a Facility Management company in an academic building with a traditional lunch restaurant on floor level. About 50% of the company's incomes are related to food service at the lunch restaurant (Magnus, personal communication), and financial data has been provided which is extracted in the same way as from Waste, making it possible to compare the food service parts of the businesses.

1.2 Problem Discussion

Considering the amounts of resources that are wasted and the costs of this waste both on a humanitarian and environmental level as well as a financial corporate level, it is obvious that waste mitigation in the hospitality industry is a problem of great importance to the involved stakeholders, and food waste from the restaurant industry is an important part of this. The problem is complex and previous academic research is relatively limited, so by making this

case study we want to evaluate the link between an existing theoretic framework and the actual work with waste mitigation in practice at a Swedish lunch restaurant with sustainability on top of the agenda.

Academic journals conclude that despite its significance, the issue of hospitality food waste needs further academic research (Dhir, Talwar, Kaur, Malibari, 2020), especially from the perspective of industry managers and professionals (Filimonau & De Coteau, 2018; Principato, Pratesi, Secondi, 2018). The understanding of factors driving food waste and existing mitigation strategies needs to increase (Sakaguchi, Pak & Potts, 2018) and managerial approaches to hospitality food waste mitigation that can be adopted by the industry on a large scale with adjustment for local conditions, also needs further exploration (Filimonau & De Coteau, 2018).

The problem of food waste is complex, as it can appear in all stages of the food supply chain, from food lost at raw material production all the way up to wasted leftovers on the plate. The reasons for the waste at different levels can be as multifaceted as handling skills, damage and loss during processing, transportation, and storage errors. But also attitudes and social factors affecting the appreciation of food and the overall understanding of the problem can be reasons for food loss and waste (Papargyropoulou et. al., 2014). The importance of waste mitigation in the hospitality industry is emphasized by the fact that the environmental impact of food waste is largest at the last stage of the food supply chain since it has then gone through all the previous stages of resource driven refinements in the food supply chain in vain (Priefer, Jörissen, Bräutigam, 2016).

Research on the subject of food waste has historically been limited but a rise in interest is seen since around 2015 (Dhir, Talwar, Kaur, Malibari, 2020). An implication and consequence of this research subject being so young is the absence of common standards developed that can serve as global quantification, comparison, and evaluation guidelines. However, some definitions, measuring points and theories are used in several different academic articles and thereby function as common ground going forward within the field.

In order to get a grip on waste mitigation in practice, restaurants need to have facts and figures to work with, which calls for a deeper knowledge of the drivers and main sources of waste generation in the food supply chain (Priefer, Jörissen, Bräutigam, 2016). Due to a lack of legislation and a common framework for quantification of food waste within the industry, the incentive for a restaurant to collect data regarding food waste, manage or even mitigate food

waste is largely based on the individual restaurant's understanding of the potential of this data and positive impacts of waste mitigation. This motivation is until now not widely spread, and therefore long-term data about food waste at a restaurant is rarely seen, and where data is available, the lack of common methods for quantifying food waste leads to low comparability over time and between different food service institutions (Eriksson et al., 2018). For restaurants and other actors within the hospitality industry sector to commence the journey towards food waste management and mitigation, clearer instructions and tools to help managers are needed. One tool in the form of a theoretical model is the managerial framework for food waste mitigation by Filimonau & De Coteau (2018), which aims to help managers working within the hospitality sector to "manag[e] food waste across the different areas of hospitality operations" (p. 234).

1.3 Purpose

By using the managerial framework for food waste mitigation to describe and analyze the food waste management strategy of a Swedish case restaurant, we want to test its applicability in practice and contribute to the fine-tuning of the framework. This also requires exploring the impacts of implemented waste mitigation actions on financial key performance indicators.

1.4 Research Questions

The main research question of the report is:

- ❖ Which possible adjustments to Filimonau's & De Coteau's (2018) managerial framework for food waste mitigation in the hospitality industry can be derived from the application of the framework to a case study in the Swedish context?

Additional, supportive research questions are:

- How is food waste mitigation and management addressed in the chosen restaurant?
- Do the restaurant's financial results differ from those of a comparable restaurant with less ambitious food waste mitigation efforts?

1.5 Delimitations

This study aims to take a wide perspective on food waste mitigation and management in the hospitality industry, but some delimitations are necessary to keep focus on the purpose. When it comes to food waste and its categorization, this study is concentrated on avoidable food waste, as this is a category possible to influence to a high degree. Unavoidable food waste has not been considered. Also in this study, all food waste is seen as belonging to the same category and treated equally. However, food waste could have been further divided into different categories, such as for example meat, vegetables, dairy, or oils and fats, which would have allowed for an investigation of the climate impact and resources wasted in more detail as a result of the varying impacts from different food categories. Further, this study has focused on the restaurants Waste and Ooto and the study's scope was not broadened to a larger population of food services due to time limitations.

2. Theory

In the following chapter the concept of food waste will be defined and explored based on relevant literature and information provided by the Food and Agriculture Organization of the United Nations (FAO). Thereafter, this report provides an overview of characteristics and quantifications of food waste in Sweden. This is then followed by a summary of the drivers of, and solutions to food waste within the hospitality industry that are being identified in the studied literature. The theory chapter concludes with a detailed presentation of a theoretical framework for food waste management by Filimonau & De Coteau (2018), which will be used later on to analyze the interview responses and insights on the restaurant's food waste mitigation efforts gained via these interviews.

2.1 Defining Food Waste

In order to investigate the implications of food waste, first a clear definition is necessary. In scientific literature about inefficient use of food resources the definition of food waste is discussed and not always consistent. FAO (n.d.) divides the phenomenon into two groups, Food Loss and Food Waste. FAO defines food loss as “the decrease in the quantity or quality of food resulting from decisions and actions by food suppliers in the chain, excluding retailers, food service providers and consumers.”(FAO, n.d., paragraph 6) Food waste, on the other hand, is defined as “the decrease in the quantity or quality of food resulting from decisions and actions by retailers, food service providers and consumers.”(FAO, n.d., paragraph 9.) Despite this distinction used by the FAO and other authors (Parfitt, Barthel & Macnaughton, 2010; Gustavsson, Cederberg, & Sonesson, 2011; Filimonau & De Coteau, 2018; Thyberg & Tonjes, 2015; Principato, Pratesi, Secondi, 2018; Andersson & Stålhandske 2020 and Ai & Zheng, 2019), the concepts of food waste and food loss are often used interchangeably in the literature. This is the case for several of the articles used in the theoretical underpinning of this report (Dhir, Talwar, Kaur & Malibari, 2020; Monier et. al., 2010; Priefer, Jörissen & Bräutigam, 2016; Sakaguchi, Pak & Potts, 2018; Stenmarck, Jensen, Quedsted & Moates, 2016; Betz et. al., 2014). In our report, we will adopt the definitions for the terms food waste and food loss suggested by the FAO and therefore distinguish between food loss and food waste.

In a UK survey (Oakdene Hollins, Responsible Hospitality Partnership and WRAP, 2013), food waste is further explained as food that is wasted from food service activities, including food preparation, consumer leftovers, food spoiled during preparation and discarded ingredients. This wasted food is categorized as either avoidable or unavoidable food waste. Avoidable food

waste is edible food that could have been eaten but was not for reasons like e.g., consumer behavior, distasteful preparation, oversized portioning or excess production. Unavoidable food waste is inedible parts of food associated with food preparation e.g., eggshells and bones. (Oakdene Hollins, Responsible Hospitality Partnership and WRAP, 2013) In this study we will focus on the group Food waste and the category Avoidable food waste.

Although a common standard for measuring food waste is not yet in place, some common monitoring points in the different stages of the food distribution chain are identified in the existing literature with small variations. These can be defined as kitchen waste, which is the food wasted during storage and cooking. Serving waste is food that is prepared but not served due to e.g., overproduction, and not being re-used in following cooking processes. Plate waste is the food served but later on left on the plate by customers for reasons like oversized portions or taste not satisfactory. (Silvennoinen et al., 2015; Heikkilä et al., 2016).

2.2 Food Waste in Sweden

After having laid out the most important concepts connected to the topic of food waste, an overview of the characteristics of food waste in Sweden will be presented. This will enable a better understanding of the business practices and anti-food-waste initiatives undertaken by the study object and allows for a comparison between the specific case study and the nationwide situation. This overview over food waste in Sweden is based on a report issued in the beginning of 2020 by the Swedish Environmental Protection Agency and a report from 2011 on Global Food Losses and Food Waste commissioned by the FAO. Also, this section is concluded with a presentation of a study of food waste in the Finnish hospitality sector to evaluate origins of food waste.

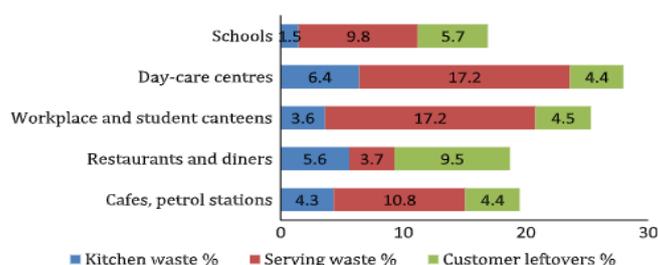
The report “ Global food losses and food waste – Extent, causes and prevention” commissioned by the FAO and written by Gustavsson, Cederberg & Sonesson (2011) is based on two studies: one examining food loss and waste in low-income countries and the other one in medium to high income countries, into which Sweden can be categorized. While food losses and food waste occur along the whole food supply chain no matter the income levels of a country, different emphases have been discovered. In low-income countries the majority of food waste occurs in the beginning of the supply chain, while for medium and high-income countries the lion share (about 40 %) of lost food was recorded during the later stages of the food supply chain, such as the retail and consumer level.

The report “MATAVFALL I SVERIGE - Uppkomst och behandling 2018” by Andersson & Stålhandske (2020) provides an overview of where food waste arises and what is done to mitigate it from a Swedish point of view. In 2018, Sweden’s food waste amounted to 1,3 million tons or 133 kilograms per person. In total, food handling in Sweden causes almost half of the country’s contribution to eutrophication and between 20-25 percent of Sweden’s total climate impact. The vast majority of food waste, 71 per cent, arises in private homes. Restaurant stood for 73 000 tons, or 7 kilo per person, of food waste. This number has slightly increased since 2014 which can possibly be explained by a growing restaurant industry, an increase in meals consumed at restaurants and a general increase in Sweden’s population. In general, the data around food waste in the restaurant industry is said to be uncertain and for some parts of a restaurant’s supply chain, such as wholesalers, no data is available at all. The report also demonstrates that using food waste for the production of biogas as a substitute for fossil fuels will lead to a bigger climate impact than reducing food waste altogether. (Andersson & Stålhandske, 2020)

In Sweden’s neighboring country, Finland, Silvennoinen et. al. (2015) conducted a study about food waste in the Finnish hospitality sector. In figure 1 it is shown where the food waste (stated in % of total food produced) originates in different food service outlets. The authors report that in restaurants and diners 18,8% of the produced food are wasted. Unlike other food service forms, restaurants see the majority of food waste coming from plate waste. This means that of all the produced food, 9,5% end up as customers leftovers (so called plate waste), 3,7% as serving waste and 5,6% as kitchen waste. In other words, customer leftovers account for roughly half of the total food waste in restaurants and diners. (Silvennoinen et. al., 2015)

Figure 1

Origins of Food Waste in Different Food Service Outlets by Silvennoinen et. al. (2015)



Note. This model was produced by Silvennoinen et. al. in 2015. From: Food waste volume and origin: case studies in the Finnish food service sector. *Waste Management*, 46 , 140-145, p.143.

2.3 Drivers of Food Waste in the Restaurant Industry

In their systematic literature review, Dhir, Talwar, Kaur & Malibari (2020) present the drivers of food waste in the hospitality sector that have been identified in the reviewed literature. This is of importance since effective food waste management requires an in-depth understanding of food waste's origin and quantity (Ai & Zheng, 2019). With our study object being active in the restaurant industry, a part of the hospitality sector, and the purpose of this study being to test and fine-tune the managerial framework for food waste mitigation, a list of drivers and solutions commonly identified in the literature used for this study is being compiled to evaluate the validity of the theoretic model chosen for this work. Dhir, Talwar, Kaur & Malibari's list of drivers of food waste in the hospitality industry is used as a starting point and drivers identified in other relevant articles are being added to it (see table 1).

Table 1*Compilation of Drivers and Solutions connected to Food Waste in the Restaurant Industry*

Article, Author, and Year	Drivers	Solutions
<p>Food waste in hospitality and food services: A systematic literature review and framework development approach</p> <p>By Dhir, Talwar, Kaur & Malibari, 2020</p>	<ul style="list-style-type: none"> • Food menu composition, pre-prepared versus whole food products and production procedure (McAdams et al., 2019) • Employees' skill levels (Kasavan et. al., 2019; McAdams et al., 2019) • Procurement procedures and product development (Heikkila et al., 2016) • Portion sizes (Berkowitz et al., 2016; Von Massow and McAdams, 2015) • Culture, inventory management and awareness of food waste's environmental impact (Lanfranchi and Giannetto, 2017). • Type of meal, opening hours and used ingredients (Principato et al., 2018) • Overproduction and food spoilage (Aamir et al., 2018) 	<ul style="list-style-type: none"> • Improve demand forecasting and purchase planning (Principato et al., 2018; Filimonau et al., 2019a; Filimonau et al., 2020b; Bharucha, 2018; Charlebois et al., 2015; Pirani & Arafat, 2016) • Improve menu design (Principato et. al., 2018) • Increase staff commitment (Strotmann et. al., 2017) • Facilitate harmonic interactions between staff and diners (Pirani & Arafat, 2016) • Reduce overproduction (Aamir et. al., 2018) • Handle and store food items correctly (Barucha, 2018; Aamir et. al., 2018 and Principato et. al., 2018) • Increase or maintain cooking skills (Okumus, 2020; Papargyropoulou et. al., 2019) • Minimize spillage of dishes during the serving process (Okumus, 2020) • Ensure consistent and visually pleasing plating of dishes (Betz et. al., 2014) • Appropriate portion sizes (Betz et al., 2014; Charlebois et al., 2015)

		<ul style="list-style-type: none"> • Readiness to use doggy bags for possible leftovers (Hamerman et. al., 2018) • Attitudes regarding food waste (Lorenz et al., 2017; Sirieix et al., 2017)
<p>Global food losses and food waste – extent, causes and prevention</p> <p>By Gustavsson, Cederberg, & Sonesson, 2011</p>	<ul style="list-style-type: none"> • Only general drivers of food waste are identified in this article, of which the following are applicable to the hospitality sector: • Consumer behavior • Poor coordination within the supply chain • Insufficient purchase planning • Expiring “best-before-dates” • Consumers can afford to waste food 	<ul style="list-style-type: none"> • Raise public awareness about food waste • Redistribution of overproduction and leftovers via donation or selling • Education on safe and hygienic food handling
<p>Final Report - PREPARATORY STUDY ON FOOD WASTE ACROSS EU 27</p> <p>By Monier et. al., 2010</p>	<ul style="list-style-type: none"> • Portion sizes • Logistics (demand forecasting) • Attitudes (refusal of “doggy bags”) • Awareness • Knowledge (of food redistribution options) 	<ul style="list-style-type: none"> • Standardized measuring and reporting methods for food waste • Revise food labels • Set EU-wide food waste targets • Collect food waste separately • Raise consumers’ awareness about food waste
<p>Food waste within food supply chains: quantification and potential for change to 2050</p> <p>By Parfitt, Barthel & Macnaughton , 2010</p>	<p>Only general drivers of food waste are identified in this article, of which the following are applicable to the hospitality sector:</p> <ul style="list-style-type: none"> • Low price of food • Disconnection between consumers and the production of food (food is not highly valued) 	<ul style="list-style-type: none"> • Change consumers’ values through education about food waste • Strengthen problem awareness • Extend shelf life through technical advancement

<p>Food waste: Causes, Impacts and Proposals</p> <p>By BCFN, 2012</p>	<ul style="list-style-type: none"> ● Over-generous portions ● Mistakes during purchase planning ● Customers not taking leftovers home due to lack of opportunities provided or lack of acceptance for these opportunities (refusal of doggy bags) ● Inappropriate ordering ● Incorrect forecasting of demand ● (Mis)interpreting food labeling ● Storage and preservation errors 	<ul style="list-style-type: none"> ● Standardized definitions and measurement methods for food waste ● Better understanding of drivers of food waste ● Prioritize food waste prevention, not re-use or redistribution ● Find ways to reuse or redistribute food waste/leftovers ● Put food waste management high up on the political agenda ● Improve food supply planning via cooperation within the food supply chain ● Raise awareness about food waste and its consequences amongst consumers
---	---	--

The listed drivers range from consumers’ attitudes (Monier et. al., 2010), over opening hours (Principato, Pratesi & Secondi, 2018) to incorrect demand forecasting (BCFN, 2012; Monier et. al., 2010; Gustavsson, Cederberg, & Sonesson, 2011; Filimonau & De Coteau, 2018). But despite this great variation, recurring themes can be found, and common drivers identified. The common drivers of food waste in the hospitality industry according to the studied literature are (i) poor demand forecasting/poor purchase planning, (ii) (over-generous) portion sizes, (iii) consumers’ behavior and attitudes, (iv) food labeling issues, (v) insufficient inventory management/ storage errors, (vi) menu design, (vii) cooking process/ production procedure and (viii) refusal of so-called “doggy bags”. Of these nine common drivers, the two most frequently mentioned are *poor demand forecasting/poor purchase planning* and *(over-generous) portions sizes*.

2.4 Solutions to Food Waste in the Restaurant Industry

In this section, solutions that are being suggested by the articles’ authors in connection with the drivers of food waste (see table 1), are being presented and elaborated.

Dhir et. Al. (2020) identify three different stakeholder categories in which food waste reduction measures can be anchored. These stakeholder categories are a restaurant’s *manager*, *staff*, and *diners*. For each of these stakeholders, variables that can either lead to food waste generation or the reduction thereof are listed. For managers to contribute to food waste mitigation, they

can improve forecasting and purchase planning processes (Principato et al. , 2018; Filimonau et al., 2019a; Filimonau et al., 2020b; Bharucha, 2018; Charlebois et al., 2015 and Pirani and Arafat, 2016), work with menu design (Principato et. al., 2018), increase commitment amongst staff (Strotmann et. al., 2017) and facilitate harmonic interactions between staff and diners (Pirani & Arafat, 2016). Concerning the staff as a stakeholder, the possibilities to reduce food waste within the kitchen range from reducing overproduction (Aamir et. al., 2018), over handling and storing food items correctly (Barucha, 2018; Aamir et. al., 2018 and Principato et. al., 2018) to increasing or maintaining cooking skills (Okumus, 2020; Papargyropoulou et. al., 2019). Serving staff can combat food waste generation by minimizing spillage of dishes during the serving process (Okumus, 2020) and by ensuring consistent and visually pleasing plating of dishes (Betz et. al., 2014). From the diners' perspective leverage points are appropriate portion sizes (Betz et al., 2014 and Charlebois et al., 2015), readiness to use doggy bags for possible leftovers, (Hamerman et. al., 2018) and attitudes regarding food waste (Lorenz et al., 2017; Sirieix et al., 2017).

In the report “Global food losses and food waste” from 2011 by Gustavsson, Cederberg & Sonesson general drivers and solutions of food losses and wastes are presented. The drivers and the solutions are not specially geared towards the hospitality sector. In fact, the constituents of the food supply chain most frequently addressed are individual consumers, retail, the agricultural production stages, and the linkages between these entities of the supply chain. Despite not specifically addressing the hospitality sector, several of the drivers identified in the report are applicable to the hospitality sector (see table 1). The authors (Gustavsson, Cederberg & Sonesson, 2011) continue by suggesting prevention methods for each of the causes of food waste. Prevention methods or solutions relevant to the hospitality sector are most and for all (i) raising public awareness about food waste and its consequences and thereby changing consumer attitudes, (ii) finding or creating market channels through which “sub-standard”(while still being safe and desirable for consumers) products can be sold or donated, and (iii) increasing skills and knowledge concerning safe and hygienic food handling throughout the whole food supply chain.

The preparatory study of Monier et. al. (2010) begins like many reports by identifying the causes or drivers of food loss and waste. The drivers that are affecting the hospitality industry directly, are listed in the table above (see table 1). Solutions for the hospitality industry suggested by Monier et. al. (2010) are “pay-by-weight” systems in combination with self-

serving, avoiding single serving items (e.g., small butter or jam packages), require customers to make a table reservation in advance, avoiding “all-you-can-eat-buffet” approaches, enabling and encouraging the use of doggy bags, and researching where and how leftover food can be donated or otherwise saved from being thrown out. After creating an inventory of the food waste prevention initiatives during the years 2010 and prior, Monier et. al. (2010) concludes by giving five policy recommendations. It is recommended to (i) introduce standards on how to measure and report food waste quantities, (ii) revise food date labels in order to clarify their meaning and to (partly) standardize them throughout the European Union, (iii) set union-wide targets for the prevention of food waste, (iv) collect food waste separately and to (v) raise individual consumers’ awareness about food waste by running information campaigns (Monier et. al., 2010). While the policy recommendations cannot be applied to restaurants and other hospitality businesses directly, the recommendations can be a hint for how to combat food waste within the industry.

When discussing possible solutions against food waste, Parfitt, Barthel & Macnaughton (2010) begin by emphasizing that the entire food supply chain needs to be subjected to food waste prevention initiatives and not only parts of it. For developed countries such as Sweden, the authors identify the most promising solutions as (i) educating consumers and thereby changing consumers’ values through deepened knowledge, (ii) strengthening the problem awareness throughout the food supply chain (including consumers), and (iii) extending shelf life of products through technical advancement. Additionally, it is expected that educating consumers about how to store food correctly and how to read and interpret food labels, as well as making food labels clearer and easier to understand, can lead to a reduction of food waste.

In the report “Food waste: causes, impacts and proposals”, the Barilla Center for Food & Nutrition Foundation (hereafter: BCFN) (2012) proposes seven suggestions on how less food waste can be produced and how the negative impact of food waste on the environment and economy can be reduced. As a start, it is suggested to introduce “common definitions and metrics” (BCFN, 2012, p.112) both for how food waste and loss are to be understood and how they are to be measured. Secondly, the authors call for deeper, more detailed knowledge on the causes of food waste. The third suggestion is a matter of reprioritization: the primary focus has to be on avoiding food waste all together, not on measures of food waste recovery. Instead of immediately concentrating on how food waste can be reused or redistributed, the question that should be addressed first is how food waste can be avoided or at least be reduced in its amount.

However, it is necessary to find ways to use or reuse food waste, either through distribution or through finding new utilizations, and doing so is proposed as the fourth solution by the authors. Further, it is suggested that managing and combating food must be put up high on the political agenda which allows a unified approach to food waste reduction throughout the whole food supply chain. The sixth suggestion stresses the importance of cooperation. The cooperation between different entities within the food supply chain is suggested to improve the “planning of food supply” (BCFN, 2012, p.112) and thereby cut food waste. The list of prevention ideas concludes with the point “information for education” (BCFN, 2012, p.112). This refers to the necessity of raising awareness about food waste and its consequences amongst consumers and showing them how to change their planning, purchasing, preparation and disposal behaviors.

In a similar fashion to how common drivers of food waste have been identified above, recurring themes in relation to suggested solutions can be found in the studied literature as well. The most frequently mentioned mitigation approach is to increase awareness among consumers, for example through information campaigns or other educational efforts (see Dhir et. al., 2020; Parfitt, Barthel & Macnaughton, 2010; BCFN, 2012; Gustavsson, Cederberg & Sonesson, 2011 and Monier et. al., 2010). Another commonly suggested measure is for operators in the hospitality industry to redistribute more of their overproduction either by donating or selling leftover food (Dhir et. al., 2020; BCFN, 2012 and Gustavsson, Cederberg & Sonesson, 2011). Avoiding buffet-style food serving is also recommended recurrently (Gustavsson, Cederberg & Sonesson, 2011; BCFN, 2012; Dhir et. al., 2020 and Monier et. al., 2010). And finally, the need for introducing standardized methods for measuring and reporting on food waste is expressed throughout the literature (Monier et. al., 2010; Dhir et. al., 2020; Parfitt, Barthel & Macnaughton, 2010 and BCFN, 2012).

2.5 Theoretic Framework for Food Waste Management in Hospitality Operations

As described in the purpose, an assessment of a theoretic framework from the perspective of a Swedish lunch restaurant context is the course of action of this paper. What now follows is a presentation of the chosen theoretic framework.

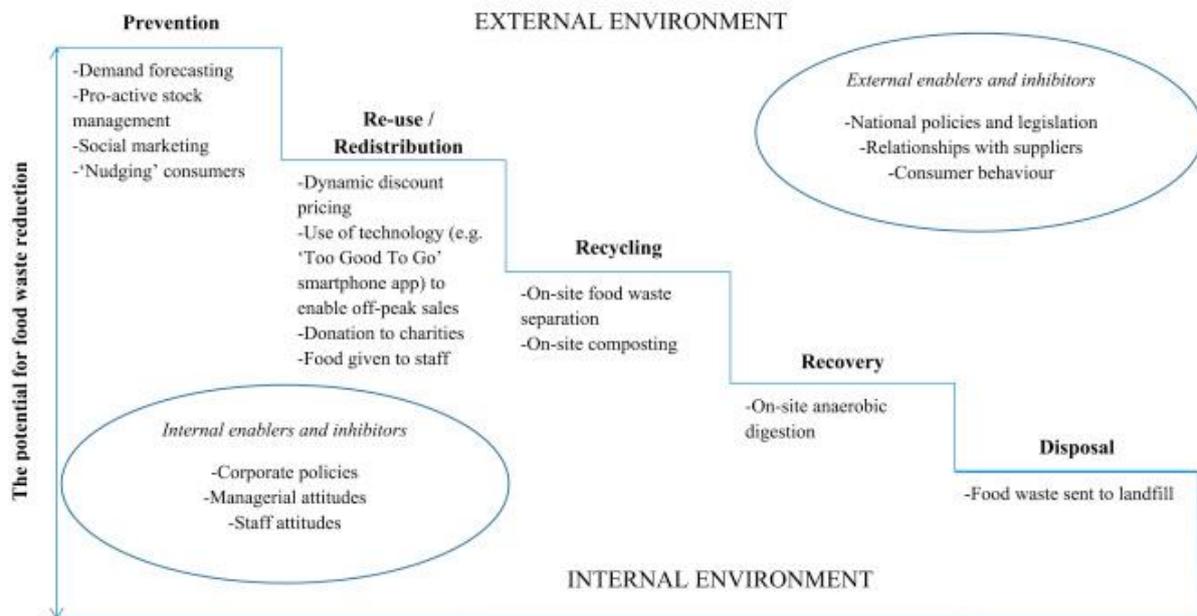
A theoretic model concerning waste mitigation and management in general that is seen in different shapes and names around the world but with similar components and thus can be considered well known is the Waste Hierarchy, amongst others implemented by the EU in 2008(EU, 2008). The Waste Hierarchy model has been adapted to the context of food waste by

Papargyropoulou et al.(2014) and was named the Food Waste Hierarchy. This model takes on a holistic approach of the food supply chain and is a framework of priorities for most efficient waste mitigation. It considers all three dimensions of sustainability (environmental, economic and social), and concludes that the highest priority is prevention by avoiding food surplus and preventing avoidable food waste, followed by re-use by redistributing surplus food to people in need. Next options are recycling as animal feed or by composting, recovery by extracting energy through anaerobic digestion and only as a last resort disposal into landfill in a controlled manner.

In a critical review of food waste management in hospitality operations by Filimonau & De Coteau (2018), the food waste hierarchy is further developed as they add internal and external factors that can either help or hinder food waste mitigation and introduce examples of tools to use in practice for food waste mitigation (see figure 2). Filimonau & De Coteau (2018) call this the “Hospitality food waste transformation framework with examples of activities that can be undertaken by hospitality managers to minimise food waste occurrence” (p.241). In the prevention phase, examples of factors mitigating food waste are better forecasting of the demand, stock management and nudging consumers in different ways through information campaigns, portion size controls etc. In the Re-use/Redistribution phase, selling leftover meals via different apps or donating to charity are mentioned. In the Recycling phase, composting waste and subsequently using it as fertilizer is investigated as an attractive solution. In the Recovery phase the anaerobic digestion of waste is suggested to extract energy, preferably on-site, but limited space can be a constraint. As a last resort food waste should be sent to landfill in the Disposal phase. When it comes to factors helping or hindering waste mitigation, internal factors can be corporate policies, which can be highly focused on sustainability as a part of the business model or the opposite, very strict regarding food safety, thus restricting re-use and redistribution of food waste. Managerial and staff attitudes and knowledge also are significant factors either promoting or discouraging food waste mitigation since it influences the actual efforts and achievements being made within this area. External factors can be national policies and legislations where an example mentioned is strict legal responsibilities when donating food which can be a constraint to this action. Also, relations and cooperation with suppliers and consumers’ attitudes towards food and the discard of leftovers affect the amounts of food waste generated.

Figure 2

The Hospitality food waste transformation framework by Filimonau & De Coteau (2018)



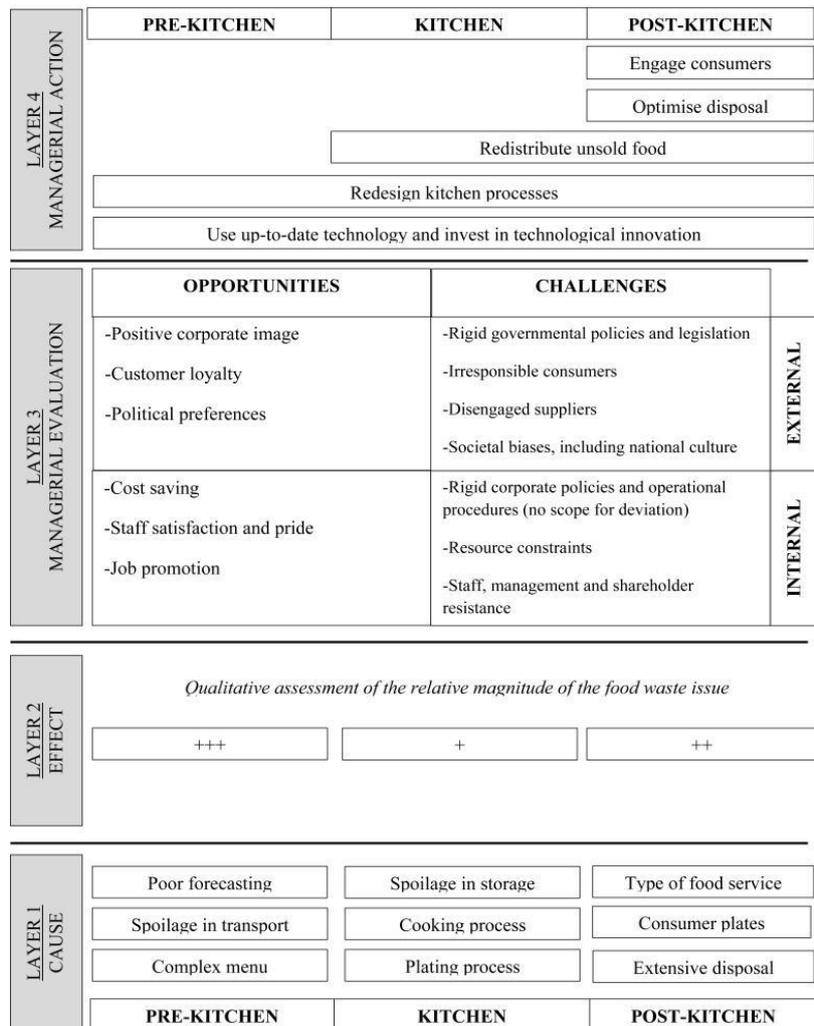
Note. This model was produced by Filimonau and De Coteau in 2018. From: Food waste management in hospitality operations: a critical review. *Tourism Management*, 17, 234-245, p. 241.

Drawing upon the idea of the hospitality food waste transformation framework, Filimonau and De Coteau (2018) continue the work in their critical review by also presenting two models based on their findings, which are of interest to this case study.

First, a framework of critical evaluation is presented (see figure 3) which addresses causes, effects, managerial evaluations, and finally managerial actions for hospitality food waste mitigation.

Figure 3

The Framework of Critical Evaluation by Filimonau & De Coteau (2018)



Note. This model was produced by Filimonau and De Coteau in 2018. From: Food waste management in hospitality operations: a critical review. *Tourism Management*, 17, 234-245, p. 238.

The authors state that within the hospitality business, waste mitigation efforts can be applied during three stages which form the foundation of the framework: Pre-kitchen, kitchen and post-kitchen. In these stages different causes of food waste are identified and together this forms the first layer of the model. In the pre-kitchen stage, waste can be minimized by careful menu planning, cooperation with suppliers, stock management and accurate forecasting of expected demand. The kitchen stage focuses on proper and efficient usage of raw ingredients. In the post-kitchen stage active interaction with customers to minimize leftovers and handling of surplus food are key factors. In the second layer the authors introduce the financial aspect of the matter and assess the magnitude and potential savings of mitigation efforts in the different

stages. It is concluded that the pre-kitchen and post-kitchen stages have the biggest influence on waste mitigation and financial savings. Layer three identifies opportunities and challenges with dealing with the issues and divides those opportunities and challenges into being affected by internal or external factors. The final layer identifies actions to be performed by managers in order to succeed with the food waste mitigation.

Following the framework of critical evaluation, Filimonau & De Coteau (2018) present their managerial framework for food waste mitigation, hereafter: the managerial framework (see figure 4). It builds on the previous model and serves the purpose of summarizing specific practical management actions, core in-house competencies and financial resources required for waste mitigation as well as the financial potential of actions as follows:

Figure 4

The Managerial Framework for Hospitality Food Waste Mitigation by Filimonau & De Coteau (2018)

Operational stage	Pre-kitchen (pre-consumption)				Kitchen				Post-kitchen (consumption)	
Operational area	Demand forecasting	Procurement	Stock management	Menu design	Storage	Preparation	Plating	Serving	Sale / Customer service	After sale / After service
Operational measures to reduce food waste	Maintaining continuous 'cold chain' - input from all stakeholders required									
	Regular food waste monitoring - input from all stakeholders required									
	Evidence-based forecasts	Short and responsive food supply chain	Demand-driven stock forecasting	Analysis of recipes	Contemporary technology and modern facilities	'Skilful' cooking	Portion control	Full plate service versus buffet service	Education and awareness-raising	Revenue maximisation for unsold food via use of technology (e.g. 'Too Good To Go' smartphone app)
	Use of (more advanced) demand forecasting models			Portion size planning						Food re-use / redistribution
	Use of seasonal ingredients									
			Re-use ingredients			'Skilful' plating			Food recycling Food recovery	
Core in-house competencies required	Understanding of demand drivers	Knowledge of suppliers and negotiation skills	Regular stock inventory	Knowledge of menu engineering	Knowledge of kitchen equipment	Knowledge of cooking and food serving techniques		Understanding the implications of the adopted business model and addressing them pro-actively	Knowledge of consumer behaviour and principles of behavioural economics	Knowledge of appropriate (technological) solutions and how to access these
Training needs	Managerial and chef training		Chef training		Kitchen staff and chef training	Chef training		Managerial, chef, kitchen and waiting staff training	Waiting staff training	Managerial, chef, kitchen and waiting staff training
Estimated initial investment cost	High		Low	Medium		Low	Medium	Low	Low/Medium	
Estimated potential financial savings	High				Medium	Low	Medium	High		

Note. This model was produced by Filimonau and De Coteau in 2018. From: Food waste management in hospitality operations: a critical review. *Tourism Management*, 17, 234-245, p. 242.

In this model the actions providing the highest financial returns are found in the pre-kitchen and post-kitchen stages. By assessing the demand accurately, the right amounts of raw materials are purchased and processed and therefore waste is avoided in the first place which

is the preferred way of mitigation according to the waste hierarchy. Another important issue is the cooperation and negotiation with suppliers enabling an efficient purchase process. However, these measures and competencies require an initial investment and for the two mentioned mitigation efforts, advanced demand forecasting and negotiation skills, the initial costs are estimated to be high. Other sources of food waste with large savings potential are located in the post-kitchen stage: consumer awareness of the issue and the handling of leftover food. By making the consumer aware of the problem and the negative effects of food waste, the amounts of food on the plate can be better optimized and adapted to the customers' needs, and the utilization of doggy bags for leftovers can gain acceptance. Re-use and redistribution of unsold food into new dishes or take away boxes also decreases waste, creates income from food otherwise wasted and reduces the cost for waste disposal. The initial costs of the efforts in the post-kitchen stage are estimated as low to medium while estimated potential financial savings are high and thus these efforts are likely to be financially profitable.

As can be seen in the above explained frameworks, the causes of food waste and recommended prevention measures suggested by Filimonau & De Coteau (2018) overlap to a great extent with the earlier identified common drivers and solutions in the studied literature and thereby lending credibility to the chosen model. Examples of these overlaps are:

- Poor demand forecasting leading to mistakes in purchase planning and overproduction (BCFN, 2012; Monier et. al., 2010; Gustavsson, Cederberg, & Sonesson, 2011; Dhir et al., 2020)
- Storage and inventory management leading to spoilage and expiring “best-before-dates” (BCFN, 2012; Gustavsson, Cederberg, & Sonesson, 2011; Dhir et al., 2020)
- Menu design(Dhir et al., 2020)
- Type of food service (Dhir et al., 2020; Monier et. al., 2010)
- Cooking and plating process and skills (Dhir et al., 2020)
- Portion size control (BCFN, 2012; Monier et. al., 2010; Dhir et al., 2020)
- Consumer awareness and behavior (BCFN, 2012; Gustavsson, Cederberg, & Sonesson, 2011; Monier et. al., 2010; Parfitt, Barthel & Macnaughton, 2010)
- Re-use and redistribution of food waste(BCFN, 2012; Monier et. al., 2010; Gustavsson, Cederberg, & Sonesson, 2011; Dhir et al., 2020)

The authors do not consider the framework complete, but to serve as a basis that can be developed and adjusted to the particular context where it is used (Filimonau & De Coteau, 2018). This prompt from the authors encouraged us in our choice of model.

3. Method

The method section is structured in accordance with Patel & Davison's (2016) suggestion and starts out with the identification of research participants in the form of organization and individuals. The next part comprises a presentation and discussion of the techniques that we used for data collection. This is followed by a discussion about validity and reliability. Here we also take the chance to discuss possible biases.

3.1 Study object

At first a broad area of interest was identified: resource efficiency within a corporate sustainability context. The next step was to find a suitable case to study. The chosen case is a lunch restaurant situated in central Gothenburg that has a distinct sustainability profile (Martina S., personal communication) and that is looking to improve its sustainability work, more precisely the ways how the restaurant can mitigate food waste. This study object was found via Miljöbron Väst, a sustainability agency that has a business relationship with said lunch restaurant. A preformulated case, provided by Miljöbron in collaboration with the lunch restaurant, was then adapted to suit the task of writing a scientific report within the field of corporate sustainability. This company was chosen because it had expressed the explicit wish to work with these issues and because of a preexisting connection to Miljöbron Väst. Furthermore, the restaurant has a clear sustainability focus and the project was set up with the explicit goal to find ways to mitigate food waste. This led us to believe that the restaurant was suited to be the study object of a case study and might even be considered a critical case and therefore allowing to transfer key findings to similar cases (Eriksson & Kovalainen, 2016).

As a means of trying to find resulting implications from the food waste mitigation actions done, we believed a comparison between our case restaurant and another restaurant with the same owner, but a more traditional business mindset would be of help. Our focus in this comparison was on the financial consequences of food waste mitigation.

3.2 Interviewees

To gain a broad perspective on the operations within the restaurant, interviewees filling different roles in the company was chosen. The interviewees are the restaurant's owner, two cooks, one on-site manager and the restaurant's current communications intern.

3.3 Data collection

Concerning data collection, several techniques were applied. Certain data and information were provided by the restaurant itself or by Miljöbron. This was mainly the case for information about the restaurant's different initiatives on reducing food waste and about the restaurant's financial performance and other key-performance indicators. Financial data in the form of annual reports and sales reports from both restaurants were supplied by the common owner, and the data was extracted in order to facilitate comparison between the two restaurants despite their business models not being exactly similar. To widen the scope of the financial comparison, contact was established with the Swedish hospitality industry organization Visita and a report on key figures of the hospitality industry published in 2013 (Visita, 2013) was supplied, along with a short informal interview with the chief economist Thomas J. Additionally, interviews with restaurant employees and managers were designed and conducted. The purpose of these interviews was to contextualize the numerical data and deepen our understanding of the restaurant's food waste initiatives and the company's general organizational and managerial structure. The interviews were designed to be short, qualitative interviews of a guided and semi-structured nature (Eriksson & Kovalainen, 2016). This approach allows for an informal and relaxed interview atmosphere while still producing somewhat structured and systematic interview material (Eriksson & Kovalainen, 2016).

According to Patel & Davidsson (2016), when it comes to qualitative studies the concepts of validity and reliability are intertwined and overlapping to such an extent that the concept of reliability is hardly being used. Validity aims at using measuring methods that are able to measure the phenomena that is being studied. Within qualitative research, validity focuses on the internal logic of the analysis. To ensure a good internal logic is to ensure validity within qualitative research. (Patel & Davidsson, 2016) The analysis and comparison of restaurants' gross margins is an attempt to find evidence for a correlation between food waste mitigation and a positive financial performance. However, this analysis does not allow for statements about causality, and findings have to be interpreted with caution.

Financial performance data from the restaurants Waste and Ooto was supplied by the common owner of the businesses. The aim of comparing Waste and Ooto was to explore whether any significant differences in financial aspects can be found depending on their varying focus on waste mitigation. This was done by finding common measures within the financial statements, such as the gross margin. To find more clearly visible patterns we would have needed a longer history of data than the maximum available of 2019 to Q1 2022. One example of data not perfectly fitting our cause is the Cost of Various Food, where e.g., coffee is included which is then sold both as a part of the lunch offering and separately through various arrangements with companies in the same building, which incomes we have chosen not to include in order to focus on the food part of the business. However, our opinion was that this deviation was minor and had no large consequences for the study.

3.6 Literature Review and Source Criticism

A literature search was conducted via different academic web search engines using the search terms *sustainable restaurants*, *food waste*, *food waste mitigation* and *waste management*. This led to the formulation of a theory section. The articles used in formation of the theory chapter are peer reviewed to ensure reliability and validity.

Because some of the data is provided by the study object itself or a party in close relation to them, it is crucial to be cautious and try to validate the data. Also, it has to be considered that responses from persons working close together within the same organization might be very homogeneous and therefore results might be skewed. Issues of reliability have been taken into consideration by using official financial and non-financial statements, and other public documents.

4. Result and Analysis

In this section, findings from the interviews are compiled, presented, and analyzed with help of the managerial framework, the hospitality food waste transformation framework, and the framework of critical evaluation.

4.1 Interview responses

For this study, a total of 6 staff members of Waste were asked to participate in a personal interview. Due to time constraints and the respondents' preferences, 4 interviews were held in person and 2 staff members answered the questions of the interview guide (see appendix 1) in writing instead, of which one answer was delayed and therefore not included. What follows now, is a compilation and analysis of the collected empirical material. The main themes that were discussed during the interviews were the motives for reducing food waste, which food waste mitigation initiatives have been implemented or suggested by the staff, the sources of food waste for this particular organization and obstacles to successful food waste mitigation and management.

4.1.1 Motives for food waste mitigation

All respondents agree that it is of uttermost importance for the restaurant to try and reduce its food waste. While some emphasize economic reasons, other respondents see it as a moral duty, as necessary for legitimacy or just the natural thing to do. The given economic reasons were the potential to save costs, both by cutting procurement costs and by lowering waste disposal expenses, and an improved ability to attract customers due to delivering a sustainable, high-quality product. Several of the respondents expressed their satisfaction about how their workplace's vision, to reduce food waste, aligns with their personal beliefs and several times a sense of pride could be detected. When asked, all respondents say that working at Waste differs from working at other restaurants in Sweden or globally as the focus on sustainability and food waste is much more articulated than previously experienced.

The responses given to the question on why the restaurant should combat food waste can be compared to the opportunities, both external and internal, presented in layer 3 of Filimonau's and De Coteau's (2018) framework of critical evaluation. Opportunities that were named during the interview sessions and that can be found in Filimonau's and De Coteau's (2018) framework are *cost saving* and *staff satisfaction and pride*. During several interviews the respondents expressed that they believe food waste mitigation to lead to customer loyalty and

a positive corporate image. But because no external interviewees, e.g., customers, were included in the study, external opportunities, such as customers' loyalty or a positive corporate image, could neither be confirmed nor disproven and are therefore not marked as overlaps in figure 5. However, the given responses of the staff members indicate that they also see these external opportunities as relevant for their restaurant.

4.1.2 Obstacles to food waste mitigation

The question about which obstacles to food waste mitigation there are at the restaurant yielded homogenous answers. All respondents identified time and money as the biggest hinder for the restaurant to improve its food waste mitigation efforts. Additionally, it was expressed that the necessary change in consumer values and behaviors, which is a key component to successfully reducing food waste, constitutes a challenge. Also, the difficulties in forecasting the number of customers and their demands were named as a significant problem. When discussing options for re-distribution of overproduction, strict legislation regarding food safety and liabilities was named as a hindering factor.

The respondents' statements can be compared with the managerial evaluation of internal and external challenges and opportunities (see figure 3) that Filimonau & De Coteau (2018) present in their article. This comparison yields many overlaps between the challenges suggested by Filimonau & De Coteau (2018) and the challenges expressed or observed during our empirical study. These overlaps are *strict or rigid policies and legislation*, *consumers' irresponsible behavior* and *resource constraints*. But internal challenges such as rigid policies within the organization or resistance from within the organization were not observed during this study. Whether disengaged suppliers or societal biases are constituting challenges for the restaurant of this case study cannot be evaluated based on the collected empirical material. This leads to the conclusion that the challenges for restaurant Waste lie both within the external and the internal sphere. Therefore, future food waste mitigation efforts need to address both spheres.

The overlaps between the opportunities and challenges suggested in the framework of critical evaluation and opportunities and challenges found in the empirical material are summarized and presented in figure 5.

Figure 5

Challenges and Opportunities at Waste

LAYER 3 MANAGERIAL EVALUATION	OPPORTUNITIES	CHALLENGES	EXTERNAL	
	-Positive corporate image	-Rigid governmental policies and legislation		EXTERNAL
	-Customer loyalty	-Irresponsible consumers		
	-Political preferences	-Disengaged suppliers		
		-Societal biases, including national culture		
	-Cost saving	-Rigid corporate policies and operational procedures (no scope for deviation)	INTERNAL	
	-Staff satisfaction and pride	-Resource constraints		
-Job promotion	-Staff, management and shareholder resistance			

4.1.3 Main causes of food waste

The respondents could choose up to three of eight drivers of food waste earlier identified as commonly mentioned throughout the studied literature (see section “Drivers of food waste”). The drivers or options that the respondents could choose between were (i) Difficulties in demand forecasting/purchase planning, (ii) Portion sizes not matching customers’ needs, (iii) Consumers’ behavior and attitudes, (iv) Food labeling issues, (v) Storage errors/inventory management problems, (vi) Menu design/choice of meals served, (vii) Cooking process/production procedure and (viii) Reluctance towards doggy bags (both restaurants and/or customers). The most frequently chosen option was *Difficulties in demand forecasting/purchase planning* with a response rate of 5, followed by *Consumers’ behavior and attitudes* and *Menu design/choice of meals served* with a response rate of 4 each. Even the alternatives *Storage errors/inventory management problems* and *Cooking process/production procedure* were named once each. However, here it was emphasized that lack of time caused the problem rather than lack of competence or knowledge.

Of note here is that, on the one hand, consumers are considered to be the main source of food waste during open-ended questions. But at the same time, demand forecasting, which is an internal skill and process, is chosen as one of the main sources of food waste during the multiple-choice questions. The application of the framework in the form of interview questions made this discrepancy visible.

The causes of food waste stated by the interviewees are all found in the framework of critical evaluation by Filimonau & De Coteau (2018) and demand forecasting, as well as consumer awareness, and behavior are among the most frequently identified drivers of food waste in literature about food waste mitigation in the hospitality industry. Other drivers frequently overlapping in the literature such as storage and inventory management leading to spoilage and expiration, portion size control and re-use/redistribution of food waste were to a large extent not considered main drivers of food waste in our case study. This could show that Waste has already come a long way in its efforts with food waste mitigation and that the theory in these cases is better suited for companies in the beginning of their implementation of food waste mitigation and management. According to the managerial framework, mitigation of food waste by better demand forecasting has the highest potential for financial savings of the chosen actions, but estimated initial investments are also stated to be the highest when implementing more advanced demand forecasting models. So, after picking the low hanging fruits, more extensive investments and efforts seem to be required in order to make a difference in the area of food waste mitigation.

4.1.6 Occurrence of food waste during different operational stages

All respondents state that the largest source of food waste lies within the post-kitchen stage. However, when respondents elaborated their answers on this question it became clear that one of the most significant challenges is the overproduction which in turn is caused by difficulties in forecasting demand which in the theoretical model belongs to the pre-kitchen stage.

Generally, this question led to some confusion, which sheds light on why dividing drivers between different stages in the production process as it is done in the managerial framework can be problematic: drivers of food waste in later stages are dependent on decisions and actions taken during earlier stages. This interdependence and interwovenness is difficult to depict, describe and explain by using only the managerial framework by Filimonau & De Coteau (2018).

4.1.2 Implemented measures against food waste

Already during the start-up phase, food waste mitigation has been considered. From the start a serving-method was chosen that is associated with less food waste. Food is being served by the kitchen staff and there are no buffet-options. Indeed, one respondent emphasizes that the idea of an all-you-can-eat salad-buffet was rejected due to the large amounts of food waste associated with this serving style. The restaurant's procurement process focuses on the use of

seasonal ingredients and is adapted to the goal to reduce food waste too: to an as high degree as possible, the restaurant buys produce and other raw ingredients that otherwise would have been discarded by the wholesalers.

The food waste mitigation effort that is named most frequently, is how the restaurant works with informing the customers about food waste and its consequences. This is done by setting up information graphics on the interior walls of the restaurant and through direct communication between one of the kitchen staff and the customers during the serving process. During that moment another food waste mitigation action/measure is taking place: Part of the direct communication between the staff and the customer is the question about the customer's desired portion size. Communication with the customers, both about portion sizes and the issue of food waste, was named as the most important and effective measure against food waste that has been implemented in the restaurant. However, adapting portion sizes to individuals' demand and needs is not guaranteed to happen because sometimes there is not enough time for this personal communication due to moments of high customer inflow, and the staff has to prioritize other tasks.

Another way the restaurant staff works with mitigating food waste, is by constantly expanding knowledge on food preparation methods and experimenting with new ways to utilize a bigger percent of the raw ingredients and thereby finding new areas of use for ingredients. This action targets both avoidable and unavoidable food waste. Even one day's overproduction gets re-used during the cooking process the next day and is being served as *bistro dishes, soups, wraps or take away boxes*.

In order to be able to quantify the restaurant's food waste, the customers' plate waste is being measured. This has been done since 2019. In addition to these measurements, a cooperation with Generation Waste has recently been initiated. Generation Waste is a company which through analysis, education and a digital measuring tool helps restaurants with reducing food waste in order to improve sustainability performance and profitability. Through measuring food waste in different stages in the food production chain, necessary actions are identified and implemented.(Generation Waste, n.d.) Unfortunately for this study, the access to Wastes historical measurement data has been delayed and not delivered on time to be included in this research paper. Also, the cooperation with Generation Waste is just in the beginning and no data is available during the work with this paper.

Another recently introduced food waste mitigation measure is time-differentiated pricing. While the idea of selling bistro dishes and other leftover products at a reduced price has been present for some time, a few months ago a time-differentiated pricing system for lunch was introduced. The restaurant serves lunch between 11:15 am and 2:00 pm. During the first half an hour the price for lunch is 109 SEK, the following 45 minutes the price is raised to 119 SEK and between 12:30 pm and 2:00 pm lunch costs 100 SEK (see picture X). The purpose of this is to achieve an even and steady inflow of customers instead of having everyone arriving at the same time. By achieving this evenness in customer inflow, the restaurant staff have time to communicate with every customer individually which is said to contribute to food waste mitigation as described earlier.

Most of the initiatives that the restaurant has undertaken can be categorized to be “prevention” measures in accordance with the hospitality food waste transformation framework. But the restaurant also works with re-use and redistribution in the form of price discounts and by turning overproduction into bistro dishes, soups, wraps and take away boxes. Further, the separation of food waste falls into the re-cycling category and despite not practicing compostation or anaerobic digestion on-site, the collected food waste is subjected to off-site anaerobic digestion and not ending up in a landfill.

When analyzing whether the restaurant’s food waste mitigation measures take place pre-kitchen, kitchen, or post-kitchen, it is the kitchen stage where many efforts are concentrated. However, this might be a consequence of the majority of respondents working in the kitchen stage themselves and therefore having the more knowledge about initiatives taken in this stage rather than during other stages. Moreover, when taking into account which initiatives are seen as most important by the staff, it is the post-kitchen stage that comes into focus.

Generally, the study object’s food waste management and mitigation are characterized by building a personal relationship with the customer. It is in direct conversation that portion sizes are adapted to customer needs, customers are informed about the restaurant’s procurement strategies and an appreciation for food and its origin is being fostered within the consumer. Although this personal relationship between staff members and customers is a core element in the food waste management strategy of Waste, relationship building is not named as a measure in any of the operational areas within the managerial framework presented by Filimonau & De Coteau (2018).

4.1.3 Proposed measures against food waste

In regard to the question what the restaurant should do to reduce food waste some responses were suggestions for operational actions while other suggestions can be categorized as more strategic or even prerequisites for successful food waste management. In terms of operational actions, it was suggested to increase knowledge amongst staff and customers through intensified communication efforts and education. Further, the idea was mentioned to work more with price differentiation for leftovers to decrease the amount of overproduction that has to be discarded. There are also plans to introduce a pay-per-weight system for salads to be able to offer a salad bar as a main dish option but without the food waste associated with all-you-can-eat buffet style serving. One respondent mentioned the possibility of starting a compost and generating revenue off of selling fertilizer. Several respondents communicated the need for more staff. One suggestion was to employ another person to be able to buy more sub-standard produce from wholesalers and work with the processing of food. This suggestion takes up the most significant restraint the restaurant faces at the moment: resources. It was also advocated to not publish the current week's menu in advance. This would allow for more flexibility which in turn enables the staff to adapt which meals they offer to whatever produce and other foodstuffs are available as discarded by wholesalers and have to be used most urgently.

The food waste mitigation measures suggested by various staff members fall well into Filimonau's and De Coteau's (2018) operational areas "menu design", "sale/customer service" and "after sale/after service". One action mentioned in the managerial framework is food redistribution. The managerial framework is suggesting the use of new technologies, e.g., the use of apps like "Too Good To Go" or "Karma" for selling leftover dishes as take-away. In our interviews, we asked about this option as an alternative, but it was rather solidly rejected. The reasons for this were the high costs and administration efforts that occur when using these apps. Instead, Waste has decided to handle redistribution on its own by selling take away boxes with food from previous servings at reduced price as well as using leftover food the following day as ingredients in wraps, soups and what they call bistro dishes.

When taking a long-term perspective, the respondents name a steady flow of customers as the overarching goal. The restaurant needs to have a steady flow of customers both during lunch everyday but also throughout the course of a longer time span in order to ease demand forecasting. This steady flow of customers is supposed to be achieved by increasing demand

without increasing the restaurant's capacity. The idea is, simply put, to improve the customer value offered by the restaurant and create demand up to and above the capacity of the restaurant meaning the restaurant will always have a steady demand because there are more customers willing to buy their product than the restaurant can sell. Secondly, customers' awareness of the food waste problem has to be increased and the willingness to compromise has to rise amongst the customers. During one interview an example is given, that if the restaurant had a steady customer inflow and customers were willing to compromise, it would be up to the restaurant to dictate some of the terms and conditions and thereby it would be possible to make more sustainable choices such as only offering vegetarian options on certain days.

The staff's long-term perspective is missing a pendant in Filimonau's and De Coteau's (2018) managerial framework as the framework is focusing on operational measures, not strategic ones. However, it can be said that the targeted, overarching goals address challenges in connection with the operational areas of *demand forecasting* and *sales/ customer service*.

Figure 6 visualizes the application of the managerial framework to Waste's food waste mitigation strategy. The areas where the majority of food waste has been identified to occur is marked with red. Implemented food waste mitigation measures are highlighted in green while suggested measures are highlighted yellow.

Figure 6

The Managerial Framework applied to Waste’s Food Waste Mitigation Efforts

Operational stage	Pre-kitchen (pre-consumption)				Kitchen				Post-kitchen (consumption)		
Operational area	Demand forecasting	Procurement	Stock management	Menu design	Storage	Preparation	Plating	Serving	Sale / Customer service	After sale / After service	
Operational measures to reduce food waste	Maintaining continuous 'cold chain' - input from all stakeholders required				Regular food waste monitoring - input from all stakeholders required						
	Evidence-based forecasts	Short and responsive food supply chain	Demand-driven stock forecasting	Analysis of recipes	Contemporary technology and modern facilities	'Skilful' cooking	Portion control	Full plate service versus buffet service	Education and awareness-raising	Revenue maximisation for unsold food via use of technology (e.g. 'Too Good To Go' smartphone app)	
	Use of (more advanced) demand forecasting models			Portion size planning							Food re-use / redistribution
				Use of seasonal ingredients							
	Re-use ingredients			Food recycling							
Core in-house competencies required	Understanding of demand drivers	Knowledge of suppliers and negotiation skills	Regular stock inventory	Knowledge of menu engineering	Knowledge of kitchen equipment	Knowledge of cooking and food serving techniques	Understanding the implications of the adopted business model and addressing them pro-actively	Knowledge of consumer behaviour and principles of behavioural economics	Knowledge of appropriate (technological) solutions and how to access these		
Training needs	Managerial and chef training	chef training	Chef training		Kitchen staff and chef training	Chef training	Managerial, chef, kitchen and waiting staff training	Waiting staff training	Managerial, chef, kitchen and waiting staff training		
Estimated initial investment cost	High		Low	Medium		Low	Medium	Low	Low/Medium		
Estimated potential financial savings		High			Medium	Low	Medium		High		

Note. The red areas in the model are the main sources of food waste according to the staff. Areas highlighted with green represent implemented food waste mitigation measures and yellow areas represent planned or suggested food waste mitigation measures. An area can be highlighted with none, one, two or three color(s).

4.2 Discrepancies between theory and practice

When analyzing the interview responses through the lens of Filimonau’s & De Coteau’s (2018) framework for food waste management many overlaps and similarities between theory and the collected empirical material can be identified. But within several areas, the comparison between theory and practice lead to the discovery of discrepancies and give an indication for possible fine-tunings that Filimonau & De Coteau (2018) themselves anticipate for their theoretical framework. In the managerial framework the focus lies on the initial cost for food waste reduction measures. However, during the interviews it came to light that it was the continuous amount of staff time needed that posed a challenge. This is of particular concern during the post-kitchen stage where the managerial framework names several operational measures, e.g., education and awareness raising of customers, food redistribution or food recycling.

Further, the managerial framework only focuses on how a company can reduce its own food waste, rather than how it can contribute to reducing the food waste that other companies within the food supply chain produce. To work with other actor's food waste as a resource is a food waste mitigation measure that is used in practice as our case-study shows and could be mentioned as an operational measure in the managerial framework.

The adaptation to national context is mentioned as necessary by Filimonau & De Coteau (2018) themselves. We suggest such an adaptation to the Swedish waste management system for the hospitality food waste transformation framework presented by Filimonau & De Coteau (2018). The version presented by the authors is missing that food waste does not have to be subjected to on-site anaerobic digestion to be recovered. In the Swedish context, off-site anaerobic digestion is the common destiny of food waste (Avfall Sverige, 2022.). The hospitality food waste transformation framework does account for external factors to foster or hinder food waste reduction, which this could arguably be. But we suggest adding off-site anaerobic digestion as a recovery measure for more clarity.

4.3 Waste's financial performance in comparison

Another objective of this study is to analyze the financial aspect of food waste mitigation and whether correlations between waste mitigation and management, and financial performance can be found.

4.3.1 Gross Margin Comparison

The key figures analyzed are the cumulative costs of raw materials acquisition set in relation to incomes from food service. A measurement of this is the gross margin of the operations which is calculated by the using the following formula:

$$\text{Gross margin (\%)} = (\text{Net revenue} - \text{Cost of goods sold}) / \text{Net revenue} \times 100$$

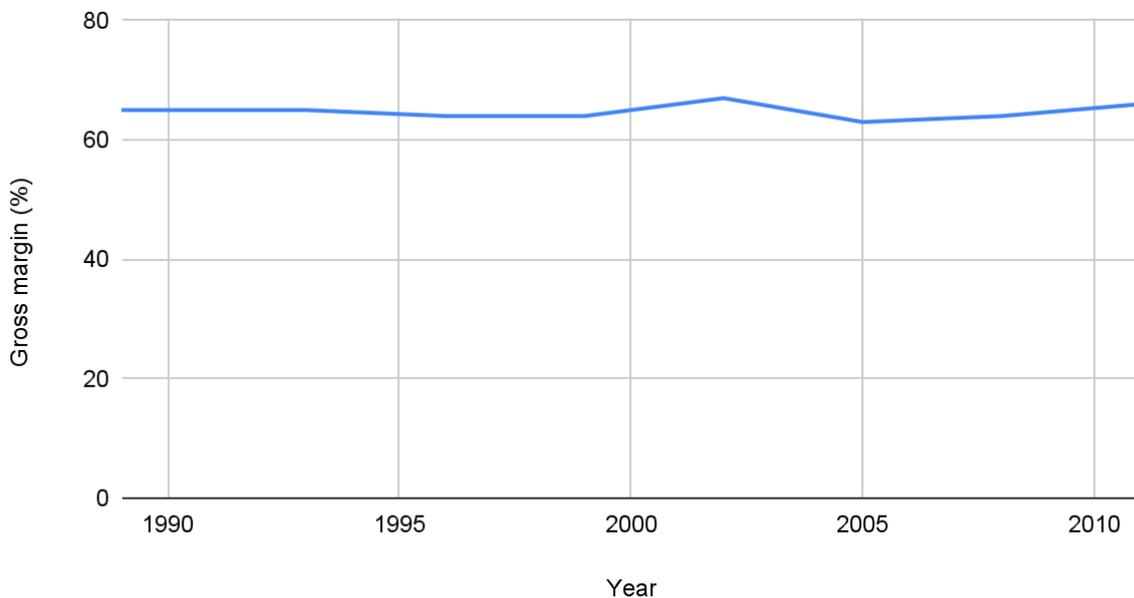
The gross margin gives a guidance on the possibility of profitable business because the higher the gross margin, the better leverage is deducted from the purchased raw materials. Calculating gross margin also helps estimating how much resources are left available for labor, marketing and other parts of the operation. Logically, successful food waste mitigation would mean a more efficient use of the resources acquired, leading to less resources bought and hence lower acquisitions costs and a higher gross margin. Therefore, examining and comparing the gross margin of different restaurants can aid to gain an understanding and possibly be evidence about

whether active food waste mitigation lowers raw material costs in relation to net revenue from food service.

In order to make this comparison, financial data was gathered from restaurants Waste and Ooto. The data retrieved is covering the period 2019 until and including Quarter 1 of 2022, meaning the entire life span of restaurant Waste. The comparison between Waste's and Ooto's gross margin was done to identify possible financially visible implications of the active work with food waste mitigation conducted by Waste. To widen the scope of comparison a report on key figures of the hospitality industry in Sweden published 2013 was used (Visita, 2013). This report is significantly older than the data retrieved from Waste and Ooto, but as stated in the report and also confirmed through personal communication with Thomas J, chief economist at Visita, the gross margin tends to be stable over time (see figure 7). Therefore, we considered Visita's report (2013) to be valid as a source for comparison and analysis.

Figure 7

Average Gross Margin in the Hospitality Industry



Note. This figure is based on data published in the report “Nyckeltalsundersökning 2013” by Visita (2013).

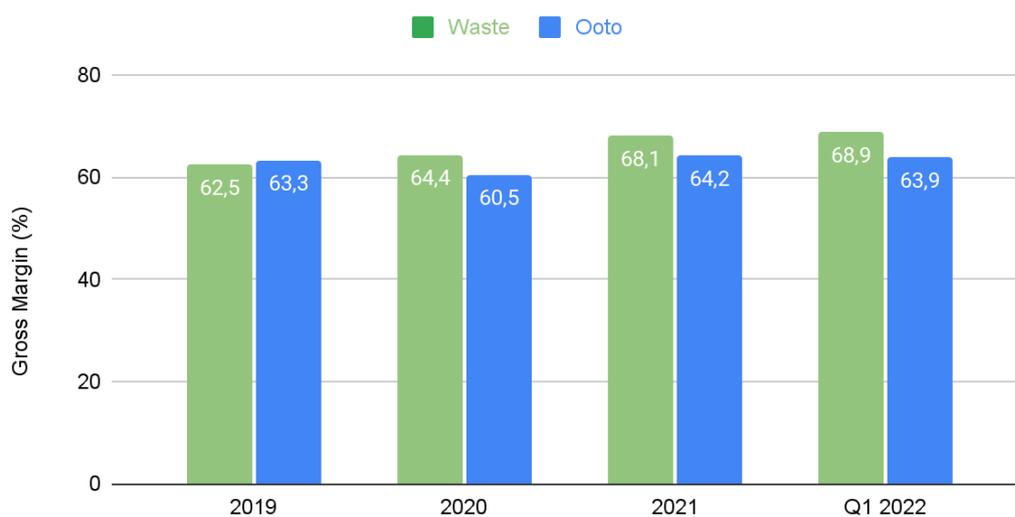
The average gross margin provided by Visita reflects all kinds of restaurants in the hospitality industry, but in the report particular figures for lunch restaurants in 2011 are also mentioned. It is concluded that lunch restaurants have the lowest gross margin of the different types of restaurants and also the highest variation in this key figure. Because of the high variation, no

mean value is presented, but the median value is 61%, where every fourth (upper quartile) lunch restaurant has a gross margin higher than 66% and every fourth (lower quartile) has a gross margin lower than 54%. (Visita, 2013)

Calculations of the gross margin for each year for restaurant Waste and Ooto are displayed in figure 8, and there are no unambiguous findings indicating large discrepancies between the two study restaurants. When looking at the numbers, restaurant Waste has a slightly higher gross margin from 2020 and onwards that increases over time. In the case of Ooto, from the numbers we were able to extract, no trends can be detected, and the gross margin is rather stable.

Figure 8

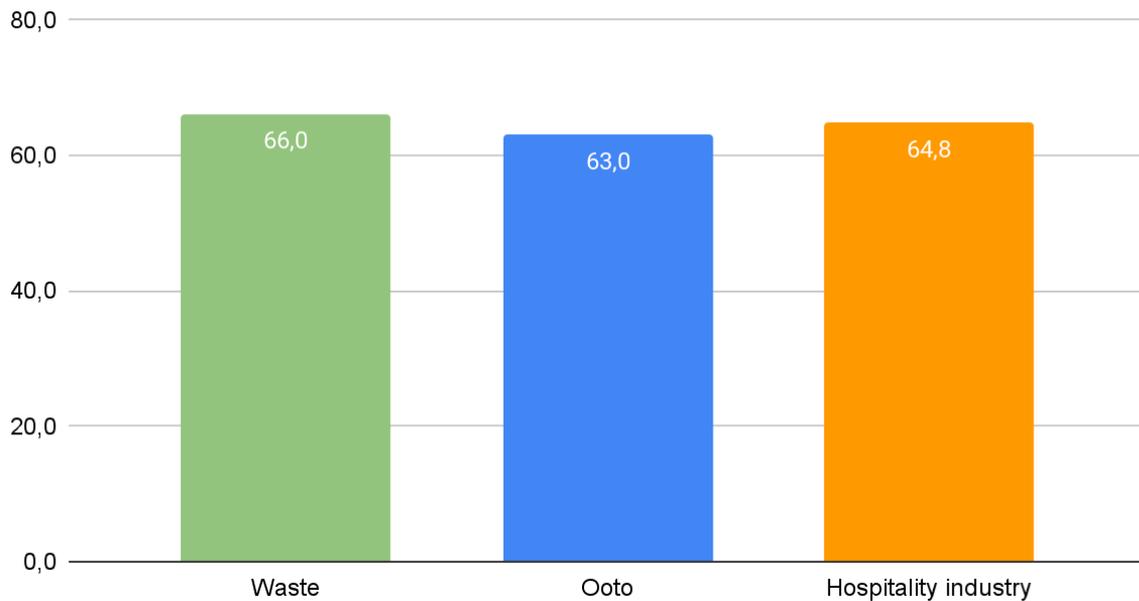
Comparison of Waste's and Ooto's Gross Margins



When comparing Waste's and Ooto's average gross margin with the average gross margin across all lunch restaurants no large discrepancies can be found (see figure 9).

Figure 9

Comparison of Average Gross Margins



However, considering the high variance in the gross margin for lunch restaurants supplied by Visita (2013), the positive trend at restaurant Waste depicted in figure 8 could be a sign of successful waste mitigation practices where organizational learning is improving the waste mitigation actions over time and hence contributes to cutting costs and thereby improving gross margin. But the analyzed time interval for Waste and Ooto is rather short, and it would have been interesting to see if it is a true trend of rising gross margins at Waste which will continue rising as more knowledge is gathered over time in the organization. Also, even with a confirmed positive trend of the gross margin this does not prove a causal relationship between food waste mitigation efforts and a higher gross margin. There can be several different factors influencing the financial result not visible in the applied numbers.

One important factor of influence during the majority of the studied time interval for our case restaurant is the Covid-19 pandemic, which hit the restaurant business hard (SCB, 2022). This has probably distorted the numbers in a way that would not have been seen if numbers were available for a “*business as usual*” time period. During the time of the pandemic, demand for food service was not only lower (SCB, 2022), but probably also much harder to predict, which might have resulted in forecasting problems and extraordinary amounts of over produced food going to waste and thus higher cost of goods sold, which affects the gross margin in a negative way. On the other hand, a solid knowledge and motivation for food waste mitigation and food

re-use could act as a crash pillow against this effect which would speak in favor of Waste. Mitigation and re-use could however only help up to a certain degree when a community is influenced to such a large extent as was the case during the pandemic. But despite a short time-interval and the pandemic, numbers are showing that as the society has moved on to a more normal situation, the restaurant business has started to recover (SCB, 2022). This could imply a more solid and predictable demand becoming visible, and in this case the improvement in the most recent numbers of Waste can be a sign of positive financial implications of their work with food waste mitigation.

A second factor of influence to the gross margin not visible in numbers is the actual quality of the ingredients bought by a restaurant. For restaurant Waste, buying an increasing amount of discarded food from wholesalers at reduced price would imply a higher gross margin over time, but as stated in one interview, the main purpose of this restaurant is not profit maximization but rather exploration of efficient sustainability actions. To the interviewee this meant that the more resources were made available through efficient waste management, the more could be spent on high quality ecological ingredients, which in turn has a balancing effect on the gross margin development of restaurant Waste.

Another aspect of interest is the fact that during interviews it was concluded that handling wasted raw ingredients requires more work. Therefore, the ambition was to make a comparison of labor costs in relation to revenues, but because labor costs are reported as one cost item for each entire company it was not possible to extract the amounts of labor costs explicitly stemming from food production in either case, resulting in this measurement being left unexamined. Considering the minor differences in gross margin between Waste and Ooto, the stated extra work required for taking care of discarded food from wholesalers could actually be significant enough to counteract the benefits of the slightly better gross margin, but this remains undiscovered.

4.3.2 Revenue from food redistribution

As earlier mentioned, one way of taking care of unsold food is by redistribution and Waste takes care of its overproduction in several different ways. By adding together the incomes from the initiatives *bistro dishes, wraps, soups and take away*, an income of 176614 SEK has been created through the redistribution and re-use actions in 2021. The revenue created by redistribution and re-use actions in Q1 of 2022 as well as what proportion of the total income is accounted for by these actions is summarized in table 2.

Table 2*Revenue from Food Redistribution at Waste*

	2021	Q1 2022
Incomes from food redistribution (in SEK)	176614	65956
As % of total income from Food Services	6,8	7,5

The incomes are so far only minor and constitute a small portion of total revenues, but still, it is a positive way of taking care of over produced food and constitutes a clear positive link between food waste mitigation and revenue creation.

One remark, which was also mentioned during interviews, is the fact that the sale of a dish consisting of redistributed food means a customer chooses this alternative instead of the daily offering, with the consequence that less of the fresh produced food is sold and a lower income is retrieved from the cheaper leftover dish. This finding is not fully consistent with the managerial framework, where the financial savings potential from food redistribution and re-use is stated to be high with low to medium initial investment requirements. Yet again, proper demand forecasting to minimize overproduction would be the most efficient way to overcome financial losses due food waste in our case study.

5. Discussion

In this case study we apply the theoretical managerial framework for food waste mitigation to a Swedish lunch restaurant with the aim to suggest adjustments to the managerial framework (Filimonau & De Coteau, 2018). Our observations are to a large degree consistent with Filimonau's & De Coteau's (2018) insights and findings, and the framework can in many ways be applied to the context of this study. For example, the analysis of opportunities and challenges in Layer 3 of the framework of critical evaluation is consistent with the reality of the case restaurant in several points. Opportunities such as cost savings and staff satisfaction and pride are articulated in our interviews as well as the challenges of consumer behavior and resource constraints.

The managerial framework also contains many aspects consistent with the case study. In the managerial framework, demand forecasting is estimated to have the highest savings potential. From interviews this was the most frequently mentioned main cause for food waste in the organization. One consequence of deficient demand forecasting is overproduction which in turn was identified to lead to the largest quantities of food waste at the case restaurant. Therefore, improving demand forecasting would lead to a significant reduction in food waste and the estimation in the managerial framework appears to be correct. Consumer behavior is also given a high savings potential in the framework. This driver was likewise frequently mentioned in interviews and by active interaction with customers, a better portion size control is achieved resulting in less plate waste. The third frequently mentioned cause for food waste was menu design and choice of meals served. Here the framework suggests operational measures like analysis of recipes, use of seasonal ingredients and re-use of ingredients and ascribe this area a high savings potential. In this area the case restaurant has come a long way already which has been described earlier. However, the idea to not publish the menu too long in advance and therefore remain more flexible and prevent raw ingredients from going bad, is not explicitly mentioned in the managerial framework.

This study has also pointed out some inconsistencies between theory and empirical findings. The managerial framework estimates initial investment costs for its suggested actions but does not really include any appreciation of resources required for continuation of these mitigation actions. For example, the re-use and redistribution of food requires more work according to our empirical findings, resulting in higher labor costs. Also, the nature of the restaurant business includes concentrated periods of high workload making it questionable if the model appreciates

this nature of the business, and hence if all actions are possible to implement in reality the way the model is suggesting regarding the number of employees required to handle mitigation actions and the consequential costs of this. The staff also describes that a lack of time and staff resources causes food waste, for example, there is not enough time to check what is in stock that needs to go soon. This is consistent with the challenge of resource constraints in the framework of critical evaluation. But when looking holistically at the managerial framework, spending more time on e.g., raising customer awareness could actually intensify the problem of stock management, and therefore lead to an increase in food waste. This contradictory relationship between some of the food waste mitigation actions is not addressed in the model.

In addition to an estimation for the initial cost of the suggested operational measures, the managerial framework by Filimonau & De Coteau (2018) also connects these measures with “potential financial savings”. However, in our case study we show that food waste management can generate revenue and not just avoid or lower costs. In the way that in the study of economics cost avoidance and revenue creation is not the same, this should also be distinguished between within the managerial framework.

The restaurant staff have identified demand forecasting as one of the biggest challenges. However, none of the concrete food waste mitigation measures suggested by the staff target this area. Instead, the majority of already implemented and suggested food waste mitigation measures are found during the kitchen or post-kitchen stage. Here, the managerial framework acts as an analysis tool for the restaurant’s food waste management strategy and the framework is a good way to visualize the discrepancy between drivers of food waste and implemented measures or intended/desired measures in a restaurant, as earlier depicted in figure 6.

In theory, it seems to be advisable to focus on post-kitchen food waste (so called plate waste), because it has a significant impact on the total food waste, both according to Filimonau & De Coteau (2018) and Silvennoinen et. al. (2015). However, according to the interviews in this case study, plate waste is already very low due to a well-functioning serving procedure rather easy to implement, and demand forecasting is again the primary problem and also more costly and difficult to influence. This case study has not the same quantitative evidence in this matter as previous studies, but unanimous qualitative data speaks in favor of focusing on demand forecasting. Looking at this issue can also give rise to another possible shortcoming of the model: how useful is the framework for restaurants that already have an ambitious sustainability profile? It might as stated earlier be the case that this model is more suitable for

initial implementation of waste mitigation and management. Another concern with focusing on post-kitchen waste are the causal relationships between the different operational stages. Food waste generated in later stages might be caused by mistakes or lacking operational measures during earlier stages. Focusing on reducing post-kitchen waste might lead to that an organization only treats the symptoms, not the condition itself. To abide this problem a thorough analysis of the sources of food waste within the particular hospitality establishment should lay the foundation for working with the managerial framework.

6. Conclusion

During our case study we have dived deep into how food waste is managed and mitigated at a restaurant located in Gothenburg, Sweden and which consequences this might have on the restaurant's financial performance. Food waste management is addressed in several ways in the investigated organization and is regarded a high priority among the staff. Most implemented measures target preventing food waste, or more specific plate waste. In terms of the analysis of the financial statement in the case study, the results were limited by the lack of data and no causal relationship could be established. However, evidence was found that food waste mitigation measures can lead to revenue creation, not only cost savings. The application of the theoretical framework for food waste mitigation in the hospitality industry to a Swedish restaurant has resulted in several suggestions for how this very same framework can be adjusted. We suggest to:

- add relationship building as an operational measure, for example in the post-kitchen stage.
- develop a model to depict, describe and explain the interdependence between the causes of food waste associated with the different operational stages of the production process. This model's aim would be to help managers prioritize operational measures that address the route of the problem and not only its consequences.
- emphasizing the importance of thinking holistically by introducing operational measures that target the food waste of other companies within the food supply chain. One organization's waste is another organization's raw ingredients.
- not only focus on the initial cost for measures to reduce food waste but also include the costs to maintain these measures.
- adapt the hospitality food waste transformation framework to the Swedish waste management system when using Filimonau's & De Coteau's (2018) theoretical framework in a Swedish context.
- not only include potential financial savings in the managerial framework but also potential creation of revenue.
- conduct a thorough analysis of the sources and amount of food waste within the particular hospitality establishment. This analysis constitutes the foundation for working with the managerial framework and allows for better prioritization of operational measures.

This paper has contributed to the knowledge creation within the field of food waste mitigation by illustrating a real-life example of a restaurant that has food waste management and mitigation high up on their agenda. This illustration gives hands-on examples of food waste mitigation measures and how they can be categorized in the managerial framework.

With the combination of the theoretical managerial framework and this case study, suggestions have been derived for how to improve the managerial framework. This paper can also be a reference point for later studies that choose to again analyze the study object in this case-study once more detailed data on food waste is available, the restaurant has reached even further in its organizational learning and also has a longer history of financial performance. Finally, this paper contributes to a Sweden-specific tool for food waste management that can be used by practitioners and help them to translate academic findings into actions and thereby contribute to accelerating the transition to a hospitality industry that helps to achieve the SDG 12.3.

6.1. Future Research

The restaurant is currently initiating a cooperation with Generation Waste, a service that actively analyzes waste data and provides suggestions for how to reduce food waste and increase profitability. This will generate valuable data on food waste produced at different stages. We recommend utilizing this data for future research within the field of food waste in the Swedish restaurant industry. In the course of that, it might be interesting to follow up our case study to see if staff estimates of where most food waste occurs are consistent with measurements or not. In order to validate or correct the findings of our study, the study should be repeated with a larger number of Swedish lunch restaurants. Additionally, we recommend a quantitative study that compares gross margin between restaurants with and without food waste mitigation efforts in order to produce statistically significant and reliable results. Executing this quantitative study at a later point in time would allow for an analysis of the financial performance of a longer time period and without distraction from the pandemic. Therein it might be possible to identify a clearer trend.

References

- Aamir, M., Ahmad, H., Javaid, Q. & Hasan, S.M. (2018). Waste not, want not: a case study on food waste in restaurants of Lahore, Pakistan. *Journal of Food Products Marketing*, 24 (5), 591-610. <https://doi.org/10.1080/10454446.2018.1472695>
- Ai, N., & Zheng, J. (2019). Community-Based Food Waste Modeling and Planning Framework for Urban Regions. *Journal of Agriculture, Food Systems, and Community Development*, 9(1), 39–58. <https://doi.org/10.5304/jafscd.2019.091.009>
- Andersson, T. & Stålhandske, S. (2020). Matavfall i Sverige : Uppkomst och behandling 2018. <http://naturvardsverket.diva-portal.org/smash/get/diva2:1453904/FULLTEXT01.pdf>
- Avfall Sverige. (2022). Biologisk återvinning. [online] Available at: https://www.avfallsverige.se/avfallshantering/avfallsbehandling/biologisk-atervinning/?fbclid=IwAR073OBILKj3DiP7EFTwNIPqjNWLK4PuJTBwdJkpFN05oJKeY_cfsXwSy0s [Accessed 19 May 2022].
- Betz, A., Buchli, J., Gobel, C. & Müller, C. (2015). Food waste in the Swiss food service industry - magnitude and potential for reduction. *Waste Management*, 35, 218-226. <https://doi.org/10.1016/j.wasman.2014.09.015>
- Bharucha, J. (2018). Tackling the challenges of reducing and managing food waste in Mumbai restaurants. *British Food Journal*, 120 (3), 639-649. <https://doi.org/10.1108/bfj-06-2017-0324>
- Berkowitz, S., Marquart, L., Mykerezzi, E., Degeneffe, D. & Reicks, M. (2016). Reduced-portion entrées in a worksite and restaurant setting: Impact on food consumption and waste. *Public Health Nutrition*, 19(16), 3048-3054. [doi:10.1017/S1368980016001348](https://doi.org/10.1017/S1368980016001348)
- Charlebois, S., Creedy, A. & von Massow, M. (2015). “Back of house” - focused study on food waste in fine dining: the case of Delish restaurants. *International Journal of Culture, Tourism and Hospitality Research*, 9 (3), 278-291. <https://doi.org/10.1108/ijcthr-12-2014-0100>

- The Barilla Center for Food & Nutrition Foundation. (2012). *Food Waste: Causes, Impacts and Proposals*. Barilla Center for Food and Nutrition. Available at <https://www.barillacfn.com/m/publications/food-waste-causes-impact-proposals.pdf>
- Dhir, A., Talwar, S., Kaur, P. & Malibari, A. (2020). Food waste in hospitality and food services: A systematic literature review and framework development approach. *Journal of Cleaner Production*, 270. <https://doi.org/10.1016/j.jclepro.2020.122861>
- Directive 2008/98/EC. Directive 2008/98/EC of the European Parliament and of the council on waste and repealing certain directives. *Official journal of the European Union*. L312/3. Available at: <https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX%3A32008L0098>
- Eriksson, M., Persson Osowski, C., Björkman, J., Hansson, E., Malefors, C., Eriksson, E., & Ghosh, R. (2018). The tree structure — A general framework for food waste quantification in food services. *Resources, Conservation and Recycling*, 130, 140-151. <https://www.sciencedirect.com.ezproxy.ub.gu.se/science/article/pii/S0921344917304214>
- Filimonau, V. & De Coteau, D.A. (2018), Food waste management in hospitality operations: a critical review, *Tourism Management*, 71, 234-245. <https://www.sciencedirect.com/science/article/pii/S0261517718302449#bib85>
- Filimonau, V., Fidan, H., Alexieva, I., Dragoev, S. & Marinova, D.D. (2019). Restaurant food waste and the determinants of its effective management in Bulgaria: an exploratory case study of restaurants in Plovdiv. *Tourism Management Perspectives*, 32, 100577. <https://doi.org/10.1016/j.tmp.2019.100577>
- Filimonau, V., Todorova, E., Mzembe, A., Sauer, L. & Yankholmes, A. (2020). A comparative study of food waste management in full service restaurants of the United Kingdom and The Netherlands. *Journal of Cleaner Production*, 258, 120775. <https://doi.org/10.1016/j.jclepro.2020.120775>.
- Food and Agriculture Organization of the United Nations. (n.d.). *Food Loss and Food Waste*. Retrieved from <https://www.fao.org/food-loss-and-food-waste/flw-data>

- Food and Agriculture Organization of the United Nations. (2022, March 11). *The importance of Ukraine and the Russian Federation for global agricultural markets and the risks associated with the current conflict* [Information note]. Retrieved March 10, 2022 from https://www.fao.org/fileadmin/user_upload/faoweb/2022/Info-Note-Ukraine-Russian-Federation.pdf
- Generation Waste. (n.d.) *OM GENERATION WASTE*. Retrieved from <https://www.generationwaste.se/om-oss/>
- Gruia, R., Florescu, G.-I., Gaceu, L., Oprea, O. B., & Țane, N. (2021). Reducing Environmental Risk by Applying a Polyvalent Model of Waste Management in the Restaurant Industry. *Sustainability*, 13(11), 5852. MDPI AG. <http://dx.doi.org/10.3390/su13115852>
- Gustavsson, J., Cederberg, C. & Sonesson, U. (2011). Global Food Losses and Food Waste - Extent, Causes and Prevention. Food and Agriculture Organization of the United Nations (FAO), Rome.
- Hamerman, E.J., Rudell, F. & Martins, C.M. (2018). Factors that predict taking restaurant leftovers: strategies for reducing food waste. *Journal of Consumer Behaviour*, 17 (1), 94-104. <https://doi.org/10.1002/cb.1700>.
- Heikkila, L., Reinikainen, A., Katajajuuri, J.-M., Silvennoinen, K. & Hartikainen, H. (2016), Elements affecting food waste in the food service sector. *Waste Management*, 56, 446-453. <https://www-sciencedirect-com.ezproxy.ub.gu.se/science/article/pii/S0956053X16303245>
- Kasavan, S., Mohamed, A.F. & Abdul Halim, S. (2019). Drivers of food waste generation: case study of island-based hotels in Langkawi, Malaysia. *Waste Management*, 91, 72-79. <https://doi.org/10.1016/j.wasman.2019.04.055>
- Lanfranchi, M. & Giannetto, C. (2017). Economic analysis of food waste in the catering activity: results of a survey conducted in South Italy. *Quality - Access Success*, 18 (159), 105-110. https://www.scopus.com/record/display.uri?eid=2-s2.0-85026676268&origin=inward&featureToggles=FEATURE_NEW_DOC_DETAILS_EXPORT:1

- Lorenz, B.A. & Langen, N. (2018). Determinants of how individuals choose, eat and waste: providing common ground to enhance sustainable food consumption out-of-home. *International Journal of Consumer Studies*, 42 (1), 35-75.
<https://onlinelibrary.wiley.com/doi/10.1111/ijcs.12392>
- McAdams, B., von Massow, M., Gallant, M. & Hayhoe, M.-A. (2019). A cross industry evaluation of food waste in restaurants. *Journal of Foodservice Business Research*, 22 (5), 449-466. <https://doi.org/10.1080/15378020.2019.1637220>
- Monier, V., Mudgal, S., Escalon, V., O'Connor, C., Gibon, T., Anderson, G., Montoux, H., Reisinger, H., Dolley, P., Ogilvie, S. & Morton, G. (2010). Final report – Preparatory study on food waste across EU 27; European Commission [DG ENV-Directorate C]. BIO Intelligence Service, Paris. Available at:
https://ec.europa.eu/environment/eussd/pdf/bio_foodwaste_report.pdf
- Oakdene Hollins, Responsible Hospitality Partnership and WRAP. (2013). Overview of waste in the UK hospitality and food service sector. Available at:
www.wrap.org.uk/content/overview-waste-hospitality-and-food-service-sector
- Okumus, B. (2020). How do hotels manage food waste? evidence from hotels in Orlando, Florida. *Journal of Hospitality Marketing & Management*, 29 (3), 291-309.
<https://doi.org/10.1080/19368623.2019.1618775>
- Papargyropoulou E., Steinberger JK., Wright N., Lozano R., Padfield R. & Ujang Z. (2019). Patterns and Causes of Food Waste in the Hospitality and Food Service Sector: Food Waste Prevention Insights from Malaysia. *Sustainability*, 11(21), 6016.
<https://doi.org/10.3390/su11216016>
- Parfitt, J., Barthel, M., & Macnaughton, S. (2010). Food waste within food supply chains: quantification and potential for change to 2050. *Philosophical Transactions: Biological Sciences*, 365(1554), 3065–3081. <http://www.jstor.org/stable/20752997>
- Pirani, S.I. & Arafat, H.A. (2014). Solid waste management in the hospitality industry: a review. *Journal of Environmental Management*, 146, 320-336.
<https://doi.org/10.1016/j.jenvman.2014.07.038>

- Priefer, C., Jörissen, J. & Bräutigam, K.R. (2016), Food waste prevention in Europe – A cause-driven approach to identify the most relevant leverage points for action. *Resources, conservation and recycling*, 109, 155-165.
<https://doi.org/10.1016/j.resconrec.2016.03.004>
- Principato, I., Pratesi, C.A. & Secondi, L. (2018). Towards Zero Waste: an Exploratory Study on Restaurant managers. *International Journal of Hospitality Management*, 74, 130-137. <https://doi.org/10.1016/j.ijhm.2018.02.022>
- Sakaguchi, L., Pak, N., & Potts, M. (2018). Tackling the issue of food waste in restaurants: Options for measurement method, reduction and behavioural change. *Journal of Cleaner Production*, 180, 430-436.
<https://www.sciencedirect.com/science/article/pii/S0959652617330950>
- Silvennoinen, K., Heikkilä, L., Katajajuuri, J.-M. & Reinikainen, A. (2015). Food waste volume and origin: case studies in the Finnish food service sector. *Waste Management*, 46, 140-145.
<https://www.sciencedirect.com/science/article/pii/S0956053X15301197>
- Sirieix, L., Lala, J. & Kocmanová, K. (2017). Understanding the antecedents of consumers' attitudes towards doggy bags in restaurants: concern about food waste, culture, norms and emotions. *Journal of Retailing and Consumer Services*, 34 (C), 153-158.
<https://www.sciencedirect.com/science/article/pii/S0969698916302296>
- Statistiska Centralbyrån. (2022). Stark återhämtning för restauranger 2021. Available at: <https://scb.se/pressmeddelande/stark-aterhamtning-for-restauranger-2021/>
- Stenmarck, Å., Jensen, C., Quedsted, T. & Moates, G. (2016). Estimates of European food waste levels. 10.13140/RG.2.1.4658.4721. Available at: <https://www.eurofusion.org/phocadownload/Publications/Estimates%20of%20European%20food%20waste%20levels.pdf>
- Strotmann, C., Gobel, C., Friedrich, S., Kreyenschmidt, J., Ritter, G. & Teitscheid, P. (2017). A participatory approach to minimizing food waste in the food industry - a manual for managers. *Sustainability*, 9 (1), 66. <https://doi.org/10.3390/su9010066>.

The United Nations Department of Economic and Social Affairs. (n.d.a). *The 17 goals / Sustainable Development*. United Nations. Retrieved March 17, 2022, from <https://sdgs.un.org/goals>

The United Nations Department of Economic and Social Affairs (n.d.a). *Goal 12*. United Nations. Retrieved March 17, 2022, from <https://sdgs.un.org/goals/goal12>

Thyberg, T. (2015). Drivers of food waste and their implications for sustainable policy development. *Resources, Conservation and Recycling*, 106, 110-123. [https://www-sciencedirect-com.ezproxy.ub.gu.se/science/article/pii/S0921344915301439](https://www.sciencedirect-com.ezproxy.ub.gu.se/science/article/pii/S0921344915301439)

Visita (2013). Nyckeltalsundersökning 2013. Stockholm: Visita.

Von Massow, M. & McAdams, B. (2015). Table Scraps: an evaluation of plate waste in restaurants. *Journal of Foodservice Business Research*, 18 (5), 437-453. <https://doi.org/10.1080/15378020.2015.1093451>.

Waste [@wastegbg]. (n.d.). Posts [Instagram profile]. Retrieved March 14, 2022, from <https://www.instagram.com/wastegbg/>

Appendix 1 - Interview Guide

Interviewees can choose to be interviewed in Swedish or English. The interview starts with explaining the purpose of our study and that the answers will be anonymized, asking for permission to record the interview, and explaining that it is the interviewee's personal opinion that we are interested in. We then proceed with providing the definition of food waste concerning this study. This is followed by several questions, of which the order and exact wording is being adapted to the situation to ensure a natural flow of the conversation. If requested by the interviewee the interview questions can be answered in writing instead.

What follows now is a preliminary interview guide:

- What is your role at the restaurant?
- Do you have a formal education or training for this role? Please elaborate.
- Is it important that the restaurant tries to reduce its food waste? (Scale 1-5)
- Where do you see the primary source of food waste within the restaurant's operations?
- What has the restaurant done to reduce food waste?
- Which initiatives have led to the biggest changes in the amount of food waste in your opinion?
- Which initiatives would you want to see done at the restaurant?
- What do you see as the greatest challenges to realize these initiatives?
- What is the most efficient thing the restaurant can do to combat food waste?
- Has the restaurant's food waste been measured (e.g., by weighing it)? If yes, how? Is this data available?
- What are your thoughts about introducing different portion sizes with different pricing or a pay by weight system?
- Which of the following options contribute the most to the occurrence of food waste at the restaurant? (Name up to 3 options)
 - Difficulties in demand forecasting/purchase planning
 - Portion sizes not matching customers' needs
 - Consumers' behavior and attitudes
 - Food labeling issues
 - Storage errors/inventory management problems
 - Menu design/choice of meals served
 - Cooking process/production procedure
 - Reluctance towards doggy bags (both restaurants and/or customers)

- Which stage is (in terms of quantity) the largest source of food waste at the restaurant?
(Choose only 1 option) [explain what is meant by those concepts]
 - pre-kitchen
 - Kitchen
 - post-kitchen