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An Analysis of Food Waste Mitigation Strategies in Grocery Retail: Practices and Lessons from the German Market

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Master in International Management

Supervisor:
Prof. Catarina Roseta-Palma, Associate Professor at ISCTE Business School, Department of Economics

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BUSINESS
SCHOOL

Department of Marketing, Strategy and Operations

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Resumo

A nível global, um terço dos alimentos produzidos para consumo humano é desperdiçado ou extraviado a cada ano. Particularmente nos países industrializados, isto tem enormes consequências económicas, ambientais e sociais. Enquanto intermediários entre produtores e consumidores, retalhistas alimentares, como os supermercados, desempenham um papel importante para mitigar o desperdício alimentar. Faltam estratégias de mitigação de desperdício alimentar para apoiar os profissionais do setor. O objetivo deste estudo é encontrar as estratégias mais eficazes de mitigação de desperdício alimentar no retalho de mercearia e desenvolver um 'Quadro Estratégico para o Desperdício Alimentar' que combine o conhecimento anterior com a experiência de especialistas na Alemanha. No âmbito da análise qualitativa de conteúdos, foram conduzidas oito entrevistas semi-estruturadas com especialistas em desperdício alimentar de supermercados, instituições de caridade alimentar e outras organizações do retalho alemão. Os dados foram codificados e analisados através de uma abordagem dedutiva-indutiva. Os resultados revelam cinco fatores internos e cinco fatores externos que levam ao desperdício alimentar, bem como dezasseis áreas estratégicas com quarenta e uma estratégias possíveis para a mitigação do problema. Os especialistas alemães identificam a redução de preço em lacticínios e outros produtos perecíveis, formações de sensibilização para os funcionários, campanhas sobre data de consumo preferencial para os clientes, atualização de sistemas de controlo de inventário e donativos a instituições de caridade alimentar como as estratégias mais eficazes contra o desperdício alimentar.

Palavras-chave: Gestão de Desperdício Alimentar, Estratégias de Mitigação, Quadro Estratégico para o Desperdício Alimentar, Retalho de Mercearia

JEL Classification System:
M140 Corporate Culture; Diversity; Social Responsibility
Q010 Sustainable Development

Abstract

Globally, one third of the food produced for human consumption is wasted or lost every year. This has serious economic, environmental and social consequences, namely in industrialized countries. As intermediaries between producers and consumers, food retailers such as supermarkets play a significant role in mitigating food waste. Further research is required to enable professionals to be effective in developing food waste mitigation strategies. The study's aim is to find the most effective food waste mitigation strategies in grocery retail and to develop a 'Food Waste Strategy Framework' that combines knowledge from previous research with the experience of experts in Germany. In the context of qualitative content analysis, eight semi-structured interviews with food waste experts from supermarkets, food charities and other organizations in the German grocery retail sector were conducted. Data was coded and analyzed with a deductive-inductive approach. Results reveal five internal and five external causes driving food waste, plus sixteen strategy areas with forty-one possible food mitigation strategies. German experts suggested price reduction on dairy products and perishables, employee awareness training, customer campaigns about the best-before date, updated inventory control systems and donation to food charity organizations as the most effective strategies against food waste.

Keywords: Food Waste Management, Mitigation Strategies, Food Waste Strategy Framework, Grocery Retail

JEL Classification System:

M140 Corporate Culture; Diversity; Social Responsibility

Q010 Sustainable Development

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Glossary of Acronyms

BBD	Best before date
BMEL	Bundesministerium für Ernährung und Landwirtschaft
DK	Denmark
EPA	Environmental Protection Agency
EU	European Union
FAO	Food and Agriculture Organization
FL	Food loss
FLW	Food loss and waste
FSC	Food Supply Chain
FW	Food waste
FWH	Food Waste Hierarchy
FWSF	Food Waste Strategy Framework
LFHW	Love Food Hate Waste
Mio.	Million
NGO	Non-Governmental Organization
NL	The Netherlands
SDG	Sustainability Development Goals
UK	United Kingdom
UN	United Nations
WRAP	Waste and Resources Action Programme

1 Introduction

"Companies that work across the value chain, (…), are in a good position to orchestrate a response to the crisis and have a meaningful impact. (…) the amount of food that is lost and wasted annually is estimated to be worth some $1.2 trillion, a sizable opportunity for companies to improve their efficiency and boost their top line." (Abecasis et al., 2020)

With this quote, Abecasis et al. (2020) describe the mindset change that needs to occur in order to fully reach the potential gains associated with mitigating food loss and waste in the grocery retail sector. This sector produces substantial amounts of food waste (FW) in Europe. For example, 12.7 million (Mio.) tons of food from farm gate to consumer, are currently wasted in Germany (Schmidt et al., 2019). There is growing public recognition of the negative economic, environmental and social implications of this (Filimonau & Gherbin, 2017). In 2015, the United Nations set up 17 sustainable development goals (SDGs) for 2030, in which SDG Target 12.3 specifically demands "halving global food waste per capita at retail and consumer levels and reducing food loss along production and supply chains" (FAO, 2018). As do many other countries in the EU, Germany recognizes the need to manage its food loss and waste (FLW) and it has agreed to halve it by 2030 (Bundesministerium für Ernährung und Landwirtschaft, 2019; Hermsdorf et al., 2017).

The current movement in society, the new legislation to reduce FW and minimize its negative impacts is putting strong pressure on food retailers and their managers. By reducing its vast FW, the retail sector could lower its costs, improve food security and nutrition, and contribute towards environmental sustainability (Hermsdorf et al., 2017).

Even though researchers point out that FW is generated mainly at the consumption level (Principato et al., 2015), food retailers such as supermarkets play a crucial and powerful role as intermediaries between producers and consumers (Cicatiello et al., 2016; Midgley, 2014). However, professionals in the food retail industry are still lacking in the implementation of FW mitigation strategies. For them, FW is a key sustainability challenge which needs to be tackled (Martin-Rios et al., 2018).

The developing concern with FLW has resulted in a recent increase of publications on the issue (Xue et al., 2017). Yet the issue of FW in supermarkets has not been well investigated. Moreover, management practices and solutions to reducing FW have been given little attention (Filimonau & Gherbin, 2017). Furthermore, little research has been put into waste causes at the downstream level of food supply chains (FSC) to which supermarkets belong. (Yetkin Özbük & Coşkun, 2020). In 2017, Filimonau & Gherbin stated that managerial research is important

in helping understand how FW is dealt with. Further research is needed to better identify effective FW mitigation management strategies in supermarkets.

The aforementioned arguments underline the need to revise FW strategies. The aim of this work is to find the most effective FW mitigation strategies in supermarkets and to develop a corresponding framework that combines knowledge from previous research with the experience of FW experts in Germany. This could increase supermarket professional's prospects of recognizing the best FW practices and allow the introduction of new strategies to reduce it. This objective can be narrowed down to the main research question that is to be answered: How can supermarket professionals improve their food waste management? In order to facilitate the data collection process and the analysis of the data within this thesis, the central research question is divided into the following sub research questions:

1. What are the internal and external causes driving food waste in supermarkets?
2. What are the current strategies used by the grocery retail sector?
3. How do food waste experts prioritize strategies against food waste?

The present study complements the existing body of literature on FW mitigation practices in Europe as it explores food mitigation strategies in the German market. Discovering German FW management practices could provide interesting insight into that of other countries in Europe.

Furthermore, there is no existing framework of best management practices and strategies to overcome the FW mitigation problem in supermarkets. Such a model, to be created by this work, could help practitioners become more aware of strategies that could be implemented in supermarkets. Additionally, it could support managers to improve their strategies and therefore gain social awareness, thereby influencing consumers who account for the largest proportion of food wastage (United Nations, 2016). Finally, supermarkets could have a positive environmental impact and also increase economic gains through less FW.

The following chapter outlines definitions, relevant concepts, frameworks and correlations related to the subject areas. In addition, it gives an overview of the most important internal and external causes driving FW. The literature on FW mitigation strategies in the EU and German grocery retail context is outlined and evaluated. Based on that knowledge a framework for professionals to manage FW in supermarkets is established. The identified research gap is supported by the method and data collection procedure introduced in chapter three. Chapter four presents the results and key findings of primary data collection as well as analyzing

German store managers, FW experts and food charity managers' understanding and knowledge of FW mitigation strategies through a content analysis. Furthermore, it discusses the results with the FW literature. Chapter five draws the conclusion and provides study limitations as well as recommendations for future research.

2 Literature Review

This section covers the relevant literature available on the subject in order to gain a deeper theoretical understanding of the FW issue, both in general and in the grocery retail sector. As well, FW models, useful for the food retail sector, are discussed. Researched internal and external causes of FW are outlined in order to gain an understanding of FW in supermarkets. Additionally, strategies and practices against FW are compiled in order to set up a theoretical framework which could assist supermarket managers with FW management.

2.1 Food Supply Chain

Global food chains are complex and often determined by the expectations of customers. In addition, the trend of moving from rural to urban areas results in larger distances between production and consumption, complicating the food supply chain even further (Buchner et al., 2012).

The type of FW and waste production is determined by the stage of the supply chain (González Vaquè, 2015). González Vaquè classifies these stages as agricultural production, management and storage, treatment, distribution and consumption and has some overlapping stages with Buchner. Buchner et al. identified six main segments in the food supply chain that are displayed in Figure 2.1. The first is ‘cultivation, agricultural production, and harvest’ (in dark green), the second ‘first processing’ (in light green), the third ‘industrial processing’ (in blue), the fourth ‘distribution’ that is divided by wholesale and retail distribution (in purple) and the final stage coincides with the final consumption and is divided in ‘restaurants and food services’ (in orange) and in ‘household consumption’ (light blue).

Figure 2.1: Stages of the Food Supply Chain (Buchner et al., 2012)

2.2 Food Waste Definitions

There are crucial differences between FW, food loss (FL) and food surplus which must be understood. Currently, there is no international consensus either among key stakeholders or in the literature on how FW should be characterized (Buchner et al., 2012; Garrone et al., 2014). The FAO describes food loss as “the decrease in the quantity or quality of food resulting from

decisions and actions by food suppliers in the chain, excluding retail, food service providers and consumers", while "food waste is the decrease in the quantity or quality of food resulting from decisions and actions by retailers, food services and consumers" (FAO, 2019). This distinguishes food loss and waste according to the production, post-harvest, processing and distribution stages in the food supply chain. Nonetheless, not all institutions differentiate between FW and FL (Girotto et al., 2015). Spang et al. (2019) describe FLW as "any food intended for human consumption that ultimately is never eaten by humans" throughout the supply chain (including spoilage, shrinkage and discards). The authors, however, also differentiate FL and FW according to the stages of the food supply chain, similarly to the FAO definitions.

Other sources make a distinction between avoidable FW (parts of food which can be eaten and considered as edible), unavoidable FW (e.g. peelings, shells, tea bags) and potentially avoidable FW (e.g., bread crust, potato skin) (Buchner et al., 2012; FAO, 2019; González Vaquè, 2015; Papargyropoulou et al., 2014; Waste Reduction Action Programme [WRAP], 2012).

In contrast, Garrone uses the definition 'surplus food', which describes for example edible food (produced, manufactured, retailed or served) that for different reasons is not sold to or consumed by the intended purchaser. Furthermore, surplus food is that which is not used to feed humans or animals, to produce new products (e.g. jams or juices), new materials (e.g. fertilizers) or energy (Garrone et al., 2014).

This work utilizes the description of FLW, FL and FW as espoused by Spang et al. (2019). FW are the goods that start at the retail food supply chain level and were originally intended for human consumption but never got consumed (Spang et al., 2019).

2.3 Research Context

FLW is recognized as a global dilemma and is seen as a key element in the creation of a sustainable food system (UN, 2015). According to the Food and Agriculture Organization (FAO), one third (around 1.3 billion tons) of the food produced for human consumption is wasted or lost every year (FAO, 2018). This could be enough to nurture 795 Mio. people who are starving worldwide (Gustavsson et al., 2013). Furthermore, about 4.1 billion tons or 61% of food wastage is preventable and could be consumed by humans (Waste Reduction Action Programme [WRAP], 2012). In developed countries, such as Europe and North America, about 95-115 kg per year per person is wasted, while in developing countries, such as those in Sub-

Saharan Africa and South/Southeast Asia, it is 6-11 kg per year per person (FAO, 2018). Developed countries clearly have the highest food wastage amount (González Vaquè, 2015; Martin-Rios et al., 2018; Ribeiro et al., 2018). Through urbanization and population growth a 60 per cent increase in the total demand of food is expected by 2050 (FAO, 2019). Accordingly, the reduction of food losses and waste can help to meet this increasing demand and decrease pressure on food production. Hence, most governments of European countries have set policies to minimize FW (Priefer et al., 2016).

The FLW problem is getting increased attention due to its environmental, social and economic impacts (Cicatiello et al., 2016; Martin-Rios et al., 2018; Mourad, 2016). It is deemed unethical to waste food while some people are going hungry and in addition there are environmental and economic consequences. If less food was wasted, fewer resources would be required to produce food (Thyberg & Tonjes, 2016). The economic impact of FW could be seen as "the value that is lost with waste" which refers to the production cost and the market price of the food (Buchner et al., 2012). From an environmental point of view, lost and wasted food has a significant impact on climate change, biodiversity, land, water scarcity and water pollution (FAO, 2018). Reducing FLW is therefore a key sustainability challenge for the food industry (Martin-Rios et al., 2018).

At managerial level, supermarket professionals still do not implement many FW management practices (Thyberg & Tonjes, 2016). In 2013, the global economic cost of FW was $750 billion per year in all sectors (excluding seafood) (Pearce & Berkenkamp, 2017). Managers need to understand the economic costs of FW in order to change their management behavior (Thyberg & Tonjes, 2016). The financial impact of FW is a risk factor for supermarkets (Pearce & Berkenkamp, 2017) and FW reduction efforts can be rewarding in terms of money saved by non-disposal ($14 for every $1 invested). Furthermore, a creative application of FW can create new revenue streams. Pearce & Berkenkamp state that poor FW management practices threaten companies' brand image, while consumers tend to take their perception of a company's social and environmental image into purchasing decisions. Thus, wasteful behavior, like disposing food instead of donating it, can have a negative impact on the supermarket sales.

2.4 FW in the European Union (EU)

Of all the EU member states, the Netherlands has the highest amount of FW with 579kg per capita (kg/year) whereas Greece has the least with 44kg per capita per year (Buchner et al., 2012; European Parliment, 2017).

In 2016, the European Commission revealed the most recent estimates of European FW levels. The study reported that the total FW in the EU-28 was 88 Mio tons in 2012. This equates to an average of 173 kg of FW for every European citizen**.** With 47 Mio. tons (53 %), private households had the largest amount of food wastage. This was followed by the processing sector with 17 Mio. tons (19%), the food service sector with 11 Mio. tons (12%), the production sector with 9 Mio. tons (11%) and the wholesale and retail sector with 5 Mio. tons (5%) (European Commisson, 2016; Stenmarck et al., 2016).

In addition, research by Priefer et al. concludes that the highest waste rates in Europe occur at the first stage (manufacturing/processing) and the last stage (household sector) of the FSC and thereby confirms the data from the European Commission (Priefer et al., 2016).

2.5 German FW

Germany is not an exception in the struggle with FW (Hermsdorf et al., 2017). It was ranked 10th out of 28 countries for the least FW per capita in Europe in 2010. At that time, Germany wasted approximately 11 Mio. tons of food throughout the food supply chain (Buchner et al., 2012; Gadde & Amani, 2016). Yet more recent studies by REFOWAS and Hühne found that Germany increased its FLW to 12.7 Mio. tons in 2015 (Schmidt et al., 2019). This growth is a direct result of excessive production, mismanagement, and wasteful behavior (Facchini et al., 2018).

Of the 85.2 kg/year wasted by an average German citizen, 37.3kg could be avoided (Schmidt et al., 2019). Figure 2.2 indicates the percentages of FLW in the different sectors. As is the case elsewhere in Europe, private households and the processing sector generate the highest waste and loss.

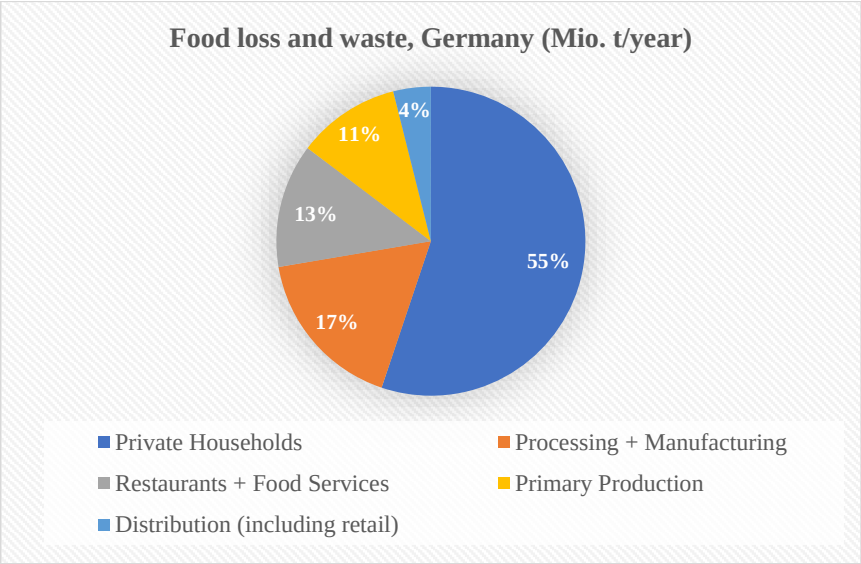

Figure 2.2: German FLW of Different Sectors (Stenmarck et al., 2016)

2.6 German FW at Grocery Retail Level

Overall, the retail sector is wasting 696,484 tons/year. Fruits and vegetables (328,245 t/y) plus bread and pastries (206,399 t/y) have by far the highest losses, followed by dairy products (60,255 t/y), meat (53,307 t/y) and other food (48,279 t/y). With bread and pastries, the German retail sector faces 17.62 % of loss in sales, followed by fruits and vegetables (5.12%), meat products (2.1 %), dairy products (1.55%) and other food with 0.48 % (Schmidt et al., 2019). Utilizing this information, retail managers could prioritize their FW practices more effectively.

Estimates of FW in grocery stores are difficult to ascertain. Parfitt et al. (2010) found several variables to be involved, such as international (53 different legislative acts on FW in EU) and national legislation, accounting methodologies, corporate policies and managerial practices. These lead to missing data availability and accessibility and therefore lower the precision of FW estimates (Filimonau & Gherbin, 2017).

Vittuari et al. (2015) clustered FW in supermarkets into four major categories: pre-store waste; recorded in-store waste; unrecorded in-store waste; and missing quantities (Vittuari et al., 2015). Most food is wasted due to poor aesthetics, structural damage or because it surpasses the ‘best before’ or ‘use by’ dates (Filimonau & Gherbin, 2017).

2.7 Food Law across Europe

The EU established a Circular Economy Package which consists of an EU Action Plan for the Circular Economy and annex to the action plan (European Comission, 2015; European

Commisson, 2015). In 2018, the waste law was updated, and all EU countries are required to minimize FW at each level of the FSC, track the level of FW and report back on progress. Furthermore, EU countries are obligated to meet the SDG target 12.3 of halving FW per capita until 2030. For that reason, the EU commission is preparing a unified EU methodology of FW measurement, setting up a multi- stakeholder platform called the EU Platform on FL and FW (European Commisson, 2016; European Parliment and Council, 2008; European Union, 2018; Giordano et al., 2019; Vittuari et al., 2015). More information about specific examples of successful legislative change and initiatives against food waste can be found in the Annex A.

2.8 Frameworks relevant to Food Mitigation Strategies

2.8.1 Food Waste Hierarchy

An increasing number of studies address FW utilizing the concept of a 'hierarchy' derived from the '3Rs' (reduce, re-use, recycle), commonly used in waste management (Papargyropoulou et al., 2014). In 1975, this hierarchy was determined in a European directive for the first time in the Council Directive 75/442/EEC and Council Directive 2008/98/EC. The U.S. Environmental Protection Agency (EPA) (US Environmental Protection Agency [EPA], 2015, 2018) assented to a comparable framework in a 'Food Recovery Hierarchy'. Until today, the hierarchical frameworks are part of American and European environmental laws (Mourad, 2016).

Papargyropoulou et al (2014) note that the 'Food Recovery Hierarchy' fails to include the economic and social impacts, primarily focusing on environmental impacts. This environmental focus has been criticized by several economists. In their opinion, the 'Food Recovery Hierarchy' should be regarded as a flexible guideline for formulating waste strategies (Giordano et al., 2019; Papargyropoulou et al., 2014; Sedlmeier et al., 2019).

In 2014, Papargyropoulou et al. (2014) adjusted the 'Food Recovery Hierarchy' to the 'Food Waste Hierarchy' (FWH), which "considers the three dimensions of sustainability (environmental, economic, and social), offering a more holistic approach in addressing the food waste issue". To assess FW mitigation strategies in supermarkets it is crucial to grasp the FWH displayed in Figure 2.3 (Hermsdorf et al., 2017). The FWH provides retailers with a roadmap for FW management and determines suitable strategies for tackling the rising food waste problem (Papargyropoulou et al., 2014).

As illustrated in Figure 2.3, the prevention level of the FWH of Papargyropoulou et al (2014) represents the most desirable option, whereas the disposal level is the least desirable

option (Hermsdorf et al., 2017). Pearce & Berkenkamp emphasize that strategies that prevent food from being wasted minimize the over usage of water, agricultural chemicals, energy, and other resources for food production such as manufacturing, transport, packaging and disposal. Prevention strategies provide food retailers with the greatest financial gain by decreasing expenses of buying, storing and disposing food (Pearce & Berkenkamp, 2017). The second most preferred strategy is to re-use food waste. Donating food that would be wasted to organizations that supply food-insecure populations (for human consumption) is a common strategy. Level three describes the food that is unsuitable for human consumption. Therefore, providing the FW to farms for animal feed and composting represent the best alternative strategies. On the recovery level, it is recommended to use food waste for energy generation via anaerobic digestion. Given that disposal, through landfill and incineration, yields greenhouse gases while organic matter and nutrients are lost, the last level is the least preferred strategy in the FWH. Prevention strategies offer the strongest opportunity for both cost savings and environmental benefit and should thus be prioritized (Pearce & Berkenkamp, 2017).

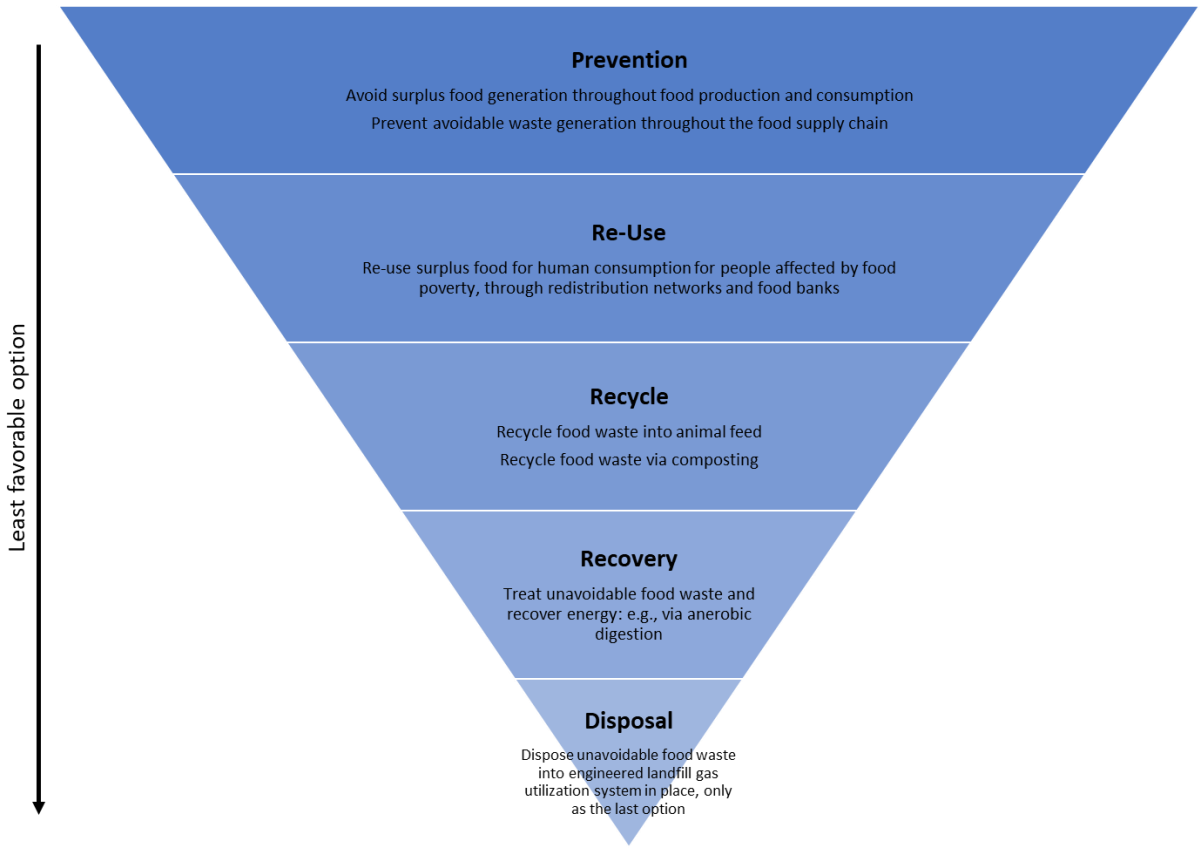

Figure 2.3: Adaption of Food Waste Hierarchy (Papargyropoulou et al. 2014)

2.8.2 Food Surplus and Waste Framework

Papargyropoulou, et al. (2014) also proposed a "Food surplus and waste framework" which offers and prioritizes strategies for coping with food surpluses and avoidable as well as unavoidable food waste. As in the FWH, the most preferred strategies are displayed at the top and the least favorable options at the bottom of the framework (Papargyropoulou et al., 2014). The framework begins with unwanted food surpluses, aiming to avoid overproduction and oversupply. In retail businesses such as supermarkets, food surplus prevention includes the supply only of what is required. Therefore, correct portion sizing and addressing unsustainable consumption patterns is key. All surplus food that has not been sold for consumption should be redistributed to people in need. As displayed in Figure 2.4, food surplus that is not used for human consumption is called FW. FW is separated and defined as avoidable and unavoidable and the figure illustrates the different and most appropriate waste management options according to these two categories.

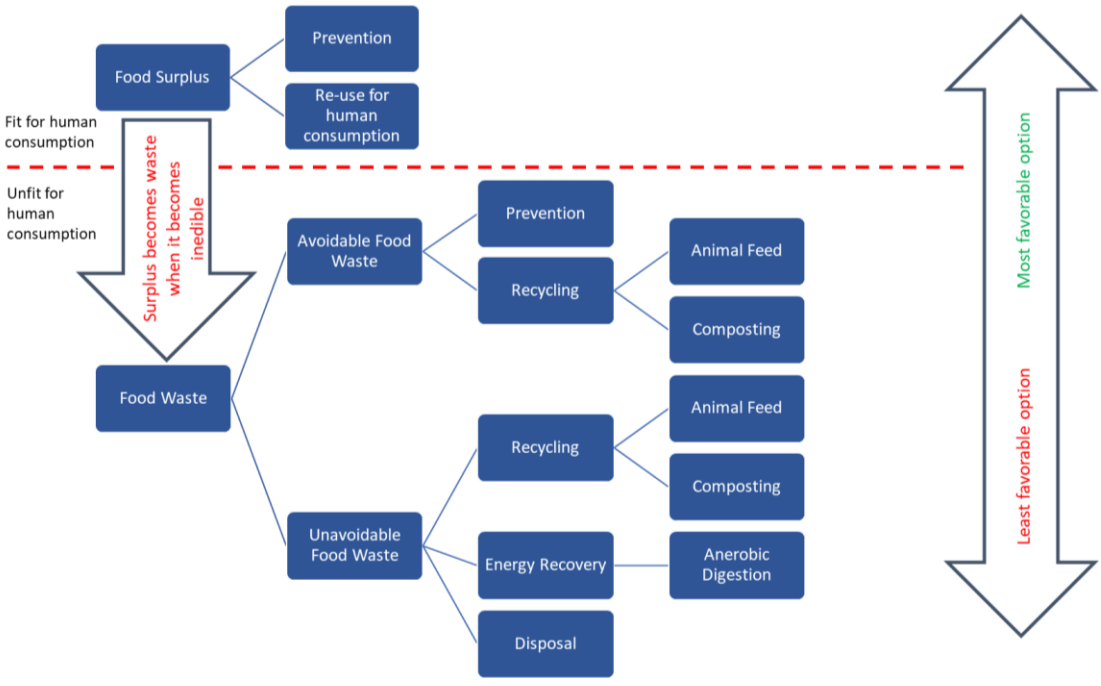

Figure 2.4: Adaption of Food Surplus and Waste Framework (Papargyropoulou et al. 2014)

2.8.3 ASRW Framework- Availability-Surplus-Recoverability-Waste

Garrone et al. (2014) developed another framework building on the knowledge of the FWH. This model can be utilized to understand and quantify surplus food, 'recoverable' surplus food and FW at company, sector and country levels. In Figure 2.5, 'Food scrap' (e.g. vegetable peels) describes food that is no longer suitable for human consumption.

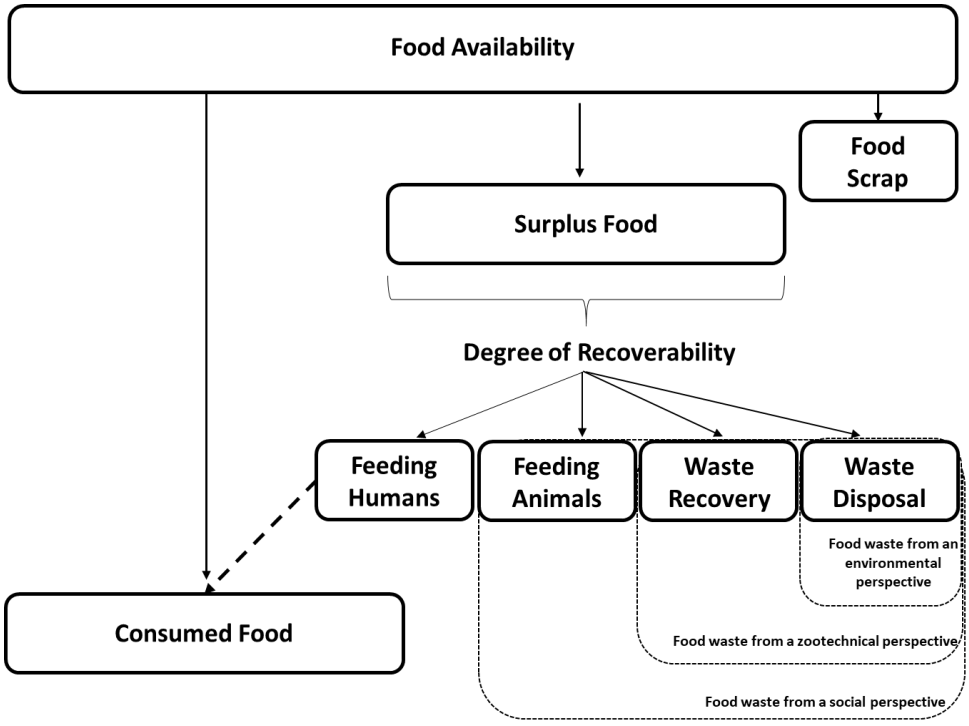

Figure 2.5: Adaption of the ASRW Conceptual Model (Garrone et al., 2014)

In Figure 2.6, retail food waste types with their functions and possible uses are illustrated. Edible food waste can still be recovered for human consumption, through food waste recovery projects, making it possible to collect food waste and donate it to charities. Edible food is described as food where the packaging is still closed, fruits or vegetables are over- or undersized, packages are mis-shaped and surplus stocks exist. Inedible food, such as rotten fruits or vegetables, open packages and food where the cold chain is broken, is not suitable for human consumption. Yet inedible food can be used for animal feeding, recycling or disposal (Cicatiello et al., 2016).

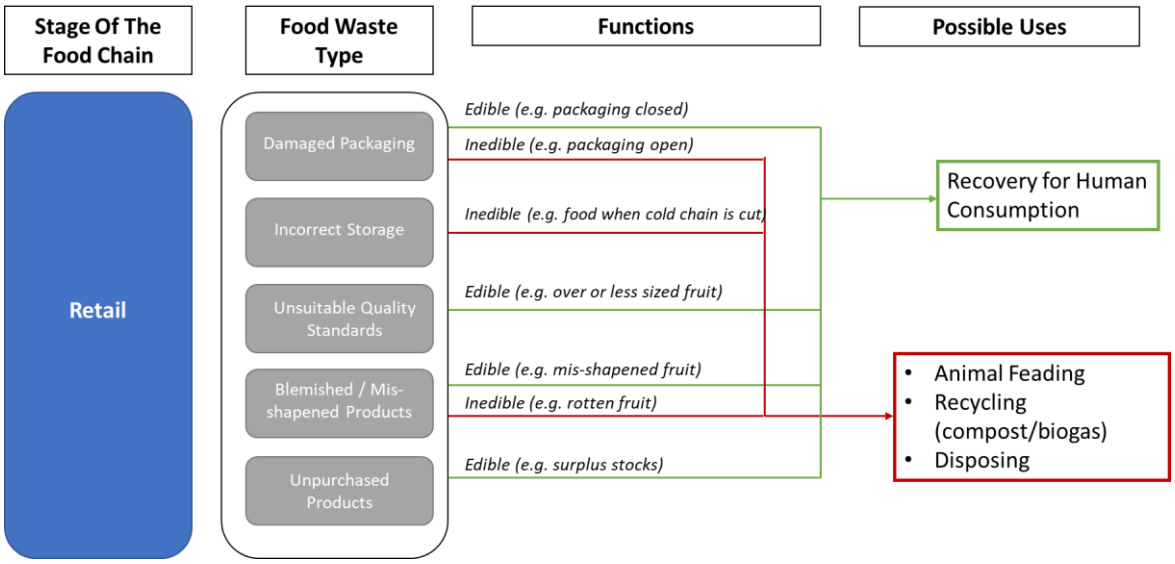

Figure 2.6: Adaption of Possible Uses of Retail Food Waste (Cicatiello et al., 2016)

2.9 FW Causes in Grocery Retail

Yetkin Özbuk & Coşkun (2020) reviewed 92 papers concerning FW in the FSC and classified three groups of factors: internal, micro-environmental and macro-environmental. As illustrated below, each factor can be further divided into several sub-factors. The present work classified internal factors as internal causes of FW, and micro-environmental as well as macro-environmental factors as external causes of FW.

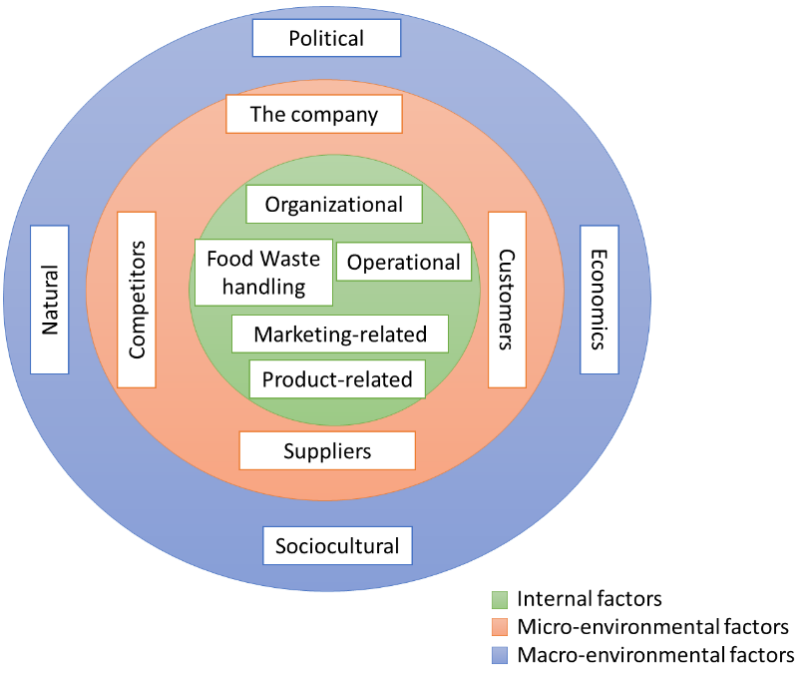

Figure 2.7:A Synthesis of Food Waste Factors at Downstream Entities of the Supply Chain (Yetkin Özbük & Coşkun, 2020)

2.9.1 Internal Causes

Filimonau & Gherbin (2017) point to food where the 'best-before' date has expired, unlabeled fruit and vegetables, aesthetic and minor packaging issues as the main causes of FW. However, for this dissertation the most current research into internal causes driving FW was gathered, and the most influential causes were clustered. In particular, Table 2.1 displays employees (operational), management (organizational/operational), forecasting (FW handling practice), marketing (marketing-related) and technology (FW handling practice) as the most important internal FW causes of which supermarket experts should be aware.

Internal Causes	**Explanation**	**Authors**
Employees	- Insufficient training / Untrained staff - Lack of employee knowledge/awareness/concern - Lack of employee motivation and concentration - Employee attitude towards food waste - Lack of resources/availability - Labor costs for FW prevention tasks - Dropped items/poor handling - Balancing on-shelf-availability and waste - Poor stock rotation on shelves - Improper handling and storage--> shorten shelf life plus early and quick spoilage - Sorting food that needs to be taken off the shelves by best-before-dates requires additional time and in the case of perishables, additional refrigerated storage space.	(Chalak et al., 2018; Filimonau & Gherbin, 2017; Yetkin Özbük & Coşkun, 2020)
Management	- Limited authority to management change towards FW - Intense management efforts for checking freshness of products - Managers limited knowledge/awareness - Few/no food waste reduction strategies implemented	(Filimonau & Gherbin, 2017; Martin-Rios et al., 2018; Syroegina, 2016; Yetkin Özbük & Coşkun, 2020)
Planning/ Forecasting	- Inaccurate forecasting/poor demand planning due to weather changes and demand, seasonal products which results in overstocking - Inventory management not in line with demand due to too large order quantities - Incorrect application of inventory turnover - Inaccurate storage and incorrect stock turnover - Incorrect monitoring of food waste	(Canali et al., 2017; Chalak et al., 2018; Cicatiello & Franco, 2020; Mena et al., 2011; Priefer et al., 2016; Schmidt et al., 2019; Spang et al., 2019; Syroegina, 2016; Yetkin Özbük & Coşkun, 2020)

Marketing	PRICE - Obligation for retailers to order a wide range of products and brands from the same producer in order to get beneficial prices - Bigger product selection leads to more waste, but also more sales PROMOTION - Inaccurate promotional forecast - Efforts to meet customers' needs for the provision of full display shelves in retail stores - Some promotions can cause waste due to reduced forecasting accuracy and inefficient information sharing between manufacturer and retailer results in more FW in households - Lack of communication PRODUCT: - Inefficient product display - Packaging defects resulting in product damage - Packaging/labeling mistakes - Lack of markets for suboptimal production - Avoidance of offering cosmetically substandard produce - Unoptimized selection of goods on shelf - Waste of highly perishable products such as fruit and vegetables/very short shelf-life for some products (1 day for bread)	(Chalak et al., 2018; Filimonau & Gherbin, 2017; Mena et al., 2011; Priefer et al., 2016; Syroegina, 2016; Yetkin Özbük & Coşkun, 2020)
Technology	- Losses due to lack of cold, lack of hygienic + specialized facilities - Technical malfunctions: Damaged products and spillage - Improper merchandising planning and control system	(Chalak et al., 2018; Cicatiello & Franco, 2020; Hermsdorf et al., 2017; Mena et al., 2011; Priefer et al., 2016; Schmidt et al., 2019; Spang et al., 2019; Yetkin Özbük & Coşkun, 2020)

Table 2.1: Internal causes of FW compiled by thesis author

Forecasting is the most commonly mentioned cause of FW, followed by technology. Marketing and employees are reported by the same number of authors and store management is least mentioned.

2.9.2 External Causes

Table 2.2 displays the most important external causes driving FW in grocery retail. Crucial external causes are customers (micro-environmental), suppliers (micro-environmental), political (macro-environmental), and other decisions made at corporate level (micro-environmental). Most authors referred to customers as the biggest external cause of FW followed by political, suppliers and corporation.

External Causes	Explanation	Authors
Customers	- Demand for high quality items, which includes high quality appearance and attractive presentation - Refrain from buying products they perceive as aesthetically flawed or appear imperfect - Wasteful consumer culture and disconnection between food production and consumption - Demand for fully- stocked shelf and fresh products - Steer away from products nearing expiry, best by or use by dates - Lack awareness on the scale of the food waste problem and its environmental implications - Misunderstanding of food labelling as many customers perceive the 'best before' label as a safety indicator - Varying consumer demand - Expectations of food portions/serving sizes - In Germany, almost 70 % of consumers check the best before date and do not buy products near to 'best before' date	(Chalak et al., 2018; Filimonau & Gherbin, 2017; Schmidt et al., 2019; Spang et al., 2019; Syroegina, 2016; Yetkin Özbük & Coşkun, 2020)
Supplier	Suppliers that deliver products with: - Lack of overall freshness - Insufficient communication - Poor management - Relations among the entity's contractual agreements/requirements - Damaged packaging - Bulk purchasing, inability to impact on the size and the frequency of deliveries by suppliers	(Cicatiello & Franco, 2020; Spang et al., 2019; Syroegina, 2016)
Political	**Germany** - FW recovery or donation not incentivized (tax exemptions, tariffs for donation not given) - No public policy (consideration of donation as preferred option) - Complex donation arrangement - Regulation on food labeling (misleading label information) - 'Containering'-->not allowing food to be taken from supermarkets bins even though still fully edible - Legal aspects / deviation from trade classes, product requirements, official order of destruction due to marking errors - Recall of goods due to violation of food law regulations - More laws are demonstrated in Annex B **Europe** - Compliance with safety standards on time limits on storing opened packaging, prepared food, unrefrigerated products, and temperature of frozen meat - European restrictions on the possibility of using animal residue - Complexity and fragmentation of European legislation on labelling information; - Waste disposal taxation and/or fees lower than the real environmental and operational costs of FW - Lack of legislation establishing priorities in the use of food destined to waste and incentives from energy policy - Lack of tax breaks and fiscal incentives on food donations;	(Canali et al., 2017; Hermsdorf et al., 2017; Priefer et al., 2016; Schmidt et al., 2019; Sert et al., 2018)
Corporation	- Decision to dispose of FW due to no revenue from environmental decision making - Supply chain design choice - Corporate policy and tactics=> obstacle for applying food waste management practices at a store level (managers at store level have a better overview and knowledge of situation)	(Filimonau & Gherbin, 2017; Sert et al., 2018)

Table 2.2: External Causes of FW compiled by thesis author

2.10 Management Strategies against FW

The current research into FW causes from different countries, guided the assumptions underlying possible FW mitigation strategies. For the internal causes of FW, employees, forecasting and management and employee training seem to be most relevant. Furthermore, the forecasting issue could be minimized by improved demand planning and updated technology. The marketing causes could be resolved by setting up tailored marketing and communication strategies. For the external causes identified, customer awareness campaigns are the most applicable solution.

Brancoli et al. emphasize that strategies against FW, including reduction actions and alternative waste treatment, help to lessen costs and minimize the environmental impact (Brancoli et al., 2017). Therefore, it is important to learn about the most successful management practices against FW. In the literature, references to 18 areas with specific practices to mitigate FW can be found: technology, employee training, marketing practices, packaging, suboptimal food, customer training/education, apps for consumers and grocery retail, waste tracking, adaption of products to consumer demand, donations, redistribution, upcycling, animal feed, anerobic digestion, composting, biofuel production and disposal Annex C provides a detailed list of FW strategies.

2.11 Food Waste Strategy Framework (FWSF)

After collecting and summarizing the most important strategies against FW, the information on the aforementioned models and strategies were combined, and a new theoretical framework was established (Figure 2.8) to demonstrate the different levels of food waste mitigation. For each level, several strategy areas are assigned.

The prevention level demonstrates the most important and positive practices for supermarket managers (Pearce & Berkenkamp, 2017). The first priority at this level is to realize that suboptimal and ugly food management and marketing practices are crucial practices in mitigating FW. Priority two is employee training, technology improvements, waste tracking, packaging and optimization of product selection. The third priority is consumer campaigning and education and lastly the adaptation of consumer demand.

The re-use level of FW is the second important level. At this level donation and redistribution should be applied first. Next, the usage of FW applications such as ‘Too Good To Go’; the third priority is upcycling, for example through the incorporation of suboptimal

foods in menus of supermarket restaurants. In the recycling level, animal feed and composting have the same priority.

The recovery and disposal levels are the least favorable options and are therefore not examined in this thesis. In Figure 2.8, the strategy areas are prioritized by the frequency of authors reporting on them in the current research literature. The goal is to prioritize the strategy areas in each level, which is analyzed in the current work and also evaluated with the interview partners.

Level	Strategy area	Prio
Prevention	"Suboptimal/Ugly" food management Marketing practices	1
	Employee Training Technology improvement Waste tracking Packaging Optimization of Product selection	2
	Consumer Campaigns/Education	3
	Adaption to consumer demand	4
Re-Use	Donation to humans Redistribution and secondary markets	1
	Apps	2
	Upcycling	3
Recycle	Animal Feed Composting	1
Recovery	Anerobic digestion: Biorefining Biofuel production	1
Disposal	Incineration	Last resort

	Most favorable practices
	2nd favorable
	3rd favorable
	4th favorable
	Last option

Figure 2.8: FWSF (own illustration)

3 Methodology

As described in the introduction, the primary objective of this thesis is the identification of the most effective strategies against FW in supermarkets. This chapter explains the research process adopted in this study and outlines the data collection method, research design and approach, the research instrument and its sample, and the process of data analysis.

3.1 Data Collection Method

Secondary data was collected to assess the concept of FW, causal and influencing internal and external causes, and strategies against FW in supermarkets. The data came from peer-reviewed, relevant and high-quality journals, from ISCTE university databases including b-on (bibliotecta do conhecimento online), Emerald, ABI/INFORM Collection and the OECD ilibrary. Reliability of content and sources was ensured where possible by triangulating data. Additional data was acquired through in-depth, semi-structured, non-standardized interviews with supermarket store managers, German experts in FW and a manager from the food charity organization 'Die Tafel'.

3.2 Research Design- Qualitative Research

In the current work, qualitative research is applied. To ascertain how supermarket store managers handle food waste in their stores, a theoretical framework with different strategy levels and strategy areas was developed "to better understand the nature of the problem" (Saunders et al., 2009). Given this is a relatively unexplored area, current research does not necessarily reflect the knowledge and insights of German supermarket managers working with FW in their stores every day. Hence, it is crucial to gather qualitative data to investigate which, why and how certain strategies are used in supermarkets with a good reputation in their FW strategies. Additionally, internal and external causes of food waste that supermarkets face are evaluated.

Qualitative research is designed to reveal the range of behavior and perceptions of the target audience that drive it in relation to specific topics or issues. The results of qualitative research are more descriptive than predictive. Qualitative research, by definition, is a survey and analysis of non-standardized data using special, non-statistical methods (Mayring, 2015a).

As stated by the office for national statistics UK (2016), "Qualitative research can describe or provide further understanding of a subject and its contextual setting, provide explanation of reasons and associations, evaluate effectiveness and aid the development of theories or strategies." (Office for National Statistics UK, 2016). The discovery of new, previously unknown phenomena or facts is to be given space through openness and flexibility in the research process. At the heart of the qualitative research process is the desire to let the target group of interest speak out in order to be able to grasp the subjective point of view. The basic assumption is that the interviewees are experts themselves and should be understood as such. The aim of qualitative research is to explore unknown phenomena and develop new models and theories (Mayring, 2015a; Saunders et al., 2009). For this reason, qualitative research is applied in this master thesis.

3.3 Research Instrument: Semi-Structured Interviews

Qualitative data was collected through in-depth semi-structured interviews. There were several differences in interviews, but they all adopted the same concept of not having predetermined answers, thus allowing interviewees to share viewpoints and experiences openly (Lamnek, 2002). In general, non-standardized interviews have open-ended questions which are not formulated or planned. A semi-structured anonymous interview framework with open-ended as well as limited closed questions was considered most suitable for exploring the core phenomenon of this study. In these interviews, experts were asked to respond to the main research and sub-research questions.

3.3.1 Sample Selection

All interview partners were selected using the purposeful sampling strategy with a small sample size and high chance of information acquisition. As stated by Creswell (2012, p. 234), "it is better to select a few, rather than many, individuals (…) to provide an in- depth understanding of the phenomenon." (Creswell, 2012).

The interviewees were selected from different areas in Germany to prevent the impact of local parameters. It was decided to involve three different areas of expertise to be interviewed with different perspective and insights on FW and FW strategies in Germany. The interviewees were selected based on to their expertise in food waste, supplementary knowledge and position in their company or organization. Five supermarket store managers, two experts in food waste and one food charity manager were chosen to assure relevance (Saunders et al., 2009).

The manager of the food donation charity 'Die Tafel' provided insights and opinion regarding the general view of food waste in Germany, to understand cooperation between supermarkets and charity organizations, which problems they face and how to improve the partnership. In addition, the manager was interviewed about positive working collaborations with supermarket managers. Two FW experts were interviewed, to gain insights into food waste management strategies in the German market, their assessment of supermarkets regarding FW mitigation strategies and possible contacts of supermarket store managers.

As a third and most important group, the supermarket store managers were consulted, because of their "first-hand knowledge on food waste as they face the issue on the ground" (Filimonau & Gherbin, 2017). The significance of using store managers as interviewees was that there is a scarcity of managerial research in the German grocery retail sector. For the selection of the interview partners, an analysis of the supermarkets that have an outstanding reputation in food waste management practices was undertaken. An adapted version of the "Content Analysis of supermarkets" (Filimonau & Gherbin, 2017) demonstrated Annex D was applied.

Moreover, the research by rbb24 in September 2019 presents Real, Penny and Lidl supermarkets as the retail stores most dedicated to food mitigation practices. Kaufland, Rewe and Aldi were in the middle and Edeka and Netto had a low interest (Avram, 2019).

The content analysis by Filimonau & Gherbin (2017) was used to get a better overview of which FW strategies the supermarket companies included in their current strategies. In particular, supermarket strategies on prevention, re-use, recycling and recovery were analyzed. In the content analysis the eight supermarket chains with the biggest market share in Germany were evaluated due to their influence and reach in the sector. With 21.5 %, the Edeka Group, which is mainly divided into Edeka and Netto, has the greatest market share. Following with 14.7 % is the Rewe Group that consists of Rewe and Penny supermarkets. In third place the Schwarz Group with Lidl and Kaufland has 14.7 %. With 11.1 % the Aldi Group with Aldi Nord and Aldi Süd is in 4th position and lastly Real belongs to the Metro AG holding 3.65% of the market share (Redaktion LZ, 2019).The result of the content analysis regarding FW management in German supermarkets was triangulated with corporate websites content, research by rbb24 and the expert knowledge displayed in Annex E. It is noteworthy that not every supermarket chain has FW reduction goals.

Overall, supermarket chains were not referring to many FW mitigation strategies on their websites. Most strategies were in the area of technology, consumer campaigns and education, marketing, suboptimal food management, with only two including employee training. Penny,

Edeka, Lidl, Aldi and Rewe were found to be the most relevant and interesting interview partners for the research (see Annex E).

3.3.2 Sample

"An expert describes the specific role of the interview partner as a source of specialist knowledge on the matters to be explored. Expert interviews are a method to deduce this knowledge." (Gläser & Laudel, 2010). When selecting interview partners, several criteria were applied. All interviewees must have a leading position, with the authority to make decisions concerning the topic of interest. Store managers, experts and the charity manager must have had a minimum experience of three years in their current position. In addition, the stores must have a good reputation for its FW strategies. In the end, two store managers from Edeka, one from Lidl, one from Penny one from Rewe were interviewed. Aldi did not allow interviews with its store managers or any other manager and was therefore not included. Edeka, Rewe and Penny stores are mostly privately-owned, and they have freedom to change current strategies or easily adopt new ones. As store managers of discounters, Aldi and Lidl are more tied to corporate strategy and approvals than the privately-owned supermarkets.

In Table 3.1 to Table 3.3 the different expert group interviewees are presented with the individual interview ID, duration of the interview, location of their workplace, the supermarket store type, their job title, expertise and ty. The interview ID is used in the result and conclusion as a reference.

Group 1: Food Charity Manager "Die Tafel"

Interview ID	Duration	Location	Job/Experience
A1	36:40 minutes	Lower Saxony	**Job Title:** Tafel manager and Treasury Advisor 9 years in this position

Table 3.1: Food Charity Manager

Group 2: Food Waste Experts in Germany

Interview ID	Duration	Location	Job/Experience
B2	41:59 minutes	North Rhine Westphalia	**Job Title:** Food Security and Inventory Differences 20 years in this position, expert in food waste management
C3	37:32 minutes	Berlin	**Job Title:** Advisor for sustainable land use, climate protection, nutrition and food waste 15 years in this position, expert in food waste management

Table 3.2: Food Waste Experts in Germany

Group 3: Store Managers

Interview ID	Duration	Location	Supermarket Store Type/ Job Title/ Experience
D4	36:11 minutes	Bavaria	**Store Type:** Privately owned supermarket **Job Title:** Store Manager of three markets 4 years experience in this position Responsible for the development of sustainability topics and general tasks of store management
E5	45:10 minutes	Baden-Württemberg	**Store Type:** Privately owned supermarket **Job Title:** Store Manager of one supermarket 5 years experience in this position Responsible for sustainability, availability of goods, the clients, demand planning
F6	42:07 minutes	Baden-Württemberg	**Store Type** Privately owned supermarket **Job Title:** Store Manager of four supermarkets 5 years experience in this position Responsible for sustainability program, project management and customer satisfaction
G7	54:51 minutes	North Rhine-Westphalia	**Store Type:** Discount supermarket **Job Title:** Manager of six stores 4 years experience in store management position Past 2 years responsible for six stores as a sales manager
H8	42:02 minutes	North Rhine-Westphalia	**Store Type:** Discount supermarket **Job Title:** Sustainability Manager (former Store Manager) 3 years experience in store management position. Past 3 years responsible for sustainability and food waste in the supermarket chain

Table 3.3: Store Managers

3.3.3 Interview Guideline

The guided semi-structured expert interview is a common instrument of the qualitative research method (Gläser & Laudel, 2010) and was chosen for the collection of data for the analysis of the research question. In this interview type, the special knowledge of the experts and their individual perspectives on the topic can be discussed. This type of non-standardized interview questions require a certain degree of structure, which is carried out on the basis of guidelines (Kaiser, 2014). This guide ensures a collection of similar information within the interviews and (Gläser & Laudel, 2010) ensures a focus on the prepared topics and questions. Nevertheless, the opportunity for spontaneous comments and ad hoc questions remain (Berger-Grabner, 2016). The interviewer's task is to maintain control over the course of the interview without interrupting the communication process (Kaiser, 2014). This also means that the interviewer must be able to be spontaneous without interfering too dominantly in the conversation (Hopf, 1987).

The interview questions were formulated according to the principles of openness, neutrality, simplicity and clear wording to ensure that the interviewee can provide the desired information without bias (Gläser & Laudel, 2010). In addition, care is taken to generate suggestions for the interviewee to tell a story, without remaining too unspecific (Bogner et al., 2014).

Each interview began with an introductory question requesting background and experience information from each expert. These questions can be easily answered and make the interviewee feel comfortable in the interview setting (Gläser & Laudel, 2010). The next section was designed to get answers to the research questions. The questions are content related and aim to elaborate on the general view of FW in Germany and the supermarket setting. Further, the interest was on the internal and external causal factors in food waste and the strategies that are used by their supermarkets against food waste on a corporate and individual level. Next, the most effective mitigation strategies against food waste were elaborated and interviewees were asked about the FWH. A basic explanation of the theoretical FW Strategy framework (FWSF) was then provided by the interviewer.

The following questions were formulated to get opinions about the framework and assess how experts would prioritize the different strategy areas inside the different strategy levels. In addition, other comments about the model were taken into consideration. As a last point of the content section, a question about the improvement areas within the food waste charity organization collaboration was asked. In the concluding section of the interview, an open question gave the expert the opportunity to express additional information that had not been addressed within the interview. There were different interview guidelines for the three expert groups. The one for the store managers had the most questions, followed by the expert interview and lastly by the food charity manager interview. This was due to different engagement levels with the FW mitigation strategies.

In Annex F and Annex G, the interview guidelines for the store managers, for the experts in food waste and for the food charity manager can be found in English and German. The interviews were conducted in German, due to this being the primary language of all interviewees.

3.3.4 Preparation and Execution of the Interviews

According to Gläser & Laudel (2010), good theoretical and strategic preliminary considerations regarding data collection are crucial parameters for high-quality research (Gläser & Laudel, 2010). For the preparation of interviews, Kaiser (2014) recommends a pre-test, a test of the interview questions before the actual interview (Kaiser, 2014). The aim here is to test the interview guideline for its suitability for obtaining the desired information and data and to check the interview length (Bogner et al., 2014). Due to the Covid-19 pandemic, it was not possible to test the interview with a professional working in the food waste management area. Thus, the interview was tested and reviewed by three different random test persons from ISCTE academia. Those testees estimated it would take 40-50 minutes for the store manager and 20-30 minutes each for the expert and food charity manager interviews.

The experts received a customized invitation by email with the basic project details and interview intent. If they agreed to take part, an interview date was arranged via a phone call. All interview partners were cognizant of the research and had the flexibility to withdraw at any stage. The interviewees were informed that the interview would last for 20-50 minutes depending on their responses and the interview group from which they came. In order to ensure reliability of subject or participation bias, anonymity was provided to all interviewees. Observer bias was minimized by transcribing and triangulating the audio files immediately after the interview.

3.4 Data Analysis

A content analysis to evaluate causes of FW waste, current strategies against FW and the FWSF was performed. As a first step, the audios of the interviews were transcribed with the assistance of the audio dictate function of Microsoft Word. The German transcripts were collected in the extra document ‘All interview transcripts’ and are available upon request. Next, the transcribed interviews were ‘cleaned’ of spelling or grammatical errors and were anonymized. Finally, the data was analyzed and codified with the qualitative research software ‘MaxQDA’.

According to Berger-Grabner (2016), the subsequent evaluation of the interviews can be best carried out by means of qualitative content analysis. Bogner et al. (2014) also recommend this method for obtaining information. Mayring (2015) describes this method as "category-based text analysis". The reduction and analysis of the text to answer the research question is the main goal (Berger-Grabner, 2016). The decomposition and compression of the data material

into smaller elements is a decisive part of the analysis. This means that a construct of different categories and sub-categories is created during the closer examination of the text in order to be able to compare the generated data. A category summarizes a particular aspect that appears relevant for the evaluation (Braun & Clarke, 2006; Mayring, 2010). The allocation of the individual categories to relevant text passages is systematic and guided by rules (Mayring & Fenzl, 2014). This category construct ultimately forms the center of the analysis process (Berger-Grabner, 2016).

There are different techniques of qualitative content analysis as determined by the systematics and rules according to which the categorization is carried out. In the present work, a deductive-inductive approach was used to assign categories to the data material. This mixed method approach included both qualitative and quantitative analysis procedure (Mayring & Fenzl, 2014). On the one hand, a deductive approach, is suitable for theory testing and refinement and is used to evolve categories from theoretical concepts and theories (Mayring, 2015b; Skjott Linneberg & Korsgaard, 2019). On the other hand, an inductive approach develops a category formation directly from the material and is therefore performed without bias and preconception (Mayring, 2015b).

In order to answer the first and second sub-research questions from the theoretical perspective, the literature review on causes of FW, strategies against FW and theoretical frameworks was built up before conducting the interviews. Therefore, categories and codes were deducted from the theoretical frameworks to evaluate if theory matches practical experience from the experts. In Annex H, a simplified version of a codebook recommended by Mayring was established before starting with the analysis (Mayring, 2010). After applying the categories and codes to the transcripts, inductive ‘in vivo’ codes were created. Neale (2016) suggests that inductive after deductive coding can be “…valuable in complementing, expanding, qualifying or even contradicting the initial hypotheses or assumptions of the researcher.”.

For the inductive coding, the first step consisted of "… identifying initial concepts in the data and grouping them into ‘categories’ (open coding)" (Corley & Gioia, 2004). In the next phase, the categories were cross-referenced, and similarities and differences were highlighted. The categories were then grouped under so-called ‘themes’ to allow for an interpretative analysis of the data. In a next step, the topics were related to each other and aggregated under ‘dimensions’.

The construct of categories, topics and dimensions was applied for the deductive and inductive codes (Gioia et al., 2013). Therefore, after the analysis of the transcripts with the

deductive codes all data was reviewed line-by-line to identify possible new inductive codes (Neale, 2016). A coding tree recommended by Corley & Gioia (2004) was created to demonstrates the identified deductive codes in black and inductive codes in green (Annex I). In addition, each ‘theme’ was quantified by text passages assigned to demonstrate the importance. The deductive code ‘apps’ in the strategy level ‘re-use’ was removed from the coding tree as it fitted better in the theme ‘Redistribution and secondary markets’.

To answer the last sub-research question, some quantitative data was derived from the interviews. Seven of the eight interviewees prioritized the strategy areas in the strategy level. With the data, the conformity of these prioritizations was calculated. The comments on the FWSF were summarized.

4 Interview Results & Discussion

This chapter captures the results extracted from the expert interviews and discusses them with FW literature.

4.1 Interview Results

The interview results are structured by the sub-research questions and the coding tree displayed in (Annex I). Before starting with the analysis, the word cloud and count option of MaxQDA was utilized to identify which words were mentioned most frequently in the interviews. A summary is contained in Annex J.

In the first questions, experts were asked for a FW definition and if they saw FW as a problem for supermarket store managers. Furthermore, their general attitude towards FW was requested. Even though all of the experts defined FW slightly differently; they all agreed that FW is food produced for human consumption "and that all food that has not served this purpose for some reason, because it has been damaged in the production process, because it is no longer saleable in our stores and then is no longer consumed by a human being, is in my opinion wasted." (G7). In all cases, there was a general agreement that FW is a major problem of store managers and the grocery retail sector. Interviewee D4 summarized "Food waste is a huge problem in the grocery retail industry and a big cost block for us in the stores". Moreover, expert C3 described the retail sector as the "linchpin of FW".

All interviewees not only had an interest in decreasing FW in business and felt responsible for the topic, but also saw it as their personal mission to mitigate and prevent FW as much as possible. With the statement "Of course we also want to be economical, but we also do it out of conviction, because we …have a responsibility in society", F6 demonstrated that the grocery retail sector has the power to influence society, and that responsibility and operating economically are of equal importance. "It is one of our interests to prevent food waste as much as possible" (G7). All the responses led to the assumption that interest in preventing FW is connected to better FW management.

4.2 What are the Internal and External Causes Driving Food Waste in Supermarkets?

All experts were asked to point out the main internal and external causes driving FW.

4.2.1 Internal Causes

In the transcripts of the interviews 30 text passages were employee, 24 marketing, 14 management, 10 technology and five planning and forecasting related causes.

4.2.1.1 Employees

Five experts mentioned that lack and availability of human resources was one of the main internal causes of FW. Furthermore, six experts noted that incorrect ordering occurs in stores due to wrong planning or unreliable customer behavior, untrained staff, unpredictable employee absence or sick leave. “Staff can make mistakes and order incorrectly. Not everything is fully automated yet. And as soon as the human being somehow plays a role, you also have a built-in error source.” (G7).

Other causes were a lack of FW awareness by the employees and bad storage handling. Store manager E5 reported that in the past his corporation gave employees products that could not be sold in store. Now “We are not allowed to do that anymore, because employees have already taken too much advantage of it. Unfortunately, the employees have intentionally damaged the products and packaging to take home the products they wanted” (E5). G7 confessed that some store managers do not employ enough staff in stores to handle extra FW tasks, so they are stressed and sometimes pay less attention to FW.

4.2.1.2 Marketing Practices

Marketing practices were the second strongest internal cause of FW. Seven of the interviewees describe product variety and product quantity at any time of the day as a major internal factor of FW in their stores.

Most justified a large product range in their stores with customer expectations and buying behavior, as well as strong external competition. If they do not offer a large array of products, they would lose customers to their competitors. B2 states that “The shelves must be fully stocked, otherwise the customer has no stimulus to buy”. However, D4 believes that “it is also

our fault. The food retail industry has educated the consumers in this way". Especially after holidays, themed products such as Easter chocolate bunnies are still available in stores, but not bought anymore by customers. Most of these products are donated, but even then nobody wants to consume them anymore (A1). The trend of having less and smaller packaging also results in more FW and shifts the problem from the consumer to the supermarket (B2). C3 commented that the best-before date (BBD) is not communicated well enough and that some promotional offers also lead to more FW in the end.

4.2.1.3 Store Management

The management of the store can be an internal factor of FW as well. In this thesis, the management causes of FW can overlap with the 'corporate engagement' causes depending on whether the store is privately owned or not. Six experts gave a wide range of reasons for that. A1 was critical that some stores still give away top-quality products to charity instead of selling them to customers. She thinks the quality standards of the products are too high. Furthermore, C3 believes that supermarket chains are not transparent enough with their FW data. In D4`s opinion, store managers are acting too risk-averse in throwing food away instead of gifting it to customers. F6 and H8 claimed that internal regulations regarding food quality are too strict.

4.2.1.4 Technology & Forecasting

All experts assert that technology can be one of the main internal causes of FW, if it is not updated to current standards or if there are malfunctions. G7 admits that "The fresh food sector is still managed mostly manually but we are starting now with the digitalization and automation process. We will waste less food with that…" Experts A1, B2 and G7 believe that a lot of times the forecasting is not planned well and that with accurate planning FW could be mitigated.

4.2.2 External Causes

The interviewees referred 56 times to customers, 29 to political implications, 25 to corporate engagement, 12 to suppliers and eight to competitor related external causes driving FW.

4.2.2.1 Customers

Seven of the experts said that customer requirements for food are high quality, freshness and an economical price. In addition to that, food variety and availability at any time of the day is

desired. All experts agreed that these requirements result in more FW. A1 remarked that “Even people that pick up food at our charity organization, have high quality standards. So, I can only imagine what customers expect in supermarkets”. F6 believes that “The customer regulates the range of products through his demand… The customer needs to recognize that for example 40 types of butter are not needed and that perhaps five types of butter are enough.” (F6).

Furthermore, H8 and A1 observed the tendency of the customer to select products far away from BBD, even if they intend to eat the products in the next days. Besides that, customers lack FW awareness and food value. German customers are very price oriented, even in wealthy neighborhoods (D4). E5 criticizes that “There is always money for a big TV but not for food…”. D4 remarked that the reality of actual buying behavior is very different to what customers say: “In surveys customers state that they still would buy the peppers that are a bit dented. But in reality, if the peppers don't look perfect, they won't buy them. We observe that every day”. Another external cause of FW is the bad food handling behavior of customers. They sometimes break, spill and grab products, leading to their disposal. (E5).

4.2.2.2 Political Implications

There are several laws that affect FW in the opinion of the interviewees. The most mentioned law was the BBD liability law. Until the BBD the manufacturer is liable for the products, but after it the grocery retail sector takes responsibility (B2). That is why products that have expired the BBD are risky for grocery retail stores.

Furthermore, strict hygiene laws can cause FW too. Store managers who want to give their FW to farmers or for feed processing have to deal with almost higher quality standards than for humans (H8, B2, C3). The outcome is that fewer stores donate to farmers, zoos or others. E5 commented that changing these laws would lead to less food waste. B2 also mentioned the extended opening hours lead to more FW. In addition to this he remarked, that even for the food placed in bins, the supermarket is liable. The supermarket is also liable if people take food from their bins (‘Dumpster Diving’ or ‘Containering’).

4.2.2.3 Corporation

Discount supermarket stores are especially affected by the actions of upper management in the corporation. A1 and G7 reported that the purchasing department in the head office orders some goods one year in advance. They buy for all discount supermarkets and divide the products among their stores. In some stores, certain products do not sell well. Furthermore, management

puts strict internal quality checks on variety, quantity and prices of products. Three of the store managers reported that they have almost no freedom in initiating FW strategies or changing them accordingly. H8 believes that most supermarkets focus more on quality, price and freshness before considering sustainability of their products.

4.2.2.4 Suppliers

Three of the experts commented on external causes of FW through suppliers. E5 remarked that suppliers force them to offer the product range they are producing. If there was less production, less food would be wasted. F6 detects that sometimes suppliers send products with BBDs too close to expiry, that they deliver broken or damaged food, and that some of their products suffered cold-chain interruptions. G7 reported that some suppliers force them to display certain products in the stores that they do not want: "We already know that we won't sell the product. But … for example says, if you want to have the other products, you need to position this product in your stores.". This food will be mainly wasted as well.

4.2.2.5 Competitors

E5 stated that discount supermarkets are responsible for low prices in Germany and therefore also the price competition. All experts talked about the strong competition in the grocery retail industry. Supermarkets which open near other grocery retail stores always have an effect on those stores.

4.3 What are the Current Strategies used by the Grocery Retail Sector?

All experts were asked to describe which strategies they were currently using in their stores and why they were doing so. Figure 4.1 displays the expert prioritization of the strategy areas.

Before asking for strategies from the experts, it was essential to understand their opinion about current FW management and awareness in Germany. All experts considered that the German government and ministries had improved their regulatory FW measures and communication in recent years. B2 commented that: "FW also became more popular and present in the media in the last years. The Ministry of Consumer Affairs has also run its campaigns as for example 'Zu gut für die Tonne'. One of the parts of this campaign is to explain that the 'best-before date' is only a suggestion by when the food is edible. Also, retailers have

more pressure now to do something about FW" (see also Annex B). C3 indicated one positive outcome is that "Compared to other countries, Germany takes a very structured FW approach".

However, there is room for improvement. D4, E5 and F6 criticized the fact of food being very low priced, which causes customers to not value food enough. "Customers in France for example value food more because it is more expensive. The average German also does not want to spend much money on food." (E5). In addition to this, C3 remarked that "…in Germany the FW data is insufficient and we only have estimates. In addition, FW data from supermarkets are not available to the public. We need more transparency of the data!"

4.3.1 Strategies in the Prevention Level

4.3.1.1 Technology Improvement

Most interviewees discussed the technology improvement strategy area. Six out of eight experts emphasized that an inventory control system was very important and that it should be updated to current standards. The system needs to include weather data, a first-in first-out control system, holiday season forecasts and an adapted demand planning for each situation. Furthermore, it is crucial to use data from the past to see customer patterns. "If the inventory system orders smartly, you can save a lot of food." (D4). G7 proposed that "the store manager is a dispatcher who initiates an order. But in the future, he's more likely to be an administrator. He will maintain systems, maintain the store, and then the system will calculate what he needs. Based on statistics, systems are much better than the store manager's gut feeling. For us, it is the greatest leverage…" He also suggested that this is the best way to prevent FW for discounters in Germany.

D4 and F6 both recommended using the 'Apeel Technology' which covers fruit or vegetables with an extra natural skin that is eatable, innocuous and helps them to stay fresh twice as long as normal. D4 emphasized that "The fruits and vegetables last much longer with the extra wrapping layer. That's good progress." Furthermore, H8 reported that they are testing a technology that executes a real-time analysis of bread and bakery stocks and demand, so they do have less FW in this product group. Besides, B2 recommended using a "gentle lighting system for meat that makes it look good and last longer."

4.3.1.2 Marketing Practices

Marketing practice was the second most frequently mentioned strategy area. All experts discussed product discount offers between 30-50 % for products that are close to the BBD as

"… one of the most important and effective strategies against food waste." (E5). Two of the experts recalled that it is necessary to offer individual sellable products and to have more demand-oriented portions. In addition to this, expert C3 and F6 believe that customer education regarding BBD would help prevent them buying only products with the longest durability. F6 declared that "as long as we have accompanied this topic from a marketing perspective, we have noticed an improvement of buying behavior here. As soon as we have stopped with the communication, the customer has fallen back into his rut." The store manager observed that stopping and repeating this communication was the best approach for educating customers.

4.3.1.3 Customer Campaigns

As customer campaigns and education are closely related to marketing practices it is no surprise that it was the third most referred strategy in the interviews. Two words that were articulated the most in this context were awareness and sensitization. Since for a lot of the customers the meaning of the BBD is still not clear, it was deemed essential to explain on the packaging of the product (B2, C3, E5, G7, H8). With a "Smell, taste, enjoy" and "mostly still good after best before date" label on their own brand products, the supermarket chains could make customers aware of their incorrect understanding (G7, H8). Dairy products especially, are a dedicated product group for that campaign due to their rapid perishability.

Two of the FW professionals recommended creating more customer communication about the source of the products, as customers would support regional farmers, meaning shorter delivery routes, which would decrease FW. Expert F6 and H8 are convinced that communication on social media and websites about FW in general, explanations and games about how to store food and a recipe book for leftovers can help raise customer awareness. Only D4 believes that it is not possible to change the customer perception and awareness of food and FW without a major change in society.

4.3.1.4 Employee Training

The next most commonly referred strategy area was employee training. Seven experts see employee training in the area of awareness towards FW, inventory management, operational process management and shelf handling as a very crucial aspect.

G7 believes that it is substantial to train employees on how to react towards wasteful customer behavior, for example the squeezing and grabbing of food, as well as the practice of putting refrigerated items somewhere else in the store. Employee awareness is the most

effective strategy for FW prevention (H8). In her stores, “The food waste topic is ingrained in our employee training program. Every year a sustainability topic takes place in our sustainability week. Two years ago, we educated our trainees in FW and gave them the title of ‘food rescuers’. They also worked on a food waste challenge and had to brainstorm for ideas to prevent and reduce food waste in our stores… We also created customer campaigns for the stores and write about FW in our internal employee magazines…”.

Furthermore, all her stores have a sustainability ambassador. Expert C3 underlined the success of H8`s employee training strategy and states that “…the survey executed afterwards has shown quite a good picture. The trainees were much more aware of the value of food and knew better how to deal with it in the supermarket and at home. All in all, the handling and perception of food was improved and passed on from the trainees to others. Through the training, a greater commitment was triggered.”.

4.3.1.5 Waste Tracking

Waste tracking is mentioned by six of the eight experts. All of them track FW in value lost in euros, with the amount of money they have to pay for the dumpsters or bins and with the value lost in percentages. In Germany, as yet there is no congruent measuring technique for FW in weight.

The interviewees’ FW ranges between 0.2-10% depending on the product group. The most wasteful group is bread and bakeries with almost 10 % of FW. Three of the store managers have a FW reduction goal and are evaluated accordingly. Two experts highlighted that having an ambitious reduction goal is the key to success. “We set our own goal, which is to reduce food waste by 30 percent over the entire value chain by 2025. This is really important I think.” (G7). Two experts reported about collaboration with the government, other companies and the EHI retail institute to find a new measuring technique for FW in Germany. This topic will be more elaborated in the reporting strategy area later in this section.

4.3.1.6 Adaption to Consumer Demand

In the FW model the ‘adaption to consumer demand’ is defined as a quantitative adjustment of products according to demand. Fifteen quotes were found in the interviews in this strategy area. Furthermore, it is connected to the ‘technology’ area. Five experts saw the adaption of consumer demand as an important strategy area. They suggest that demand-oriented planning means a shorter ordering schedule, smaller order units and safety of stock. F6 outlined the

benefits of the supermarket store having a contract with a nearby supplier "… a farmer who delivers his cherries or his strawberries, or his potatoes, then I can order a certain amount, if I notice that it's not enough, then I can reorder again, and he's right there, so that's of course a great thing, because I can adapt better to the consumer demand and I am not wasting that much food. And I've got very fresh products…" In addition to that, H8 recommended stopping orders of bread and pastries, fruit and vegetables at a certain time of day.

4.3.1.7 Networking & Collaboration

The 'networking and collaboration' strategy area emerged from inductive coding. This new 'theme' is supported by fourteen text passages in the interviews. Seven of the experts recommended collaborating with other stakeholders and being part of a network as beneficial in fighting FW.

Three FW professionals joined a network with different stakeholders from politics, Non-Governmental Organizations (NGOs), an institute of FW research and other supermarket chains. "The networking group 'Handel' aims to develop a suitable weight measurement method for FW in the food retail sector. Together with the ministry and all other stakeholders, we are committed and trying to bring more transparency in the topic. If we measure FW and know how many tons we actually waste, we can set better reduction targets…A consistent measurement technique of FW will help us all." (H8). Together with the Ministry of Economics and other stakeholders, G7 is engaged in a cross-sector network against FLW. It is working on FLW strategies to reach the goal of halving FLW by 2030.

Moreover, D4 and F2 advise using an internal network for an exchange of FW experiences. In addition to this, they do have a WhatsApp group with the close-by stores to be able to exchange goods in case they have too many or too few products in their stores. B2 and E5 have worked on partnership-based collaboration with suppliers. E5 can send back seasonal products such as chocolate and B2 recommended that having a good relationship with your supplier and being transparent about sales numbers of the subcontractor products, would guarantee both parties would waste less food.

4.3.1.8 Optimization of Product Selection

Optimization of product selection was mentioned fourteen times by the interviewees. In the causes of FW, too much variety of products in stores was mentioned as critical. Four experts believe that store managers should select more regional products for their stores. Using this

strategy themselves they claimed that less food is wasted, due to a faster and more flexible reordering process as well as shorter transportation routes. Three experts also mentioned that new products should be tested first before they are included in the supermarket product portfolio.

4.3.1.9 Suboptimal or Ugly Food Management

Suboptimal or ugly food management was discussed by five experts. Two of them offer misshapen food in bio quality mixed with normal-looking vegetables and fruits. The 'ugly' food was well received by the customers and at the same time farmers do not have to be underpaid. D4 offered ugly food in the past but had to give up on this strategy due to customer rejection of the products. F6 wanted to implement this strategy but couldn't find the right supplier and G7 believes that it is a good strategy but is not offering it himself.

4.3.1.10 Reporting

Reporting is a new strategy area that emerged while inductive coding. Expert C3 and H8 suggested that reporting is an important method for food waste management. Both mentioned Tesco in the United Kingdom as the pioneer in reporting about FW and hoping that the German grocery retail sector would emulate it. C3 gave the example that in "Great Britain or the Netherlands a lot more work is done on the food supply chain and the food waste data of grocery retail companies is published. It started with Tesco, but now in the UK there are 40 companies that report publicly on their food waste …". Furthermore, C3 and H8 recommended to set reporting measures and a FW mitigation goal.

4.3.1.11 Packaging

Smart and portion-sized packaging was only mentioned by two experts as a possible food management strategy and is therefore the least important strategy area in the prevention level. H8 made the comment that: "You could reduce food waste if you made the packaging smaller, but of course that also means that you simply have more packaging. Packaging is seen as a more important issue at the moment." B2 confirmed this statement and noted that "on the one hand we have the whole discussion about packaging minimization and reduction, especially in the fruit and vegetable sector. This means that the less packaging I have around the product, the less it is protected from external influences, and the faster the product perishes.".

4.3.2 Strategies in the Re-Use Level

4.3.2.1 Donation for Human Consumption

Donation dedicated for human consumption is the most important strategy in the re-use level. All experts are using donation in their FW strategies or recommend doing so. Besides one of the store managers, all donate FW to the food charity organization

'Die Tafel' and conveyed that they have an excellent relationship with them. On top of donating food to charity, three experts recommended offering products that cannot be sold anymore or are not wanted by 'Die Tafel' for free to the customer. F6 explains: "We have a 'Zu gut für die Tonne' corner in our stores where we give away food for free to the customers… Even if the 'best before date' has already expired we offer the products, because we select goods that perhaps don't need a 'best before date', like flour or noodles, where it's nonsense with the 'best before date'… As a store manager, I am happy to take the responsibility and liability, because I know that this food can still be consumed".

H8 prioritized 'die Tafel' as a donation partner, but indicated they also collaborate with the food charity organization 'Foodsharing'. If one of her stores still has food leftovers after the 'Tafel' pick up, then 'Foodsharing' is contacted. From the experience of store manager D4, free giveaways do not cannibalize products sold in the supermarkets. D4 shared "…that's not true, people still buy. The customers are really happy when they see the boxes at the end of their shopping and get a 'present' before they leave. For me and the customers this has only advantages. They are happy and I save the waste fees for one ton per week.". Expert C3 remarked that "…donating is very important, but it is more important that abundance is not created in the first place."

4.3.2.2 Redistribution & Secondary Markets

Seven of the interviewees considered redistribution and selling products to other businesses relevant to mitigate FW. Five of the interviewees redistribute their goods to another store, three send back products to suppliers and three are collaborating with other businesses.

C3 believes that "… any component that helps to raise awareness of the issue is good... 'Sirplus' and 'Too Good To Go' are excellent examples of redistributing food. I`m glad that because of these businesses, society is more engaged with FW and that the topic it is discussed more." D4 prefers to donate food to his customers instead of "supporting a business that is making money off my products".

4.3.2.3 Upcycling

Four experts addressed upcycling in their interviews. They send bread & bakery products back to the suppliers, so they can produce new products from it. In addition to this, they reuse chocolate, milk, bananas and other products to sell them in their integrated restaurant or fresh salad bar. F6 remarked that "All goods that can be processed and sold again before expiry are our gain."

4.3.3 Strategies in the Recycling and Recovery Level

Four experts reported different recycling strategies. One store manager indicated he gives fruit, vegetables and bread to a zoo, three give it to farmers and two to an animal feed producer. In addition to that, D4 gives away his coffee grounds to the customers. They use it for composting or creating new products from it as a coffee peeling for example. None of the experts referred to recovery strategies.

4.3.4 Other Countries' Approaches

As a German FW expert and as a member of an international organization, C3 recommended the most dedicated FW strategies from other countries. She believes that learning from the UK, where already 90-95 % of the food industry reports its FW, and the Netherlands (NL) where they are also starting to be more effective, could be a major milestone for FW management in Germany.

H8 is also involved in FW networks in Germany and exchanges knowledge with different stakeholders. Both experts described Tesco in the UK as a worldwide pioneer in FW strategies. Tesco "publishes its food waste quantity every year on every possible level. They are able to measure it very, very accurately and draw measures and goals from it." (H8). C3 reports that "Tesco started to publish their data already in 2014. Even though they first got highly criticized for it, their measures were driving them to less FW so other companies also started to be committed in this area. That was a nice positive competition effect." Furthermore, she noted that this was only possible with the help of the Waste and Resources Action Programme (WRAP), a non-governmental organization that consults for the grocery retail industry and assists them with a tailored action plan (see also Annex A).

The Netherlands and Denmark (DK) have similar organizations and C3 believes that this could also be advantageous for Germany. She also explained that in the current reports the UK,

NL and DK have one of the highest FW per capita, because these countries are measuring FW more accurately than others: “The countries that have mainly not addressed the issue further, such as Greece or Hungary or Lithuania, have very, very little food waste per capita. For us this was more an indication of data availability.” (C3).

C3 also addressed a positive legislative change in Italy, where the ‘Good Samaritans’ law defines “the organization collecting the food is now destined as the end-user. Because of that, the liability is neither drawn to the supermarket nor to the charity organization.”

Additionally, C3 believes that mandatory donation, as written into law in France, would not be feasible for Germany. She noted that an obligation driving companies to donate, would also place more obligations on volunteers of food charity organizations to work even harder. In her opinion, that should not be the goal in the fight against FW.

4.4 How Do Food Waste Experts Prioritize Strategies against Food Waste?

After analyzing the FW strategies that are known and implemented in Germany, seven of the eight experts were asked about the FWH and their opinion about the model. Only the food charity manager (A1) was not consulted for this part due to an expected lack of knowledge in this area.

Three of the experts knew the FWH, two had heard of it and another two did not recognize the model. However, for all of them the FWH appears logical and useful for FW management. “I think it is clear that you first have to act preventively in order to have as little food waste as possible. After that, emphasis should certainly be placed on re-use and further processing into food, followed by use as animal feed, while energy recovery should be considered of secondary importance. In this respect I agree with the model of the waste hierarchy.” (B2). Furthermore, all agreed that the prevention and the re-use level is the most important level for store managers and that at this level the most FW could be averted. “The most important part for me as a store manager is the prevention and re-use level. At the recycling stage, the quantity is so small that I don't consider it as important as the other first levels” (D4).

In addition to the FWH, the FWSF (Figure 2.8) was presented to the experts for an assessment of the framework and a prioritization of the strategy areas in the different strategy levels. All experts unanimously concluded that the structure and the division is coherent. “Yes, if I see it that way, it is based on the food waste hierarchy. The assignment of the strategy areas to the strategy levels also makes sense. I like how you divided the different strategy areas” (E5).

Two experts still had remarks for improvement of the model. F6 commented that she would divide prevention into two levels. She would set up the first level by building and raising awareness of the value of food to the customer and employee level. Furthermore, for her employee training and having the newest technology on demand planning and FW tracking is crucial. In a second prevention level, she recommended initiating strategies that involve rescuing the food from being thrown away, for example with price reductions. “I would say, in prevention level one, I don't have a problem with food waste yet. I first provide knowledge, awareness and the right technology. The second level is the stage in which I have a problem with the food and need to have an action plan as price reduction and so on.” (F6). She suggested that after that stage the re-use stage begins, with donating to charity organizations, and that this stage should be separated from in-store FW handling processes. B2 proposed that “… the model would make more sense if you assign it to the respective product groups and analyze them. After that you assign the respective strategies for every product group. That's probably one step too far, but that would be interesting as well”.

While all experts agreed that the FWSF is a useful model for store managers, expert E5 noted that “…this is more useful for the corporate strategy department of the company. But that is because of how we are structured as a company. Unfortunately, as a store manager I can't do much about FW strategies initiation… Perhaps it would be good for them to take another look at this. It would maybe also help them.”.

In the Annex K, the analysis of the prioritization of the experts is displayed. The result of the prioritization of the FW strategy areas is presented in Figure 4.1.

Level	Strategy area	Expert Prio	Theory Prio	Same Prio
Prevention	Marketing practices	1	1	1
	Employee Training		2	/
	Technology improvement			/
	Customer Campaigns/Education		3	/
	Waste tracking	2	2	2
	"Suboptimal/Ugly" food management		1	/
	Optimization of Product selection		2	2
	Adaption to consumer demand		4	/
	Packaging	3	2	/
	Networking/Collaboration	n.a	/	n.a.
	Reporting		/	
Re-Use	Donation	1	1	1
	Redistribution/Secondary markets			
	Upcycling	2	3	/
Recycle	Animal Feed	1	1	1
	Composting			
Recovery	Anaerobic digestion (Biogas: heat/ electricity)	1	1	1
	Biorefining (fuels, chemicals, materials			
	Biofuel production			
Disposal	Incineration	/	/	/

	Most favorable practices	n=7
	2nd favorable	
	3rd favorable	
	4th favorable	
	Last resort	

Figure 4.1: FWSF Prioritization Comparison (own illustration)

As demonstrated in Figure 4.1, marketing practices, employee training, technology improvement and customer campaigns/education are rated as the most effective strategy areas by the experts. In addition to this, donation for human consumption and the redistribution strategy area were prioritized as the most effective. In the recycle and recovery level all strategy areas were seen as equally important. For more details about the individual strategies affiliated to the strategy areas please refer to Annex C and chapter 4.3. Moreover, in the interviews 30-50 % price reduction on dairy products and perishables, employee awareness training, customer campaigns especially about the BBD, an updated inventory control system and donation for human consumption to food charity organizations were mentioned the most frequently as the most effective strategies against FW. The ‘Same Prio’ column in Figure 4.1 shows the corresponding priorities found in literature and in the expert interviews. These are elaborated in the next chapter discussion.

4.5 Discussion

As noted in the literature review, there is no consistent definition for FW. In the interviews it became clear that also store managers and other experts had slight variations in their definitions. The interviewer made sure, nonetheless, that all interviewees had the same understanding of FW with regards to causes, strategies, the FWH and the FWSF. For further investigations in this area and especially for the proposed FWSF, it is important to ensure a common understanding of FW.

In the literature review, data on FW in Germany was derived mostly from the REFOWAS and Hühne report. C3 found that FW amounts must be even higher, because FW in Germany is not measured by weight yet. Test results of her study organization demonstrate that more food is wasted by grocery retail. Keeping this in mind, improving the FW strategies in supermarkets could have a more marked effect than assumed.

A comparison of the results of the causes of FW from literature and the results of the interviewees shows, that both sources indicate the same. Only one other external cause of FW, ‘competition’ was detected. Therefore, theory and practical experience are almost aligned. To identify the most important internal and external causes driving FW, it was assumed that the number of authors referencing the different causes of FW would imply the importance of each rationale. As displayed in Figure 4.2, the FW experts in Germany assigned a different order on the internal causes of FW. While ‘employees’ was the least important cause of FW in research, it was the most frequently mentioned in interviews. Furthermore, technology and forecasting were the biggest internal causes in research literature, yet the experts reference them as the least important. Marketing and store management are in both cases between the second and fifth position. However, it is significant that primary and secondary research discovered the same internal causes of FW.

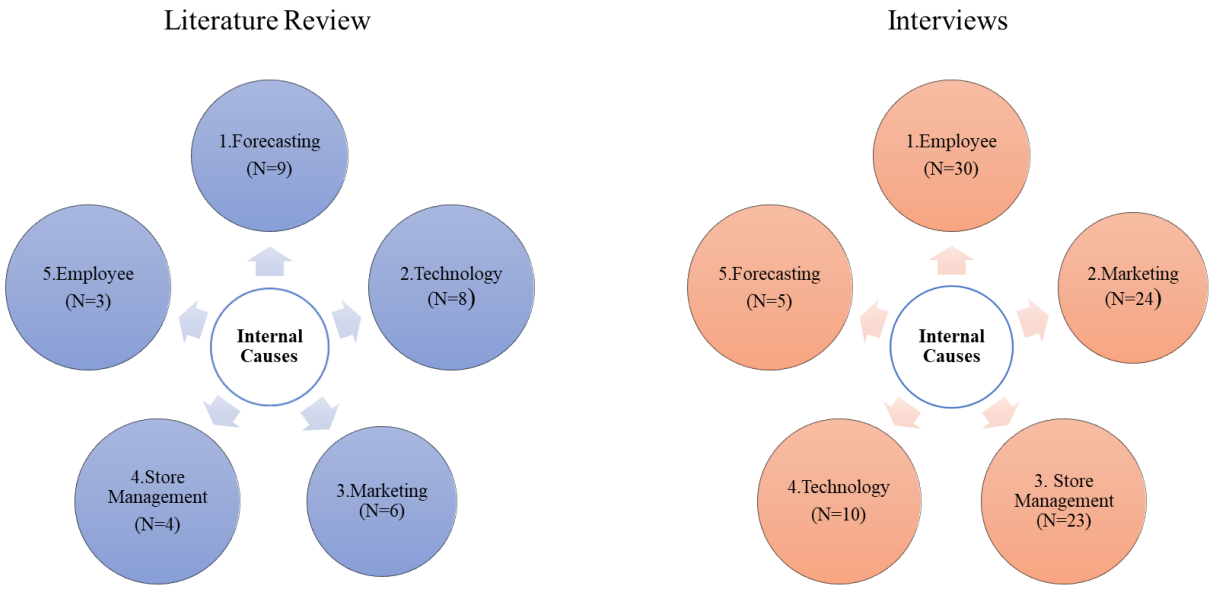

Figure 4.2: Internal Causes of FW Comparison (own illustration)

As demonstrated in Figure 4.3,research literature and the FW experts in Germany agree that customers and political implications are the external causes of FW. Suppliers and corporation causes are reversed.

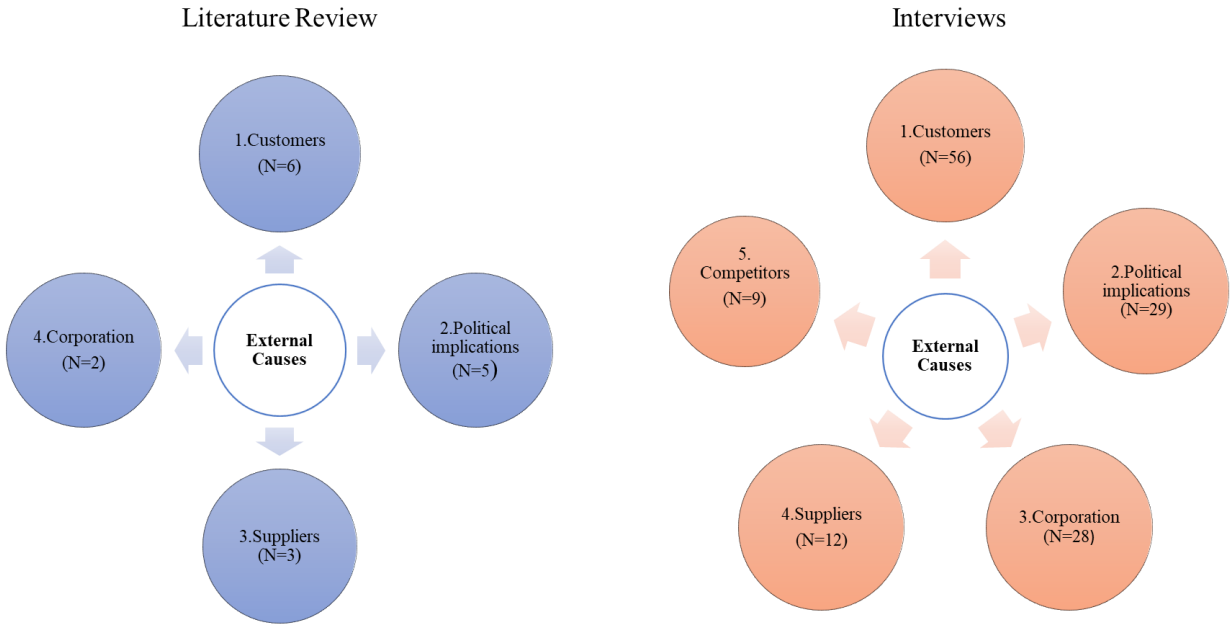

Figure 4.3: External Causes of FW Comparison (own illustration)

Store managers of privately-owned supermarkets and the strategy department of discount supermarkets need to be aware of their biggest internal and external causes of FW. Identifying these first, especially the internal causes driving FW, will lead to finding appropriate strategies (Filimonau & Gherbin, 2017; Gadde & Amani, 2016; Yetkin Özbük & Coşkun, 2020).

Moreover, it should be mentioned that the interview participants did not refer to all the possible internal and external causes found in the literature review. To make themselves familiar with these would improve their perception of what the causes can be for FW in their store. Furthermore, there is a mismatch of internal causes and strategies commented on by the experts. These again show the lack of awareness of causes of FW. As demonstrated in the coding tree in Annex I some new causes of FW were found as well. Too high-quality standards by the store management or corporation can result in more FW in the store. In addition to this, if sustainability or FW mitigation is not included in the corporation's strategy more food will be wasted. Competitors who have a wider range of products and have products available all the time will automatically put external pressure on the supermarkets to compete.

Besides finding the current FW mitigation strategies used by European countries (chapter 2.10 and Annex C), FW experts indicated that connecting with the UK, NL and Denmark might have a major impact on German FW management as these countries are more advanced in FW strategies.

As demonstrated in the coding tree in Annex I, comparing the strategies from both research sources, two new strategy areas and nine new strategies were identified. FW experts note six new strategies in these two new strategy areas which are described in chapter 4.3.1. Another new strategy is to inform customers about the meaning of the BBD on the packaging and to give advice to test the edibility of food. Two of the experts of privately-owned supermarkets recommended to give away free food to in-store customers. The goods are only gifted to the customers if not collected by charity organizations. Interviewees suggested signing more contracts with regional farmers. Additionally, an internal redistribution of goods to other stores is carried out by several interviewees. Another important strategy was returning unsold products like bread and chocolate to suppliers. They could reuse chocolate for fillings or produce new dough for bread or bakery products.

Seven of the strategies found in the secondary research, are not elaborated by the FW experts in Germany: setting up free fruit boxes for kids, abolishing BBD labels from products that do not require one (for example noodles), setting up a rewarding system for workers that reach FW mitigation goals, setting up customer communication about less availability of products at a certain time of the day, sending an E-newsletter with information about FW, reviewing quality standards and product specifications of fruit and vegetables and reconsidering packaging for a longer durability of the products. In the re-use level, new products could be produced by sending fruits and vegetables to food processors that will repurpose them in other products.

Although the ‘Food Recovery Hierarchy’ and the ‘Food Waste Hierarchy’ are referenced in almost all FW managements papers, only three of the interview participants recognized the model. However, all agreed that it is a useful model for FW strategies. Papargyropoulou, et al. (2014), and the FW experts from Germany, identify the prevention and re-use level as the most important FW mitigation levels in supermarkets.

The recommendation of splitting prevention into two levels could be taken into consideration for future research (F6). Furthermore, the insight of B2 to analyze strategies towards product groups could be beneficial as some product groups are more wasteful than others, as documented in the chapter 2.6. E5 und G7, however, made it clear that this model would not be useful for store managers at discount supermarkets. It would either be beneficial for store managers of privately- owned stores or for the strategy department of discount supermarkets.

By examining primary and secondary research results, it emerged that the FWSF was only partly confirmed. As demonstrated in Figure 4.1, marketing practices were affirmed as the most effective strategy area and evidence was provided that 30-50 % discounts on dairy products and perishables is the most effective strategy in the prevention level. In addition to this, the donation strategy area with the strategy of donating to food charity organizations and the redistribution strategy area with the internal or external redistribution of food strategy is confirmed as the most successful strategy in the re-use level. As prioritization level two and therefore second most effective, waste tracking and optimization of product selection was determined by primary and secondary research. As the FWSF was generated by secondary research, further testing of the framework is required.

The new strategy areas ‘networking and collaboration’ and ‘reporting’ could not be assessed, as they emanated from inductive coding. For all other strategy areas, the prioritization is not confirmed by the experts.

Overall, it is important to realize that all strategies considered in this master thesis are a part of the solution to fighting FW in supermarkets. As H8 also confirmed: “*I think there are some strategies that have a bigger influence, but still the most effective FW mitigation would include as many strategies as possible*.” In addition to this, all insights about causes and strategies could be used from other countries to enhance their FW strategies in their supermarket stores.

5 Conclusion

The study's aim was to find the most effective FW mitigation strategies in supermarkets and to develop a corresponding framework that combines knowledge from previous research with the experience of FW experts in Germany. During this study it became apparent that FW was much more of a problem for supermarkets and all associated FSC members than anticipated. As in many other countries in Europe, FW data in Germany is still insufficient, and supermarkets do not measure their FW correctly. Thus, supermarkets have a higher potential to mitigate FW and saving costs than described in the current literature.

Albeit the experts interviewed were pioneers in FW, they were not aware of all FW causes and FW mitigation strategies in supermarkets. Hence, the summary of internal and external causes of FW (Table 2.1 and Table 2.2), the 'Food Waste Strategy Framework' (Figure 4.1) and the collected FW mitigation strategies (Annex C) in the current work are a valuable guide for FW professionals and give them the prospect of recognizing opportunities to introduce or improve their FW strategies. FW experts in Germany confirm that customer behavior and political implications are the biggest external cause of FW. The results indicate that evaluating the internal and external causes of FW, especially the internal causes of FW will lead to finding optimal strategies.

In this study sixteen FW mitigation strategy areas with forty-one corresponding strategies were identified. Furthermore, the German FW experts claimed that an 30-40 % price reduction on dairy products and perishables, an employee awareness training, customer campaigns about the BBD, updated inventory control system and donation for human consumption to food charity organizations are the most important strategies against FW.

The results of the study demonstrate that an interest in preventing FW is connected to better FW management. Furthermore, the UK, DK and NL were found as role models in the FW mitigation strategies. As proven in this study, it is crucial to connect, learn and collaborate with FW networks and organizations in other countries for collaborative learning and in order to get more effective. Working together with FW consulting organizations could be another way to minimize the food wastage in supermarkets.

FW and its connected negative impacts are of concern to German retail managers, but still are not their highest priority.

5.1 Limitations of the Research

The conducted research and analysis have some limitations which need to be acknowledged. To begin with, the qualitative research paradigm utilized in the current work is known for limited generalizability and representativeness of results. Nevertheless, it allows for the consideration of under-studied topics and presents an appropriate research strategy to gather first insights from key informants (Silverman, 2000). In the interviews related to this master thesis, the focus is on the German market, although practices from other EU countries are considered in the literature review and strategies are provided for comparison and advancement of FW strategies.

Possible spillovers of supermarket FW strategies on the up- and downstream FSC are not investigated in this thesis.

Moreover, the COVID-19 pandemic and consequential lockdowns affected the research. Supermarket store managers proved less likely to agree to interviews, for health and security reasons. One discount grocery retailer refused to contribute to the project due to overload of student interview requests. Additionally, most of the store managers denied the request for interviews due to busy work schedules. C3 confirmed the difficulty with the following: “Already before COVID, it was incredibly difficult in Germany to get interviews with people about food waste. Especially supermarket experts.” That is why, only five store managers, two FW experts and one food charity organization manager were interviewed. Having these different FW experts enlightened the thesis topic from different perspectives, but the sample is small. In addition to this, expert A1 might be biased due to her work in a charity organization.

Furthermore, in the current work, hypermarkets, convenience stores and bio-markets were excluded.

5.2 Recommendations for Further Research

As this master thesis was limited by COVID-19, future interviews about FW mitigation strategies should be investigated after the pandemic, using personal contact with the interviewees. Body language and certain reactions could thereby be better assessed. For further research it is also recommended to repeat the study with a larger interview sample. The research consisted of the theory development approach which was tested the first time as a part of the masters thesis. Further testing of the FWSF results, mentioned in the chapter discussion, could extend this study. With a quantitative survey approach, sample size could be increased. A prioritization assessment scheme should be introduced and elucidated. In addition to this, new strategy areas of 'network & collaboration' and 'reporting' should be included in the research.

Furthermore, it would be also beneficial to separate privately owned and discount supermarkets to gain more insights into their approach regarding FW management strategies. Besides that, it could be reasonable to look at strategies against FW in bio-markets, convenience stores and hypermarkets. As mentioned in the chapter results, the recommendation to apply the FWH to the designated product groups and to analyze the strategies accordingly could assist to discover matching strategies per product group (B2).

Although the retail industry accounts for a small percentage of FWL, it could be of interest to examine the influence of supermarkets through their FW customer campaigns and customer communications, marketing practices and contracts on upstream producers and downstream consumers.

Since the UK, DK and NL are pioneers in FW it would be interesting to conduct similar analyses in each of these countries to determine which strategies work well in each country and what could be learned by all.

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8 Annexes

Annex A: Examples of Successful Legislative Change and Initiatives against FW

France

In 2016, France was the first country to establish a new law which banned supermarkets from throwing away or destroying unsold food. This law forces supermarkets that are larger than 4,305 square feet to sign donation contracts with not-for-profit organizations. Furthermore, they are not allowed to throw away food approaching its BBD (Gruber et al., 2015; Midgley, 2014). In the case of non-compliance with law, fines of up to €75,000, or two years of imprisonment apply (Giordano et al., 2019). Therefore, France was ranked first in the Food Sustainability Index 2017 (The Economist, 2017).

Japan

In order to reduce FW, Japan enacted the 2001 Food Recycling Act which gives instructions to reduce and recycle FWs into fertilizer and feed. Businesses that produce significant volumes of food waste are expected to take steps to minimize and recycle the waste by 20 per cent and report their food waste status to the government on a regular basis (Parry et al., 2015).

UK

The "Love Food Hate Waste" (LFHW) campaign and the WRAP provides information for local authorities and helps individuals, communities and organizations in reducing food waste. WRAP also carries out research regarding important measures relating to food waste in the UK. It has built up a comprehensive evidence base which defines the most significant impacts that can be made on FW. With all its initiatives, WRAP achieved 1.3 Mio. tons less household food waste in 2012 compared to 2007 and a 15% reduction of food waste in households (Parry et al., 2015; Waste Reduction Action Programme [WRAP], 2012; WRAP, 2020).

Italy

Since 2016, Italy has set up a law that allows supermarkets, businesses and farmers to donate food past its sell-by date. Furthermore, they pay less waste tax the more food they donate. Moreover, the Italian government promotes "family bags" that contain leftovers from food in restaurants (Giordano et al., 2019).

Denmark

Besides the private campaigns as ‘‘Stop Spild af Mad’’ (Stop Wasting Food), several governmental initiatives were introduced in Denmark. One example for this is the voluntary ‘‘Initiative Group Against Food Waste’’ where private and public stakeholders are working together to achieve reduced food waste in the Danish food system (Halloran et al., 2014).

Annex B: German FW Policies

The German "Bundesministerium für Ernährung und Landwirtschaft" (BMEL) which is the federal ministry of nutrition and agriculture determined that the Thüne institute report results of 2015 should be the baseline for measuring FLW and setting German goals for the SDGs. Taking this into account, by 2030 it is estimated the waste will be from 6.35 Mio. tons of food to 12.7 Mio. tons all over the supply chain (BMEL, 2019a, 2019b).

The Federal Government is currently providing around €16 Mio. within the framework of research programs that aim to reduce food waste. It promotes the development of digital solutions to improve the distribution of food to non-profit organizations. Innovative measurement systems are being promoted in order to develop sustainable approaches, e.g. for the collection of food waste in out-of-home catering (BMEL, 2019b; Bundesministerium für Ernährung und Landwirtschaft, 2019).

Even though the food waste goals are communicated to the different sectors, there are no binding policies against food waste in Germany. The Green Party wants to establish new laws to support the UN SDG mission and argues that Germany will not be capable of halving its food waste if it does not start to introduce new laws. There is currently a law that dictates taxes on food donations to non-profit organizations and a law that prohibits and penalizes getting food from the supermarket bins. The Green Party wants to abolish this law. Furthermore, the party is committed to establishing several new laws binding reduction targets for food production and trade, setting up an 'anti-disposal law' (dispense still edible food), adjusting quality standards (for example for 'too small' apples), introducing disclosure and transparency obligations for food production plus trade and out-of-home consumption, bringing the best-before date closer to the actual spoilage date and strengthening regional food production and marketing structures. Furthermore, they want to promote nutritional education in schools and day-care centers to convey appreciation for food (Bündnis 90 - Die Grünen-Bundestagsfraktion, 2020).

The BMEL is responsible for the German national strategy against food waste and initiated the program and campaign 'Zu gut für die Tonne!' (translated: Too good for the bin). The program focuses on food waste along the entire FSC. With a wide range of information such as teaching and advertising materials as well as tips on the correct storage of food, recipes for 'best leftovers', events, campaign days like 'Zu gut für die Tonne!' draw attention to the topic of food waste and demonstrate how easily it can be managed in everyday life. Retailers and businesses get nominated for a federal prize in this program which is intended to support civil

society commitment against food waste. In 2019, the discounter ‘Penny’ won a price for several integrated initiatives to fight food wastage (BMEL, 2019a; Bundesministerium für Ernährung und Landwirtschaft, 2019).

Another important aspect is liability in the context of food waste. The Federal Ministry of Food and Agriculture in Germany states that producers and retailers are liable for any damages related to the redistribution of food that would otherwise have been wasted. However, this liability can become more complex when redistributors are involved. An exact documentation of information from all involved parties is therefore crucial in order to define the liability within a certain case of damage (Hermsdorf et al., 2017).

Annex C: List of FW Strategies

Area	Strategies	Confirmed by
Technology	Establish product tracking system Establish the newest cold chain technology + temperature control system Establish shelf life tracking technology Investment in infrastructure and transportation machinery	(Aschemann-Witzel et al., 2018; Mena et al., 2011; Pearce & Berkenkamp, 2017; Spang et al., 2019; Syroegina, 2016)
Employee Training	Implement employee's awareness training --> What is food waste, what does it mean for our supermarket? Establish inventory management and operation process training --> accurate order placement, careful handling of stock, and a greater focus on product expiration and BBD (e.g., stocking shelves according to the "first-in/first-out" principle, marking down the price of food products on time) therefore improving shelf-life, less damages "Extend their training activities and consider implementing a reward system --> monetary or non-monetary (hours, bonus) --> appreciation for high-quality work and thus increase motivation and potentially contribute to a decrease in the high turnover rates of personnel in the retail and wholesale sector"(Gruber et al., 2015) Implement waste tracking training for designated employees Incorporate FW–related KPI into staff performance reviews Establish clear process of stock-rotation	(Filimonau & Gherbin, 2017; Gruber et al., 2015; Mena et al., 2011; Papargyropoulou et al., 2014; Pearce & Berkenkamp, 2017; Spang et al., 2019; Stöckli et al., 2018)
Marketing	Discounts for short shelf life products and items near expiration or eroding quality and appearance Sell single have a box with single items with communications that indicates importance that single item food is not left behind --> "I'm a single banana—take me home!" Happy hour up to 60 % for products that will be disposed otherwise (The New York Times, 2019) Limitation of volume based promotion of perishables -->Abolish: 'buy-one-get-one-free' (BOGOF) or 'buy-one-get-two-free' (BOGTF) offers Set up a box with free fruit that is not sellable anymore, but still edible for kids Abolish BBD food labelling	(Abecasis et al., 2020; Filimonau & Gherbin, 2017; Mena et al., 2011; Papargyropoulou et al., 2014; Secondi, 2019; Spang et al., 2019; Syroegina, 2016; The New York Times, 2019; Young et al., 2017)
Packaging	- Offer smaller packages or single items - Reconsider packaging to extend shelf life	(Aschemann-Witzel et al., 2018; Filimonau & Gherbin, 2017)

Suboptimal Food (Blemished, wrong-sized, mis-shaped products)	Revise food standards --> 'ugly' food is not waste --> Usage of cosmetically substandard produce in supermarket selection Communication in store for suboptimal food items, designated area for suboptimal foods Product Specifications Review --> Revise size and aesthetic requirements of fruits and vegetables --> Analyze if there might be use for different shaped vegetables and fruit, in Portugal customers accept smaller apples for their children as they are easier to hold and, this led to increase in sales and did not cannibalize other products	(Abecasis et al., 2020; Aschemann-Witzel et al., 2018; Cicatiello et al., 2016; Filimonau & Gherbin, 2017; Jurgilevich et al., 2016; Rohm et al., 2017; Spang et al., 2019; Syroegina, 2016)
Consumer Training / Education	- Initiate consumer campaigns (educational and awareness) -->informational intervention: videos, website, social network, brochures, workshops, events to inform about environmental consequences of food waste and consumer household practices (procedural knowledge) --> Demonstration of desired behavior in a video (WRAP example: Demonstration of daily food practices that reduce food waste, how to store, portion or freeze certain food) - Promote sustainable consumption habits through campaigns, awareness and educational programs - Offer online games in an App or on a website in which you can test if you can properly store your food, freezing methods and preparation habits - Education on food waste topics in communication channels - Educate consumers about food, food chains, effects on environment, sustainability, waste management and packaging - Establish social media and e-newsletter interventions with proven significant reductions in self-reported food waste by customers over the study period (Young et al., 2017).	(Adam, 2015; Aschemann-Witzel et al., 2018; Cicatiello et al., 2016; Filimonau & Gherbin, 2017; Jurgilevich et al., 2016; Papargyropoulou et al., 2014; Spang et al., 2019; Stöckli et al., 2018; Syroegina, 2016; Young et al., 2017)
Applications for consumers	- Offer FW phone applications for customers: → Food shopping list → 'Too Good To Go'	(Aschemann-Witzel et al., 2018; Spang et al., 2019; Stöckli et al., 2018)
Waste Tracking	- Establish food waste tracking - Improve food waste reporting and analysis - Provide current food waste tracking methods -->Cicatiello (2020) offers an improved recording routine - Measure current volumes and causes of food waste. - Food reporting: Publicly disclose information on food waste management programs and progress toward KPIs and goals on an annual basis. - Establish quantifiable goals, benchmarks, and key performance indicators (KPI), and make them public	(Adam, 2015; Brancoli et al., 2017; Cicatiello et al., 2016; Cicatiello & Franco, 2020; Mena et al., 2011; Papargyropoulou et al., 2014; Pearce & Berkenkamp, 2017)

Adaption of products to consumer demand	Decreasing product quantity at the end of the day --> avoiding restocking products that have already sold out (particularly fresh produce) or shortly before a store closes -->adjusting the quantity of goods processed in store, such as fresh juices and baked goods, to the change in demand throughout the day -->Purpose of these waste reduction measures needs to be carefully communicated to customers alongside their implementation (could have a strong positive effect on food waste reduction, in conjunction with the respective public policy measures or may negatively affect their service level and competitiveness)	(Gruber et al., 2015; Syroegina, 2016)
Optimization of product selection	Decrease product range	(Syroegina, 2016)
Donation	- Collaborate with food charity organizations like 'Die Tafel' - Establish corporate food donation process --> establish processes that give store managers the authority to pass on unsaleable but still consumable products --> Responsibility for initiating collaborations and setting up redistribution processes lies with the parent organization of retail and wholesale stores, as such collaborations are beyond a store manager's responsibility (Headquarters are the best in establishing these partnerships and collaborations) -->Commitment to active food donations	(Aschemann-Witzel et al., 2018; Filimonau & Gherbin, 2017; Gruber et al., 2015; Papargyropoulou et al., 2014; Pearce & Berkenkamp, 2017; Spang et al., 2019; Syroegina, 2016)
Redistribution + secondary markets	Establish partnership with food rescue organizations would use also imperfect produce or damaged packaged products --> example: Fruta Feia (https://frutafeia.pt/), Sirplus Sell surplus food and waste to other businesses -->Sign up for online product lists where products can be sold Collaborate with other businesses in that area: --> Too Good To Go (https://toogoodtogo.com/en-us) --> SirPlus (https://sirplus.de/) --> Dings Dums Dumplings (https://www.dingsdums.de/) Set up a commercial food surplus recovery network built on social networks	(Aschemann-Witzel et al., 2018; Cicatiello et al., 2016; Gruber et al., 2015; Papargyropoulou et al., 2014; Pearce & Berkenkamp, 2017; Spang et al., 2019)
Upcycling	Incorporate suboptimal and surplus food into menus of supermarket restaurants Repurpose food that can't be sold in retail stores --> Make visible for processors which excess of fruit and vegetables are available --> A lot can be repurposed by processors for use in products such as juices, natural flavorings, and additives, therefore built up a network Use fruit and vegetables of retail distribution centers that are not appropriate for retail sale as powder for processors --> significant portion of FW is concentrated in retail distribution centers --> they can be dehydrated to create a powder that is used to manufacture a variety of foods, including yogurt or snack bars --> "One players waste can become a high value ingredient for food processors..."	(Abecasis et al., 2020; Spang et al., 2019)
Animal Feed	Give vegetables and fruits to farmers	(Jurgilevich et al., 2016; Spang et al.,

		2019; Syroegina, 2016)
Anerobic digestion:	not analyzed for detailed strategies	(Pearce & Berkenkamp, 2017; Spang et al., 2019; Syroegina, 2016)
Composting	not analyzed for detailed strategies	(Jurgilevich et al., 2016; Pearce & Berkenkamp, 2017; Spang et al., 2019; Syroegina, 2016)
Biofuel production	not analyzed for detailed strategies	(Jurgilevich et al., 2016; Spang et al., 2019; Syroegina, 2016)
Disposal/incineration	not analyzed for detailed strategies	(Spang et al., 2019)

Annex D: Adaption of Content Analysis Example of Supermarkets in the UK

Grocery Retail Chain	Food Donation	Price Reduction	Customer Awareness Campaigns	Labelling & Packaging	Other	Zero Waste to Landfill	UK Market Share (2016)
ASDA	Surplus + supplier sendovers donated to FareShare and Kind Direct	Regular price reductions for close to the 'use by' date food + Promotion of "wonky veggies" bags at a discounted price	Voluntary agreement with the "Love Food Hate Waste" campaigns	Not printing 'best before' date but just packaging date	Reducing food purchase time in the food supply chain + organizing food waste conference for suppliers	Yes	15.5 %
TESCO	Surplus food donated to FareShare + ad-hoc online platform "Food Cloud" available for local charities	Regular price reductions for close to the 'use by' date food + "Perfectly imperfect" food bags at a discounted price	/	/	Bakery wastage sent for animal feeding and cooking oils diverted for bio-fuel production	Yes	28.2 %
SAINSBURY`s	Surplus food donated to FareShare – store managers make agreements with local charities on food donations	/	"Waste Less, Save More" campaign, regular awareness building campaigns and only platform with consumer tips to avoid waste	Advanced food freezing instructions + voluntarily commitment to develop new, more sustainable packaging for their own-brand food products	Store in Cannock (Staffordshire) has become the first in the UK to be powered by energy produced from food waste	Yes	16.7 %
The Cooperative Food	Encouraging donations to FareShare – decisions are made by store managers	"Still Fresh" policy for maximum price reductions applied to food which is close to the 'use by' date	"Working on Waste" voluntary campaigns	Scientific approach for new packaging design to enhance shelf-life of food	/	Yes	6 %
Marks & Spencer	Donations of up to 45 % of unsold food – partnerships with FareShare, Company Shop, FoodCycle and Neighbourly	Three levels of price reductions for food close to the 'use by' date	Voluntary agreement with "Love Food Hate Waste campaign + "Festive Freeze" + "Cookery classes	Investing in new packaging development i.e. plantic bioplastic skin packs + clearer labelling and freezing instructions for own-branded food products	Investment in developing new demand forecasting techniques	Yes	No data availab le
Waitrose	Encourage charities to register for food donations	Regular price reductions for food close to 'use by' date + "Little Less Than Perfect" fruits and vegetables sold with a discount in 40 stores	Voluntary agreement with the "Love Food Hate Waste" campaigns	Clearer guidance for food cooking, portioning, storage and freezing	/	Yes	5.3 %
Morrisons	Surplus donation to FareShare, HisChurch and local charities where possible	Regular price reductions for close to the 'use by' date food	Voluntary agreement with the "Love Food Hate Waste" campaigns	Not printing 'best before' date on fruits and vegetables + storage printed on products, provided online and magazines	Surplus for staff canteen + food preparation in store + partnership with Company Shop which sells imperfectly packaged products at lower prices	Unknow n	10.9 %
Total							82.6 %

Filimonau & Gherbin (2017) provided an example of how to carry out an analysis of food retailers in the United Kingdom (UK) market. As a first step, they recommend analyzing corporate websites and annual reports of major supermarkets to better understand the importance and goals attributed by the grocery retail sector to food waste management. This overview is also useful for a comparative analysis as to see how the industry manages food waste. This model is used to find the supermarkets which are most successful in their FW mitigation strategies in the German market and therefore add to knowledge from the UK. Supermarket managers from the most successful supermarket chains are, then, interviewed.

	Information from	Company Websites				RBB	BMEL/ Interviews/ Own Research	Official Food Trade Journal
	Supermarket Chain	Prevention	Re-Use	Recycling/ Recovery	FW Reduction Goal	RBB Ranking Engagement against FW	Other	Market Share from 2018
Edeka Group	**Edeka**	**Technology:** Apeel Sciences natural skin that preserves fruits and vegetables, products have a longer life span **Consumer campaign:** cooking suggestions for leftovers	**Donation** to "die Tafel": only partially, not every market is donating Some stores use **TooGoodToGo**	/	/	No commitment	2017- **Won price** against FW, web shop for milk products **Fair-Tailer**: products for free if packaging etc. is damaged (nearly won another price in food waste reduction) **Interviewee D:** recommended a specific store due to their excellent FW strategies	14,70%
	Netto	**Technology:** Software tracking FW **MKT:** Price reduction product shortly before "best before date" **Employee training:** of store employees to prevent FW **Suboptimal food management:** "Nobody is perfect" for a lower price	**Donatio**n to "die Tafel": only partially, not every market is donating	/	/	No commitment	/	7,60%
Rewe Group	**Rewe**	**Employee training**: Sustainability ambassador, regular training on FW **Technology:** Modern forecasting systems and automated ordering procedures	**Donation** to "die Tafel" almost 100 %	/	/	Moderate commitment		10,50%
	Penny	**MKT:** "Smell, taste, enjoy" initiative "mostly still good after best before date" label (on own brand products), price reduction product shortly before "best before date" **Consumer campaign:** "Kostbares Retten"- "Save precious food" **Consumer education:** Cooking hacks to waste less food Offering **suboptimal foods**, bio products that have not the "right" shape, initiative called "Bio-Helden" (Bio heroes), tips on correct storage of food and optimal, recycling of residues **Technology:** Purchase Planning APP, Modern forecasting systems and automated ordering procedures **Employee training:** regular training on FW, trainee FW training + engagement in competition how to avoid FW	**Donation** to "die Tafel" 70-80 %	/	Minus 50 % until 2030	Full commitment	**Price 2017** "Zu gut für die Tonne" (BMEL) for "Bio Helden" and "Kostbares Retten" **Interviewee A and C:** recommended Aldi as interview partner **Webpage**: Eight FW strategies areas are represented in company strategy	4,20%
Schwarz Group	**Lidl**	**MKT:** "See, smell, taste" initiative "Ich halte oft länger" label (on own brand products), price reduction product shortly before "best before date" 50% **Consumer education:** How to store food (fridge) **Technology:** efficient ordering systems only for daily demand	**Donation** to "die Tafel" 90-100 %+ Brotzeit.ev breakfast for kids in need	Biogas	Minus 30 % until 2025	Full commitment	**Interviewee A**: recommended Lidl as interview partner	12,20%
	Kaufland	**Technology:** Demand order planning **MKT:** " initiative "Oft länger gut" label next to best before date (on own brand products), price reduction product shortly before gut""best before date" **Suboptimal food:** Offering "Die etwas Anderen"- different shape	**Donation** to "die Tafel" 80%	/	/	Moderate commitment	**Price 10/2019:** "Exzellente Nachhaltigkeit"	2,50%
Aldi	**Aldi**	**MKT:** "Smell me! Taste me! I am often good for longer" initiative "mostly still good after best before date" label (on own brand products), price reduction product shortly before "best before date", single items for single households **Consumer education**: Consumer could post their leftovers on FB and chefs gave advice to still use the food for a meal, Tips for a conscious food handling: How can I shop without having to throw something away afterwards? How do I store which foods so that they stay fresh longer? And how do I freeze surplus goods without losing quality? **Consumer campaign**: "Save leftovers"--> "Tips for the correct handling of food" in supermarkets, at home and in restaurants **Suboptimal foods**: "Krumme Dinger", Bio **Technology:** optimal inventory tracking, the optimal transport and storage temperature and the avoidance of interruptions the cold chain, monitoring system	**Donation** to "die Tafel" and Caritas 80-100 %	Animal feed, Bioenergy	/	Moderate commitment	**Member of the EU initiative REFRESH** (national platform, discussing the next steps concerning the collection of food waste data): obligation to initiate measures to reduce food losses **Have adapted waste hierarchy in strategy** **Interviewee A and C:** recommended Aldi as interview partner **Webpage**: Eight FW strategies areas are represented in company strategy	11,10%
Metro AG	**Real**	no comments	**Donation** to "die Tafel" 100 % Cooperation with TooGoodToGo	/	Minus 50 % until 2025	Full commitment		3,65%

Annex F: Interview Guideline in English

Interview Guideline Food Charity Organization

ISCTE IUL
Instituto Universitário de Lisboa

Master thesis: An Analysis of Food Waste Mitigation Strategies in Grocery Retail: Practices and Learnings from the German Market

Interview-Guideline

- **Organizational**
  - ☐ Personal introduction
  - ☐ Introduction to research
  - ☐ Explanation of research goal and role of the interview
  - ☐ Anonymization possible, if needed
  - ☐ Obtain permission to record interview
  - ☐ Note: there are no right or wrong answers
  - ☐ Questions from the interviewee during the interview are possible
  - ☐ The questions do not include any suggestions or hints, please try to answer unbiasedly
  - ☐ Note: Start of recording

Recording starts

- **The interviewee** *--Introductory --*
  - What is your job role in your company/organization? Which tasks and responsibilities do you have?
  - How long have you worked in your current position? Describe the jobs and business sectors you have worked in?
- **Dimension I: Food Waste** *--Content-related --*
  - How would you define FW?
  - In your opinion, how is the issue of food waste dealt with in Germany?
- **Dimension II: Causes for Food Waste**

Short explanation of drivers and barriers from Interviewer

  - Which top 5 drivers (internal factors) would you list for food waste in supermarkets? Please name them and describe why!
  - What are the top 5 barriers (external factors) blocking and influencing food waste reduction practices in supermarkets? Please list them and describe why!
- **Dimension V: Collaboration with Food Charities and Businesses**
  - With which supermarkets you have the best collaboration with and why?
  - To what extent could supermarkets improve their cooperation with "die Tafel"?
  - Besides food charity organizations do you think it is also important to work with other food rescuing businesses? Which businesses are you aware of?
- **Future Prospects** *--Concluding questions--*
  - What further efforts could be made collaboratively between charities and grocery retail stores in terms of food waste management?

ISCTE IUL
Instituto Universitário de Lisboa

Master thesis: An Analysis of Food Waste Mitigation Strategies in Grocery Retail: Practices and Learnings from the German Market

Interview-Guideline

1 Organizational

- ☐ Personal introduction
- ☐ Introduction to research
- ☐ Explanation of research goal and role of the interview
- ☐ Anonymization possible if needed
- ☐ **Obtain permission to record interview**
- ☐ Note: there are no right or wrong answers
- ☐ Questions from the interviewee during the interview are possible
- ☐ The questions do not include any suggestions or hint, please try to answer unbiasedly
- ☐ Note: **Start of recording**

Recording starts

---

2 The interviewee *--Introductory --*

- What is your job role in your company/organization? Which tasks and responsibilities do you have?
- How long have you worked in your current position? Describe the jobs and the business sectors you have worked in?
- How is your company involved with food waste?

3 Dimension I: Food Waste *--Content-related --*

- How would you define food waste?
- In your opinion, how is the issue of food waste dealt with in Germany?
- Is food waste a problem for the grocery retail sector respectively supermarkets? Please elaborate!
- Do you know any supermarket stores or food store chains that are pioneers in the field of food waste mitigation strategies and management?

4 Dimension II: Causes for Food Waste

- Which top 5 drivers (internal factors) would you list for food waste in supermarkets? Please name them and describe why!
- What are the top 5 barriers (external) blocking and influencing food waste reduction practices in supermarkets? Please list them and describe why!

5 Dimension III: Strategies against Food Waste

- How do you perceive the engagement of food waste in supermarkets?
- In your opinion, what are the most effective and important strategies against food waste in supermarkets?
- Are you familiar with the 'Food Waste Hierarchy'? What do you think of this model in terms of strategies against FW in supermarkets?
- What do you think about the theoretical framework that has been developed for strategies against FW. Do you have any additions, remarks etc.?
- How would you prioritize the different strategies areas per level?

6 Dimension V: Collaboration with Food Charities and Businesses

- To what extent could supermarkets improve their cooperation with 'die Tafel'?
- Are there any other collaborations that supermarket managers should be aware of/be working with?

7 Future Prospects *--Concluding questions--*

- In your opinion, what challenges will supermarket managers face in fighting food waste in the next decade?

Interview Guideline Store Managers

ISCTE IUL
Instituto Universitário de Lisboa

Master thesis: An Analysis of Food Waste Mitigation Strategies in Grocery Retail: Practices and Learnings from the German Market

Interview-Guideline

1 Organizational

- ☐ Personal introduction
- ☐ Introduction to research
- ☐ Explanation of research goal and role of the interview
- ☐ Anonymization possible if needed
- ☐ **Obtain permission to record interview**
- ☐ Note: there are no right or wrong answers
- ☐ Questions from the interviewee during the interview are possible
- ☐ The questions do not include any suggestions or hints, please try to answer unbiasedly
- ☐ Note: **Start of recording**

Recording starts

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2 The interviewee *--Introductory --*

- What is your job role in your company? Which tasks and responsibilities do you have?
- How long have you worked in your current position?

  If not that long Describe the jobs and business sectors you have worked in?

3 Dimension I: Food Waste *--Content-related --*

- How would you define food waste?
- How do you measure food waste in your supermarket store(s)?
- Do you think food waste a problem of supermarket store managers? If yes, why?

4 Dimension II: Causes for Food Waste

Short explanation of drivers and barriers from Interviewer

- Which top 5 drivers (internal factors) would you list for food waste in supermarkets? Please name them and describe why!
- What are the top 5 barriers (external factors) blocking and influencing food waste reduction practices in supermarkets? Please list them and describe why!

5 Dimension III: Strategies against Food Waste on a Corporate Level

- How would you describe the corporate role of food waste strategies/practices of your supermarket chain?
- In your opinion, what are the most effective food waste reduction strategies employed by your company?

6 Dimension IV: Strategies against Food Waste on Supermarket Level

- What are the food waste strategies/practices of your supermarket?
- In your opinion, what are the most effective food waste mitigation strategies in your supermarket store?
- Do you know the 'Food Waste Hierarchy'? What do you think about this model with regards to FW mitigation strategies in supermarkets?
- What do you think about the theoretical framework proposed by the interviewer? Do you have any comments? How would you prioritize the strategy area in the different strategy levels?

7 Dimension V: Collaboration with Food Charities and Businesses

If not mentioned on corporate website:

- Do you cooperate with the food charity organization "die Tafel" or any other organizations or businesses? Do you see any improvement areas in your collaboration?

OR

I found your company is working together with…

- Do you see any improvement areas in your cooperation?

8 Future Prospects *--Concluding questions--*

- What else is important to you in terms of the whole subject matter?

Annex G: Interview Guideline in German

Interview Leitfaden Tafel

ISCTE IUL
Instituto Universitário de Lisboa

MA: Analyse der Strategien gegen Lebensmittelverschwendung in deutschen Supermärkten: Praktiken und Erfahrungen im deutschen Markt

Interview-Leitfaden

Organisatorisches

- ☐ Persönliche Vorstellung
- ☐ Vorstellung des Themas
- ☐ Unterrichtung über das Ziel der Untersuchung und die Relevanz des Interviews
- ☐ Auf Anonymisierung der Aussagen hinweisen, wenn gewünscht
- ☐ **Ausdrückliche Genehmigung zur Aufzeichnung** des Gespräches einholen
- ☐ Hinweis: es gibt keine richtigen oder falschen Antworten
- ☐ Rückfragen von Seiten der Interviewteilnehmer während des Interviews sind möglich
- ☐ Die Fragen sollen nichts suggerieren, bitte möglichst unbefangen antworten
- ☐ Hinweis: **Beginn der Aufzeichnung**

Aufnahme beginnt

---

1. **Der Interviewteilnehmer** *--Aufwärm-Teil--*
   - Welche Rolle haben Sie in Ihrem Unternehmen/Organisation? Welche Aufgaben übernehmen Sie?
   - Seit wann sind Sie in Ihrer aktuellen Position? Welche Positionen hatten Sie davor inne und für wie lange?
2. **Dimension I: Lebensmittelverschwendung (LMV)** *--Inhaltlicher Teil--*
   - Wie definieren Sie LMV?
   - Welche Rolle spielt ihr Unternehmen/Organisation in diesem Bereich?
   - Wie wird Ihrer Meinung nach in Deutschland mit dem Thema LMV umgegangen?
3. **Dimension II: Gründe für Lebensmittelverschwendung**

Kurze Erklärung von internen und externen Einflussfaktoren vom Interviewer

   - Welche Top 5 driver (interne Treiber) sehen Sie für die LMV in Supermärkten?
   - Welche Top 5 barrier (externen Faktoren) sehen Sie für die LMV in Supermärkten?
4. **Dimension V: Zusammenarbeit mit Tafeln und anderen Businesse (z.B. SirPlus)**
   - Was wäre die wichtigsten Schritte für eine bessere Zusammenarbeit zwischen Supermärkten und Wohltätigkeitsorganisationen wie „die Tafel"?
   - Neben „Food charity" Organisationen gibt es andere Kooperationen und Businesses, die Filialleiter kennen sollten bzw. mit denen Sie zusammenarbeiten sollten?
5. **Ausblick** *--Schlussteil--*
   - Sehen Sie ungenutzte Potenziale zwischen Supermärkten und Charity-Organisationen, die mit einer besseren Zusammenarbeit im Bereich LMV erfolgreicher wären? Wenn ja, welche und warum?

Interview Leitfaden Experten

ISCTE IUL
Instituto Universitário de Lisboa

MA: Analyse der Strategien gegen Lebensmittelverschwendung in deutschen Supermärkten: Praktiken und Erfahrungen im deutschen Markt

Interview-Leitfaden

1 Organisatorisches

- ☐ Persönliche Vorstellung
- ☐ Vorstellung des Themas
- ☐ Unterrichtung über das Ziel der Untersuchung und die Relevanz des Interviews
- ☐ Auf Anonymisierung der Aussagen hinweisen, wenn gewünscht
- ☐ **Ausdrückliche Genehmigung zur Aufzeichnung** des Gespräches einholen
- ☐ Hinweis: es gibt keine richtigen oder falschen Antworten
- ☐ Rückfragen von Seiten der Interviewteilnehmer während des Interviews sind möglich
- ☐ Die Fragen sollen nichts suggerieren, bitte möglichst unbefangen antworten
- ☐ Hinweis: **Beginn der Aufzeichnung**

Aufnahme beginnt

---

2 Der Interviewteilnehmer *--Aufwärm-Teil--*

- Welche Rolle haben Sie in Ihrem Unternehmen/Organisation? Welche Aufgaben übernehmen Sie?
- Seit wann sind Sie in Ihrer aktuellen Position? Welche Positionen hatten Sie davor inne und für wie lange?
- Welche Rolle spielt ihr Unternehmen/Organisation in diesem Bereich?

3 Dimension I: Lebensmittelverschwendung (LMV) *--Inhaltlicher Teil--*

- Wie definieren Sie LMV?
- Wie wird in Deutschland mit dem Thema LMV umgegangen?
- Ist LMV in Ihren Augen ein Problem für Supermärkte und den Lebensmitteleinzelhandel? Wenn ja, bitte erläutern Sie diese!
- Kennen Sie Supermarkt Filialen bzw. Ketten die ein besonderer Vorreiter im Thema Lebensmittel Management/food waste Strategien sind?

4 Dimension II: Gründe für Lebensmittelverschwendung

Kurze Erklärung von internen und externen Einflussfaktoren vom Interviewer

- Welche Top 5 driver (interne Treiber) sehen Sie für die LMV in Supermärkten?
- Welche Top 5 barrier (externen Faktoren) sehen Sie für die LMV in Supermärkten?

5 Dimension III: Strategie gegen Lebensmittelverschwendungen

- Welche Rolle spielt LMV in der Unternehmensstrategie der Supermärkte aktuell?
- Können Sie sagen welche Strategien in Supermärkten als am wichtigsten und effektivsten empfinden?
- Kennen Sie die Abfallhierachie? Was halten Sie von diesem Modell in Bezug auf Strategien gegen LMV im Supermarkt?

- Was denken Sie über das entworfene theoretische framework zu Strategien gegen Lebensmittelverschwendung. Haben Sie dazu Ergänzungen, Anmerkungen etc.? Verstehen Sie das Modell?
- Wie würden Sie die verschiedenen Strategien Bereiche pro Level priorisieren?

6 Dimension V: Zusammenarbeit mit Tafeln und anderen Businesses

- Inwiefern könnten Supermärkte ihre Zusammenarbeit mit den Tafeln verbessern?
- Gibt es andere Kooperationen mit Organisationen, die Filialleiter kennen sollten bzw. mit denen Sie zusammenarbeiten sollten?

7 Ausblick *--Schlussteil--*

- Mit welchen Herausforderungen im Bereich Lebensmittelverschwendung werden Supermärkte, Ihrer Einschätzung nach, im nächsten Jahrzehnt konfrontiert sein?

Interview Leitfaden Filialleiter

ISCTE IUL
Instituto Universitário de Lisboa

MA: Analyse der Strategien gegen Lebensmittelverschwendung in deutschen Supermärkten: Praktiken und Erfahrungen im deutschen Markt

Interview-Leitfaden

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- ☐ Persönliche Vorstellung
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- ☐ Unterrichtung über das Ziel der Untersuchung und die Relevanz des Interviews
- ☐ Auf Anonymisierung der Aussagen hinweisen, wenn gewünscht
- ☐ **Ausdrückliche Genehmigung zur Aufzeichnung** des Gespräches einholen
- ☐ Hinweis: es gibt keine „richtigen" oder „falschen" Antworten
- ☐ Rückfragen von Seiten der Interviewteilnehmer während des Interviews sind möglich
- ☐ Die Fragen sollen nichts suggerieren, bitte möglichst unbefangen antworten
- ☐ Hinweis: **Beginn der Aufzeichnung**

Aufnahme beginnt

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2 Der Interviewteilnehmer *--Aufwärm-Teil--*

- Welche Rolle haben Sie in Ihrem Unternehmen/Organisation?
- Seit wann sind Sie in Ihrer aktuellen Position?

  Wenn noch nicht so lange Welche Positionen hatten Sie davor inne?

3 Dimension I: Lebensmittelverschwendung (LMV) *--Inhaltlicher Teil--*

- Wie definieren Sie LMV?
- Wie messen Sie LMV in Ihrem Supermarkt?
- Sehen Sie LMV als Problem von Filialleitern? Falls ja, warum?

4 Dimension II: Gründe für Lebensmittelverschwendung

Kurze Erklärung von internen und externen Einflussfaktoren vom Interviewer

- Welche Top 5 driver (interne Treiber) sehen Sie für die LMV in Supermärkten?
- Welche Top 5 barrier (externen Faktoren) sehen Sie für die LMV in Supermärkten?

5 Dimension III: Strategien gegen Lebensmittelverschwendung auf Unternehmensebene

- Welche Rolle spielt aktuell LMV in Ihrer Unternehmensstrategien?
- Welche vorgegebenen Strategien gegen LMV sind Ihrer Meinung nach die wirksamsten bzw. sinnvollsten Strategien in Ihrem Unternehmen?

6 Dimension IV: Strategien gegen Lebensmittelverschwendungen auf Supermarktebene

- Welche Strategien gegen LMV verfolgen Sie in Ihrem Supermarkt?
- Was sind Ihrer Meinung nach die effektivsten Strategien gegen LMV in Ihrem Store?
- Kennen Sie die Abfallhierachie? Was halten Sie von diesem Modell in Bezug auf Strategien gegen LMV in Supermärkten?
- Was denken Sie über das entworfene theoretische framework zu Strategien gegen Lebensmittelverschwendung?
- Wie würden Sie die verschiedenen Strategien Bereiche pro Level priorisieren?

7 Dimension V: Zusammenarbeit mit Tafeln und anderen Businesses (z.B. SirPlus)?

- *Wenn nicht gefunden* - Arbeitet Ihr Supermarkt mit den Tafeln, anderen Firmen oder Organisationen zusammen? Welche? *Gibt es Verbesserungspotential in Ihrer Zusammenarbeit*

  ODER

- *Ich habe gesehen, dass ihr Unternehmen mit ... zusammenarbeitet. Wo gibt es Verbesserungspotential bei der Zusammenarbeit?*

8 Ausblick *--Schlussteil--*

- Was ist Ihnen hinsichtlich der gesamten Thematik noch wichtig zu erwähnen?

Annex H: Codebook

Dimension	Themes	Description	Example Quote
Internal Causes of FW	Employees	Insufficient training / Untrained staff Awareness and Attitude Lack of resources/availability Labor costs for FW prevention tasks Storage Handling	“We are not allowed to do that anymore, because employees have already taken too much advantage of it. Unfortunately, the employees have intentionally damaged the products and packaging to take home the products they wanted” (E5)
	Marketing	Price structure Promotion techniques Product display, quantity, selection and labeling	“The shelves must be fully stocked, otherwise the customer has no incentive to buy” (B2)
	Management	Limited authority Limited Knowledge/Awareness Extra effort for FW	"If the product does not have the perfect quality , the supermarkets and discounters reject the products or give them to us. I do not understand how the supermarket manager can agree on this." (A1)
	Technology	Out-dated technology Technical malfunctions	“The fresh food sector, is still managed mostly manually but we are starting now with the digitalization and automation process. We will waste less food with that…” (G7)
	Planning & Forecasting	Inaccurate forecasting Inaccurate Inventory management	"They should simply plan better. Wrong forecasting is a major cause for FW…" (A1)
External Causes of FW	Customer	Awareness and attitude towards FW Quality and variety expectations Buying behavior Labelling knowledge/best before date	“Even people that picking up food at our charity organization, have high quality standards. So, I can only imagine what customers expect in supermarkets” (A1)
	Political	Law restrictions Law complexity and opacity Engagement level of government	“the organization collecting the food is now destined as the end-user. Because of that, the liability is neither drawn to the supermarket nor to the charity organization.” (C3)
	Corporation	Engagement with stores	"...there are already very, very strict regulations. The internal quality assurance for example is very very strict.. That's something that I unfortunately cannot influence, but sometimes I'd like to. In my opinion, the quality standards are too high. So what can I do? It's basically a written law. (E5)
	Supplier	Communication & Relationship Product delivery quality	“We already know that we won’t sell the product. But … for example says, if you want to have the other products, you need to position this product in your stores.” (G7)

Strategies Prevention	Technology improvement	Update Technology	“If the inventory system orders smartly, you can save a lot of food.” (D4)
	Marketing practices	Discounts on products Fruit box for kids Happy Hour Limitation of volume based promotion Abolish BBD labelling	“as long as we have accompanied this topic from a marketing perspective, we have noticed an improvement of buying behavior here. As soon as we have stopped with the communication, the customer has fallen back into his rut.” (F6)
	Customer Campaigns /Education	Awareness Promote sustainable consumption habits FW communications Social media and E-newsletter interventions	"Private label articles there is more and more this imprint "I often last longer than you think". With this we actually want to tell the customer that, quite honestly, only the BBD has been exceeded, which does not mean that you have to throw away the food directly, but rather try or smell it. So a carton of milk can be consumed after one week or even two after the BBD has expired." (G7)
	Employee Training	Awareness Inventory management + operation process+ shelf management Rewards system Waste tracking/KPI for store manager	“The food waste topic is ingrained in our employee training program. Every year a sustainability topic takes place in our sustainability week. Two years ago, we educated our trainees in FW and gave them the title of ‘food rescuers’. They also worked on a food waste challenge and had to brainstorm for ideas to prevent and reduce food waste in our stores… We also created customer campaigns for the stores and write about FW in our internal employee magazines…” (H8)
	Waste Tracking	Establish FW tracking Establish waste goals and KPIs	“We set our own goal, which is to reduce food waste by 30 percent over the entire value chain by 2025. This is really important I think.” (G7).
	Adaption to Consumer Demand	Adjusting product quantity Communication about change	“… farmer who delivers his cherries or his strawberries, or his potatoes, then I can order a certain amount, if I notice that it's not enough, then I can reorder again, and he's right there, so that's of course a great thing, because I can adapt better to the consumer demand and I am not wasting that much food. And I've got very fresh products…” (H8)
	Optimization of product selection	Decrease product range	“Great Britain or the Netherlands a lot more work is done on the food supply chain and the food waste data of grocery retail companies is published. It started with Tesco, but now in the UK there are 40 companies that report publicly on their food waste …” C3
	Suboptimal/ Ugly food	Revise food standards Communication Product Specifications Review	"The whole subject of ugly fruit and vegetables has been playing a role for us for a long time. We have our entire organic range, the 'Biohelden', which are either crooked or not, it may be that there is no extra crumb brand, so to speak, but that it is simply mixed in the bags. So it is also less work for the producers, because they simply do not have to sort it out." H8)
	Packaging	Smaller packages Reconsider packaging	“on the one hand we have the whole discussion about packaging minimization and reduction, especially in the fruit and vegetable sector. This means that the less packaging I have around the product, the less it is protected from external influences, and the faster the product perishes.”(B2)
Strategies Re-Use	Donation to humans	Through charity organisation Establish corporate food charity process	“We have a ‘Zu gut für die Tonne’ corner in our stores where we give away food for free to the customers… Even if the ‘best before date’ has already expired we offer the products, because we select goods that perhaps don't need a ‘best before date’, like flour or noodles, where it's nonsense with the ‘best before date’-…with the ‘best before date’ the manufacturer is liable after that date we are liable. As a store manager, I am happy to take the responsibility and liability, because I know that this food can still be consumed” (F6)
	Redistribution and secondary markets	Collaborate with FW businesses	“… any component that helps to raise awareness of the issue is good... 'Sirplus' and 'Too Good To Go' are excellent examples of redistributing food. I`m glad that because of these businesses, society is more engaged with FW and that the topic it is discussed more.” (C3)
	Upcycling	Restaurants Repurpose food	“All goods that can be processed and sold again before expiry are our gain.” (F6)
Strategies Recycle	Farmers/ Animal Feed	Give FW to farmers and animals	"In our market, for example, we have the zoo that comes by every morning, and picks up fruits and vegetables, for example salad and radishes… "(E5)
	Composting	Compost for customers	"We also give the coffee grounds from the coffee machines as a gift to customers. It's a pity if you throw them away. Some people take it as fertilizer or use it for peeling etc." (D4)

Annex I: Coding Tree

New categories (also FW strategies) and themes (also FW strategy areas) are marked in green.

Dimension	Themes	Quantity Theme	Categories
Internal Causes of FW	Employees	30	Insufficient training / Untrained staff
			Awareness and Attitude
			Lack of resources/availability
			Labor costs for FW prevention tasks
			Storage Handling
	Marketing	24	Price structure
			Promotion techniques
			Product display, quantity, selection and labeling
	Management	23	Limited authority
			Limited Knowledge/Awareness
			Extra effort for FW
			Quality standards
	Technology	10	Out-dated technology
			Technical malfunctions
	Planning & Forecasting	5	Inaccurate forecasting
			Inaccurate Inventory management
External Causes of FW	Customer	56	Awareness and attitude towards FW
			Quality and variety expectations
			Buying behavior
			Labelling knowledge/best before date
	Political	29	Law restrictions
			Law complexity and opacity
			Engagement level of government
	Corporation	28	Strategic direction
			Engagement with stores
	Supplier	12	Communication & Relationship
			Product delivery quality
	Competition		External pressure
Strategies Prevention	Technology improvement	33	Update Technology
	Marketing practices	32	Discounts on products
			Fruit box for kids
			Happy Hour
			Limitation of volume-based promotion
			Abolish BBD labelling
	Customer Campaigns/Education	23	BBD communication on products
			Awareness
			Promote sustainable consumption habits
			FW communications
			Social media and E-newsletter interventions
	Employee Training	21	Awareness

			Inventory management + operation process+ shelf management
			Rewards system
			Waste tracking/KPI for store manager
	Waste Tracking	21	Establish FW tracking
			Establish waste goals and KPIs
	Adaption to Consumer Demand	15	Adjusting product quantity
			Communication about change
	Networking and Collaboration	14	Collaboration with suppliers/partners
			FW network with political, NGO, grocery retail
			Internal Network on FW
	Optimization of product selection	14	Decrease product range
			Regional products
	Suboptimal/Ugly food	6	Revise food standards
			Communication
			Product Specifications Review
	Reporting	5	FW in company report
	Packaging	4	Smaller packages
			Reconsider packaging
Strategies Re-Use	Donation to humans	25	Through charity organization
			Establish corporate food charity process
			Corner for free products in store
	Redistribution and secondary markets	14	Collaborate with FW businesses
			Internal redistribution
			Redistribution to suppliers
	Upcycling	8	Restaurants
			Repurpose food
			Send back to supplier
Strategies Recycle	Farmers/Animal Feed	6	Give FW to farmers and animals
	Composting	1	Compost for customers

Annex J: Word Cloud MaxQDA

The world cloud below demonstrates the frequency of the words used in the interviews. Since the master thesis student worked with MaxQDA and interviews were conducted in German the presentation was not possible in English.

In the table below words used in the word cloud are translated to English. Moreover, the table illustrates the frequency of the words in all interviews and their percentage.

Position	Word in German	Word in English	Frequency	%
1	lebensmittelverschwendung	food waste	111	1.22
2	tafel	food charity organisation	88	0.97
3	lebensmittel	food	87	0.96
4	kunden	customers	73	0.80
5	unternehmen	company	68	0.75
6	deutschland	germany	54	0.60
7	mitarbeiter	employees	47	0.52
8	strategien	strategies	43	0.47
9	gemüse	vegetables	38	0.42
10	handel	trade	37	0.41
11	mhd	bbd	37	0.41
12	supermarkt	supermarket	37	0.41
13	markt	market	36	0.40
14	obst	fruit	36	0.40
15	filialleiter	store manager	34	0.37
16	supermärkten	supermarkets	29	0.32

17	waste	waste	29	0.32
18	prävention	prevention	28	0.31
19	strategie	strategy	28	0.31
20	menschen	people	25	0.28
21	filialen	stores	23	0.25
22	zusammenarbeit	collaboration	21	0.23
23	supermärkte	supermarkets	20	0.22
24	brot	bread	19	0.21
25	tonne	ton	19	0.21
26	lebensmitteln	food	18	0.20
27	händler	dealer	17	0.19
28	discounter	discounter	16	0.18
29	preis	price	16	0.18
30	bewusstsein	awareness	15	0.17
31	consumer	consumer	15	0.17
32	lebensmittelverluste	food losses	15	0.17
33	treiber	driver	15	0.17
34	verschwendung	waste	15	0.17
35	frische	freshness	14	0.15
36	lebensmittelabfälle	food waste	14	0.15
37	mindesthaltbarkeitsdatum	best before date	14	0.15
38	nachhaltigkeit	sustainability	14	0.15
39	verbraucher	consumer	14	0.15
40	verpackung	packaging	14	0.15
41	verschenken	give away	14	0.15
42	abfall	waste	12	0.13
43	bauern	farmers	12	0.13
44	maßnahmen	measures	12	0.13
45	vermeiden	avoid	12	0.13
46	marketing	marketing	11	0.12
47	organisation	organization	11	0.12
48	priorisierung	prioritisation	11	0.12
49	regal	shelf	11	0.12
50	training	training	11	0.12
51	wegschmeißen	throw away	11	0.12
52	zoo	zoo	11	0.12
53	abschriften	food waste	10	0.11
54	backwaren	baked goods	10	0.11
55	gesetze	laws	10	0.11
56	produkt	product	10	0.11
57	produkten	products	10	0.11
58	ugly	ugly	10	0.11
59	umsatz	turnover	10	0.11
60	verwertung	recovery	10	0.11

Annex K: Calculation of the FWSF Prioritization

Column D to J illustrate the priorities assigned by the interview participants. The results are explained by the example of the strategy area 'Suboptimal/Ugly food management'. The column 'Frequency of Prio' (K) indicates the prioritization that was selected by most of the experts. 'The average of prio' (L1) was calculated with the average of the sum of D2 to J2 (see formula in L1). 'The average frequency average of prio' was estimated by the average of the sum of K2 and L2 (see formula M1). In the last column (N2), the result from the previous column (M2) is adjusted. It was decided to only use three prioritization levels since it guarantees a better overview. All results of column M that are higher or equal to 3 were corrected to prio three, as for example 'Packaging' that is 5.0.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	**Level**	**Strategy area**	**Theory Prio**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**Frequency of Prio**	**Average of Prio** =SUM(D:J)/7	**Average Frequency Average of Prio** =SUM(K:L)/2	**Corrected result**
2	**Prevention**	"Suboptimal/Ugly" food management	1	2	3	3	4	4	3	1	3	2.2	2.6	2
3		Marketing practices		6	3	1	1	4	3	1	1	2.7	1.9	1
4		Employee Training	2	3	2	1	1	1	7	2	1	2.4	1.7	1
5		Technology improvement		7	2	1	1	5	1	2	1	2.7	1.9	1
6		Waste tracking		8	1	2	4	2	6	2	2	3.6	2.8	2
7		Packaging		5	5	5	5	7	6	2	5	5.0	5.0	3
8		Optimization of Product selection		4	2	4	3	2	2	3	2	2.9	2.4	2
9		Customer Campaigns/Education	3	1	4	1	1	6	5	1	1	2.7	1.9	1
10		Adaption to consumer demand	4	3	3	3	3	3	4	1	3	2.9	2.9	2
11	**Re-Use**	Donation	1	1	1	1	1	4	2	1	1	1.6	1.3	1
12		Redistribution/Secondary markets		2	1	1	1	1	1	2	1	1.3	1.1	1
13		Apps	2	3	3	3	3	2	3	3	3	2.9	2.9	3
14		Upcycling	3	3	2	2	2	3	4	3	2	2.7	2.4	2
15	**Recycle**	Animal Feed	1	1	1	1	1	2	1	1	1	1.1	1.1	1
16		Composting		2	2	1	2	1	2	1	2	1.6	1.8	1
17	**Recovery**	Anaerobic digestion (Biogas: heat/ electrictity)	1	1	2	1	1	2	3	1	1	1.6	1.3	1
18		Biorefining (fuels, chemicals, materials		1	1	1	1	1	2	1	1	1.1	1.1	1
19		Biofuel production		1	3	1	1	3	1	1	1	1.6	1.3	1
20	**Disposal**	Incineration												
21														
22		Most favorable practices	n=7											
23		2nd favorable												
24		3rd favorable												
25		4th favorable												
26		Last resort												