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Retailer's role in reducing food waste
Case study of Finnish retailers

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Master's thesis

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Abstract of master's thesis

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Abstract

RELEVANCE AND MOTIVATION

Food waste is increasingly becoming a "hot" topic in both public discussion and scientific research. It is brought about by cultural shifts related to the global rise of middle class, transition to more perishable types of food, urbanization and growth in single-person households. Numerous international organizations such as UN and OECD have acknowledged the problem, and in 2012 EU called for urgent actions to halve the union's food waste by year 2025. Retailers are chosen as the object of research in this thesis because they are central players in the food industry that can reach out to and influence suppliers and consumers alike.

OBJECTIVES

The objectives of this thesis are to obtain a general understanding of the food waste phenomenon at different stages of the supply chain, identify concrete practices that retailers could adopt in order to reduce waste and explore how many of the identified practices Finnish retailers have implemented. Additionally, the thesis aims to find out what practices are key to reducing food waste in Finnish retailers' opinion. An evaluation model is developed based on the chosen practices and later used for evaluating Finnish retailers' efforts.

METHODS

The main research method utilized in this thesis is case study. Two Finnish retailers, S-group and Kesko, which together serve over 90% of market share were studied. First, data was collected from the official web pages of Finnish retailers to get a general view of what practices they had adopted and what challenges related to reducing food waste they face. Second, two structured interviews were conducted with S-group and Kesko representatives to obtain more detailed information regarding whether or not and how the practices were being implemented.

FINDINGS

The results show that the two Finnish retailers have adopted all of the identified practices to some extent and the issue of food waste is taken extremely seriously. The majority of the practices were rated at the highest level, and potential improvements were identified related to the usage of cosmetically substandard produce and consumer education regarding food waste. Both retailers claimed the careful planning of demands and orders to be the key to reduced food waste. While the retailers have demonstrated substantial efforts to decrease food waste in their supply chain and stores, it was recommended that additional measures are taken in order to educate consumers and influence their behavior.

Keywords food waste, retailers, food supply chain, supply chain management, CSR, sustainability

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TAUSTA JA MOTIVAATIO
Ruokahävikistä on viime aikoina tullut yhä ajankohtaisempi aihe niin julkisessa keskustelussa kuin tieteellisessä tutkimuksessakin. Tämä johtuu maailmanlaajuisen keksiluokan kasvun aiheuttaman kulttuurin muutoksesta, siirtymisestä helposti piilaantuviin elintarviketyyppeihin, kaupungistumisesta sekä yhden hengen kotitalouksien lisääntymisestä. Monet kansainväliset järjestöt kuten YK ja OECD ovat tunnustaneet ongelman, ja vuonna 2012 EU vaati pikaisia toimia unionin ruokahävikin puolittamiseksi vuoteen 2025 mennessä. Elintarvikkeita myyvät kauppaketjut ovat tämän tutkimuksen kohteena siitä syystä, että ne ovat keskeisiä pelaajia elintarviketeollisuudessa ja voivat vaikuttaa sekä ruoan toimittajien että kuluttajien käyttäytymiseen.

TUTKIELMAN TAVOITTEET
Tutkielman tavoitteena on saada yleiskäsitys ruokahävikistä ilmiönä, tunnistaa konkreettisia käytäntöjä jotka kauppaketjut voisivat omaksua ruokahävikin vähentämiseksi sekä selvittää, kuinka monta tunnistettua käytäntöä suomalaiset kauppaketjut ovat toteuttaneet. Lisäksi pyritään saada selville mitkä ovat tärkeimmät käytännöt ruokahävikin vähentämiseksi suomalaisten kauppaketjujen silmissä. Valitut käytännöt ovat järjestetty arviointimallin muotoon, joka sitten käytetään suomalaisten kauppaketjujen ponnistelujen arvioinnissa.

TUTKIMUSMENETELMÄT
Tutkielman pääasiallinen tutkimusmenetelmä on tapaustutkimus. Siinä tutkittiin kaksi suurinta suomalaista elintarvikekauppaketjua, S-ryhmää ja Keskoa, joiden yhteinen markkinaosuus on yli 90%. Ensiksi, tiedot on kerätty yritysten virallisilta verkkosivuilta saadakseen käsityksen kauppaketjujen omaksumista käytännöistä sekä niiden kohtaamista haasteista. Sitten toteutettiin kaksi strukturoitua haastattelua S-ryhmän ja Keskon edustajien kanssa, mistä ilmeni yksityiskohtaisempia tietoja siitä, onko käytännöt omaksuttu ja millä tavalla.

TULOKSET
Tutkimuksessa todettiin, että S-ryhmä ja Kesko ovat omaksuneet melkein kaikki tunnistetut käytännöt ja että ruokahävikkiin suhtaudutaan erittäin vakavasti. Suurin osa käytännöistä arvioitiin korkeimmalle tasolle, ja parantamisen varaa tunnistettiin liittyen kosmeettisesti huonolaatuisten kasvisten käyttöön sekä kuluttajien valistukseen ruokahävikin aiheesta. Kauppaketjut ovat osoittaneet huomattavia ponnisteluja ruokahävikin vähentämiseksi niiden toimitusketjujen varrella sekä kaupoissa, mutta lisätoimenpiteitä suositeltiin kuluttajien käyttäytymiseen vaikuttamiseksi.

Avainsanat ruokahävikki, vähittäiskauppa, ruoan toimitusketju, toimitusketjun hallinta

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1 Introduction

Food waste is becoming an increasingly relevant issue on a global scale due to the dietary transitions to more perishable types of food as well as cultural shifts brought about by the rise of middle class in developing countries and a global trend of urbanization. According to Food and Agriculture Organization of the United Nations (FAO, 2013a), if food waste was a country, it would be the third country by total carbon footprint after the U.S. and China. The magnitude of the problem becomes apparent also as High Level Panel of Experts on Food Security and Nutrition (HLPE, 2014) estimates that out of the total food produced, 28 to 36% is wasted depending on the region. While for the developed countries food waste mostly constitutes a waste of resources and a major economic loss, in the developing world it affects the basic accessibility of food for the poorest classes of the populations. Waste and Resources Action Programme (WRAP, 2008) estimated that about 1/3 of all purchased food is wasted by consumers in the UK, and at the same time there are approximately 1 billion people in the world who chronically suffer hunger, according to the United Nations.

Therefore, there is a pronounced need for action when it comes to reducing food waste. In 2012, European Union (EU) acknowledged the scale of the problem and called for urgent action in order to halve food waste by year 2025. This thesis is going to adopt a retailers' viewpoint at the problem, because retailers can be seen as key players of the food supply chain that are capable of performing significant changes within their own operations and also parties with significant market power over large numbers of suppliers. Moreover, grocery stores are consumers' main touch points with the food industry and thus retailers are able to effectively reach out to consumers and influence their behavior.

1.1 Research gap and research objectives

Food waste as a research topic is not new, however the last 6-7 years have seen a significant increase in the number of publications. The topic is rather interdisciplinary, with the fields of study ranging from environmental and agricultural studies to business and logistics. The majority of publications are reports by international organizations such as the United Nations (UN), Organization for Economic Cooperation and Development (OECD), European Union (EU), as well as smaller specialized entities such as UK's charity Waste and Resources Action Programme (WRAP). The key publications on the topic are also strongly based on the reports, and most reports are quite similar in content and are different mostly in the way they structure the information.

There are also journal articles that describe case studies examining mostly the composition and causes of food waste in various retailer chains. For example, Eriksson et al. (2012) studied the composition of food waste in several stores in a Swedish retail chain, and Lanfranchi et al. (2014) focused on retail outlets in Eastern Sicily. When it comes to Finland, most of the country-specific studies were conducted by a group of researchers including Katajajuuri, Silvennoinen and others. Katajajuuri et al. (2014) estimated the volumes of food waste in Finland; Silvennoinen (2014) conducted a study that closely examined the volume and composition of food waste generated by Finnish households; and Silvennoinen (2012) examined the food waste coming from the food service sector.

On the corporate side, management consulting company Oliver Wyman has paid special attention to the topic and published several reports about retailer's role in reducing food waste. Oliver Wyman (2014b) identified the practices that retailers could undertake in order to reduce it and Oliver Wyman (2014a) listed managerial best practices that can help retailers improve their food waste performance. Both reports are highly practical and give concrete recommendations to retailers.

While there have been a lot of theoretical studies that broadly discussed the issue and several case studies that quantified and measured the composition of food waste in various stores and food service points, there has not yet been a study that examined and evaluated the variety of individual retailer's practices related to reducing food waste. Therefore, a research gap has been identified. Finland is a developed country and the topic of food waste has become especially relevant recently, and therefore it would be interesting to get an insight into what practices Finnish retailers adopt to cut food waste. The basic expectation is that the issue is taken really seriously because food waste always constitutes an economic loss, and that there are a variety of practices implemented at different stages of the supply chain.

The five research objectives of this thesis are the following:

1. Obtain a holistic view of the topic of food waste and its placement within supply chain management (SCM).
2. Identify the causes of food waste and concrete practices that the retailers could adopt in order to reduce it.
3. Construct and operationalize an evaluation framework of retailer's efforts aimed at reducing food waste at different stages of the supply chain.
4. Evaluate how many of the practices Finnish retailers have adopted and to what extent.

5. Determine what practices are key to reducing food waste in Finnish retailers' opinion.

The thesis is first going to discuss the concepts within Supply Chain Management (SCM) that are relevant to the topic of food waste. Then it is going to build a multi-sided view of the food waste issue and subsequently construct an evaluation model of concrete practices that retailers could adopt in order to cut food waste. Finally, it is going to examine and evaluate Finnish retailers' practices, discuss the findings and make suggestions for improvements on the matter.

1.2 Case study research method

Yin (2003, p. 13) defines case study as "*an empirical inquiry that investigates a contemporary phenomenon within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident*". It is a good research method as it allows to improve the theory by the means of combining existing theories with practical insights. Case study approach is recommended to be utilized when the aim is to answer "*how*" and "*why*" questions and the investigator cannot manipulate the behavior of the objects of the study (Yin, 2003, p. 9).

A multiple case study approach should be utilized when the expectation is to find similar results, or find different results but for reasons that can be predicted (Yin, 2003, p.47). Rowley (2002) discusses that multiple case studies are a much more robust method that single case study due to the ability to replicate the results. The more cases are used, the more robust the results can be claimed to be.

There are three types of case studies: exploratory, descriptive and explanatory. Exploratory case studies are used to explore the patterns in the data and then create a model. Descriptive case studies are used when there is a ready model and the aim is to study particular aspects of a topic. Explanatory case studies involve analysis and aim to explain the underlying reasons for something. Yin (1994, pp. 4-6)

The benefits of case studies, as outlined by Vissak (2010) is that they allow studying phenomena within contexts and in their full complexity. Data for the case studies can be collected from multiple sources and case studies do not require a large sample size, contrast to i.e. statistical methods. On the drawbacks side, case studies are more time-consuming than i.e. surveys and they can be greatly affected by subjective factors such as interviewees' own evaluations, interviewees might attempt to ignore negative details and only provide

information that supports a developed theory. Moreover, they have been criticized for lacking rigor in results validity and a limited ability to draw generalizations, especially when the sample size is small. This is because it is not always possible to distinguish between a pattern supporting or refuting a theory and a company's context. (Vissak, 2010)

The case study method is well suited to the purpose of this thesis because one of the aims is to provide an answer to the question of how Finnish retailers adopt various practices in order to reduce food waste. The multiple case study approach is going to be used because two Finnish retailer chains will be examined. The type of case study to be utilized is descriptive case study, as the model will be first created and later particular aspects of the retailers' operations will be examined and evaluated.

Another reason to use the case study method is that the food waste phenomenon is embedded into retailers' operations, and it is closely related to i.e. general efficiency and overall freshness of the products (Oliver Wyman, 2014b). Therefore, it would be rather meaningless to study it outside of this context and try to separate it from other factors and incentives that are relevant to retailers.

The two cases to be studied are the two largest Finnish retail chains, S-group and Kesko. They operate a variety of retail stores of different sized around Finland and also in neighboring countries. The case companies were selected based on their market share. Finnish grocery retail space is very consolidated with S-group and Kesko serving over 90% of market. Therefore, the results obtained from the two chains can be claimed to accurately describe how Finnish retailers reduce food waste as the sample covers almost all of the market.

2 Supply chain management concepts

This section is going to discuss supply chain management concepts that are relevant to the topic of food waste and food retailing. The notion of supply chain management will be introduced, then efficiency and sustainability concepts are going to be examined, as well as the description of food supply chain. Logistics theory that forms the basis for this thesis can be broadly divided into two parts: efficiency improvements and sustainability issues. Efficiency improvements include concepts like demand forecasting, collaborations with suppliers, as well as inventory management. Sustainability comprises topics similar to corporate social responsibility (CSR) and reverse logistics.

Supply chain, as defined by Waters (2003, p.7) "*consists of the series of activities and organizations that materials move through on their journey from initial suppliers to final customers*". Supply chains can be found everywhere, and the only case when there is no supply chain is when final consumers physically come to initial producers and purchase the goods. Such actions are very time-consuming for the consumers and it is impossible to obtain everything one needs directly from initial producers. Therefore, supply chains are created in order to narrow the geographical and time gap between producers and consumers. (Waters, 2003 p.7)

Supply chain management is defined by Simchi-Levi (2003, p.1) as "*a set of approaches utilized to efficiently integrate suppliers, manufacturers, warehouses, and stores, so that merchandise is produced and distributed at the right quantities, to the right locations, and at the right time, in order to minimize systemwide costs while satisfying service level requirements*". The concept of efficiency and a match between supply and demand can therefore be considered as the essence of supply chain management.

2.1 Efficiency improvements

Efficiency improvements are essential for the long-term success of a business and its competitive position. Efficiency improvements are usually associated with reduced costs, and therefore can be seen as one of the main sources of competitive advantage.

Rushton (2014, pp. 81-83) claimed that many of the trends in logistics generally start in the grocery multiple retail sector and then spread onto other industries and sectors, and thus grocery chains are a source of innovative ideas related to logistics. He described the recent trends that are dominating the retail sector: inventory reduction with a heavier reliance on

inventory replenishment systems, maximization of selling space, the use of electronic point of sale (EPOS) systems and subsequent adoption of just-in-time (JIT) concepts. Also the number and role of distribution centers (DC's) has changed, and now there are generally fewer distribution centers with reduced stockholdings and many of the activities such as labeling and unpacking have been moved from stores to DC's in order to increase their efficiency. (Rushton, 2014)

Simchi-Levi (2003, pp. 44-47) described that inventory needs to be held for the reasons of unexpected changes of customer demand, uncertainty in supplier cost, availability and demand, delivery lead times as well as economies of scale related to the transportation of large batches of products. When managing inventory, the objective is to minimize the systemwide costs rather than separate ones. Some of the efficient inventory management practices described were periodic reviews, reduced safety stock levels, ABC approach which prioritizes tight inventory management for the top selling items, shift towards vendor-managed inventory as well as quantititative approaches that allow minimizing systemwide inventory costs. (Simchi-Levi, 2003, pp. 44-47)

Inventory management is closely linked to order management as orders determine the frequency and volume of inventory turnovers. A classic model for order batch is economic lot size (ELS), which depicts the tradeoffs between ordering and holding costs and calculates the economic order quantity (EOQ), which is the order quantity at which the total inventory costs are minimized. (Simchi-Levi, 2003, pp. 44-47)

Accurate demand forecasting is vital for efficient supply chain management as it allows to predict how much end product is required; thus, less waste ends up being generated within the whole system and also shortages and therefore lost sales can be avoided. Simchi-Levi (2003, p.127) defines demand forecasting as "*a process in which historical demand data are used to develop long-term estimates of expected demand, that is, forecasts.*" However, demand forecasting is not limited only to factors that are external to the company's decisions: Simchi-Levi (2003, p. 127) also mentions demand shaping, which is an impact that marketing interventions such as promotions, discounts and product selection alterations have on customer demand. They also have to be taken into account when planning demands in addition to historical data.

Better-integrated information flows are key to the improved accuracy of forecasts. Therefore, collaborative systems such as collaborative planning, forecasting and

replenishment (CPFR) jointly developed by Warner-Lambert and Walmart (Simchi-Levi, 2003, p. 111). Such systems facilitate the exchange of forecasts, sales and trends between organizations that allow managers to make better planning decisions, which in turn leads to efficiency improvements.

2.2 Sustainability management

Corporate social responsibility (CSR) is defined by European Commission as "*a concept whereby companies integrate social and environmental concerns in their business operations and in their interaction with their stakeholders on a voluntary basis*". It is common knowledge that the objective of a business is to make profits, and therefore the economic concerns are by default taken into account. Legislative requirements force companies to abide by certain social and environmental principles, however there might be loopholes in legislation especially in developing countries that companies might be tempted to abuse. CSR describes a philosophy where companies would strive to avoid compromising social and environmental integrity for additional profits.

Sustainability, in turn, is defined by the United Nations as the "*development that meets the needs of the present without compromising the ability of future generations to meet their own needs*". Humanity's dependence on non-renewable energy sources and the detrimental effect of human activity on the natural ecosystems are the two problems that are most commonly discussed when it comes to sustainability. The concept is becoming increasingly relevant especially due to the rise of global population and the need to efficiently use and sustain the planet's resources. Food security for the growing population is also a big concern, as well as the sustainability of food production.

Forsman-Hugg et al. (2013) identified seven CSR dimensions that are present in the food supply chain: "*environment, product safety, nutrition, occupational welfare, animal welfare, economic responsibility and local well-being*". They also discussed the expediency of involving in CSR in the agri-market that is already heavily regulated and highly competitive. However, it was suggested that in such a market differentiation is extremely important, and a high level of CSR adoption could become a strong source of differentiation and competitive advantage as well as minimize the effects of potential reputation concerns in the long run. Wiese and Toporowski (2013) studied CSR failures in the food industry and found that the failures might have a very negative effect on a company's financial performance. One of the key challenges identified was the traceability of suppliers' suppliers

operations, as the food industry is characterized by a large number of suppliers. They suggested resorting to agency theory when managing supply chain relationships, and claimed that retailers' own quality requirements and tight partnership with suppliers are efficient in mitigating agency problems.

When food waste is not reduced at source, it is important that reuse and disposal channels are organized so that the materials can be directed to the best possible use. The reverse logistics concept is related to returns of goods from consumer to manufacturer, product recalls because of quality and safety concerns as well as recycling and disposal (Rushton, 2014, pp. 651-654). Harrison and Hoek (2008) mention that companies need to pay attention to reverse logistics because of reputation concerns, a "green" company image and benefits that this brings about. However, they discuss that reverse logistics infrastructure and its maintenance are also a cost for companies, and therefore it is common that development of reverse logistics infrastructure is resisted and advancements in this area are driven by legislation rather than businesses. Reverse logistics in grocery retailers' operations include donations of food to charities and food banks as well as to animal feed, recycling unsold food and packaging materials, and also final disposal measures.

2.3 Food supply chain

Manzini (2013) described that the food supply chain comprises companies involved in manufacturing, processing and transformation of raw materials or semi-finished products related to agriculture, forestry, zootechnics and fishing. Logistics and distribution are also part of the food supply chain. Food industry is the largest one in Europe by turnover and is consists of over 300 000 companies, 99% of which are small and medium-sized enterprises (SME's). (Manzini, 2013)

Verdouw et al. (2016) describe several characteristics of the food supply chain. The nature of products that it processes is often highly perishable, and this requires the use of distinct inventory planning models. Another characteristic is that due to natural factors affecting agriculture the supply might be quite unstable. Also, food supply chain is subject to strict safety and sustainability requirements that might vary between legislations. (Verdouw et al., 2016)

The network structure of food supply chains is quite complex as it includes a large number of suppliers, as well as many other types of players such as supplier cooperatives, packaging companies, inspection and certification organizations, food labs and food traders.

Food supply chain deals with a large variety of distinct product groups that require different treatment in production and distribution. Also, there are numerous distribution channels such as large supermarkets, small family shops, farm shops, web shops and the catering industry. (Verdouw et al., 2016)

Dani (2015, pp. 2-6) described the main actors that are present in the food supply chain: input suppliers, producers, processors, retailers and distributors, hospitality sector, and, finally, consumers. Matopoulos et al. (2007) took a wider and a more detailed view on the food supply chain by adding research centers and farmer cooperatives, breaking down distributors into exporters, transporters and importers as well as separating chemical industry and input suppliers. Matapoulos's representation of the agri-food supply chain is presented in Figure 1.

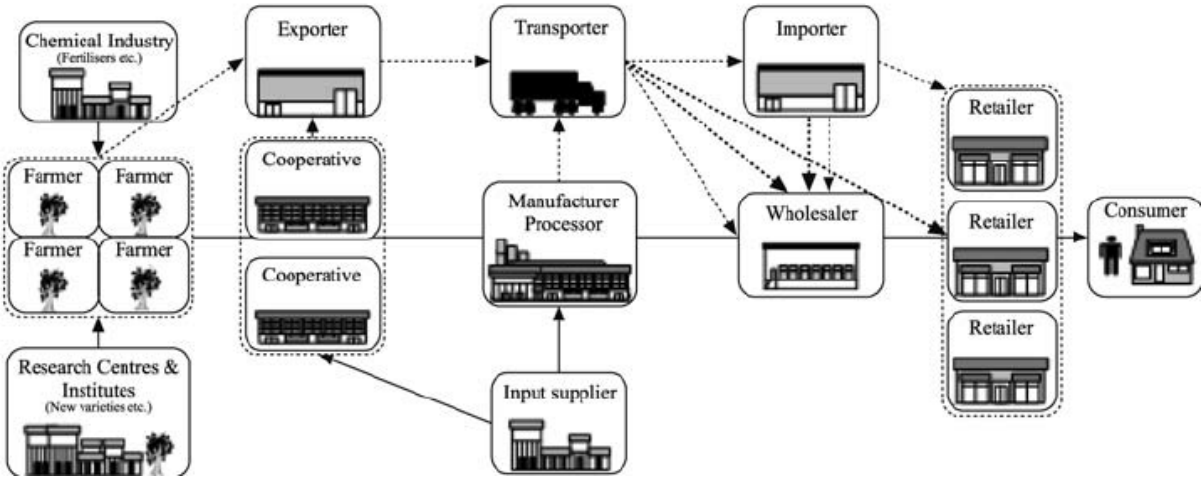


Figure 1. Actors in the agri-food supply chain

Source: Matopoulos et al. (2007)

At the very top of the supply chain are the producers who supply raw food, such as fruit, vegetables, fish, meat and grains. Dani (2015) describes also the so-called 'input suppliers' that are massive international corporations providing producers with seeds, fertilizers, pesticides and machinery. Next, when the raw food has been produced, it is sold to food processors who transform the raw food into products than can be stored for a longer time and are better suited to consumer preferences. Examples of food processing are conservation or juicing of fresh fruit, grain milling, baking as well as freezing. (Dani, 2015)

According to Matopoulos's visualization, farmers' activities are enabled by the chemical industry as well as research centers that develop new varieties, and farmers form

into cooperatives. Input suppliers serve both farmers cooperatives and food processors, however it is highly likely that input suppliers might serve farmers directly. In this case the input suppliers imply companies that supply machinery for agriculture and processing as the chemical industry and research centers have been separated into their own entities.

After the processor stage comes the distribution stage that acts as a link between producers, processors, hospitality sector and consumers. Some distributors, such as trading companies, act purely as links between different non-consumer entities, while others, such as retailers, showcase the products of the food industry to consumers. Previously, retailers were mostly small family-owned stores, however nowadays there is a global shift towards large international retail chains. The hospitality sector (caterers) also acts as a medium between food producers/processors and final consumers by providing customized and ready products. (Dani, 2015)

In Matopoulous et al.'s (2007) schematic view, distributors are divided into exporters, transporters, importers, wholesalers and retailers. In many cases, one or several of these stages is omitted. Also, the distribution network might obtain the products from farmers, cooperatives or manufacturer/processor's levels alike.

Finally, consumers are the ones that reap the fruits of the activities that other food supply chain actors undertake. Consumers supply the upstream actors with revenues and determine the development of food supply chains. For example, there is a current trend towards more natural and healthy foods, and therefore food producers, processors, retailers and caterers need to take this into account when planning and developing their operations in order to better suit consumer needs. (Dani, 2015)

Overall, the food supply chain can be described as a rather complex network with nonlinear flow, large variety of production and processing methods as well as the final products. Food supply chains are especially challenging to manage because of unpredictable external factors such as weather and natural phenomena having a large effect on the supply, high perishability of handled products and also the strict and various legislation requirements that might vary significantly from country to country.

2.4 Food retailing

The verb "*retail*" is defined by Merriam-Webster dictionary as "*to sell in small quantities directly to the ultimate consumer*". BusinessDictionary.com add that retail is a "*business or*

person that sells goods to the consumer, as opposed to a wholesaler or supplier, who normally sell their goods to another business". Food retailers are the primary focus of this thesis and therefore it adopts a food retailer's viewpoint in discussing the literature and concepts presented.

The food retail market consists of retailers of different sizes and organization. Retailers might be individual stores or retail chains operating numerous stores. Historically, most retailers were rather small shops, often operated by families. However, as pointed out by Dani (2015), nowadays small retailers are being replaced by large, often international, retailer chains. In Finland, for example, there are very few, if any, small individual stores, and the market is almost wholly served by three large retailer chains, two of which are domestic.

Dawson (2008) discusses that in food retail, economies of scale play a significant role especially when it comes to purchasing. About 80% of costs in UK food retail arise from purchasing, and therefore a reduction in purchasing costs brings a significant competitive advantage. Also, there are significant economies of scale in regard to replicative store design, marketing and other customer acquisition costs, as well as customer communication systems such as loyalty cards. (Dawson, 2008)

Different retailers serve different customer segments, and this defines a retailer's branding strategy to a large extent. There are various types of food retailers such as superstores, hypermarkets, convenience stores, food boutiques, web stores and vending machines. It is also common that one retailer chain operates several types of stores. (Dawson, 2008)

Food retail has a distinctive feature of being rather conservative with its sales channels due to the nature of products it offers. While sales in other industries such as clothing, books and electronics have increasingly shifted to the Internet, food retail has been relatively immune to such changes. This is to a large extent attributable to the perishable nature of many groceries and therefore the fact that consumers need to replenish their food supplies several times a week. For example, fruit and vegetables as well as fresh milk and meat products cannot be stored for a long time and therefore continuous replenishment is required. Also, consumers might not be willing to forego the control of what they purchase especially in regard to fresh fruit and vegetables, since while shopping in physical stores they have a possibility to pick the items that are attractive to them and ensure the fresh food quality.

Therefore, the grocery retail network is built in a way that there are a relatively small number of large superstores that are usually located at a distance from residential areas, and a larger number of smaller local stores in residential areas that allow consumers to shop for groceries close to their homes without significant time and transport resources. One example of this, as described by The Telegraph (2011), is the Tesco mobile supermarket that proved to be very successful in South Korea. They placed glass walls on metro stations showing pictures of their products as if they were on a shelf in a real store. Consumers could make a purchase by scanning a QR code and after filling in a shopping basket, they could order the products to be delivered directly to their homes at a designated hour. This is one of the examples of how grocery retailing is starting to use other sales channels, however, the change in this industry is happening quite slowly.

3 Overview of food waste

This section is going to provide a holistic overview of the issue of food waste based on the existing literature and other relevant sources. The aim of this section is to form a solid basis for creating the evaluation framework that will later be used to evaluate the variety of Finnish retailers' practices aimed at reducing food waste.

The topic of food waste is not directly covered in research pertaining to supply chain management, and therefore the resources utilized in this chapter are taken from comprehensive reports and scientific papers that are specifically related to food waste.

3.1 Definition of food waste

According to Bagherzadeh et al. (OECD, 2014), there is currently no commonly agreed on definition of food waste. They suggest the following definition: "*Food Loss and Waste refer to the decrease in mass (quantitative) or nutritional value (qualitative) of food - edible parts - throughout the supply chain that was intended for human consumption*". The distinction between food loss and food waste is characterized to lie in different stages of production: while food loss occurs before reaching the final product stage (during production and distribution), food waste typically takes place in retail and consumption. (Bagherzadeh et al., 2014)

This distinction between food waste and food loss is also acknowledged by Parfitt et al. (2010). FAO add that non-edible parts of food products as well as feed for animals cannot be considered as food loss or waste since they were not originally intended for human consumption. However, the report considers the food that was eventually used for non-food purposes (feed for animals, compost, biofuels) as food loss/waste due to the unplanned nature of its non-food use (FAO, 2011).

FUSIONS (2014), on the contrary, draw a distinction between food waste and potential food waste that ended up being used as animal feed, recycled or otherwise reprocessed. Name "*valorization and conversion*" is suggested for this phenomenon. Also, FUSIONS (2014) consider inedible parts of the food to be food waste.

Smil (2004) goes further into the nutrition efficiency indicators and discusses that there is a growing discrepancy between food production and consumption. Not only does it include food thrown away, but also food consumed in excess of the per capita nutritional requirement of an average of 2000 kcal per capita per day. It is mentioned that overconsumption of food

can be regarded as part of the wasteful consumption culture in the developed countries and among the more well off segments of population in developing countries. In the longer run, it causes high levels of obesity and other health problems and thus calories overconsumption cannot be regarded as a sustainable practice. Therefore, he considers it to be part of the larger problem of food waste and loss. (Smil, 2004)

Although Smil's (2004) observations are definitely valuable and add a new angle to the concept, this thesis will adopt the definition of food waste and loss suggested by Bagherzadeh (2014) and some additions by FAO (2010) and FUSIONS (2014). The reason for this is that the thesis is focusing on retailers' role in reducing food waste, and while supermarkets can to some extent affect the culture that leads to massive calories overconsumption, their role in changing such consumer culture cannot be viewed as the leading one.

According to FAO (2010) inedible parts of food will not be considered food waste, and this thesis will adopt the term "*valorization and conversion*" for the food waste that was used to feed animals or reprocessed as suggested by FUSIONS (2014). Such definition will be adopted because inedible parts of food waste cannot be consumed, and there is a significant difference between simply disposing of food as in the case with food waste rather than using it for other purposes.

Additionally, although there is a described distinction between food loss and food waste, this paper will refer to food waste and food loss as just "*food waste*" for the sake of simplicity. Nevertheless, it can be assumed that most of the issues discussed in this thesis refer to food waste rather than food loss because retailers' activities are mostly associated with food in the post-production stage. Another important aspect to note is that drinks will be considered as part of the food concept in this thesis.

Some definitions of food loss/waste also consider food theft to be part of the concept. For example, Lukic et al. (2014) discusses food theft as part of food waste for retailers. However, while food theft is certainly a source of shrink and loss for retailers, considering it as food waste could lead to distortions in calculating the amount of food waste. This is because part of the stolen food, although obtained illegally, is consumed by humans, and thus does not satisfy the definition of food waste mentioned previously. A portion of the stolen food that does end up being wasted is estimated at the consumer level in the same way as the wasted food that was obtained legally. Therefore, food theft cannot be considered as part of the common food waste definition and will be out of scope in this thesis.

All in all, the definition of food waste to be used in this thesis will be the one described by Bagherzadeh et al. (OECD, 2014): "*Food Loss and Waste refer to the decrease in mass (quantitative) or nutritional value (qualitative) of food - edible parts - throughout the supply chain that was intended for human consumption*". Inedible parts, overconsumed food and food theft will not be considered to be food waste, and food that was used for animal feed or reprocessed will be referred to as "*valorization and conversion*".

Table 1 shows the sources and definitions of food waste described in this section.

Table 1: Definitions of food waste

Source	Definition
Bagherzadeh et al. (OECD, 2014)	"…the decrease in mass (quantitative) or nutritional value (qualitative) of food - edible parts - throughout the supply chain that was intended for human consumption"
FAO (2011)	" "Food" waste or loss is measured only for products that are directed to human consumption, excluding feed and parts of products which are not edible"
FUSIONS (2014)	" Any food, and inedible parts of food, removed from the food supply chain … and composted, crops ploughed in/not harvested, anaerobic digestion, bio-energy production, co-generation, incineration, disposal to sewer, landfill or fish discarded to sea... are termed 'food waste'. Any food, or inedible parts of food, sent to animal feed, bio-material processing or other industrial uses are termed 'valorisation and conversion' and are distinct from 'food waste'. "
Smil (2004)	Addition: Food waste also includes food consumed in excess of the daily nutrition requirement of 2000 calories per person on average.
Lukic et al. (2014)	Addition: Food waste also includes food theft.

3.2 Type of food wasted

A typology of food waste is suggested by WRAP in 2008 and synthesized by Kelleher and Robins (2013). Food waste by avoidability is divided into the following categories (Kelleher & Robins, 2013):

- Avoidable – food that is suitable for consumption at some time before the disposal
- Possibly avoidable – food that is consumed by part of the people and not consumed by others (bread crust), or that is edible when prepared in a certain way and not edible when prepared in other ways (potato skins)

- Unavoidable – parts of food products that are inedible, or waste that arises from food preparation and that is not usually suitable for human consumption (bones, tea bags, egg shells)

This thesis will not consider unavoidable food waste described above to be part of the food waste based on Bagherzadeh's definition since it does not satisfy the "edible parts" description. Thus, the concept of food waste used in this thesis will only include avoidable and possibly avoidable food waste.

There are significant differences between types of foods in terms of waste rates. FAO (2011) provided estimates of what percentages of different foods were lost in each region of the world at different stages of production, distribution and consumption. Although there were noticeable regional differences, fruit and vegetables (37-55%), cereals (20-35%), as well as roots and tubers (33-60%) were consistently the most wasted foods in almost all of the regions in retail and consumption. Large proportions of fish and seafood (30-50%) were also shown to be wasted across all regions.

Parfitt et al. (2010) described a separation of food products into perishable and non-perishable i.e. based on the projected storage time and moisture content (couple of years of storage and a low level of moisture for non-perishables vs. short-term storage and a very high moisture content for perishables). Quite expectedly, most perishable foods are the ones that constitute largest proportions of food waste. (Parfitt et al., 2010)

3.3 Data collection and measurement in food waste research

Data collection on food waste is not a straightforward process, because data needs to be collected throughout the supply chain. As discussed by FAO (2013b), collecting food waste data is a challenge because there are no common measurement methods and companies are under no legal obligation to collect and report food waste rates. It is even harder to estimate consumers' food waste, since they do not routinely keep count of the amount and type of food they waste, and their own estimations might give a very misleading picture of the scope of their food waste. For example, HISPACOOP (2012) show that Spanish consumers estimated their household food waste to stand at 4%, however, the real number was 18%. Therefore, collecting data on consumers' food waste requires conducting waste audits along with mere interviews. FAO (2013b) mentions that waste audits can be carried out not only for individual households, but also for restaurants, canteens and other organizations. A challenge

of waste audits, as noted by Kelleher and Robins (2013), is that food decomposition and mingling can distort the ability to measure and evaluate the amount and type of food.

A comprehensive analysis of household food waste using waste audits and interviews was conducted by WRAP (2008). More than 2000 householders were interviewed and four weeks later their household waste in sacks or other containers was collected from them. All discarded food items were picked out from the containers, weighted and categorized. Later the cost of each type of food waste was quantified in order to calculate the approximate value of food wasted. In Finland, a similar study was conducted by Silvennoinen et al. (2014): 380 households were surveyed and their food waste during 2 weeks' time was weighed and documented.

There are several options of quantifying food waste, such as by weight, by cost and by calories. Measuring food waste by its total weight is the easiest option, and it can be well suited for quantifying the total amount of waste for a relatively homogenous product. However, as pointed out by Koester (2014), aggregating weights of such different products as beef and vegetables can be very misleading because beef contains many more calories than vegetables and also significantly more resources were used to produce a kilogram of beef than a kilogram of vegetables.

Additionally, Koester (2014) discusses that stage of the supply chain also needs to be taken into account when quantifying food waste. This is because a product on a store shelf includes the value of services such as transportation and handling, and also it is often the case that the raw product has been reduced in storage and manufacturing (Koester, 2014). All of these reasons prove that it does not make sense to aggregate mere weights of products wasted, as the figures would not be very informative.

Both calories and cost are more complicated measures of quantifying food waste than weight, since they require background information rather than simply weighing the mass of products wasted. Products cost can be seen as a better measure than calories since product cost also reflects the stage of the supply chain that the product is wasted at. However, measuring by cost assumes that we know at least the approximate cost of a product's share of services that it has accumulated through the supply chain, which might pose a challenge.

3.4 Reasons to reduce food waste

There are three viewpoints that can be adopted to justify the need to reduce food waste, as broadly described by Bagherzadeh (2014):

1. Food security and ethics
2. Natural resources
3. Optimization of costs

From the food security perspective, reducing food waste can be seen as part of a larger effort of providing the undernourished people of the world with sufficient food. Although reducing food waste in higher income countries will not directly make this food available for the undernourished elsewhere, it frees up water, land and biological resources to produce more food. Moreover, food that would otherwise be wasted could be redistributed to communities that are in need of it in developing and developed countries alike. (Bagderzadeh et al., 2014)

There is also a larger ethical perspective on food waste that is based on humanity's history of famine and poverty. Throughout the history food was cherished and most people could not afford to waste any food. In fact, only in 20th century many countries in the world have achieved relative food security. As a result, middle- to high-income classes around the world have developed wasteful eating habits and food's image as mainly a means of subsistence has diminished, as it became one of the aspects of a broader consumption culture. The problem is currently on its rise as middle class populations around the world are growing and an increasing number of people can afford to waste food.

Several reasons for the shift in culture were suggested by Parfitt et al. (2010): *"...consumers' low price of food relative to disposable income, consumers' high expectations of food cosmetic standards and the increasing disconnection between consumers and how food is produced.*" The third reason's magnitude was predicted to rise in the future because of world's ongoing urbanization can only be expected to rise. (Parfitt et al., 2010)

Another relevant viewpoint is that food production is taking a huge strain on the planet's natural resources by using land and water and is also producing significant harmful emissions. FAO (2013a) estimated that if food waste was a country, it would be the third country in the world by global carbon footprint after the U.S. and China.

Finally, food waste is a matter of inefficiency that could be optimized to a large extent. Manufacturers, retailers, consumers and governments would be better off if the resources that are currently being wasted could be put into use. However, one could argue that retailers might not be willing to cut consumers' food waste as that could result in diminished revenues. While the argument might be valid, nevertheless this paper would show that most retailers around the world are committing to efforts that contribute to cutting food waste also on the consumer's level.

Koester (2014) takes a critical stance on the supposed expediency of reducing food waste. He discusses that cutting food waste might not always be resource efficient. For example, investments into better storage capacities or improved transport might have not been made because investors did not consider them to be profitable. Similarly, to cut food waste retailers could replenish their fresh food supplies several times a day and customers could shop daily, however, it would require them to use additional resources, which might not cover the resulting benefits. (Koester, 2014)

Koester's (2014) argument is bringing a valuable angle to the discussion. Although cutting food waste is surely an important and noble cause, it is also true that there is a point at which efforts to reduce it might be no longer resource-efficient.

Parfitt et al. (2010) argues that another reason why food waste is becoming an increasingly relevant problem is the dietary transition from starchy staples (such as grains, potatoes etc.) to more perishable types of food and high-calorie food that uses a lot of natural resources (i.e. meat). Bennett's (1941) law claims that the proportion of starchy staples in people's diet decreases with the increase in income. As incomes are constantly increasing in developing countries, people's diets are becoming more diverse and reliant on fresh and high-calorie food (Parfitt et al., 2010). Therefore, there is a global need to develop better food supply chains where less food will go to waste in order to optimize the use of natural resources and ensure nutritional security for the planet's population.

3.5 Food recovery

Food recovery is an essential practice for all players in the food supply chain. It can be positioned within the concept of reverse logistics described by Rushton (2014) and Harrison and Hoek (2008) as it constitutes a move of goods or materials back up the supply chain. A food recovery hierarchy presented in Figure 2 has been proposed by the US EPA (Environmental Protection Agency). The hierarchy shows the preferred order of recovering

food waste. The options range from source reduction (most preferred) to landfill/incineration (least preferred). FAO (2013b) discusses that other options higher in the hierarchy should be explored before landfilling/incineration because when landfilled and incinerated, natural resources used to produce the waste are completely wasted and also discards decomposition produces carbon dioxide and methane that are known to be harmful for the environment.

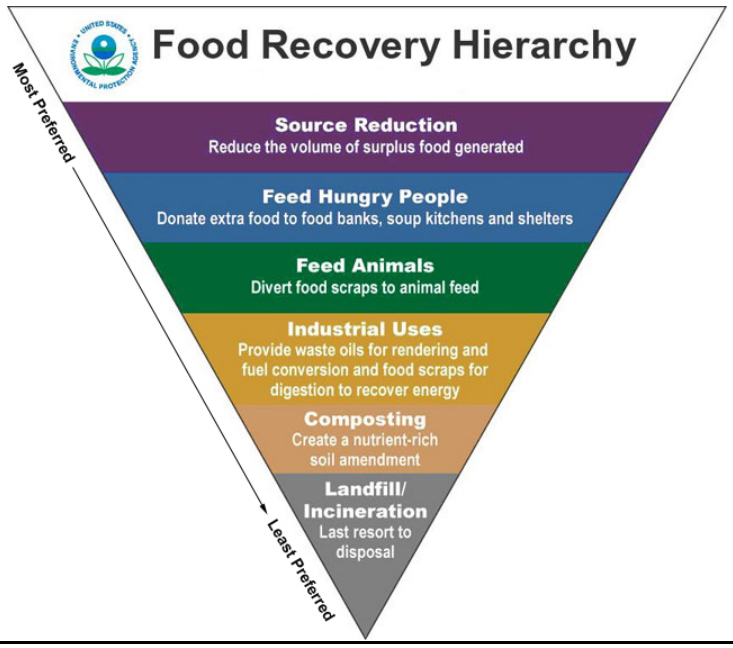


Figure 2. US EPA food waste recovery hierarchy

HLPE (2014) discusses that the hierarchy is important to policymakers in order to give them clear directions on the preferred order of resorting to the competing food recovery options. In fact, there are numerous other hierarchies mentioned by HLPE (2014) and FAO (2013b), however, all hierarchies follow more or less the same pattern regarding the order of options for food recovery.

BSR (2014) studied the US manufacturing, retail and restaurant sectors in order to identify what methods of food waste recovery are most widespread. It was established that in the manufacturing sector, 93% of food is recycled with most of it going to animal feed; in retail sector, 13% is donated to charities, 30% is recycled and the rest (58%) was discarded. In the restaurant sector, only 16% was either donated or recycled with the rest going to waste. (BSR, 2014)

BSR (2014) also studied reasons that prevent food supply chain players from donating and recycling food. The most common barriers to food donation were transportation constraints, liability concerns, regulatory constraints and insufficient refrigeration and storage

in food banks. When it comes to recycling, insufficient recycling options and transportation constraints were predominant reasons for food ending up at lower levels of the food recovery hierarchy. (BSR, 2014)

The results of BSR's study are consistent with Koester's (2014) observations that reducing food waste or increasing valorization would require many more resources that might simply not be available. As shown by BSR (2014), resource constraints are relevant not only for potential food donators, but also for charities and food banks themselves.

As can be noticed from the Food Recovery Hierarchy (Figure 2), donating food to the people in need is the best option after reducing waste at source. However, as outlined by FAO (2013b), it is not a riskless venture: first of all, retailers fear the rise of black market for the products, which might damage their reputation and lead to reduced sales. Secondly, it is mentioned that donors are afraid of being held legally liable in case of a damage caused by donated food. FAO (2013b) mentioned that in order to break the liability barrier, many countries such as US, Canada, Australia and Italy have issued regulations that alleviate donors' liability.

Stuart (2009) discussed that valorization options might pose an economically attractive alternative to landfilling: instead of paying for food waste to be landfilled, an organization can sell the discards to animal feed producers. However, as pointed out by FAO (2013b), catering waste was banned from the production of animal feed after an outbreak of Bovine Spongiform Encephalopathy disease in Europe in 2001. The paper mentions that heat treatment of catering waste could be adopted in order to return to the practice, as it kills all potentially harmful organisms and opens up wide opportunities for valorization.

There are numerous options for recycling food waste such as biofuels and composting. According to the Food Recovery Hierarchy (Figure 2), industrial uses that recover energy are more preferred than composting. Another option mentioned by FAO (2013b) is anaerobic digestion, which produces digestate, which can be used for fertilizing soil, and biogas suitable for producing vehicle fuel, electricity and heat. However, the paper mentioned that this is quite an expensive method that is nevertheless becoming increasingly widespread.

As found by BSR (2014), manufacturers, retailers and restaurants feel like there are insufficient recycling options available and this prevents them from recycling their food waste. Therefore, there is a clear demand for recycling opportunities to become more diverse and affordable.

3.6 Government regulation of food waste

Government regulations of food waste differ significantly between countries. Some regulations help decrease food waste, while others only add to it while promoting other causes. As indicated by Bagherzadeh (2014), food regulations are usually centered around food safety and population's health rather than decreasing food waste. FAO (2013b) has discussed that while soft measures such as recommendations and guidelines are important, it cannot be denied that all players in the food supply chain would more actively react to economic incentives. Bagherzadeh (2014) additionally described that most regulations and education campaigns on food waste exist in developed countries: EU, US, South Korea and Japan.

HLPE (2014) divided regulations affecting food waste into four groups:

1. Food safety schemes
2. Agricultural investment policies and infrastructure developments
3. Animal feed regulations
4. Waste disposal policies

Food safety schemes require control at the manufacturer's level, process control, proper hygiene at all levels of the supply chain, as well as an approach to prevent the spread of diseases through food. It was also pointed out that due to the rise of international trade, national food safety authorities need to cooperate closely to ensure coordination of policies and documentation in order to prevent food waste. (HLPE, 2014)

Food labeling can be seen as part of food safety schemes, and since consumers are commonly confused over food labeling, FAO (2013b) has discussed that governments need to alter the regulations in order to to bring clarity into food labels.

Governments need to ensure steady development of food supply chains. An increase in production needs to be accompanied by developments of processing industries, transportation, storage, export and retail to ensure that the produce reaches its consumer. (HLPE, 2014)

Additionally, as has been mentioned in the previous sections, most food waste in developing countries is generated due to the lack of good infrastructure, and thus government can encourage investors to participate in developing the infrastructure by providing them with additional subsidies.

Animal feed regulations could lead to increased food waste by preventing potential waste from ending up in valorization and conversion. For example, EU prohibits generating animal feed from scrap food that contacted with animal by-products. Also, EU bans using processed animal protein to feed most animals. (HLPE, 2014)

Waste disposal policies affect the availability of separate containers for organic waste, which allows scrap food to be valorized rather than go to landfill. Moreover, some countries impose different pricing options for different types of waste, and others have even banned food waste from ending up in landfills (HLPE, 2014). South Korea has been very proactive in waste disposal policies: in 2005 food waste was banned from landfills and in 2010 it introduced a volume-based tariff for food waste (Innovation Seeds, 2012).

There are also regulations in place regarding cosmetic standards of fruit and vegetables. In the EU the European Commission (EC) regulation 1221/2008 describes in detail the acceptable appearances of agricultural products on sale, and the EC regulation 543/2011 attempts to relax cosmetic standards and partly replace them with hygiene and safety standards. FUSIONS (2015) note that supermarkets often implement higher cosmetic standards than the ones prescribed by regulators, and so regulation 543/2011 also suggests that supermarkets review the strict aesthetic standards imposed over fruit and vegetables.

France has gone further in its determination to cut food waste and introduced a law that bans supermarkets larger than 400 m^2 from discarding or destroying unsold food. The law was introduced in May 2015 and supermarkets were given time until July 2016 to make agreements with charities and food banks for donating unsold food. However, French Constitutional Council has rejected the initial version of the law because of a technicality and so it will have to be amended. It is also interesting to note that the law was initiated by citizens' online petition that collected enough votes to be elevated to the national assembly, and its initiator has aimed for it to be passed up to the European Commission. However, charities have expressed concern that they might not be able to manage increased amounts of donations and will have to use more resources in order to distribute received food. Supermarkets have also protested against the law and pointed out that their food waste represents only 5-10% percent of the total. (Schofield, BBC, 2015)

Another controversial law was recently introduced in Seattle, Washington in order to ensure that food waste is being properly separated from mixed waste. It required garbage collectors to go through residential mixed waste and look for food discards. Residents whose

trash was made up of more than 10% food waste and paper received a red sticker on their bin, but from 2016 their garbage bills would be increased by $1 and they could also face fines. However, local residents heavily criticized the new policy and several of them have even filed a lawsuit against this policy as they claimed it violated their constitutional right for privacy. (Richardson, 2015)

Legislators' active involvement in cutting food waste and promoting valorization in the recent years can only be welcomed with approval and shows that the topic is very relevant nowadays. However, the controversial nature of some of the policies proposed and implemented so far proves that cutting food waste is also a very sensitive topic and thus policymakers need to take into account numerous other factors such as citizens' privacy and possible further costs emerging from following the regulations.

3.6.1 Regulations in Finland

In Finland, there are several laws and acts that affect the generation of food waste and its treatment. Food Act (Elintarvikelaki 2006/23) is in line with general EU regulations and describes food safety requirements, labeling of foodstuffs, responsibilities of food producers and authorities control of the industry. Animal Feed Act (Rehulaki 2014/502) determines the quality requirements for animal feed, labeling requirements and measures of authorities control of animal feed. Waste Act (Jätelaki 2011/646, 8§) dictates the order of dealing with waste starting from source reduction to alternative use, recycling, energy and only then disposal. The order described broadly follows the US EPA Food Recovery Hierarchy presented in Figure 2.

Finnish Food Safery Authority (Evira) orders in its Food Donation Regulation (2013, 16035/1) that the main principle of organizing food donations is food safety, and both food donors such as producers, retailers and restaurants as well as recipients, i.e. food banks and charities are responsible for food safety and following the regulations. Food waste concerns are taken into account in the regulations, and it is also possible to donate food after the expiration date has passed, however the donor is responsible for ensuring that the product does not cause any harm to the consumer. (Evira, 2013)

When it comes to the standards imposed on fruit and vegetables, the European Commission issues regulations that immediately become imposed as laws in all member states. For example, the previously mentioned EC's regulation 543/2011 describing detailed standards for fruit and vegetables also applies in Finland as Finland is an EU member state.

3.7 Campaigns and initiatives against food waste

Governments, NGOs and retailers have recently initiated numerous campaigns that aim at raising awareness about the problem among consumers and helping them effectively cut their food waste.

One of the most renowned programmes is a UK based "Love Food Hate Waste" initiated in 2007 by charity WRAP. It aims at holistically educating consumers about economical and environmental effects of food waste and provides tips on how to cut it. The programme's website offers tools for meal planning, portion calculators, recipes that use leftover foods, and also information about proper food storage, freezing and a guide to understanding food labels. The campaign is active in mass media, social media, it hosts and participates in various events and is also present with tents near stores to raise awareness while shopping. It also partnered with local authorities, businesses and organizations to strengthen its presence. The programme was later also expanded to Canada and Australia.

WRAP has estimated that for the 6 months during 2012-2013 that the campaign was actively run in West London, households' avoidable food waste has decreased by 14%. It has also estimated that for every £1 spent for the campaign, £8 worth of food was saved from being wasted.

Another programme initiated in 2012 by UNEP (United Nations Environment Programme), FAO (Food and Agriculture Organization of the UN) and Messe Düsseldorf (trade fair organization) is Think.Eat.Save. The objectives of the programme are the same as those of "Love Food Hate Waste" and their website offers quite similar information. Additionally, "Think.Eat.Save" organized a student competition that aimed at collecting students' creative ideas on cutting food waste. Unfortunately there was no publicly available information regarding the results of the campaign, and its website was not updated since 2014 so one could make a conclusion that it is no longer active.

There are also numerous other organizations and programmes that aim at educating and empowering people about food waste issues, such as US based EndFoodWaste.org, FeedBack that runs various campaigns and local initiatives such as "Stop Wasting Food movement Denmark". Most of the campaigns are quite similar in their actions; however there are also more interesting and creative initiatives such as UglyFruitAndVeg social media pages that post pictures of fruit and vegetables that would be regarded substandard and wasted because of cosmetic expectations. The page also encourages supporting a petition to

Walmart and Wholefoods in order to convince them to sell cosmetically imperfect fruit and vegetables.

3.7.1 Campaigns and initiatives in Finland

In Finland, one of the largest annually organized campaigns against food waste has been Hävikkiviikko (Waste Week). In 2015, it partnered over 100 organizations including all Finnish retailers, various catering companies, food producers and municipalities. During the week, the campaign's partners were supposed to actively promote the issue of food waste through their media channels in order to raise awareness of the topic and encourage consumers to rethink their habits. Moreover, the campaign featured numerous smaller events such as "It is edible!" (Saa syödä!) with the energy efficiency company Motiva preparing 3000 free vegetarian meals made of the food that was left unsold in stores.

There are also several recently established Finnish companies such as Froodly and ResQ that are facilitating a decrease in food waste. Froodly offers a mobile application where people could take pictures of items in stores that have been discounted based on their expiration date, so that other users of the application could easily find and purchase such items. This way the items nearing their expiration dates have a better chance of being purchased. ResQ features an application that allows its partner restaurants to offer unsold foods, especially from buffets, at discounted prices, and customers can browse the offers on a map and purchase the meals. This way, a large proportion of restaurant food waste could be prevented.

3.8 Food waste in Finland

Most of the research describing food waste in Finland was conducted by the same group of researchers including Juha-Matti Katajajuuri and Kirsi Silvennoinen from Natural Resources Institute Finland (formerly MTT). They studied the volume and composition of food waste in Finland, food waste in Finnish households as well as in Finnish catering service sector.

Silvennoinen et al. (2014) studied the volume and types of avoidable food waste in Finnish households by requesting 380 of them to weigh their solid and liquid avoidable waste during a two-week period. The results showed that on an annual level, the average volume of food waste in Finland is 23 kg per capita, 63 kg per household, and 120 million kg in total for the whole population. The average proportion of waste in the food purchased was 4-5%, which is less than the estimated 10,6% suggested by HLPE (2014) in Figure 3. The most

wasted foods were vegetables, milk products and home-cooked meals. The main reasons for waste were food spoilage, leftovers or preparation of too much food. People living alone produced the most waste on average. (Silvennoinen et al., 2014)

Silvennoinen et al. (2012) measured the food service sector waste by requesting employees in 72 restaurants to keep diaries of how much food was wasted during a week's time. Also, interviews were conducted with representatives of retail chains in order to estimate the waste in retail service. In the food catering sector, around 75-85 million kg of food was found to be wasted annually. The highest relative food waste was discovered in hospitals and elderly centers while fast food restaurants generated the least relative amount of food waste. Also, buffet restaurants were found to produce more waste than a-la-carte restaurants. In retail, the estimated amount of food waste is 65-75 million kg annually or 12-14 kg per capita. (Silvennoinen et al., 2012)

Katajajuuri et al. (2014) combined the previous studies on food waste in Finland and estimated that a total of 335-460 million kg is wasted annually. Out of that, 16-25% arise from the catering sector, 14-22% from the retail sector, 16-40% from the food production industry and 28-38% from households. As estimated amount of food wasted in the whole supply chain in Finland is 62-86 kg per capita annually. Silvennoinen et al. (2012) compared the results with FAO (2011) and European Commission's estimations of 300 kg and 180 kg accordingly per capita per year and discovered that the Finnish estimates are much lower in all industry sectors. However, the researchers admitted that more detailed studies need to be obtained to draw more reliable conclusions about the volumes.

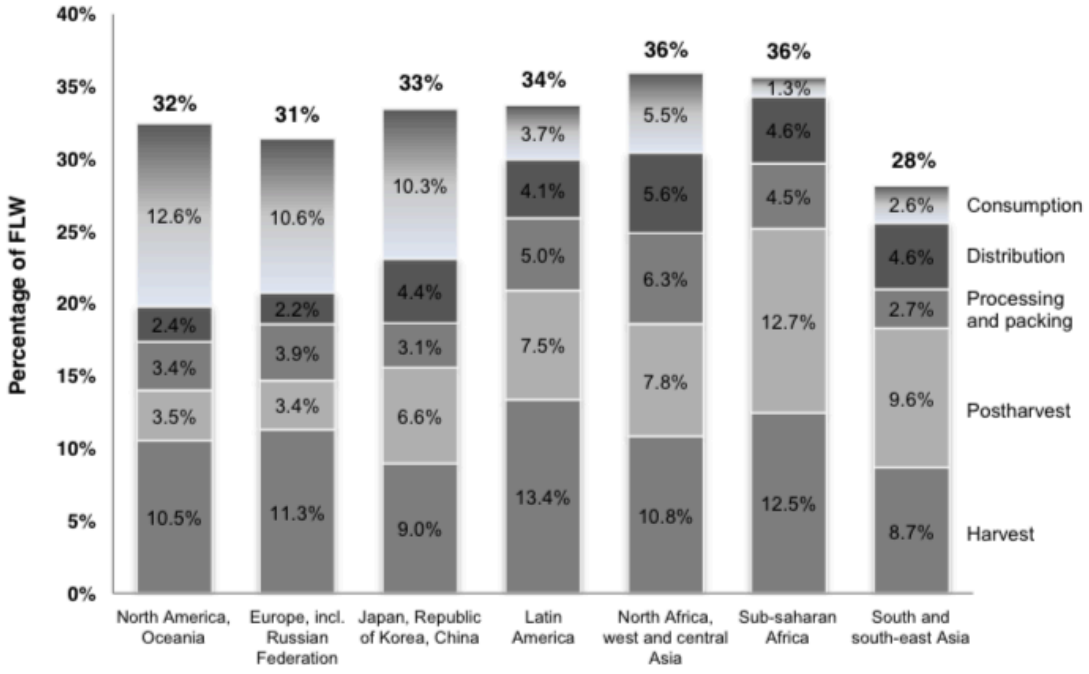
Nevertheless, the identified volumes are about 3-4 times lower than those from similar studies in other developed countries, which suggests that the food waste proportions might indeed be lower in Finland than in other developed countries. Several reasons for this could be Finns' respect towards nature and its produces, an egalitarian society where irresponsible consumption behavior might be less acceptable than in other countries as well as high level of awareness about environmental issues and sustainability concepts.

4 Causes of and solutions to food waste

This chapter is going to discuss the supply chain view on the causes and solutions to food waste. First, food waste taking place at different stages of the supply chain will be discussed and compared across regions. Then, root causes of food waste at each of the stages will be elaborated from literature and analyzed. Finally, retailer-driven solutions to the identified causes will be sought for so that they can later be formed into concrete retailer's practices and used to construct the evaluation model.

4.1 Causes of food waste at different stages of supply chain

Food waste is an issue that takes place at all stages of the food chain. Figure 3 represents estimated differences between regions in the proportion of the initial production wasted at each of the stages. Distribution level is related to waste in retail and other markets. It is interesting to note that while the total estimated proportion of food waste is not very different between regions (estimated only 8 percentage points), there are significant differences between regions in the stages at which most of the production is being wasted.



The bars represent the percentages lost or wasted at each step of the chain, expressed in percentage of the initial production (edible part originally intended for human consumption, see Figure. 1). Source: elaborated from Gustavsson et al. *(FAO, 2011a).*

Figure 3. Distribution of food waste in different regions at different stages of the food chain

(HLPE (2014) elaborated from FAO (2011))

Europe, North America as well as South Korea, Japan and China demonstrate much higher consumption food waste rates than other regions, and this could be attributed to the higher income in most of these countries. Pre-consumption stages only account for 20-23% of total losses in these countries, which is much lower than in other regions due to better infrastructure than in the developing countries.

On the contrary, Latin America, North Africa, west and central Asia as well as Sub-Saharan Africa show 30-35% waste in pre-consumption due to poor infrastructure and possibly higher temperatures in these regions, and quite small waste in consumption as most countries in this group are quite low-income.

However, as pointed out by HLPE (2014), it is important to acknowledge that the results of FAO (2011) study presented in Figure 3 need to be addressed with caution as the percentages are estimated based on a number of sources and certain data gaps were replaced with assumptions. Nevertheless, although waste percentages might be inaccurate, the big picture makes sense and supports previous studies such as Parfitt et al. (2010) in that developed countries' food waste takes place mostly on the consumer's level and developing world's food waste is largely an infrastructure problem.

In the following sections, levels of food waste and their root causes will be examined for the following levels from Figure 3 accordingly: Pre-retail that would include Harvest, Postharvest and Processing and Packing; Retail corresponding to Distribution and Post-retail that corresponds to Consumption.

4.1.1 Pre-retail

HLPE (2014) have broadly divided farmers' losses into pre-harvest and post-harvest. Pre-harvest factors that could lead to food loss have been classified into the following: careful choice of crop types, agronomic practices, as well as environmental and biological factors. All of these can significantly affect the quality of the produce and also cause part of it to be left unharvested due to quality reasons. Post-harvest losses are mostly due to incorrect harvesting schedule and damaging handling practices. It was additionally pointed out that in developing countries farmers' infrastructures are inappropriate and this results in spillage, shrink or other damage to the product that can lead to losses later in the supply chain. (HLPE, 2014)

FAO (2013b) have also used a similar division into pre-harvest and post-harvest losses, and have stressed the importance of farmers' education on agricultural, handling and storage best practices in order to reduce food waste and enable more efficient use of resources, especially in the developing countries.

Another significant issue that might lead to food waste is farmers' insufficient access to credit. Mittal (2007) found out that farmers in India focus on production and do not participate in either post-harvest activities or marketing, as those are carried out by traders and middlemen. Farmers usually have very limited access to financial resources and the yield from agricultural activities is really low, so they have little incentive and opportunity to invest in more efficient production means (Mittal, 2007). Koester (2014) supports this view and mentions that although investments into infrastructure could partly prevent food loss, farmers might be unwilling to make them due to insufficient increase in resulting profitability.

Another effect of farmers' lack of access to credit was pointed out by FAO (2011): sometimes farmers might be in a real need for cash and this might tempt them to harvest the produce before it is finally ripe, which leads to loss in weight and nutritional value, as well as possible waste of part of the produce due to it being unfit for consumption. It is suggested that in case there is a lack of access to credit, farmers could form cooperatives and together agree to provide certain quantities of produce in order to minimize creditors' risks and possibly receive prepayments from buyers. (FAO, 2011)

High cosmetic expectations of produce also significantly affect the food waste on the pre-retail stage. HLPE (2014) and FAO (2011) discussed the effect of cosmetic standards on food waste and claimed that part of the produce is left unharvested or diverted to animal feed already at the farmer's level. Koester (2014) argued that farmers might often be willing to accept food loss and use it as animal feed in order to provide retailers with good quality produce and thus establish a long-term supply relationship.

FAO (2011) discusses that farmers often produce more than needed in order to ensure that they do not fail to supply the promised amounts. Thus, the surplus can be sold to producers of animal feed for a very discounted price. Stuart (2009) suggests that this problem can be tackled by cooperation between farmers that allows them to trade surplus crops to help farmers who have experienced shortage of produce.

Stuart (2009) described a phenomenon called "*forecast order*": a retailer orders a certain amount of products to farmer or manufacturer to be delivered by a certain date. However, the order might not be confirmed until a later time when producer might have already grown or prepared part of the order. Finding another buyer might be troublesome, especially if products were ordered under a supermarket brand, thus a lot of food might be discarded. FAO (2013b) discuss that retailers are often in a position of power over suppliers, and suggest that regulations need to be imposed in order to protect suppliers from such occasions. FAO (2013b) also emphasize a general lack of communication and collaborative planning throughout the supply chain and call for an improved interaction that would allow every player to plan their operations more efficiently.

As pointed out by HLPE (2014), distribution is another part of the supply chain where there are significant differences between developed and developing countries. In developed countries, trucks with proper refrigeration are used and loading as well as unloading times are strictly controlled in order to minimize product spoilage, and waste mainly occurs when there is a technical malfunction or an accident. In developing countries, vehicles used for distribution are frequently lacking cooling systems and the process of unloading is not rigid or might be carried out roughly, which leads to delays and therefore spoiled products. Another source of waste are import customs checks, which lead to additional delays and in some cases even to the rejection and disposal of the whole shipment. (HLPE, 2014)

FAO (2013b) have mentioned that best results in terms of food waste as well as sustainability are achieved in shorter supply chains. This brings cost efficiency due to shorter distance covered by the product, minimizes food waste as there are fewer accidents and conditions breaches along the way and also satisfies consumers' demand for local and sustainable products. (FAO, 2013b)

Overall, the causes of food waste on the pre-retail stage are the presented in Table 2.

Table 2: Causes of food waste on the pre-retail stage.

Cause	Source
Improper pre-harvest and post-harvest agricultural practices	HLPE (2014), FAO (2013b)
Insufficient access to credit	Mittal (2007), Koester (2014), FAO (2011)
High cosmetic expectations of the produce	HLPE (2014), FAO (2011)
Uncertainty regarding harvest quantities	FAO (2011), Stuart

	(2009)
Unexpected retailers' demand for products	Stuart (2009), FAO (2013b)
Inadequate transportation conditions and times	HLPE (2014), FAO (2013b)

4.1.2 Retail

As can be seen in Figure 3, retail is a relatively small contributor to overall food waste across all regions; however, retailers are an important link between food producers and consumers and thus any improvements in retailers' operations could significantly affect the efficiency of the whole food supply chain.

Oliver Wyman (2014b) pointed out that one of the main drivers of food waste in retailer's supply chain is the mismatch between supply and demand. As most of the food waste, it primarily affects the waste of highly perishable products such as fruit and vegetables, as those can only be stored for a very limited time and will end up in waste if not sold within the short time frame. Therefore, the key to minimizing waste is excellent forecasting. This view is also supported within basic logistics concepts, and described by Simchi-Levi (2003).

As discussed by Parfitt et al. (2010), predicting demand is especially a challenge for small grocery stores, as their sales can vary a lot and therefore be hard to predict due to the fact that consumers mostly use them for making top-up purchases while doing their main shopping in larger and cheaper stores. Oliver Wyman (2014b) also discussed reverse dependence between sales volumes and the magnitude of fresh food waste. They claimed that given that the product selection stays constant, doubling sales volumes would lead to a 20 to 40% decrease in waste of fresh food. This could be partly attributable to a smaller volatility of demand in larger stores.

Oliver Wyman (2014a) additionally claimed that shrink, or food waste, should be managed together with freshness, as freshness greatly affects customer experiences and sales margins of the whole store. This is because if a store is having large shrink, then many products will be on shelf just before they need to be disposed of. OW offered a holistic and data-centered approach to minimizing shrink and improving freshness by collecting data per each product in each store throughout the supply chain. OW then suggested intense

management efforts to identify the root cause of shrink and addressing them. (Oliver Wyman, 2014a)

HLPE (2014) outline a common practice of retailers called the "*rule of one-third*": in the pursuit of freshness, retailers require suppliers to deliver products that have not reached one-third of their shelf life. HLPE (2014) discuss that while the practice is good from consumers' perspective, it may lead to waste of products by suppliers if they do not deliver them to retailers before one-third of their shelf life has passed.

This issue could be tackled by contracting certain amounts of products to be delivered to retailers on a regular basis and prompt communication regarding possible changes. By creating a stable and predictive model for production and distribution, suppliers will be better able to plan their production, deliver fresh products, and thus avoid waste. One issue discussed before by FAO (2011) in this respect is that suppliers might protect themselves from risks of undersupplying by producing more, however, this was suggested to be alleviated by cooperation between suppliers that allow them to trade surplus amounts.

Oliver Wyman (2014b) additionally pointed out that product selection plays a significant role in addressing food waste. They claim that expanding the selection by adding products that are duplicative with the existing ones is a sure way to increase waste due to prolonged inventory turnover. In order to cut waste, improve freshness and increase turnover, OW suggested identifying products that have close substitutes and removing the less popular ones out of the products range. (Oliver Wyman, 2014b)

Another cause of waste that is related to goods selection is the multitude of substitutable products "best before" dates according to Oliver Wyman (2014b). They claim that this is a sure way for products with shorter life to end up being wasted. However, one could argue that prolonged product life is often reached by adding preservatives which many consumers might consciously avoid, and therefore there could be a clear customer base that prefers products with shorter shelf life that contain no preservatives.

Oliver Wyman (2014b) have also stressed that stores should aim at helping customers purchase only the food that they will consume. This is an increasingly acute issue since as outlined by Parfitt et al. (2010), most countries in the world are seeing a rise in single-person households, where food waste per capita is highest. Oliver Wyman (2014b) mention that multi-pack promotions and large packages for perishable products are leading to increasing amounts of food being wasted. They suggest offering smaller package sizes as well as

limiting volume promotions for perishable products, and selling loose products along with or instead pre-packaged, so that customers could choose exactly the amounts that they would consume (Oliver Wyman, 2014b).

As shown in Figure 3, a much larger proportion of total food wasted is generated by consumers rather than by retailers in the developed world. Moreover, WRAP (2009) has established that 55% of household food waste in UK occurs because the food was not used in time. Thus, using the means suggested by Oliver Wyman (2014b), retailers could significantly help customers cut their food waste, as consumers would be able to better plan their grocery shopping and avoid buying food that would end up in waste.

HLPE (2014) discussed that in some cases displaying products in stores can also lead to waste. In case that a large amount of fruit or vegetables are displayed for the customers to choose from, it causes the following problems: products at the bottom of the pile get spoiled under the weight, mould and other contaminators may spread onto healthy produce and customers may damage the products during the choosing process (HLPE, 2014). Moreover, Oliver Wyman (2014b) have pointed out that in order to maintain full shelves, product inventory may be replenished in advance which may lead to customers choosing only the freshest products, and less fresh ones will eventually end up in waste. They suggest adopting rigid replenishment practices that ensure that products are placed on shelf only when the previous batch has been sufficiently sold out.

According to Stuart's (2009) estimations, in retail about 25-30% of fruit and vegetables are wasted solely based on not corresponding to cosmetic expectations. Moreover, HLPE (2014) and FAO (2011) have outlined that already on the farmer's level a part of produce is diverted to animal feed based on the irregular size or shape. Stuart (2009) pointed out that retailers might assume that consumers will not be willing to buy products that look irregular, however, it is suggested that retailers conduct customer surveys to identify what the consumers' real expectations are.

One good way to use produce that does not correspond to cosmetic standards is use it for preparation of ready-made foods (HLPE, 2014). However, one problem that is also outlined by HLPE (2014) is that freshly cut food is the most perishable and no conditions can effectively prolong its shelf life, thus its wastage rates are very high.

Overall, the causes of food waste on the retail stage are the presented in Table 3.

Table 3: Causes of food waste on the retailer stage.

Cause	Source
Mismatches between supply and demand	Oliver Wyman (2014b), Parfitt et al. (2010)
Lack of overall freshness	Oliver Wyman, (2014a), HLPE (2014), FAO (2011)
Unoptimized selection of goods on shelf	Oliver Wyman (2014b)
Inability to offer consumers the right amount of perishable products	Oliver Wyman (2014b)
Inefficient product displays	HLPE (2014), Oliver Wyman (2014b)
Lack of use for cosmetically substandard produce	Stuart (2009), HLPE (2014), FAO (2011)

4.1.3 Post-retail

As mentioned previously, consumer waste is an especially acute problem in the developed world due to the higher incomes and wasteful food culture. However, higher income and more urbanized populations in the developing countries are also adopting similar food habits, as indicated by HLPE (2014) and Liu (2014), who found out that waste per capita in large and wealthy Chinese cities such as Beijing is much higher than the country's average.

Parfitt (2010) collected demographic trends on food waste in developed countries from different studies and found out that smaller households waste more per capita than bigger households; young people showed higher food waste rates than older people, and household culture also affected food waste rates. Some studies showed that household income also affects food waste rates, however other studies found no difference. (Parfitt, 2010)

Restaurant/canteen food waste is also one part of post-retail waste. HLPE (2014) indicated that buffets for a set price result in more food waste than a-la-carte dishes. Silvennoinen (2012) conducted a research of restaurant food waste in Finland and found out that buffets have much higher waste rates than fast food restaurants (24% against 7%), with 17% of buffet waste being due to too much food prepared. FAO (2013b) have suggested that restaurants offer reasonably sized plates and portions and also provide diners with packaging for leftovers in order to reduce restaurant waste.

FAO (2013b) and Parfitt et al. (2010) described a growing disconnection between food production and consumption, which leads to consumers not valuing food. Moreover, the same two sources have also discussed that food nowadays constitutes a much lower share of

household budget than before, and this can lead consumers to assume that food waste does not have any significant consequences, although the environmental cost of it is very high.

WRAP (2009) has researched household waste in the UK and found out that about 95% of food was discarded for just two reasons: either the food was not used in time (55%) or too much food was prepared (40%). Another reason mentioned by HLPE (2014) is that consumers cook food using inefficient preparation methods that lead to more food being discarded, and they also lack knowledge of using leftovers for preparing other meals. Part of the problem could also be attributed to incorrect storage conditions at home, as added by HLPE (2014).

Williams et al. (2012) conducted a research on the role of packaging in total food waste and concluded that 20-25% of food waste is due to packaging reasons such as inability to extract the product completely from the package and package size not corresponding to household's needs. This might be an especially acute problem for single-person households since smaller packages for perishable products might not always be available. The magnitude of the problem is predicted to increase since as outlined by Parfitt et al. (2010), the number of single-person households is going to rise in the future.

Adequate packaging is key to ensuring product preservation throughout the supply chain. HLPE (2014) discussed that while efforts to reduce packaging are preventing packaging waste, they could have an adverse effect on general food waste because insufficient packaging shortens products' shelf life. Thus, it is important to find the right balance between reduced packaging and its preservation capabilities.

Although food labeling is an essential part of packaging, it was mentioned in numerous sources as a separate phenomenon (HLPE, 2014), Parfitt et al. (2010) and FAO (2013b). It was pointed out that consumers are often confused by labeling and its misinterpretation leads to completely edible food being discarded. There are regional variations of laws and regulations on food labeling, but for example in EU the Directive 2000/13/EC describes the "best before" date as the following:

"The date of minimum durability of a foodstuff shall be the date until which the foodstuff retains its specific properties when properly stored."

The "use by" date is prescribed to be used for the following foods:

" ...foodstuffs which, from the microbiological point of view, are highly perishable and are therefore likely after a short period to constitute an immediate danger to human health..."

The difference between the two is significant, however, as indicated by HLPE (2014), the multitude of food labels may mislead consumers and cause them to discard still perfectly edible products when their "best before" date has passed. Growth from Knowledge (2009) estimated that up to 20% of household food consumers' misunderstanding of food labels causes waste. Therefore, consumers need to receive education about the differences between dates in order to prevent additional food waste.

Overall, the causes of food waste on the post-retail (consumer) stage are the presented in Table 4.

Table 4: Causes of food waste on the post-retail (consumer) stage.

Cause	Source
Wasteful consumer culture and disconnection between food production and consumption	FAO (2013b), Parfitt et al. (2010)
Poor management of purchased groceries	WRAP (2009), HLPE (2014)
Inadequate packaging forms and sizes	Williams et al. (2012), HLPE (2014)
Misunderstanding of food labeling	(HLPE, 2014), Parfitt et al. (2010), FAO (2013b)

4.2 Retailers' practices aimed at reducing food waste

There are numerous practices that retailers could adopt along their supply chains and in stores in order to manage and reduce food waste. This chapter aims to discuss the practices that could help overcome the causes of food waste identified in Section 4.1 and strengthens the arguments with wider focused research such as category management, demand forecasting, inventory management and other related fields. Also, while waste from grocery retailers constitutes a rather small part of the total food wasted, roughly 13-16% as estimated by FAO (2011), waste generated by farmers and consumers is much higher. However, retailers are the most operations-intensive and organized players of the food supply chain, and moreover large retailer chains exercise significant market power in many parts of the world, therefore it is essential that retailers collaborate with other players and help them reduce their food waste.

While the previous section that discusses causes of food waste uses the Pre-retail, Retail and Post-retail structure, this chapter is going to adopt a different approach. This is due to the fact that this thesis looks at the issue of food waste from the retailer's viewpoint, and the practices that retailers could adopt can be better structured into Pre-store, In-store and Consumer groups. This division has also been adopted keeping in mind that an evaluation framework is going to be constructed on its basis in the next chapter, and such a division is more sensible from the framework's point of view.

4.2.1 Pre-store and In-store

As discussed in Section 4.1.1 of this thesis, the main manageable challenges that affect pre-retail food waste are the following:

- Improper pre-harvest and post-harvest agricultural practices
- Insufficient access to credit
- High cosmetic expectations of the produce
- Uncertainty regarding harvest quantities
- Unexpected retailers' demand for products
- Inadequate transportation conditions and times

On the retail level, the causes were identified in Section 4.1.2 and are the following:

- Mismatches between supply and demand
- Lack of overall freshness
- Unoptimized selection of goods on shelf
- Inability to offer consumers the right amount of perishable products
- Inefficient product displays
- Lack of use for cosmetically substandard produce

Retailers can address the root causes of food waste by resorting to the practices presented in this section.

Improper pre-harvest and post-harvest agricultural practices can be minimized through providing farmers with better education on proper agricultural methods. This is mostly a problem in developing countries where farmers are poor and lack also general education. Since farmers' education on agricultural practices directly affects the quality of produce, it is in retailer's interests to promote their education and facilitate its improvement (FAO, 2013b). Retailers could partner with cooperatives in order to raise awareness about agricultural issues.

Oliver Wyman (2014b) also discusses that it frequently happens that whole batches of products are rejected due to process failures. They suggest that standards are transparently communicated throughout the value chain in order to ensure consistent quality.

As previously mentioned, part of the produce is diverted to animal feed already at the farmer's level because of not corresponding to cosmetic standards (HLPE, 2014). However, retailers could change the practice by agreeing to purchase this produce, possibly at a slightly discounted price. The irregularly shaped or sized fruit and vegetables could then be used to prepare in-store ready-made food, or sold to customers at a reduced price (FAO, 2013b). Retailers could also launch campaigns for customers that raise awareness about such produce and the fact that it is not significantly different from regular one.

Uncertainty about the amount of produce that retailers will purchase can negatively affect farmers and cause them to keep significant safety stock that would in many cases go to waste (FAO, 2011). According to Oliver Wyman (2014b), another cause for food supply chain disruption is store promotions that result in inventory overages, and also cannibalize on the sale of other products. The issue becomes even more significant due to the presence of bullwhip effect, which is defined by Lee et al. (1997) as "*increasing variability of orders up the supply chain*", which leads to increased amounts of slack inventory and therefore waste at the levels of the supply chain that are farthest from consumers.

FAO (2013b) and Oliver Wyman (2014b) suggest collaborating with suppliers on demand planning in order to allow farmers and manufacturers to plan their production amounts more efficiently. Also, although it might be tempting for retailers to exercise their market power over suppliers as described by Stuart (2009), a more sustainable way would be to cooperate and practice responsible ordering and purchasing.

The benefits of buyer-supplier collaboration have been emphasized by Fearne et al. (2006), who studied the effect of Sainsbury's collaboration with its soft fruit suppliers and found reduced waste and improved service levels after trusted suppliers were provided with access to the retailer's demand management systems.

Another concept that goes further than collaborative demand planning is Collaborative Planning, Forecasting and Replenishment (CPFR). According to Bozarth (2011), "*CPFR is a business practice that combines the intelligence of multiple trading partners in the planning and fulfillment of customer demand*". It is executed through an electronic system where buyer and supplier share information about inventories, shipments, orders etc. as well as

undertake in joint demand forecasting. Xiao (2009) modified the CPFR model for procurement of agricultural products and studied the effects of its implementation. The study established that the use of CPFR resulted in reduced inventory losses and improved service levels (Xiao, 2009).

Investing in transport and storage infrastructure is a certain way to minimize spoilage and thus food waste during logistics phases of the supply chain (HLPE, 2014). However, as suggested by FAO (2013b), an even more sustainable way for retailers to ensure reduced food waste are shorter supply chains, which mean that increased amounts of products of local origin are offered at stores and thus delivery distances can be minimized. Moreover, this brings significant benefits in terms of retailer image as it satisfies consumers' demand for locally produced food (FAO, 2013b).

Short supply chains sustainability through localized production has nevertheless been challenged by some researchers. Sundkvist et al. (2001) compared bread production facilities on the Swedish island of Gotland with those in mainland Sweden, and found that Gotland bakeries required more energy input per kg of bread due to less advanced technology. One important takeaway from this study is that it is not always sustainable to localize production, and numerous factors need to be taken into account before claiming localization's environmental sustainability.

As outlined by Oliver Wyman (2014a), freshness is a key concept in reducing waste and improving customer satisfaction. Freshness can only be attained by establishing and maintaining a well coordinated and responsive supply chain.

Part of the challenges that retailers face in attempts to improve freshness and reduce food waste is due to limited lifetime of perishable inventory. Mahmoodi et al. (2015) mention that most inventory models have the underlying assumption of infinite inventory lifetime, and therefore separate models and assumptions need to be applied to managing perishable inventory. Ferguson and Ketzenberg (2006) researched perishable products inventory usage policies and determined that FIFO (first in, first out) is a more suitable inventory policy for perishable products that LIFO (last in, first out) and SIRO (serve in random order).

Accurate demand forecasting is in the center of efficient retailing business management, and one of its benefits is reduced waste. This view is supported by numerous papers such as Chen and Ou (2011), Aye et al. (2015) and Chen et al. (2010). By improving

forecasting accuracy, retailers are able to order the right amounts of products, minimize storage costs, and ensure that stores' supply meets customer demand. This is especially important with perishable products such as fresh fruit and vegetables, dairy and meat, as their shelf life is limited and it is essential to sell or donate them within a specific time frame so that they do not end up being wasted.

One approach to resource efficiency and waste reduction that includes supplier collaboration and assortment optimization is Efficient Consumer Response (ECR). Finne and Sivonen (2008, p. 112) define it as "*a strategy for the grocery retail industry, involving close collaboration between retailers and suppliers in order to add value to the consumer*". Finne and Sivonen (2008, p. 165) discuss that a Finnish study has shown that assortment management has proven to be the most beneficial part of ECR. Another concept that according to Dussart (1998) is often used interchangeably with ECR is Category Management (CM). Dussart (1998), however, mentions that a more accurate positioning of CM is within ECR, and CM is a concept that is more specifically linked to the retailing stage. One of the definitions of category management is suggested by Kotzab and Bjerre (2005, p. 182) as the following: "*a business philosophy recognizing the category as an asset that must be developed strategically to satisfy changes in consumer needs and simultaneously assure the retailer's sales and profit targets"*. Dussart (1998) discusses that the concept emerged from the inefficiency of brand management, where every brand was managed individually and therefore each brand's profitability was sought for instead of total category profitability. Dussart (1998) also outlines that CM is frequently resorted to in an effort to cut waste and prevent inventory loss, and that optimization of product selection, including item reduction, is one of the core processes of category management.

Product displays optimization is addressed by the space management approach. Finne and Sivonen (2008, p. 173) define that space management aims to optimize the use of retail selling space. They discuss that the core planning method of the concept is drawing planograms that represent the allocation of shelf space with the correct dimensions of products.

Data collection and analysis of food waste related data is not necessarily a routine and straightforward process. FAO (2013b) mention that retailers are under no legal obligation to collect and report their food waste figures. Thus, separate initiatives and efforts are required in order to shed light on the issue, identify the key improvements areas and act on them.

Overall, the possible retailer's practices aimed at reducing food waste at the pre-store and in-store stages are presented in Table 5:

Table 5: Practices that retailers can undertake on the pre-store and in-store stage

Practice	Source
Participation in farmers' education	FAO (2013b)
Usage of cosmetically substandard produce	FAO (2013b)
Collaboration with suppliers on demand planning	FAO (2013b), Oliver Wyman (2014b), Stuart (2009), Fearne et al. (2006), Bozarth (2011), Xiao (2009)
Development of shorter supply chains	FAO (2013b)
Efforts to increase overall freshness and rigid shelf replenishment procedures	Oliver Wyman (2014a) Mahmoodi et al. (2015) Ferguson & Ketzenberg (2006)
Improvements of demand forecasting	Chen & Ou (2011), Aye et al. (2015), Chen et al. (2010)
Optimization of product selection	Finne & Sivonen (2008), Dussart (1998), Kotzab & Bjerre (2005)
Increased offering of loose products	Oliver Wyman (2014b)
Limitations of volume promotions for perishables	
Optimizing product displays	Finne & Sivonen (2008)
Improvements of food waste reporting and analysis	FAO (2013b)

4.2.2 Consumers

The four main causes of consumer food waste that were mentioned in Section 4.1.3 are the following:

- Wasteful consumer culture and disconnection between food production and consumption
- Poor management of household groceries
- Inadequate packaging forms and sizes
- Misunderstanding of food labeling

All except packaging causes are mostly awareness issues, and since retailers are consumers' main commercial touch point with regard to food, along with the catering sector, it is in retailers' power to influence consumers and convey the message that food waste is a serious problem that needs to be faced and taken action against.

FAO (2013b) suggests running campaigns that raise awareness among consumers that food waste is not an easy and cheap phenomenon, and describing concrete actions that consumers need to take in order to reduce their food waste. Campaigns such as Love Food Hate Waste and Think.Eat.Save have raised awareness about the magnitude of the problem by providing large amounts of information, creating visibility about the issue in educational institutions, in stores and by hosting different kinds of events. The same campaigns were also giving concrete advice to people about cutting their food waste by providing them with storage and freezing tips, meal plans and leftover recipes, as well as guides to understand food labeling. Additionally, retailers could distribute information clarifying differences between food labels inside their stores in the form of posters or brochures, along with information stands and competitions where food waste is the central topic.

Packaging-related causes are mostly connected with the selection of goods discussed in Section 4.1.3. As Oliver Wyman (2014b) have mentioned, retailers could help consumers waste less if consumers could purchase exactly the needed amount of food, which could be achieved by selling loose products, limiting bulk promotions and introducing smaller packages.

5 Evaluation framework of retailer's efforts in reducing food waste

In this section, a holistic framework of concrete practices that retailers could adopt in order to reduce the whole food supply chain's waste will be constructed. The required practices will be identified using the causes of food waste on different stages from Section 4.1 and based on suggested practices retailers could undertake that were discussed in Section 4.2. The practices in the Reuse stage have been identified based on the Food Recovery Hierarchy presented in Figure 2.

Out of the practices discussed, only the ones that could significantly be affected by retailers and can also be shaped into a concrete retailer's practice were included into the framework. Another criterion for choosing the practices was their suitability for evaluation. If there was not enough information available in order to evaluate how a practice is implemented, such a practice was not included in the model. The reason for this was that the results would not be conclusive and if such practices were included and evaluated.

Moreover, the framework has been created for the purpose of evaluating Finnish retailers, and therefore some of the practices mentioned in the previous literature such as "*Participation in farmers' education*" (FAO, 2013b) have been excluded from the framework. This is because, as shown in Figure 3, there are significant differences between stages of the supply chain that the waste occurs at, and therefore there are discrepancies in the practices that are required to reduce food waste. For example, refrigerated supply chains and a rather high education level of farmers can be taken for granted in Finland, while in the developing countries it is natural that most of the people cannot afford wasting food due to poverty. Thus, it makes sense that Finnish retailers should focus more on consumer education while retailers in the developing countries could put more effort into educating farmers and other suppliers.

The framework is presented in Table 6. In order to make the model more structured and understandable, the practices have been broadly grouped according to the stage of the supply chain that each practice is related to. The stages have been ordered in accordance with the flow of food supply chain. While all stages excluding 3. Reuse are mostly related to the "*Source Reduction*" level of the Food Recovery Hierarchy (Figure 2), the third stage pertains to "*Feed Hungry People*", "*Feed Animals*", "*Industrial Uses*" and "*Composting*" levels.

The stages are defined as follows:

1. **Pre-store** stage includes retailers' collaborations with suppliers as well as their own practices aimed at making the supply chain more efficient.
2. **In-store** stage is related to retailer's efforts within its stores such as product selection and discount policies.
3. **Reuse** stage pertains to efforts related to landfill/incineration diversion for the waste that was not reduced at source.
4. **Consumer education** stage is related to popularizing the topic of food waste among consumers and providing them with practical information on their role in reducing food waste.

The Pre-store and In-store stages are related to the efficiency improvements discussed in Chapter 2.1, such as Simchi-Levi's (2003) views of demand forecasting, inventory management and supplier collaboration, as well as Rushton's (2014) descriptions of trends in the retail sector. Similarly, Reuse and Consumer education stages are closely connected with sustainability management discussed in Chapter 2.2. Reuse section builds on the concept of reverse logistics described by Rushton (2014) and Harrison and Hoek (2008).

Following the Food Recovery Hierarchy was emphasized in the model because the hierarchy proposes an essential guidance to sustainability when the potential waste cannot be reduced at source. It is physically impossible to completely prevent food waste at source, and therefore it is vital that the remaining waste is utilized in the best possible way.

The practices on the Consumer education stage are aimed at reaching out to consumers regarding the scale, as well as the environmental and practical implications of the problem. Such reasons for food waste as food not being used in time or too much food being prepared described by WRAP (2009) could effectively be targeted with practical tips on grocery shopping planning as well as ideas for using the food that could otherwise go to waste. Also, education on the differences between food labels could address the common misunderstanding of food labeling and consequent food waste that was outlined by (HLPE, 2014), Parfitt et al. (2010) and FAO (2013b).

Table 6: Evaluation framework of retailer's efforts in reducing food waste

Stage	Practice	Source
1. Pre-store	Collaboration with suppliers on demand planning	FAO (2013b), Oliver Wyman (2014b), Parfitt et al. (2010), Fearne et al. (2006), Xiao (2009), Finne & Sivonen (2008)
	Sustainable order management	FAO (2013b), Stuart (2009)
	Development of shorter supply chains	FAO (2013b)
	Efforts to increase overall freshness	Oliver Wyman (2014b), Ferguson & Ketzenberg (2006)
	Improvements of demand forecasting	Oliver Wyman (2014b), Chen & Ou (2011), Aye et al. (2015), Chen et al. (2010)
	Usage of cosmetically substandard produce	HLPE (2014), FAO (2013b)
	Improvements of food waste analysis and reporting	FAO (2013b)
	Improvements of packaging	HLPE (2014), FAO (2013b)
2. In-store	Optimization of product selection	Oliver Wyman (2014b), Finne & Sivonen (2008)
	Increased offering of loose products	Oliver Wyman (2014b)
	Limitations of volume promotions for perishables	Oliver Wyman (2014b)
	Discounts for products nearing expiration dates	Author of the thesis
3. Reuse	Commitment to active food donations	FAO (2013b)
	Commitment to animal feed diversion	Stuart (2009), FAO (2013b)
	Commitment to recycling	FAO (2013b)
	Valorization according to Food Recovery Hierarchy	US EPA, HLPE (2014), FAO (2013b)
4. Consumer education	Involvement in food waste campaigns	HLPE (2014), FAO (2013b), Parfitt et al. (2010)
	Education on food waste topics in communication channels	HLPE (2014), FAO (2013b), Parfitt et al. (2010)
	Within-store actions aimed at raising awareness	Author of the thesis

It is worth noting that some of the practices might be related to more than one stage, for example, "*Increased offering of loose products*" and "*Limitations of volume promotions for perishables*" are eventually aimed at reducing consumers' food waste, however, since the practice is directly targeted at the store's product selection and the way of operations, it is placed under In-store stage.

Moreover, the practices presented in the model do not necessarily have to be aimed at reducing food waste, and a reduction of food waste can either follow or not follow from their implementation. However, since connections between certain practices and reduced food waste have been established in the previous literature, the evaluation will consider a practice to be implemented also in cases when there is no direct information on the reduced food waste as a result.

It is also important to take into account is that the framework is not aimed at identifying how well retailers cope with food waste, because is not used for comparing the actual amounts of food waste that retailers prevent from being generated. Rather, the framework will be used for evaluating the variety of practices that retailers undertake, with no information about a practice's marginal effect on food waste. This approach is due to the limitations of research methods used: as an external party, the author of this thesis would not be able to obtain the information detailed enough to analyze neither the total efficiency in reducing food waste nor the marginal contributions of certain practices.

5.1 Schematic representation of the framework

A schematic representation of the framework is shown in Figure 4. It depicts the main agents in the food supply chain (supplier, retailer, consumer), their relationships to the different stages of the framework that are shown with thin black lines, as well as the forward and reverse supply chain flows.

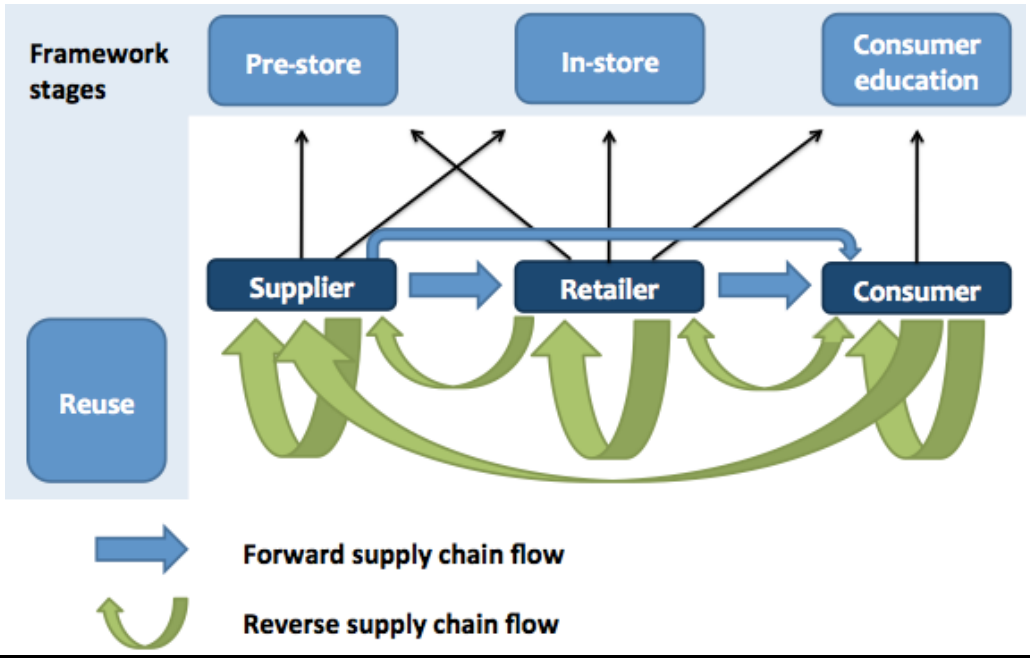


Figure 4. Schematic representation of the framework

The forward flow can be organized also without a retailer's intermediation in cases such as local farm shops where consumers purchase the products directly from producers. The Reuse stage refers to the reverse flow of the food supply chain described by Rushton (2014) and Harrison and Hoek (2008). The reverse flow can take place both between the different agents of the supply chain, as in the case when a product that was left unsold in the retail stage is recycled or used as animal feed, and also within each of the supply chain agents, such as a producer (supplier) using substandard produce for composting or animal feed. The reverse flow relationship between retailer and consumer can be described as double-sided as shown in the schema, because it includes food donations. It might be argued whether or not food donations are part of the reverse supply chain flow, but it could be regarded as reverse flow based on its presence in the Food Recovery Hierarchy along with other forms of reuse.

The black arrows depict the agents in the supply chain that each stage involves. Thus, the Pre-store stage is mostly determined by the supplier and retailer; the In-store stage involves the same agents, however, the supplier's presence is somewhat limited to the practices related to the optimization of product selection and offering of loose products; finally, the Consumer education stage involves retailers and consumers. The reuse stage is shown in a different dimension because it immediately involves all of the agents in the supply chain.

5.2 Operationalization of the framework

The framework is going to be operationalized by conducting a case study of two largest Finnish retailer chains. The information is going to be collected first from the chains' official websites and then structured interviews with representatives of the chains are going be conducted.

The questions presented in Appendix 1 were developed in order to gather information and later evaluate whether or not, and how certain practices are implemented by the retail chains. Each practice was examined using approximately 2 questions. The questions were developed so that they would provide sufficient information for further evaluation and would also shed light on how an action is implemented. One issue that was kept in mind when developing the questions was that interviews as a research method pose a danger that the interviewer might be tempted to present their company in the best positive light. Therefore, the questions were developed to be detailed enough so that a practice could be evaluated based on the detailed information rather than on an interviewee's opinion.

A three-level maturity level model will be used to identify how retailers have succeeded at implementing certain practices based on the information obtained. Maturity level models are utilized to evaluate the existing maturity level and find possible points for improvement (Bask and Kuula, 2011). For example, Humphrey (1988) developed and utilized a maturity framework for evaluating the software process. Also, a similar model was used by Bask and Kuula (2011) to evaluate the level of environmental sustainability at Nokia. The maturity level model used in this thesis has been developed based on the one that Bask and Kuula (2011) have utilized. Table 7 depicts the maturity levels that will be used to evaluate retailers' practices presented in Table 6.

Table 7: Maturity level model used to evaluate the retailers' practices.

Numerical level	Description of level
0	Not mentioned / not in use
1	Used, room for improvement identified
2	Actively used

The retailers' practices aimed at reducing food waste will be evaluated using the three levels shown in Table 7. Level 0 would mean that no information about a certain practice has been provided during the interviews, or that a practice has not been adopted by the retailer.

Level 1 will be used for practices where efforts are being made, however there is a clear improvement opportunity identified. Finally, level 2 will be utilized for practices that are actively in use and there are no clear suggestions on how to improve the process. Since the information that could be obtained in this study is rather limited in terms of details, the three-level maturity model can be considered appropriate. It consists of levels that are easy, measurable within the limitations of this study while not being excessively detailed that the evaluations could become meaningless.

6 Choice of case companies and data collection

This section is going to discuss the Finnish food retail market, the choice of case companies for evaluation as well as the methods of data collection that were utilized to obtain information about the retailers' performance regarding the practices presented in the framework.

6.1 Food retail in Finland

According to the information provided by Päivittäistavarakauppa ry, Finnish food retail market is very centralized with almost 80% of market share in 2014 being served by only two chains: 45,7% belonging to S-group and 33,1% to K-group. Also, on November 18, 2015 K-group announced that it is purchasing Suomen Lähikauppa Oy that operates Siwa and Valintatalo supermarket chains, and therefore K-group's new market share is approximately 40%. Thus, in 2015 the food retail market became even more consolidated with approximately 85% of market belonging to two domestic players. S-group and K-group are originally Finnish. Additionally, 9,2% of market share belongs to Lidl stores owned by German-based Schwarz Unternehmens Treuhand KG. It is worth to note that Finland is a relatively small country of about 5.5 million people and therefore Finnish retail players are quite small on the global scale. Table 8 presents the largest players in the Finnish grocery retailing market.

Table 8: Finnish retailer chains revenues and market shares in 2014
(Source: Päivittäistavarakauppa ry statistics)

Group	Market share	Grocery sales (mil €)
S-group	45,70%	7 627
K-group	33,10%	5 532
Lidl Finland	9,20%	1 543
Suomen Lähikauppa Oy	6,80%	1 137

Out of the retail players discussed, the two largest retailer chains, S-group and Kesko, are going to be studied in this thesis. The reason for choosing these two retailers is their large market share, as combined they serve more than 90% of the market. Since the two chains cover almost all of the Finnish retail market, the results can be claimed to describe what practices retailers resort to in Finland. In contrast, when a small sample of companies is studied, a challenge of extrapolation validity arises and the results may be claimed less valid for this reason. Therefore, it is beneficial that this concern is rather obsolete in this case.

The following sections present general descriptions of the two retailers.

6.1.1 S-group

According to its official website, S-group consists of 20 regional cooperatives that are owned by consumers. The group also includes a central organization, Suomen Osuuskauppojen Keskuskunta (SOK) that is responsible for business management such as purchasing and other supporting services. S-group has over 1600 business units and employs over 40 000 people. There are numerous types of stores and services that the group offers: general supermarkets of different sizes: Alepa, Sale, S-market and Prisma; hardware stores Kodin Terra; filling stations ABC; Sokos Hotels; as well as restaurants, cafes, catering, travel, car sales and other types of services. S-group also operates Prisma stores in Russia, Estonia, Latvia and Lithuania, and Sokos hotels in Russia and Estonia. The group has its own food brands Rainbow, X-tra (in cooperation with other Nordic supermarkets) and Kotimaista.

S-group's distinctive ownership structure is characterized by customers being the group's owners, and there are currently over 2 million so-called 'customer owners' (asiakasomistaja). They receive numerous benefits such as payment method bonus, yearly bonus as well as basic S-bank services that are free of charge. The ownership structure determines that the group plays a significant role in the Finnish society by providing a wide range of competitively priced, high quality and responsibly produced products and services.

In 2015, S-group's grocery stores revenues has been roughly €7,5 billion, and the whole group's revenues from all activities equaled €10,8 billion, of which over 95% come from operations in Finland. The group made €304 million in profits in 2015, which corresponds to a profit margin of 2,8%.

S-group's responsibility programme emphasizes employees' wellbeing, sustainably produced assortment with one important value being local production; sustainable treatment of energy and waste, responsiveness to customer demand and general openness and ethics of the group's management. It is also mentioned that one of the sustainable priorities is to decrease food waste, increase the proportion of potential waste that could be donated as opposed to recycled, and increase the efficiency of recovery methods utilized.

In 2015, the group surveyed its employees as well as external stakeholders and asked them to list the most important issues that they wish the group to tackle within its sustainability strategy. Both stakeholder groups have mentioned very similar issues such as local production, ethical practices, good treatment of employees and price advantage. Both

internal and external stakeholders have rated the treatment of food waste as the second most important issue in the company's sustainability strategy.

6.1.2 Kesko

K-group (Kesko) is a large player in the Finnish grocery retail market. According to its official website, K-group is privately owned. K-group operates grocery retail stores such as K-market, K-supermarket, K-citymarket; hardware stores K-rauta, a variety of car sales points; sport stores BudgetSport and InterSport; shoes store KooKenkä as well as other services. In 2015 Kesko purchased retail chain Suomen Lähikauppa Oy that operates Siwa and Valintatalo stores. Additionally, Kesko operates a wholesale HoReCa service that provides food to catering businesses. While 82% of Kesko's revenues in 2014 came from its stores in Finland, the company is also present in Norway, Sweden, Estonia, Latvia, Lithuania, Russia and Belarus. K-group's own food brands are Pirkka, Euro Shopper (in cooperation with European supermarkets) and K-menu. In 2015, Kesko employed around 19 000 people.

Every Kesko's grocery store is operated by a store entrepreneur called K-merchant (K-kauppias). They work quite independently while being supported by the group. K-merchant is responsible for building a store's product selection, human resources, pricing and purchasing decisions, as well as for cooperation with local suppliers. The merchant is also expected to work closely with consumers and efficiently reply to their feedback and wishes regarding the store's operations. According to K-merchants' union (K-kauppiasliitto), most of the merchants are families.

Kesko's revenues in 2015 equaled €8,7 billion. Grocery sales accounted for 54% of the group's turnover or approximately €4,6 billion. Kesko made €244 million in profits, which corresponds to 2,8% profit margin.

Kesko's responsibility strategy includes, among other things, responsible practices in all kinds of group's activities, caring for its employees, responsible purchasing and ensuring product safety, offering products that promote consumers' wellbeing and efforts to mitigate climate change. Additionally it was mentioned that Kesko determines short-, medium- and long-term responsibility goals and yearly reports their development to public. One of the goals is to decrease the amount of food waste by 10% by year 2020, and currently the implementation is claimed to be on time. Also, the proportion of reused materials from the grocery stores is clamed to be 99%, and another goal was to bring the waste that goes to landfill down to 0.

6.2 Methods of data collection

Initial data collection was conducted through documentary analysis of the materials from the two chains' official web pages. Those included general articles about food waste and advise for consumers on how to decrease it as well as comprehensive yearly reports on each of the chains' performance in corporate social responsibility, sustainability and efficiency. Some of the information collected this way was used for evaluation while other was utilized mainly in order to become familiar with the topic and prepare for the interviews.

Since a very limited amount of information was available using the method of documentary analysis, interview research method had to be resorted too. Firmin (2008) describes the structured interview as the one where all interviewees are asked the same standardized questions. In contrast to open interviews that aim at information discovery, structured interviews are usually utilized when a researcher has formed certain hypotheses that might be based on previous studies. He suggests that this method may be used when two groups are set to be compared (Firmin, 2008). As described by Firmin (2008), structured interviews method is well suited for this research because a model has already been created and a comparison of two groups is sought for.

One peril identified with this data collection method is that the interviewers might be tempted to present the practices implemented by their company in an only positive light and avoid sharing information about the negative aspects. This is a valid concern, but the nature of this study is explorative and descriptive, and it does not aim at evaluating the efficiency, nor does it aim to make any statements regarding which retailer has better succeeded at reducing food waste. Instead, the main purpose is to explore how the practices identified are being implemented and what are the key practices for Finnish retailers in reducing food waste. It is of course possible that the information will be presented in a more positive light than it actually is, but it cannot be seen to discredit the study since no strong statements are planned to be established.

The data was collected directly from S-group and Kesko. In S-group, its Compliance Manager was interviewed on February 29th, 2016. In Kesko, the interview was carried out via email. A table with the evaluation model and the questions were sent to the Communication Officer, who then collected the information from the people responsible for each of the business functions in the organization. The reply was received on March 31st, 2016. Also, some additional information was requested via email. Later, when the evaluations were

completed and formed into coherent thesis parts, they were sent to the interviewees for approval. Both of the interviewees approved the evaluations and provided minor comments that were used to improve the descriptions.

The choice of interviewees was driven by two factors. Firstly, the intention was to interview representatives of the head offices in each of the retailers in order to receive more general information and build a holistic picture. An alternative was to interview store directors, but head office representatives were preferred because they could offer a more holistic view of the topic that is less dependent on the operations of an individual store. The second factor for choosing interviewees was their availability – the two retailers are large companies that are presumably frequently contacted for research purposes, and therefore it is challenging to reach out to their representatives.

7 Evaluation of the case companies

This chapter is going to describe and evaluate how S-group and Kesko have adopted the practices included in the evaluation model. Implementation of each of the practices will be separately assessed based on the maturity level model shown in Table 7. After the evaluation, the results for each of the practices will be compared.

7.1 S-group

7.1.1 Pre-store

S-group's interviewee emphasized the close interconnection between demand forecasting, collaboration with suppliers and sustainable order management. It was mentioned that predicted demand is communicated to suppliers well in advance and in some cases even during the harvesting season. Another example provided was that by the time of the interview (February 29th) the next Christmas time demand predictions for ham were already communicated to the suppliers. The interviewee described S-group's commitment to order amounts as the basis of order management and also mentioned that if a supplier fails to deliver, there is always a "plan B" to offset the shortage. Regarding demand forecasting, it was acknowledged that one aspiration is to automate the forecasting process with a subsequent automation of ordering processes. Active supplier collaboration was described to be at the core of the group's efficient operations as well as the effectiveness of the whole supply chain. Thus, the first three practices in this section are certainly being paid a lot of attention to by S-group and therefore they can be evaluated to be at level 2.

S-group's website claims that 80% of products found in grocery stores are produced in Finland, and during the interview it was also mentioned that the group is seeking to develop shorter supply chains. However, when choosing products, a combination of factors such as price and delivery times is taken into account, so it is not only the local factor that drives the choice. The proportion of local products is very high in S-group and therefore this aspect is also evaluated to be at level 2.

According to the group's website, freshness is ensured and waste is prevented with systematic order, delivery and inventory management, and the same was also confirmed during the interview. The interviewee mentioned that the inventory usage policy applied in the group is FIFO (first in, first out) and that the so-called "*rule of one-third*" might not be in use in the group, but suppliers are expected to deliver the products with reasonable shelf-life

left. It sounds like S-group takes freshness in its stores really seriously and this is why this practice can be evaluated as level 2.

Regarding the so-called 'ugly vegetables', the interviewee mentioned that S-group's stores do not receive much of those because they are mostly in use by companies that produce ready-made food. Nevertheless, some of the cosmetically substandard tomatoes and cucumbers have been offered on an irregular basis. The interviewee claimed that the group would be ready to offer them to consumers, however currently there is quite limited availability of such produce. While the so-called "ugly veggies" are to some extent in use in S-group's supply chain, they are not being constantly offered to consumers in stores and therefore this aspect is evaluated to be on level 1.

The interviewee described that there is an IT system in each store that is used for logging in all foods that are wasted, and the information is later used in order to update demand estimates and place new orders. Thus, store personnel are also actively participating in efforts to reduce the waste. Since data is constantly collected and taken into account when planning the orders, the seventh aspect of this stage is evaluated to be on level 2.

Packaging is taken very seriously according to the group's web pages and also the interviewee. S-group gives continuous feedback to its suppliers regarding packaging, and also there are requirements for packaging that are used when choosing the products. It was emphasized that a balance needs to be found between reduced packaging and its ability to protect the product. Since S-group takes packaging concerns into consideration and also negotiates with suppliers about it, the corresponding practice is evaluated to be on level 2.

The summary of the evaluations discussed on this stage is presented in Table 9.

Table 9: Evaluation of S-group's practices on the Pre-store stage

Stage	Practice	Level
1. Pre-store	1. Collaboration with suppliers on demand planning	2
	2. Sustainable order management	2
	3. Improvements of demand forecasting	2
	4. Development of shorter supply chains	2
	5. Efforts to increase overall freshness	2
	6. Usage of cosmetically substandard produce	1
	7. Improvements of food waste analysis and reporting	2
	8. Improvements of packaging	2

7.1.2 In-store

The interviewee mentioned that product selection is revised several times a year, and items are routinely reduced if not selling well. The inventory usage policy is FIFO (first in, first out). Thus, the first practice on this stage is evaluated to be on level 2.

Regarding the products sold in loose form, the interviewee described that there is a wide variety of products offered in such form in S-group's stores: fruit, vegetables, candies, nuts, as well as meat and fish. One of the issues that need to be taken into account when planning the extension of loose items is food safety, because it might not always be safe to sell products that are not pre-packaged. There is a wide selection of products available in loose form, and therefore the second practice is evaluated to be on level 2.

During the interview it came up that S-group's stores do not generally use volume promotions (i.e. buy 3, pay for 2), rather price discounts are used and products nearing expiration dates are discounted. Thus, volume promotions for perishable products are not in use. When it comes to discounts for products nearing expiration dates, the interviewee mentioned that all product groups can be discounted, however there are certain regulations that might limit the possibilities to discount such products. Since there are no volume promotions and expiring products are routinely discounted, both of these practices are evaluated as level 2.

The summary of the evaluations discussed on this stage is presented in Table 10.

Table 10: Evaluation of S-group's practices on the In-store stage

Stage	Practice	Level
2. In-store	1. Optimization of product selection	2
	2. Increased offering of loose products	2
	3. Limitations of volume promotions for perishables	2
	4. Discounts for products nearing expiration dates	2

7.1.3 Reuse

The 2014 sustainability report mentioned that in 2014 the group undertook a large survey of its stores in order to determine what kind of food is most suitable for food donations. They determined that fresh bread as well as fruit and vegetables make up a large proportion of food that could be donated. S-group donates food to approximately 200 partners who are specialized in food aid, and the donations come either from stores or from the group's logistics centers. In small cities, lack of donation partners and transportation constraints are the most significant reasons that prevent food from being donated.

The same issues were mentioned during the interview. While donating food in Helsinki metropolitan area is easy due to the large number of charity organizations, donations might pose a challenge in distant areas of Finland that are scarcely populated. Overall, the interviewee mentioned that there are contracted cooperations between stores and charity organizations, and both stores themselves and regional cooperatives (i.e. HOK-Elanto) take part in planning and executing food donations. Donations are also made towards animal feed. Thus, practices related to donations and animal feed diversion are both evaluated to be on level 2.

The sustainability report discussed that out of the food that was neither sold nor donated, 90% was effectively reused in 2014 (88% in 2013). Recovery options included fuel, material recovery, energy recovery, composting and numerous other recovery means. Since S-group is committed to a variety of recovery options and the recovery percentage is very high, the aspect of recycling can be evaluated as level 2.

In its 2014 sustainability report, S-group has described the food recovery order that broadly corresponds to the hierarchy presented in Figure 2: source reduction, charity donations, and then material and energy recovery. The interviewee mentioned that nothing from S-group's supply chain ends up in landfill. Thus, this aspect is evaluated to be on level 2.

The summary of the evaluations discussed on this stage is presented in Table 11.

Table 11: Evaluation of S-group's practices on the Reuse stage

Stage	Practice	Level
3. Reuse	1. Commitment to active food donations	2
	2. Commitment to animal feed diversion	2
	3. Commitment to recycling	2
	4. Valorization according to Food Recovery Hierarchy	2

7.1.4 Consumer education

S-group has taken part in third-party campaigns against food waste such as Hävikkiviikko (Waste Week) described in Section 3.7.1, and therefore the involvement in third-party food waste campaigns is evaluated at level 2.

The company's web pages offer information for consumers on how to cut food waste, such as practical tips and explanation of the difference between expiration labels. Also, quite a lot of information is published on other websites that are administrated by the chain, such as

Patarumpu and Yhteishyvä. These websites offer a variety of content related to food, cooking, S-group's products as well as food waste. The group offers quite a lot of information about food waste through a variety of communication channels, and therefore its efforts regarding this aspect are evaluated at level 2.

The group does not offer any visual material within its stores that could remind consumers about the topic of food waste while doing shopping, and therefore this practice is evaluated to be at level 0.

The summary of the evaluations discussed on this stage is presented in Table 12.

Table 12: Evaluation of S-group's practices on the Consumer education stage

Stage	Practices	Level
4. Consumer education	1. Involvement in third-party food waste campaigns	2
	2. Education on food waste topics in communication channels	2
	3. Within-store actions aimed at raising awareness	0

7.2 Kesko

7.2.1 Pre-store

80% of Kesko's food suppliers are domestic, and most of the products are purchased through wholesalers. Kesko carries out centralized purchasing for K-stores, and K-merchants then supplement the selection with products from local agricultural and partially also industrial suppliers. The merchants are free to choose which products are sold in their stores, and in this way they also compete with other Kesko stores in the area.

When it comes to relationships with suppliers, Kesko strives to be in active contact with them, however this might be challenging due to the large number of suppliers and the limited capacity of the central purchasing department. If Kesko stops ordering from certain suppliers, it attempts to communicate it to them well in advance. Also suppliers can expect the orders to stop if the order amounts are becoming smaller. If a product is not selling from the central warehouse to stores, Kesko actively promotes the product to the stores at a discount so that no food goes to waste from the central warehouse.

The time gap between placing an order and product delivery varies a lot: some agreements are negotiated for years ahead while other products are purchased at international

auctions and delivered within several days. Fruit and vegetables are frequently purchased at the last moment, but it is different for less perishable goods that can be stored for longer times. With Christmas ham, for example, orders are placed more than half a year in advance. Since Kesko is actively communicating with suppliers regarding the future demand, the collaboration with suppliers on demand planning can be evaluated as level 2.

Kesko's central warehouse ordering is carried out in a similar way as in stores, but on a larger scale. Industrial goods, as well as fruit and vegetables go through the warehouse, and for example milk and meat products are often delivered directly from suppliers to the stores. In the central warehouse, the main target is to create a fast throughput of products, however this does not work with new industrial products that are ordered in large quantities and stores first try them out. With new perishable products, Kesko negotiates with the stores about quantities before placing any larger orders. The delivery times are usually short because most of the fresh products are produced domestically. The order of inventory usage is FIFO (first in, first out).

If the order amount exceeds demand, Kesko generally takes in the products and then sells them to stores at a discount. However, it can always try and negotiate with the supplier about the order amounts. This shows that Kesko is flexible and sustainable with order management, and therefore the second aspect on this stage is evaluated to be on level 2.

The ordering process from Kesko's central warehouse to stores has been largely automated. Now it works so that the program makes suggestions based on previous years' demand and trends, however K-merchants still need to take into account other factors that the program might not always recognize. Such factors can be i.e. holidays or new stores in the area that might affect sales. The program has allowed to decrease both food waste and product shortages in stores, and saved K-merchants a lot of work since previously they had to make predictions and place orders themselves. Since Kesko actively develops the demand forecasting and ordering tools, the third aspect of this stage is evaluated to be on level 2.

K-merchants are encouraged by Kesko to purchase local foods, and with fresh foods such as milk and meat, the products usually come from very close locations. For example, within Finland meat and dairy are not delivered from Vantaa to Rovaniemi because there are own producers there that can deliver the foods faster. All suppliers also have a possibility to deliver their products to the central warehouse and thus make the products available to the whole of Finland. However, this requires suppliers to manage registration, packaging and

logistics issues and thus it is not a very straightforward process. In 2015, Kesko's central warehouse purchases within Finland were €5179,2 million and K-stores' own purchases were €566,7 million.

Local foods are favored because of shorter delivery routes, positive impact on local economy and the fact that consumers place a lot of value on local products. In 2014-2016 Kesko organized networking events for K-merchants and local suppliers all around Finland. The name of the event is Lähiruokatreffit (local food meetings), and 90% of participants made purchasing agreements, so the events were highly effective in encouraging the promotion of local foods. Since Kesko is so committed to promoting local products and thus developing shorter supply chains, the fourth practice on this stage is evaluated to be on level 2.

Kesko places emphasis on freshness, and supplier agreements include freshness requirements. If the foods delivered are not fresh enough, they are sent back to the supplier. Freshness is also ensured by keeping the cold foods refrigerated throughout the supply chain and educating employees to avoid situations when the refrigeration is lost due to long waiting times or lags during loading. Fruit and vegetables that have overriped or gone bad are continuously taken away from the product displays so that the customer would not be offered bad quality produce. Freshness is greatly emphasized and controlled in the group's stores and therefore the fifth aspect is evaluated to be on level 2.

When it comes to the shelf-life of fresh foods, it is quite common that the products should have about a week of remaining shelf life when they arrive at the stores.

Kesko introduced cosmetically substandard produce to its stores a couple of years ago, however customers were not so willing to purchase them and so it was not profitable to continue offering "ugly veggies". Some stores still order such products directly from suppliers. Otherwise, suppliers are expected to cut out the cosmetically substandard produce before delivering products to Kesko. There might also be differences between stores on whether or not the cosmetically substandard produce is used to prepare ready-made food. While "ugly veggies" are to some extent used in Kesko, such produce is not constantly offered to consumers, and thus the sixth aspect is evaluated to be on level 1.

Food waste is carefully tracked and analyzed in Kesko both on the central level and on the store level. The issue is taken very seriously because food waste always leads to financial losses. In problematic situations, Kesko can help K-merchants, however K-merchants also

share expertise regarding food waste with each other. Kesko collects and analyzes food waste data, and therefore this aspect is evaluated to be on level 2.

Kesko negotiates about the products packaging with its suppliers already when making an agreement, however later on Kesko can also request its suppliers to alter the package if it would help the product be more safely transported or sold more efficiently. Thus, the eighth aspect is evaluated as level 2.

The summary of the evaluations discussed on this stage is presented in Table 13.

Table 13: Evaluation of Kesko's practices on the Pre-store stage

Stage	Practice	Level
1. Pre-store	1. Collaboration with suppliers on demand planning	2
	2. Sustainable order management	2
	3. Improvements of demand forecasting	2
	4. Development of shorter supply chains	2
	5. Efforts to increase overall freshness	2
	6. Usage of cosmetically substandard produce	1
	7. Improvements of food waste analysis and reporting	2
	8. Improvements of packaging	2

7.2.2 In-store

The product selection is continuously revised in the central warehouse because consumers' behavior changes, suppliers alter their selections and new information about i.e. sustainable production of the products is becoming available. However, the main work regarding product selection is carried out in stores by K-merchants, and the stores' selection then guides the selection of the central warehouse. New products are constantly being tested in individual stores, however if after a good start the product does not interest consumers any longer, it is taken out of the selection. Kesko stores are extremely flexible with its product selection due to the organizational structure and a high degree of freedom given to K-merchants, and therefore this aspect is evaluated to be on level 2.

Many types of products are offered in loose form: fruit, vegetables as well as fish, meat and ready-made foods that are available at the service counter. In the future, Kesko aims to increase sales from the service counter because it provides high quality products to the customer, coupled with personalized service and also helps consumers to decrease their food waste because they can purchase just the right amount of product. Since a wide variety of products are available in loose form and there are also plans to increase the use of loose products, this practice is evaluated to be on level 2.

Types of promotions are largely dependent on individual stores and K-merchants' decisions, however volume promotions similar to "buy 2 get 3" are not a common practice. Since volume promotions for perishable products can technically be used and the decision is left to the individual K-merchant, this aspect is evaluated to be on level 1.

Kesko stores discount products nearing expiration dates by 30% or 50%. There are no official requirements for how this should be done, and the decisions are left to K-merchants. However, Kesko recommends discounting expiring products to decrease food waste. Since discounting expiring products is an official recommendation for K-stores and it also does not make sense for merchants to leave the expiring products without a discount, this practice is evaluated as level 2.

The summary of the evaluations discussed on this stage is presented in Table 14.

Table 14: Evaluation of Kesko's practices on the In-store stage

Stage	Practice	Level
2. In-store	1. Optimization of product selection	2
	2. Increased offering of loose products	2
	3. Limitations of volume promotions for perishables	1
	4. Discounts for products nearing expiration dates	2

7.2.3 Reuse

Agreements with food recipients are made by each K-store individually. K-stores follow Päivittäistavarakauppa ry (PTY) guidelines in terms of product safety for donations. Only products that are guaranteed to be safe to consume can be donated. While most stores indeed actively donate the food to recipients, it is not obligatory and thus some K-merchants might decide to not participate in food donations. Thus, this aspect is evaluated to be on level 1.

When it comes to animal feed, K-merchants can make separate agreements with local players, however in practice more biowaste goes to animal feed as waste disposal companies direct part of the waste to animal feed themselves. Similar to the food donations, since every K-merchant can decide for their store whether or not the donations towards animal feed are made, this practice is evaluated as level 1.

Regarding recycling options, stores collect bio-, energy-, mixed and other sortable waste and waste management companies then direct it to suitable recovery. Currently Kesko is also running a campaign together with a gas company Gasum that utilizes biowaste from Kesko's own brand Pirkka to produce biogas that can later be used in production of new Pirkka goods. According to Kesko's official website, 98% of waste from grocery stores is

reused. Kesko utilizes various recycling options and also runs its own recycling campaigns, and therefore this aspect is evaluated as level 2.

Kesko recommends food donations to be the preferred option when dealing with food waste; only then other recovery options should be resorted to. This approach broadly corresponds to the Food Recovery Hierarchy and therefore the aspect is evaluated to be at level 2.

The summary of the evaluations discussed on this stage is presented in Table 15.

Table 15: Evaluation of Kesko's practices on the Reuse stage

Stage	Practice	Level
3. Reuse	1. Commitment to active food donations	1
	2. Commitment to animal feed diversion	1
	3. Commitment to recycling	2
	4. Valorization according to Food Recovery Hierarchy	2

7.2.4 Consumer education

Kesko regularly participates in Hävikkiviikko (Waste Week) that aims at raising awareness among consumers about food waste. Hävikkiviikko has been described in more detail in Section 3.7.1. Thus, the first practice in this stage is evaluated to be at level 2.

The chain offers a large amount of information on its web pages. The articles cover topics like methods of decreasing food waste in stores, practical tips to consumers on how to decrease domestic food waste, and general facts about food waste. Kesko offers consumers a solid information package on its webpages, and therefore the second aspect is evaluated to be on level 2.

In the previous years, materials regarding food waste were visible in stores, however there was no centralized campaign for it and nowadays not so many stores offer such material. Gasum campaign is visible in stores with those Pirkka products that are used for the production of biogas. Since some materials were previously on display and some of the stores might still offer visible material, this practice is evaluated to be on level 1.

The summary of the evaluations discussed on this stage is presented in Table 16.

Table 16: Evaluation of Kesko's practices on the Consumer education stage

Stage	Practice	Level

4. Consumer education	1. Involvement in third-party food waste campaigns	2
	2. Education on food waste topics in communication channels	2
	3. Within-store actions aimed at raising awareness	1

7.3 Evaluation overview

Table 17 shows the summary of the evaluations obtained in the previous section. The two retailers have adopted a wide variety of practices recommended by the literature, and the practices that are evaluated to be at a level that is lower than 2 are to a large extent the same in both chains. Moreover, both S-group and Kesko have mentioned the careful planning of demands and orders to be the most important practice in reducing food waste in their supermarkets. This section is going to summarize and compare the information received from the two retail chains on the basis of the same evaluation model.

Table 17: Summary of S-group and Kesko's evaluations

Stage	Practice	S-group	Kesko
1. Pre-store	Collaboration with suppliers on demand planning	2	2
	Sustainable order management	2	2
	Development of shorter supply chains	2	2
	Efforts to increase overall freshness	2	2
	Improvements of demand forecasting	2	2
	Usage of cosmetically substandard produce	1	1
	Improvements of food waste analysis and reporting	2	2
	Improvements of packaging	2	2
2. In-store	Optimization of product selection	2	2
	Increased offering of loose products	2	2
	Limitations of volume promotions for perishables	2	1
	Discounts for products nearing expiration dates	2	2
3. Reuse	Commitment to active food donations	2	1
	Commitment to animal feed diversion	2	1
	Commitment to recycling	2	2
	Valorization according to Food Recovery Hierarchy	2	2
4. Consumer education	Involvement in third-party food waste campaigns	2	2
	Education on food waste topics in communication channels	2	2
	Within-store actions aimed at raising awareness	0	1
	SUM	**35**	**33**

Pre-store

The two chains have emphasized active collaboration with suppliers and both strive to be in contact with them, so that unexpected changes are communicated in a timely manner. While some of the products might be purchased at auctions on short notice, the example of Christmas ham was made by both retailers as something that is communicated to suppliers well in advance. Both groups claimed that they are committed to order amounts and always take in the products that have been ordered even if the actual demand seems to be smaller. Kesko commented that such products can then be sold at a discount. Both chains take demand forecasting seriously and move towards a higher degree of automation in forecasting and ordering processes. The two groups have claimed that efficient forecasting techniques are key to reducing food waste.

Kesko as well as S-group place strong emphasis on selling domestically produced food, and 80% of each chain's selection consists of food produced in Finland. It was mentioned by both groups that one aspiration is to develop shorter supply chains and bring local products to the stores. The two chains have also claimed that freshness of food on sale is of utmost importance. The suppliers are expected to deliver products that have a considerable proportion of their shelf life left so that products can be sold while still relatively fresh.

The only aspect on the Pre-store stage that was not evaluated to be at level 2 was the usage of cosmetically substandard produce. Kesko mentioned that it tested the sale of "ugly veggies" at its stores and consumers did not show significant interest towards them, and this is why they are not sold at the stores on a regular basis, however, individual stores might order such produce. S-group claimed that cosmetically substandard vegetables are sometimes sold in larger supermarkets such as Prisma, and such produce might be used to prepare ready-made foods. Both groups described that they do not usually get large amounts of cosmetically substandard produce as it is expected to be cut out of the supermarket supply chain at earlier stages. This practice was not evaluated to be at the highest level because the chains do not routinely offer "ugly veggies" to consumers, as has been proposed in the previous research. Nevertheless, it is possible that there is no need for it as the produce is being effectively used otherwise.

Both chains claimed that food waste is being carefully tracked at stores and later analyzed, and therefore all levels of employees are involved in efforts to prevent food waste. When it comes to packaging, both groups have mentioned that packaging requirements are used when making agreements with suppliers, and also later on the chains can give feedback

to the supplier regarding packaging. Both Kesko and S-group have claimed the ability of package to protect the product to be very important.

In-store

Product selection is regularly revised in both Kesko and S-group's stores. In Kesko, K-merchants are fully responsible for building the product selection and constantly revising it; Kesko's central warehouse also makes constant revision of its offering. S-group have mentioned that product selection is revised several times a year.

Both S-group and Kesko offer a wide variety of products in loose form: fruit, vegetables, meat, fish, as well as candies and nuts. Moreover, the service counter in both chains' stores provides a large selection of salads and ready-made food that can be purchased in a loose form, letting the customer decide exactly how much food they would like to purchase.

Regarding volume promotions for perishable products, S-group does not at all use such promotions, while in Kesko individual K-merchants can decide what kinds of offerings are used in their stores. Nevertheless, it was mentioned that volume promotions are not a common type of offering in Kesko's stores. Kesko was ranked lower in this case as there is no policy of limiting volume promotions, and S-group does not at all use them in any of their stores.

Both S-group and Kesko regularly discount products that are nearing expiration dates. S-group have mentioned that all kinds of products can be discounted, and in Kesko individual K-merchants make decisions related to product discounts.

Reuse

Food donations are a common practice in both chains' stores. In S-group, stores themselves and regional cooperatives alike make donations agreements with local charities and food banks, while in Kesko only stores themselves make such agreements, and they also have an option to not participate in food donations. The same applies to donations made towards animal feed. Kesko was ranked lower on these practices because stores have a theoretical possibility to withdraw from taking part in food donations and donations towards animal feed.

Both groups resort to a variety of recovery means, such as energy recovery, recycling and material recovery. S-group as well as Kesko also direct over 90% of their food waste to various reuse options, which proves that both chains are committed to reuse.

Kesko as well as S-group follow the recovery order described by the Food Recovery Hierarchy, and prioritize food donations over other recovery means when dealing with food waste.

Consumer education

Both chains annually take part in Hävikkiviikko campaign (Waste Week), which includes extensive visibility of the topic in the campaign's partners' communications channels, as well as numerous events that aim at popularizing the topic and encouraging consumers to re-think their shopping and consumption habits.

S-group as well as Kesko publish a wide variety of information related to food waste throughout their communication channels. The communications include tips on how to use leftover food, shopping advice and general information about food waste that might affect consumers' perceptions of the subject.

Visual information regarding food waste is not extensively present in either of the chain's stores. S-group does not feature any educative materials about food waste in its stores. Kesko used to have such materials at some point, but now only few stores have it on display.

8 Discussion of results

Based on the information provided by S-group and Kesko, it is very clear that both retailer chains take the issue of food waste extremely seriously and have adopted a variety of measures that lead to decreased food waste. The result is also quite expected since Finland is a developed country with high average operational efficiency. Almost all of the practices elaborated from the literature are being used in the chains also for reasons of reducing food waste, and most of the practices are evaluated at the highest level. The two main improvement areas identified are the usage of cosmetically substandard produce and efforts to educate consumers about food waste.

The slightly lower scores obtained by Kesko in the evaluation can be to a large extent attributed to the fact that the chain features a lower level of operational centralization. Thus, while Kesko issues recommendations for its K-merchants, there might be discrepancies between the practices adopted by individual merchants and there is a theoretical possibility that some of the merchants might not i.e. donate food. S-group, on the other hand, has an option of imposing centralized measures on all of its stores since its management structure is more consolidated. It is important to remember that this thesis does not aim at evaluating how successful the chains were at reducing food waste, but rather how many different practices are in use in each of the chains. It is therefore possible that Kesko has been more successful at cutting food waste percentagewise despite having a slightly lower score in the evaluation model developed in this thesis.

8.1 Efficiency of methods used

Overall, the framework can be claimed to have worked well, as it provided a solid foundation for discussing the topic and building interview questions. The model is also rather multi-sided and this feature has facilitated the exploration of various aspects that influence the generation and treatment of food waste, rather than focusing only on several aspects of the topic. Therefore, it has proven to be well suited for further use to study and evaluate, for example, retailers in other European countries.

However, as discussed in Chapter 5, the framework has been customized to study and evaluate Finnish retailers. Due to significant similarities, it can also be used for studying retailers in other developed countries, but it would require some adjustments if retailers in developing countries are to be studied. This is due to the significant differences between the

major causes of food waste in developed and developing countries presented in Figure 3. For example, supplier education and infrastructure improvements are very relevant practices for the evaluation of retailers in developing countries, however, these practices were not included in the model used in this thesis because the aim was to evaluate Finnish retailers. Chapter 4 presented suggestions for complementing the framework so that it could be used to study retailers in developing countries. One example is that "*Participation in farmers' education*" suggested by HLPE (2014) and FAO (2013b) could be added for evaluation.

The case study method used in this research has proven to be just the right option as it was indeed so that the matters of food waste reduction could not be separated from the chain's core operations. As mentioned in Section 1.2, Yin (2003) described that this is exactly the situation where the use of case study method is recommended.

When it comes to the data collection methods, they were also well suited to the purpose of the research. Documentary analysis allowed to become familiar with the case companies, collect primary data on their methods of waste reduction and prepare for the interviews. The interviews were conducted in different forms, face-to-face and via e-mail, and each of the forms has shown to have both benefits and drawbacks. The face-to-face interview was good because it was easier for the interviewer to control the flow of the discussion and ask further questions, however the information that could be obtained was limited to only one interviewee's knowledge. In the case of the e-mail interview, the answers were quite heavily dependent on the person's interpretation of the question, but on the other hand the respondent was able to collect the information from different departments of the company. The challenges with interpretation were mitigated by asking additional questions also via e-mail.

The interview questions have proven to be rather well designed as they have allowed to collect quite detailed information for the evaluation. However, especially with Kesko where the interviews were conducted via e-mail, it was evident that the questions could have been more concrete as in some cases it was not clear how the answer was related to the topic of food waste reduction. During the face-to-face interview conducted with an S-group representative the interviewer had a chance to explain what is meant by a question in case it was not clear, and consequently the information obtained was more concise and suited for purpose. Thus, one lesson learned from this was that it is important to better take into account the medium of the interview and adjust the questions accordingly.

The three-level maturity model has worked well in this case, because it was general enough to provide a meaningful representation of the information obtained during the interviews. Nevertheless, this study was a very basic one and had numerous limitations, and therefore adding more levels to the maturity model would certainly add value if a more thorough and detailed study is conducted.

8.2 Theoretical contributions

The evaluation conducted in this thesis has confirmed the previous research outcomes related to the practices that could be adopted to reduce food waste. The practices identified from literature such as HLPE (2014), FAO (2013b) and Parfitt et al. (2010) were shown to be used in the real life within the two Finnish retail chains. The retailers' outlook on the topic has proven that decreasing food waste is not only a matter of CSR or sustainability, but also a central topic in food retail supply chain management that allows to increase efficiency and save costs.

Finnish retailers were shown to counter the causes of food waste that were presented in Section 4.1. Their commitment to ordering amounts and placing the orders well in advance creates stability for both parties as the suppliers can count on the fact that their products will be purchased and retailers can mitigate the risk of supply shortages. This way, suppliers can plan their operations and avoid cases such as the ones described by Stuart (2009) and FAO (2013b) when a retailer cancels an order on short notice when supplier might have already prepared all or part of it. FAO (2013b) also suggested transition to shorter supply chains, as this allows to minimize the food waste along the chain and preserve the freshness of produce. Both retailers studied adopt this practice as 80% of food found in their grocery stores is produced in Finland. Moreover, the retailers have mentioned that they are also striving to utilize food such as meat and bread that are produced in close proximity to the customer, therefore shortening the supply chain and supporting local production.

As described by Oliver Wyman (2014b) and Parfitt et al. (2010), the core cause of food waste in retail, especially in perishable types of products, is the mismatch between supply and demand, and therefore continuous improvement of demand forecasting needs to be conducted. The effectiveness of improved demand forecasting for reduced waste was supported also by Chen and Ou (2011), Aye et al. (2015) and Chen et al. (2010). Both S-group and Kesko have emphasized accurate demand forecasting, and forecasting techniques have been claimed to have significantly improved in both chains during the latest couple of

years. Both chains have automated their demand forecasting and ordering processes with the help of computer programs, and further automation was claimed to be sought for.

The benefits of supplier collaboration were outlined by Fearne et al (2006) and Oliver Wyman (2014b), and both retailers studied have claimed to stay in close contact with their suppliers and place the orders well in advance. Nevertheless, none of the retailers have discussed the use of Collaborative Planning, Forecasting and Replenishment (CPFR) or similar systems studied by Bozarth (2011) and Xiao (2009) with their suppliers, so this is something that could be recommended to take into use with key suppliers.

Both retail chains have claimed to use the FIFO (first in, first out) inventory usage policy, which is consistent with Ferguson and Ketzenberg's (2006) recommendation for the choice of the inventory usage policy for perishable products.

Kesko as well as S-group have claimed to continuously revise their product selection and remove the products that are not selling well, following Oliver Wyman's (2014b) suggestions on continuous analysis and product selection review. This is consistent with the methods of Category Management and Effective Consumer Response (ECR) described by Finne and Sivonen (2008) and Dussart (1998), which have determined that continuous item reduction is an effective way of decreasing waste and preventing inventory loss.

When it comes to sustainability, both retailer chains have emphasized the efforts to follow the Food Recovery Hierarchy in processing food waste that was not reduced at source with careful planning. Moreover, sustainability strategies adopted by the two companies included all of the food supply chain's CSR dimensions identified by Forsman-Hugg et al. (2013): "*environment, product safety, nutrition, occupational welfare, animal welfare, economic responsibility and local well-being*". The researcher suggested that an image of a socially and environmentally responsible company is a source of competitive advantage, and this view is also supported by Harrison and Hoek (2008) in regard to involvement in reverse logistics activities.

Regarding measures aimed at helping customers purchase just the right amount of product that have also been suggested by Oliver Wyman (2014b), the Finnish chains limit the volume promotions for perishables and offer a wide variety of products in the loose form so that consumers could purchase just the right amount of product. Packaging improvements were suggested by Williams et al. (2012) and HLPE (2014) as a means of preserving the

product and helping consumer waste less, and both Finnish chains have claimed that they are constantly giving feedback on packaging to their suppliers.

In regard to consumer education, Finnish retailers have proved to be quite active with food waste campaigns and media communication channels, as recommended by FAO (2013b), Parfitt et al. (2010) and HLPE (2014). They are participating in campaigns aimed at educating consumers about food waste and publishing a variety of both educational and entertaining material about food waste at their websites and other communication channels.

Overall, while the topic of food waste reduction is not explicitly discussed in scientific literature related to logistics and SCM, the widely acknowledged logistics and SCM concepts have proven to be applicable and efficient at reducing it. This supports the view that efforts aimed at food waste reduction are not separate from general improvements of efficiency and are part of a retailer's day-to-day operations.

8.3 Managerial implications

The case studies as well as the theoretical contributions have demonstrated that actions to decrease food waste are inseparable from retailers' regular operations and general good practices in the industry. Food waste always goes hand in hand with with monetary losses and therefore decreasing it is not only a matter of sustainability strategy, but also a direct cause of improvements in operational efficiency. The study has shown that Finnish retailers adopted most of the practices suggested by international researchers and also Oliver Wyman consulting company, and this would suggest that Finnish retailers could be claimed to perform well when it comes to reducing food waste also on the global scale.

With regard to comparing Finnish retailers to those from other countries, since most of the practices recommended by international researchers have been adopted, this could suggest that Finnish retailers are on par with or exceeding the efforts of retailers operating abroad. However, this cannot be reliably stated since there are no similar studies and the evaluation framework has not been applied to study retailers elsewhere. One study that could suggest that Finnish retailers as well as the whole Finnish supply chain are very efficient at reducing food waste is Silvennoinen et al. (2012) that compared proportions of food waste estimated in Finland with those from FAO (2011) and found that the proportions in Finland are about 2-3 times lower. While the results obtained by Finnish researchers cannot be considered absolutely reliable, still the identified difference is very high and could also be significant in reality. Moreover, Finland is globally viewed as an efficient and innovative

country, and therefore it would be sensible that it would also perform better than average in regard to reducing food waste.

Many of the practices aimed at reducing food waste were proven to be a source of competitive advantage. As described by Oliver Wyman (2014b), freshness is a critical matter in the overall performance of a retailer and a feature that is highly valued by consumers and is therefore used in grocery chains' marketing strategy. Freshness and food waste are highly interconnected, because a store that produces large amounts of food waste will generally have a lot of products on shelves that are nearing their expiration date and are thus not fresh (Oliver Wyman, 2014b). Therefore, decreasing food waste is a genuine source of competitive advantage because it allows to increase the operational efficiency, get rid of unnecessary losses and also increase the overall freshness.

Also, the CSR practices discussed by Forsman-Hugg et al. (2013) have been suggested to bring competitive advantage of being viewed as a good and sustainable enterprise. However, in this case where there are only two large players in the market and both of them emphasize CSR and sustainability in their operations, it is simply compulsory for each of them to keep up the high CSR standards and involve in continuous improvements of their operations. For S-group that is owned by over 2 million Finnish consumers CSR is not only a voluntary action but also a necessity since their shareholders represent over a third of Finland's population.

One important aspect identified from theoretical contribution is the adoption of Collaborative Planning, Forecasting and Replenishment (CPFR) systems with key suppliers. This has been found to reduce inventory losses as well as increase service levels. The Finnish retailers have not mentioned the existence of such systems in their supply chains, and so one recommendation would be to research if their adoption could help the two companies reap the benefits of such systems. This would in any case significantly improve the visibility throughout the supply chain, which would allow managers to make better informed decisions.

Another room for improvement was identified regarding consumer education. This is one of the most critical aspects because consumers food waste is rather high in developed countries, and Finland is one of them. As shown in Figure 3, the largest proportion of consumer food waste in European countries occurs at the consumption stage. Studies of food waste in Finland such as Silvennoinen et al. (2012) and Katajajuuri et al. (2014) also conclude that households generate a very significant proportion of overall food waste. Thus,

while retailers are very efficient at optimizing their internal operations, the most noticeable benefits from the perspective of the whole supply chain can be achieved by influencing consumers' behavior. Practices on the In-store stage such as limitations of volume promotions for perishables and increased offering of products in loose form certainly help consumers make choices that are better suited to their real needs, and therefore have a potential to decrease consumers' food waste. However, more effort could be applied towards educating consumers about food waste in a variety of ways.

The two groups already take part in annual Hävikkiviikko (Waste Week) and provide materials on their websites regarding the scale of the food waste problem and practical tips to consumers on how to reduce it at home. However, such measures could not be assumed to reach the majority of consumers. It is recommended that the retailers aim to get the message through to a wider audience by running their own campaigns and providing more in-store material that would remind consumers of the food waste issue in the course of the shopping process. For example, the chains could launch their own campaigns that would run throughout the year rather than one week a year, and make the campaigns very visible in their stores and communication channels. In-store actions could be especially efficient due to the fact that supermarkets are consumers' main touch points with the food industry and also because most consumers' decisions that eventually lead to food waste are made in stores. Therefore, it would be good if retailers could place more emphasis on such practices and make them more widespread.

Sale of cosmetically substandard produce to consumers is a practice that has not been widely adopted by Finnish retailer chains. Both chains have tested it and such produce might be occasionally on sale in individual stores. While it is highly possible that the produce is used in animal feed or for production of ready-made food, there is certainly room for improvement in this aspect. This is because part of such produce is used for animal feed or composting, and according to the Food Recovery Hierarchy a more preferable way to utilize it would be to direct it for human consumption. Moreover, it could also benefit consumers' perceptions of food to see that fruit and vegetables grow in different shapes that might deviate from the standard ones that they usually observe. This might help to overcome the growing disconnection between food production and consumption that has been mentioned by FAO (2013b) and Parfitt et al. (2010) and constitutes one of the reasons for consumers' food waste.

Overall, the two Finnish retail chains have demonstrated dedicated efforts aimed at decreasing food waste, increasing operational efficiency and involving in sustainable practices such as reverse logistics. The two main aspects where improvements could be applied were consumer education and the use of cosmetically substandard produce.

9 Conclusions

The thesis aimed at forming a holistic view of the food waste topic, finding the main reasons that contribute to food waste and identifying practices that retailers could adopt to decrease it. Also, the aim was to develop a coherent evaluation model containing retailers' practices aimed at reducing food waste and to evaluate the variety of Finnish retailers' practices with the help of the model.

The research objectives determined in the beginning of the thesis were the following:

1. Obtain a holistic view of the topic of food waste and its placement within supply chain management (SCM).
2. Identify the causes of food waste and concrete practices that the retailers could adopt in order to reduce it.
3. Construct and operationalize an evaluation framework of retailer's efforts aimed at reducing food waste at different stages of the supply chain.
4. Evaluate how many of the practices Finnish retailers have adopted and to what extent.
5. Determine what practices are key to reducing food waste in Finnish retailers' opinion.

Chapters 2 - 4 provided holistic and detailed answers to the first two questions. The causes and factors that lead to the generation of food waste were elaborated from literature, and the practices were identified using a combination of previous research and the author's personal observations and ideas. The construction of an evaluation framework mentioned in the third objective was fulfilled in Chapter 5.

Chapters 6 and 7 focused on the last two research objectives. Two largest Finnish retailers, S-group and Kesko, were chosen for evaluation, and information about their activities was collected with the help of documentary analysis and structured interviews. Retailers' practices were evaluated according to a three-level maturity model and the results were compared. In Chapter 8, the author evaluated research and data collection methods utilized, discussed theoretical and managerial implications of the results, as well as identified points for potential improvement and made concrete suggestions on how they could be implemented.

The main contributions of the study were that it developed a coherent evaluation framework that could be utilized to conduct further similar studies, and that Finnish retailers were shown to take the issue of food waste extremely seriously and adopt most of the

practices suggested by international researchers. Most practices in both Kesko and S-group were evaluated to be on the highest level according to the maturity model, which means that the chains have actively adopted most practices that have been connected with reduced food waste. Both chains named careful planning of demands and orders to be the most important factor in reducing food waste, and Kesko also mentioned improvements of product selection. Kesko achieved a slightly lower score because of its less consolidated management structure and a theoretical possibility that individual merchants might choose to withdraw from adopting some of the practices.

The two main areas of improvement identified for both retailers were the usage of substandard produce ("ugly veggies") and efforts to educate consumers about food waste. While substandard produce might be used to prepare store-made food, it is not routinely offered to consumers at reduced prices, as suggested by numerous research papers. The most important point of improvement was the efforts to educate consumers about food waste, and it was suggested that the chains start running their own all-year-round campaigns and also add visual materials to stores so that consumers could take food waste concerns into account when making purchasing decisions. Efforts related to consumer education are essential since consumer stage has the highest potential for decreasing food waste in the whole supply chain in developed countries.

9.1 Limitations of the study and recommendations for further research

This thesis presented a holistic literature review of the topic and described a very basic qualitative study of Finnish retailers' efforts to reduce food waste. The aim of the thesis was to obtain a general understanding of various aspects of the topic and determine the practices that lead to a reduction in food waste throughout the supply chain. The evaluation model was developed and practices implemented by major Finnish retailers constituting 90% of grocery market share were evaluated based on the model and using three levels of evaluation.

Nevertheless, the aim was not to compare the retailers on how well they have actually succeeded at decreasing food waste in numerical terms. Being able to make such a comparison would require "hard" quantitative data, and it would be very beneficial if such a data set could be collected and studied in the future. This would allow to actually evaluate and compare retailers on their efficiency of reducing food waste.

Another important limitation to note is that it was assumed that practices elaborated from the literature are highly correlated with reduced food waste, as the interconnection was established by numerous research publications. The thesis did not have a purpose of determining marginal contributions of certain practices and it also did not examine the deeper implications of adopting the practices due to qualitative research methods and limited access to data. One idea for further research would be to examine how well certain practices are correlated with reduced food waste. This would bring a more scientific and concrete angle to the discussion because the importance of different practices could be established and compared. Consequently, retailers as well as policymakers would be able to make better informed decisions and therefore reduce the food waste in the whole supply chain in a more efficient way.

Moreover, it would be interesting to conduct a cross-cultural study that would compare how retailers have adopted the practices and what are the societal and cultural factors that influence their adoption. Also, while the differences between developed and developing countries in regard to food waste have been widely discussed in the literature, a study of how the practices adopted by retailers differ depending on the country could provide a more practical view and a better understanding of the phenomenon.

The research topic has indeed become extremely popular during the last couple of years and therefore it is expected that numerous further and more detailed studies would be conducted in the coming years. There is still significant room for research in the field as it is rather practical and interdisciplinary.

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Appendices

Appendix 1. Interview questions

Stage	Practice	Questions
1. Pre-store	Collaboration with suppliers on demand planning	**What kinds of collaborations on demand planning are in use?** **How are predicted changes of demand communicated to suppliers?**
	Sustainable order management	**How is order management carried out in the group?** **What part of total purchases are contracted to happen on a regular basis?** **How are unexpected changes to orders managed?**
	Development of shorter supply chains	**Is purchasing localized whenever possible?** **What factors affect the purchasing of local products?**
	Efforts to increase overall freshness	**How is freshness ensured in group's grocery stores?** **By what part of their remaining shelf-life should products be delivered to stores?**
	Improvements of demand forecasting	**How are demand forecasting techniques being improved in the group?**
	Usage of cosmetically substandard produce	**Is cosmetically substandard produce (ugly veg) being used in the store's supply chain?** **Are there any plans to increase their use?**
	Improvements of packaging	**Does the group give feedback on packaging to its suppliers?** **Is packaging one of the criteria that the group uses while making purchasing decisions?**
	Improvements of food waste analysis and reporting	**What units and levels of employees are involved in practices aimed at reducing food waste?** **Are food waste analysis and reporting a routine part of business management?**

2. In-store	Optimization of product selection	**How frequently is product selection revised?** **Are items routinely reduced if not selling well?**
	Increased offering of loose products	**What kinds of products are offered in loose form?** **Is the group planning to extend its selection of loose products?**
	Limitations of volume promotions for perishables	**Are food waste concerns taken into account when planning volume promotions for perishables?**
	Discounts for products nearing expiration dates	**Are all types of products being discounted when nearing expiration dates? How are the products to be discounted being chosen?**
3. Reuse	Commitment to active food donations	**Is food regularly donated?** **Are there contracted cooperations between stores and recipients?**
	Commitment to animal feed diversion	**Is part of generated food waste diverted to animal feed?**
	Commitment to recycling	**What kind of recycling methods are in use?**
	Valorization according to Food Recovery Hierarchy	**Is the following order of food recovery in use? source reduction, charity donations, material and energy recovery and only then landfill**
4. Consumer education	Involvement in third-party food waste campaigns	**What kind of food waste campaigns has the group been involved in?**
	Education on food waste topics in communication channels	**Does the group produce any educative materials about food waste in its communication channels?**
	Within-store actions aimed at raising awareness	**Do customers receive any in-store information regarding food waste and ways to reduce it?**