Fruitful Cooperation

A Supply Chain Perspective on Food Waste Innovation

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Master Thesis Economic Geography
Final version: August 12, 2018
Supervisor: Prof. dr. A. Lagendijk

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Preface

The defining feature of the study of geography is its unique and specific attention to the interaction between human beings and their environment. The one cannot be fully understood without the other, as both components affect, and are affected by each other. In my opinion, there is no other topic in geography that embodies this intricate relationship better than food. Food epitomises a long and strenuous narrative of human invention, which has since long strived to master nature and to employ it for its own benefit. Over the years, methods of irrigation, selective breeding, fertilization and genetic modification have all made their contributions to the ongoing intensification of food production worldwide. At the same time, however, the production of food is still fraught with many challenges related to the environment, including unpredictable weather, uncontrollable pests and persistent diseases. Moreover, food is also permeated with cultural connections, eating habits and individual preferences, which add an extra social dimension to food-related issues. One of such issues is the pervasiveness of food loss and waste within contemporary food production and consumption.

In this master thesis, I hope to slightly elucidate the complex drivers and effects that are related to this issue. During my internship at the Brabant Development Agency (Brabantse Ontwikkelingsmaatschappij, BOM) over the past months, I have gained a lot of knowledge on this topic by talking with numerous inspiring entrepreneurs in the agrifood sector, meeting some prominent experts in the field, and discussing ideas with many other smart people during debates and events. I am thankful to all of you for your contributions to my final master thesis, no matter how small or big they have been. Nonetheless, I would like to use this page to thank a few people in particular. First of all, the ecosystem development team at the BOM, and most notably my internship supervisors Linda van Mierlo and Chantal Dietvorst. All of you have made my internship a very valuable experienced and I have thoroughly enjoyed being a part of your team. In particular, I could not have wished for a better supervisor than Linda, because of her enthusiastic involvement in my research project, the frequent and fruitful feedback moments, and the fact that I could always stop by for questions or advice. Also the team of Food Waste Xperts and others who are involved with innovation hub Three-Sixty in Veghel must be mentioned here, because of their support at various stages of my research. To Eja, Jac, Rob, Bob, Barbara, Judith (both of you!), Roos, Sanne, Ella, Helga and many others: your help has been very much appreciated! Finally, I would like to thank my thesis supervisor prof. dr. Arnoud Lagendijk for his concise and constructive feedback throughout the whole research process. This thesis research has truly been a challenging experience at times and I could not have achieved the same end result without all of you.

Bryan van Alebeek, Berlicum, 11 August 2018

Summary

Over recent years, many initiatives to reduce or prevent food loss and waste have been established. However, food waste numbers continue to be high all around the world, with approximately one third of the annual food production not ending up in the mouths of consumers (FAO, 2011). Food waste represent a complex issue related to production methods, logistical limitations, intricate trade relationships, health and safety regulations, norm standards, perishable products, consumer preferences, et cetera. The mitigation of food loss and waste is therefore hard to oversee and/or manage by individual companies, especially for the many Small or Medium-sized Enterprises (SMEs) that characterise the agriculture and food sector. Therefore, the need for intermediary organisations is stressed, that can help to complement SMEs' resources or function as a bridge to connect individual firm operations with more systemic supply chain level interactions that are related to the generation of food waste. This research will specifically focus on Food Waste Xperts, as a case of an intermediary organisation that is focused on innovation of food waste performance among companies. Henceforth, the main research question that is addressed in the research is:

How can intermediary organisation Food Waste Xperts be beneficial to SMEs in the agrifood sector that want to reduce or prevent food loss and waste?

In order to answer this question, the following subquestions are stipulated:

1. To what extent is food loss and waste an issue for companies in the agrifood sector?
2. What challenges do SMEs that want to reduce or prevent food loss and waste face, and what do they think they need to cope with these issues?
3. How are supplier-buyer relationships organised throughout the food supply chain and how does this affect the possibilities to reduce food loss and waste as a whole?

Theory

This research builds upon the work of two major strands in food-related research. On the side of supply chain collaboration and innovation, attention is given to modes of cooperation and coordination along the supply chain. These relationships are interpreted on the basis of Supply Chain Management approaches, and specifically look how supply chains are dynamically constituted, subsequently producing certain relations of power and responsibility among agents. On the side of routinised practices, recent development in the field of Convention theory are employed to analyse supply chain interactions. From this perspective, certain agreements and regularities emerge in

supply chains over time, which relates to matters of power and responsibility on the side of supply chain management. However, these regularities in economic action are justified by making references to specific 'orders of worth', as they have been described in the work of French sociologists Laurent Thévenot and Luc Boltanski (Thévenot et al., 2000; Boltanski & Thévenot, 2006 [1991]). The orders of worth can also be used to analyse the urgency in companies to reduce food waste, as well as to assess whether or not reduction strategies will be accepted by other companies relatively easily. The orders of worth are also related to the literature on Alternative Food Networks (AFNs), which also appeal to food waste mitigation. The question is, however, whether food waste reduction is really something that can only be addressed in alterity, or if there are also feasible leverage points to incorporate food waste reduction in conventional food systems. Furthermore, both theories were approached from a relational perspective, which means that network and supply chain relations were not conceived as being stable and fixed entities, but rather they are dynamic and constantly (re)constructed in relation with a wide variety of actors.

Methods

This research employs a mixed method design in order to triangulate and complement data sources. A sequential design was chosen, including a short survey to appraise the barriers and needs that are experienced by companies in relation to food waste reduction, and 12 in-depth interviews in different segments of the supply chain as a follow-up to the survey findings. The aim of the research was to investigate the whole food supply chain from primary production until retail and hospitality, which has generally been achieved. Data sources mainly included companies that were already actively involved with food waste reduction strategies. These sources were believed to provide more detailed knowledge on the constraints and opportunities for food waste reduction, since they are more experienced with it.

Results

Food waste is found to be of low concern for many companies in the food supply chain. Firms tend to evaluate their own business operations as already being highly efficient. Existing food waste is therefore usually regarded as an unavoidable residual and does not provide a sufficient incentive for change. Where food waste reduction is successfully incorporated in business practices, leverage points for increased efficiency and/or market competitiveness were found, indicating that food waste reduction has to be mainly modeled on existing routines. This also opens the debate on Alternative Food Networks. From this research, it seems more feasible for food waste mitigation to make an impact if it can connect to conventional food systems and their respective orders of worth, rather than being limited to small niche markets in the realm of AFNs.

Barriers for food waste reduction are found to be mainly related to market access, logistics, and a lack of supply chain cooperation in general. Especially for SMEs, it can be challenging to find sufficient market volume and set up logistical networks, since they usually lack the resources. These findings support the view that the complexity of food waste generation requires collaboration among the supply chain to achieve effective solutions. For individual companies, it will be hard to make an impact. However, the cooperation among companies and supply chains is also fraught with challenges. Paradoxically, the efficient organisation of our contemporary food system in part contributes to the generation of food waste. Products, processing tasks and trade are so fragmented over different companies, that each one of them is highly specialized and has built up the most efficient workflows for their specific company over time. Due to this efficiency – in combination with relatively low prices for many food products – even minor adaptations to the production process are not economically viable, since they would require too much investments or labour costs compared with the benefits (which cannot always be expressed in merely monetary terms). In order for innovations to be achieved, collaboration should thus focus on finding shared interests and incentives for the reduction of food waste, in combination with leverage points to share information more extensively and better align production processes and logistics between companies. Power balances can be a constraining factor in this respect, but the fragmented nature of the agrifood supply chain also allows for new markets to be formed, that can slowly grow and build new partnerships.

On the level of the supply chain, power relationships are solidified in responsibility and routines. As a general mechanism, actors try to shift the responsibility of food waste as far back in the supply chain as possible. They can do this by imposing strict cosmetic or quality standards on their products, which gives them an opportunity to reject lower grade food products. What happens to these rejected batches remains rather vague, but for the company this is not a concern since it does not longer affect their business performance. These standards can eventually lead to routines within supply chains to only use specific grades of products and reject those with divergent qualities. Although such operations might be justified to some extent, it can be argued that most of these quality standards got disconnected from health and safety regulations, and now only serve as a marketing tool to control competition with other companies and/or markets.

The most pressing challenge for the future of food is the eradication of world hunger. In light of this issue, food-related problems are often framed in Malthusian terms: there already is hunger now and within a few decades there will be even more mouths to feed. However, the current extent of food waste indicates that we can already produce enough food to feed a growing world population. The real challenge should therefore be sought in matching places with surpluses and deficits, and even more so in finding new schemes to qualify food, which also incorporate social and environmental values next to economic and nutritional ones. For companies, intermediary

organisations could be of use to bring about such innovations. With regard to issues like food waste, they have to balance between awareness-raising in order to get a majority of companies interested in the issue and hence be able to make an impact on the one hand, and supporting firms with specific problems on the other hand. Moreover, innovation intermediaries provide the main bridge to simultaneously address concerns in individual companies as well as systemic obstacles at the supply chain level. The main functioning of intermediaries in this respect is to oversee the supply chain and act as a referral to direct companies to the most fruitful leverage points for collaboration. The actions of intermediaries are then two-sided: on the one hand, awareness-raising might contribute to the further fragmentation of the agrifood sector and the establishment of new niche markets, whereas supportive activities include the (re)connection of these fragments into valuable collaborative innovation networks.

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List of Abbreviations

AFN	Alternative Food Network
AGF	Aardappelen, Groente en Fruit (potatoes, vegetables and fruit)
CREM	Consultancy bureau in the Netherlands
CSR	Corporate Social Responsibility
EU	European Union
FAO	Food and Agriculture Organization (United Nations)
GVC	Global Value Chain
HAS	Dutch institute for higher education in agriculture, food, and life sciences
LNV	Landbouw, Natuur en Voedselkwaliteit (Dutch Ministery of Agriculture, Nature, and Food Quality)
MVO	Maatschappelijk Verantwoord Ondernemen (Dutch equivalent of CSR)
SCM	Supply Chain Management
SDG	Sustainable Development Goal
SME	Small or Medium-Sized Enterprise
UK	United Kingdom
UN	United Nations
US	United States
WRAP	Waste and Resources Action Programme (action plan in the UK)
WUR	Wageningen University and Research Centre

1. Introduction

1.1 Research framework

Deformed carrots, apples with brown spots, or milk that has passed its *best before* date. There are plenty of reasons why food is thrown away instead of being eaten. In total, a third of the worldwide production of food is never consumed (FAO, 2011). The food is lost during harvesting, processing or transportation. Or it is thrown away at supermarkets, restaurants or at home. Global food loss and waste add up to 1.3 billion ton each year with an estimated market value of over 900 billion US dollars (FAO, 2015). Moreover, amounting to a total of 1.5 quadrillion kcal (Lipinksi et al., 2013), the energetic value that is wasted every year could easily feed the 815 million people (FAO et al., 2017) that currently live in hunger. Besides, food waste inherently implies the waste of other resources and inputs, including land, water, energy, nutrients, labour and money. By the same token, global food loss and waste account for about 8% of anthropogenic greenhouse gas emissions, according to recent calculations of the FAO (2015). Food loss and waste thus also involve economic, social and environmental effects that go beyond a simple dissipation of consumer goods.

The negative effects of food loss and waste have not gone unnoticed by consumers and producers alike. Over recent decades, conventional food production and consumption in general have been criticized in light of sustainability, health, transparency and fair trade concerns (Whatmore et al., 2003; Goodman et al., 2012). Still, however, food waste numbers remain high and have not shown significant signs of decline over recent years – at least not in the Netherlands (Soethoudt et al, 2017; see also Section 1.3). Why do changes fail to occur, when there is so much to gain in economic, social, and environmental terms? A lack of awareness among companies and consumers is often mentioned as a strong contributing factor (Parry et al., 2015). However, in the researcher's opinion, a simple lack of awareness cannot provide a sufficient answer to a complicated issue like food loss and waste. More structural forces must be at work, that inhibit the successful evolution of our food system to cope with contemporary social and environmental pressures.

Especially for smaller businesses within the food supply chain, effective adaptation can be difficult to achieve. Previous research has shown that small and medium-sized enterprises (SMEs) innovate in different ways than large corporations (Bos-Brouwers, 2010). Klewitz and Hansen (2014) attribute these differences to more flexible organisational structures on the one hand, which enable SMEs to innovate more radically and operate in niche markets, while, on the other hand, they are also constrained by a general lack of resources and possibilities to attract finance. These constraints often force SMEs to employ 'reactive strategies' (ibid., p. 59) towards sustainability issues and paradoxically also limit their potential for radical innovation (Baregheh et al., 2012). As a

consequence, Verboven and Vanherck (2016; 2015) argue that SMEs in particular could benefit from supportive tools and organisations, that assist these companies to translate high-level sustainability goals into low-level, actionable activities and implementation strategies.

In innovation literature, such supportive organisations are often referred to as intermediaries (Nilsson & Sia-Ljungström, 2013; Howells, 2006). Intermediary organisations have been ascribed a plethora of potential functions, including the provision of specialized business services like financing, administrative support, legal advising and training (Apa et al., 2017; Cantù et al., 2015; Tran et al., 2011), strengthening and building internal and external relationships between stakeholders (Apa et al., 2017; Cantù et al., 2015), reducing boundaries between stakeholders (Guo & Guo, 2013; Klerkx et al., 2010), and 'knowledge brokerage' (Lauritzen, 2017; Guo & Guo, 2013). From a supply chain perspective, Lauritzen (2017) especially emphasizes the role of intermediaries to bridge tensions of competence, power, and identity between different stakeholders. For Nilsson and Sia-Ljungström (2013), it is furthermore important to note that intermediary functions, while being predominantly focused on supporting individual firms, simultaneously contribute to innovations on a systemic level. This double functioning of intermediaries provides for an interesting research object, especially in light of complex issue such as food waste, that act within and throughout whole supply chains.

In the Netherlands, *Food Waste Xperts* positions itself as an intermediary organisation for companies that want to reduce or prevent food loss and waste. The organisation consists of a network of various experts who can aid companies to improve their 'food waste performance'. Food Waste Xperts' supportive activities consist of a four-step method, including a helpdesk, intake, workshop and community. This method will be described in further detail in Section 3.3.1. In this research, the case of Food Waste Xperts is used to investigate the role of intermediary organisations in stimulating innovation processes. Besides, it will adopt a supply chain perspective to move beyond the scope of individual enterprises. The relevance of this approach will be elaborated on in Sections 1.3 and 1.4. First, however, the research objective and questions will be defined in the next section.

1.2 Research objective and questions

The objective of this research is to contribute to the successful reduction and prevention of food loss and waste in the food supply chain, by making practical recommendations to intermediary organisation Food Waste Xperts with regard to the services they provide to SMEs in the agriculture and food sector. To achieve the research objective, the following research question is addressed:

How can intermediary organisation Food Waste Xperts be beneficial to SMEs in the agrifood sector that want to reduce or prevent food loss and waste?

In order to answer this question, the following subquestions are stipulated:

1) To what extent is food loss and waste an issue for companies in the agrifood sector?
2) What challenges do SMEs that want to reduce or prevent food loss and waste face, and what do they think they need to cope with these issues?
3) How are supplier-buyer relationships organised throughout the food supply chain and how does this affect the possibilities to reduce food loss and waste as a whole?

Since food loss and waste is a 'latent problem' for many companies (diary 20-02-2018), the first subquestion is necessary to assess the level of urgency within firms to reduce their food waste. This is important, in that a low level of urgency is very likely related to lower levels of commitment and motivation to reduce and prevent food waste in the long run. The first subquestion will also give insight in the kind of activities that are needed to improve the food waste performance among companies. If the level of urgency is low, an intermediary organisation like Food Waste Xperts should aim at awareness-raising first. However, when food waste is already experienced as an issue by companies, Food Waste Xperts could focus more directly on problem-solving.

Subsequently, with the second subquestion, specific challenges are identified for the companies that do experience a level of urgency and are actively working on the reduction of their food loss and waste. Besides, this subquestion will also investigate the aspects on which SMEs would like to get support in order to improve their food waste performance. The second subquestion will thus expose the barriers that currently constrain SMEs to reduce food loss and waste, and can therefore be used to set out an action plan for the future.

Whereas the first and second subquestion are mainly focused on individual companies, the third subquestion serves to place the findings of this research in the context of wider food supply chains. Therefore, the relationships between different links in the supply chain will be elucidated. Furthermore, this subquestion will be employed to reflect on the possibilities and limitations of individual companies to make an impact, as well as to find leverage points for fruitful cooperation among the whole supply chain in the agriculture and food sector.

1.3 Societal relevance

In the Netherlands, food loss and waste are monitored since 2009 by the Wageningen University and Research Centre (WUR). The monitor was developed in light of the *nota duurzaam voedsel,* a policy plan by the Dutch national government which, among other things, aimed to reduce food waste by 20% between 2009 and 2015. The policy plan was based on three pillars: (1) stimulating innovation

within the agrifood sector; (2) education and awareness-raising among consumers; and (3) international agenda-setting and research (Ministerie van LNV, 2009, pp. 17-18). Despite this policy plan, however, the amount of food loss and waste in the Netherlands has remained relatively stable, as can be observed in Figure 1.1. According to the latest calculations, between 105 and 152 kg[1] of food was wasted per capita in the Netherlands in 2015, compared to 110-156 kg in 2009 (Soethoudt et al., 2017).

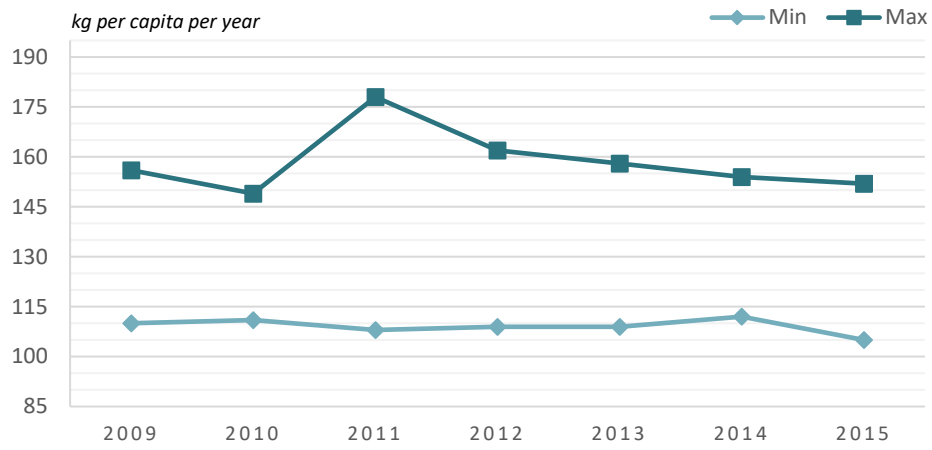


Figure 1.1. Estimated food loss and waste in the Netherlands 2009-2015. Source: Soethoudt et al., 2017, p. 4.

After the failed attempt of the *nota duurzaam voedsel*, new plans to reduce food loss and waste have been initiated. In January 2017, a *Taskforce Circular Economy in Food* was established, which comprises of 25 members from the food supply chain, government institutions and civil society organisations (WUR, 2017). Moreover, this platform is linked to the Sustainable Development Goals (SDGs) of the United Nations. The SDGs entail an agenda of 17 goals to be achieved by 2030, and were agreed upon by 193 countries in 2015. The reduction of food loss and waste is part of goal 12, which aims to "ensure sustainable consumption and production patterns" (United Nations, 2015, p. 24). SDG 12 is divided into eight subtargets, of which SDG 12.3 states to "halve per capita global food waste at the retail and consumer levels and reduce food losses along production and supply chains, including post-harvest losses" by 2030 (ibid., p. 25).

The new targets that are part of SDG 12.3 are not less ambitious than the previous *nota duurzaam voedsel*. Instead of 20% reduction in six years, the aim is now set at 50% reduction in fifteen years. To avoid another failure, this research seeks to contribute to more successful policies in two related ways. Firstly, by focusing on companies within the food supply chain, and secondly by addressing SMEs in particular. Many government programmes centre around consumer food waste,

[1] The rather wide range of this estimate can be explained by the fact that food waste data is often incomplete (for all sectors), inconsistent, and relies heavily on self-reporting. See Bos-Brouwers et al. (2015) and Soethoudt & Bos-Brouwers (2014) for a discussion on the WUR Food Waste Monitor.

including awareness-raising campaigns and education projects, e.g. the Love Food Hate Waste campaign in the UK or the *Kliekipedia* (an encyclopaedia of recipes with leftovers) in the Netherlands. The responsibility to reduce food waste in companies, however, is to a large extent left to self-regulation within the sector. As was inferred from Figure 1.1, both of these strategies have not led to the desired results so far. In order to design more suitable policies in the future, this research can therefore give insights in the factors that have limited the self-regulation of food waste within the food supply chain. Moreover, a more prominent focus on companies in the food supply chain is also desirable, since they account for about half of the total food loss and waste in the Netherlands[2].

More specifically, this research will focus on small and medium-sized enterprises (SMEs) in particular. As was already discussed in Section 1.1, SMEs innovate in different ways and therefore have different needs than larger corporations. In the Netherlands, about 95% of all businesses in the agriculture and food sector has less than 10 employees (Fris, 2014). In total, SMEs (less than 250 employees) even account for 99.9% of all companies in the sector, providing 79.5% of the total employment and producing 55.9% of the added value (ibid.). Nonetheless, initiatives to reduce food waste are mainly directed at, or driven by big (transnational) corporations. The Dutch *Taskforce Circular Economy in Food*, for instance, includes companies like McDonald's, Google, Ahold Delhaize and Royal DSM. These corporations do not only have access to vastly different resources and opportunities, they also deal with very different challenges compared to smaller-sized companies. Therefore, this research pays specific attention to the constraints and opportunities for SMEs to reduce food loss and waste, in order to provide a more nuanced view of the challenges that the contemporary agrifood sector is facing. This approach is also useful, given the economic significance of SMEs in the sector.

1.4 Scientific relevance

As was stated in Section 1.3, many food waste initiatives focus predominantly on consumers. This propensity is also reflected in research papers (see Canali et al., 2016). Especially behavioural analyses have sought to reveal the causes of food waste among consumers (e.g. Quested et al., 2013; Jones, 2004; Sanne, 2002), while the driving forces behind corporate food waste remain largely understudied. When research is conducted on food waste within companies, the focus is usually on only one specific sector, such as retail (Teller et al., 2018; Lebersorger & Schneider, 2014), wholesale (Lewis et al., 2017), hospitality (Luitjes, 2007), or the manufacturing industry (Garrone et al., 2016;

[2] The exact division of food waste over consumers and supply chain is hard to determine due to a general lack of data. Based on measurements by Voedingscentrum (2017) and CREM Waste Management (2017) in Dutch households, however, the 50/50 division can be inferred. These studies estimate household food waste to be 41 kg and 62.2 kg per capita, respectively. This division is consistent with measurements in other industrialised countries (see Lipinski et al., 2013, p. 9).

Mirabella et al., 2013). Although these studies can provide valuable and detailed insights in the dynamics of one specific sector, they often fail to address connections with other links in the supply chain. Moreover, studies that do investigate the supply chain as a whole (e.g. Parfitt et al., 2010; Prieffer et al., 2016) often fall in the trap of categorising findings by sector or supply chain link, which still limits their potential to move beyond individual companies. Nevertheless, due to the recent popularity of *Supply Chain Management* (SCM) approaches, the number of supply chain level analyses is rising rapidly.

This research seeks to make two contributions to the SCM literature. On the 'supply chain side', its aim is to assess food waste in the Netherlands in a systemic way, that moves beyond the traditional firm-focused efficiency paradigm that is still dominant in many enterprises. This paradigm is typically characterized by the industrial, standardized and bulk production of commodity goods, directed at the fulfilment of capitalist or neoliberal corporate interests (McMichael, 2009; Burch & Lawrence, 2009; Pechlaner & Otero, 2008). A more systemic approach fits within recent developments in economic geography to move away from structuralist and sectoral analyses towards more relational and networked approaches (see also Section 2.2). It is believed that such a supply chain approach is most suitable for this research, in that it reflects the complexity of food waste generation (see Quested et al., 2013; Garrone et al., 2014), as well as the fragmented organisation of the contemporary economy (see Dicken et al., 2001; Dicken, 2015). From a relational perspective, operations at the level of individual firms are considered to be dynamically constituted in interaction with other companies and organisations in the supply chain. Henceforth, supply chain relations are not fixed entities that can readily be assessed at once. Rather, these interactions should be traced from individual actors, in order to arrive at the emergent level of the supply chain as a whole. Therefore, the research questions principally focus on individual companies as the main data source from which wider supply chain interactions can be delineated. Other implications and characteristics of the relational perspective will be elaborated on in the next chapter. Moreover, the research connects with a growing body of literature on power relations and the role of product standards in the food supply chain (see Devin & Richards, 2018; Ponte & Gibbon, 2005).

On the 'management side', this research will focus on the role of intermediary organisations in assisting companies to improve their food waste performance. This approach serves a double purpose. On the level of individual firms, insights can be gained on how to effectively incorporate food waste reduction and prevention measures. Simultaneously, on the level of supply chains, intermediaries also contribute to the alignment of economic activities, that can give better insight in the systemic constraints and opportunities to mitigate food loss and waste. Similar to the SCM perspectives described in the previous paragraph, this part of the research connects with relatively new networked perspectives on innovation (e.g. Morgan, 1997; Lundvall, 1992) and literature on the

governance of Global Value Chains (GVCs; see Gibbon et al., 2008; Gereffi, 2014). These aspects will be elaborated on in the next chapter as well, notably in Section 2.2.3.

1.5 Reading guide

In Chapter two, a literature review will be presented that connects topics from Supply Chain Management theory with Convention theory and models them on the issue of food waste reduction and prevention. This literature focuses on the role of qualities, routines, innovation, cooperation and power, that will all be discussed in Chapter two. In conclusion of this literature review, a conceptual model is presented that provides the basis for this research's data collection and analysis. Moreover, Chapter two will provide a more theoretical background to expand on the scientific relevance discussed in Section 1.4, and it presents conjectures on each of the research subquestions introduced in this chapter.

Subsequently, in Chapter three, the items and relations from the conceptual model will be operationalised, together with a discussion on the strategies for data sampling, collection, and analysis that were employed for this research. The chapter will conclude with a brief introduction of the case of Food Waste Xperts, around which this research is build.

In Chapter four, the findings from both the survey and interviews will be discussed, contrasted and related to each other in order to come up with results on each of the research questions. This chapter gives an overview of the many issues that are related to food waste generation as well as reduction, and finally paves the ground for conclusions to be drawn.

After the conclusions on each of the research subquestions, Chapter five will move one step beyond individual firms and supply chains to place this research's results in a wider context of conventional and alternative food networks, power relations, and schemes for qualification. Subsequently, conclusions will be drawn on the main research question by providing some practical recommendations to intermediary organisation Food Waste Xperts, which is accompanied by a more general discussion on the role of intermediaries in supply chain innovation efforts. The chapter will conclude by addressing some of the limitations of this research, as well as assessing the possibilities for future research to expand on the issue of food waste reduction.

2. Theoretical framework

2.1 Food waste in the supply chain: an overview

The generation of food waste is a complex issue, that is influenced by multiple, interacting activities and actors. For one thing, food itself entails a number of characteristics which generate rather particular dynamics in the agriculture and food sector (Canali et al., 2016; Quested et al., 2013; Parfitt et al., 2010). On the consumption side, food is not only needed for the subsistence of human life, it is also heavily permeated with cultural beliefs, social norms, and personal attitudes, habits and preferences. On the production side, actors in the food supply chain have to cope with perishability, external factors such as weather, pests and diseases, and the fact that food is, in many cases, a natural product that cannot be (completely) standardized in terms of shape, weight or colour. Furthermore, the complexity of the contemporary food system leads to a separation of actions and consequences in space and time, which further contributes to the convoluted origins of food waste (Quested et al., 2013). Many researchers have investigated the causes of food loss and waste in different stages of the food supply chain. As a means of introduction, an overview of this literature is presented in Table 2.1. The data in this table is mainly based on literature review articles and case studies from the Global North. Background information on each of the articles can be found in Appendix I. In Table 2.1, five categories are distinguished to divide the food supply chain - viz. agriculture and production, manufacturing, wholesale/distribution, retail, hospitality and food service - which correspond with the answer options from the survey (see Appendix II).

Table 2.1 Main drivers of food loss and waste in different stages of the supply chain found in the literature.

Agriculture and production
• **Overproduction** due to subsidy schemes (Stuart, 2009) and supply agreements (Priefer et al., 2016) • Harvesting at **incorrect maturity stage** (Sargent et al., 2009; Parfitt et al., 2010) • **Crop damage** during harvesting or due to pests (Priefer et al., 2016) • **Post-harvest losses** in storage (Parfitt et al., 2010) • Non-compliance with **trading standards** (Priefer et al., 2016; Garrone et al., 2014; Stuart, 2009) • Deliberate sorting of **out-grades** to improve quality of harvest (Parfitt et al., 2010)
Manufacturing
• Wrong **forecasts** or orders (Stuart, 2009) • **Overproduction** (Stuart, 2009), especially of supermarkets' own brands (Priefer et al., 2016) • High **quality standards** for brand protection (Stuart, 2009; Parfitt et al., 2010; Garrone et al., 2014) • Rejection of **misshapen products** that are unfit for processing (Priefer et al., 2016; Halloran et al., 2014) • Frequent **changeovers** of production line (Stuart, 2009) • High **R&D costs** to process food waste (requires extra handling)(Mirabella et al., 2011) • **Excess stock** (Priefer et al., 2016) and exceeding of internal **sell-by date** (Garrone et al., 2014) • **Incidental mistakes**: contamination of production process (Parfitt et al., 2010), mislabelling or inappropriate packaging (Lewis et al., 2017), inconsistent manufacturing (Priefer et al., 2016) • **Process losses** (Parfitt et al., 2010), although in part unavoidable and/or inedible

Wholesale/distribution

- Wrong **forecasts** or orders (Priefer et al., 2016; Gunders, 2012)
- **Spoiling or damaging** during transport (Garrone et al., 2014; Parfitt et al, 2010; Sargent et al., 2000)
- Interrupted **refrigeration** (Lewis et al., 2017; Priefer et al., 2016; Gunders, 2012; Sargent et al., 2000)
- Exceeding internal **sell-by date** (Garrone et al., 2014)
- Incorrect **stock rotation** (Canali et al., 2016)
- Stringent **safety standards** (Priefer et al., 2016)
- Non-compliance with **buyer requirements** (Verghese et al., 2015)
- Obligation to **buy in bulk** (quantity discounts)(Priefer et al., 2016)

Retail

- Wrong **forecasts** (Teller et al., 2018; Priefer et al., 2016; Stuart, 2009)
- Poor **handling** of products by employees (Teller et al., 2018; Lewis et al., 2017; Parfitt et al., 2010)
- Package **damage** or too short shelf life at delivery (Teller et al., 2018; Stuart, 2009)
- **Overstocking** of shelves ('fear of running out')(Teller et al., 2018; Priefer et al., 2016; Verghese et al., 2015; Gunders, 2012, Stuart, 2009)
- Width and depth of **product range** (too much choice)(Teller et al., 2018; Priefer et al., 2016; FAO, 2011)
- Incorrect **stock rotation** (Teller et al., 2018; Verghese et al., 2015)
- Purposeful discards when **expiry date** is closing (Halloran et al., 2014; Canali et al., 2011)
- **Whole package discarded** when one item is rotting (Mena et al., 2014)
- High **quality standards** (Teller et al., 2018; Priefer et al., 2016; Verghese et al., 2015; Stuart, 2009)
- **'Cherry picking'** by customers for best looking products (Teller et al., 2018; Lebersorger & Schneider, 2014, Mena et al., 2014)
- **Confusion** about best-before and use-by dates (Lewis et al., 2017; Lebersorger & Schneider, 2014)
- **Package and portion sizes** too large (Teller et al., 2018)
- **Discounts** ('buy one get one free') stimulate overconsumption (Halloran et al, 2014; Priefer et al. 2016)
- Longer **opening hours**, hence products longer on display (Canali et al., 2016)

Hospitality and food service

- Wrong **forecasts** (Priefer et al., 2016; Pirani & Arafat, 2014; WRAP, 2013; Luitjes, 2007)
- **Volatile sales**, dependent on season, weather, competitors (Pirani & Arafat, 2016; Heikkilä et al., 2016; Luitjes, 2007)
- **Overpreparation** and poor menu planning (Betz et al., 2015; Pirani & Arafat, 2014; Garrone et al., 2014)
- Too much **carbohydrates** (potatoes, pasta, rice)(Pirani & Arafat, 2014; Luitjes, 2007)
- **Buffet style** (Papargyropoulou et al., 2016; Pirani & Arafat, 2014 and 2016; Heikkilä et al., 2016; Priefer et al., 2016; Luitjes, 2007)
- **Staff behaviour** (stock rotation; safety standards; informing guests)(Heikkilä et al., 2016; Luitjes, 2007)
- **Customer behaviour** (e.g orders too much; regards salad as mere decoration; last-minute cancellations)(Papargyropoulou et al., 2016; Pirani & Arafat, 2016; WRAP, 2013; Luitjes, 2007)
- **Excess stock** due to infrequent deliveries, obligation to buy bulk, and big package sizes (Heikkilä et al., 2016; Pirani & Arafat, 2014)
- **Oversized portions** (Priefer et al., 2016; Betz et al., 2015; Pirani & Arafat, 2014; WRAP, 2013)
- **Safety and hygiene standards** (Heikkilä et al., 2016; Priefer et al., 2016; Luitjes, 2007)

A few conclusions can be drawn from the literature study that is presented in Table 2.1. Firstly, there are both generic and specific factors that contribute to the generation of food loss and waste. Most studies so far have focused on sector-specific factors, by attributing drivers of food waste to distinct segments of the supply chain. These specific factors are related to the storage and handling of products within a particular sector, such as harvesting in agriculture, the shape of products that can

fit in a machine, refrigerated transportation in the distribution sector, the stocking of shelves in retail, and the presentation of dishes and portion sizes in the hospitality and food service sector. However, there are also generic factors that appear throughout the supply chain. These factors include the forecasting of sales, incentives to overproduce, and stringent standards on quality, safety and hygiene. Although the attribution of specific causes to specific segments of the supply chain helps to elucidate the complicated nature of (intra-)firm operations in relation to food waste generation, these generic factors reveal more structural inefficiencies in the supply chain. This research will therefore specifically build on matters of forecasting, production incentives and quality standards.

Secondly, findings from the literature review also show some contradictory factors. The most striking paradox is the rejection of misshapen products due to high cosmetic and quality standards on the one hand (Teller et al., 2018; Priefer et al., 2016; Verghese et al., 2015; Stuart, 2009), and cherry picking for the best looking products by customers on the other hand (Teller et al., 2018; Lebersorger & Schneider, 2014, Mena et al., 2014). This implies that simply lowering quality standards will not contribute much to the reduction of food waste. Rather, the cherry picking seems to justify the already high quality standards that are imposed by supermarkets, since customers apparently want even better products than the minimum quality that is accepted by the retail sector. A previous study in five Northern European countries also provides mixed results on this matter (De Hooge et al., 2017). It seems that, in principle, minor deformations or damages are acceptable to consumers (albeit with a discount), but at the moment of purchase customers aim to get the best deal and therefore often leave suboptimal food products on the shelf. These findings affirm that food waste reduction requires a shared effort of consumers and companies alike.

Thirdly, the literature review reveals an emphasis in most publications on the causes, magnitude and reduction strategies of food loss and waste, with a disproportionate attention for the retail sector. Conversely, especially agriculture and the hospitality and food service sector remain largely underrepresented. Food loss and waste in the agricultural sector is often conceived as unavoidable due to harvesting techniques, pests or weather damages (Parfitt et al., 2010). However, such conceptions miss the large amount of waste that is caused by interactions with other segments of the food supply chain (Arias Bustos & Moors, forthcoming; Stuart, 2009). Among other things, these losses are related to inadequate forecasting, supply agreements, and quality or cosmetic requirements set by buyers. With regard to the hospitality and food service sector, drivers of food waste are often aggregated with consumer behaviour. However, food waste in restaurants and other service locations is only partially caused by their customers. Betz et al. (2015) estimate that around three quarters of the food waste in restaurants can be attributed to storage, preparation and serving inefficiencies. Research on food waste should therefore pay specific attention to the dynamics and interdependencies within and beyond sectors in the food supply chain (Teller et al., 2018). Such an

approach can give a more in-depth understanding of food waste generation within our contemporary food system, and especially fills the scientific gap of addressing interactions at the interface between two supply chain segments (Mena et al. 2011). This study specifically aims to contribute to this research agenda, which will be elaborated on in Section 2.2.

2.2 Towards relational supply chain perspectives

Since the end of the Second World War, the world economy has developed in several significant ways. The economic centre of gravity has gradually fragmented towards a multi-polar world order, firms have become increasingly organised on a global level, and international trade has continued to tie up distant places to intricate global production networks (Dicken, 2015). Along with these novel organisational configurations came the need for new perspectives and tools of analysis. In particular, traditional neoclassical and political-economic models seemed unfit to account for the micro-level dynamics that were involved with these developments (Boggs & Rantisi, 2003, p. 110). Moreover, both neoclassicism and political economy share a 'teleological bent' (ibid.) to assume that capitalism acts in universal ways all over the world. As a response, more *relational* approaches have emerged in economic geography over the last thirty years, which emphasize micro-level contingencies and agency as opposed to capitalist macro-structures.

Table 2.2 Characteristics of structuralist and relational approaches in economic geography. Source: own elaboration.

Approach	Structuralist	Relational
Examples	Global Political Economy, Food Regime Theory, (Neoclassical Economics)	Global Production Networks, Supply Chain Management, Actor-Network Theory
Scale of analysis	Mainly macro, top-down	Mainly micro, bottom-up
Unit of analysis	Firms, individuals, organisations, states, institutions	Networks, chains
Power	Hierarchical, hegemonic	Diffuse
Coordination	Command-and-Control	Consensus, alignment
Interaction	Transactional	Collective learning, qualification
Properties	Inherent to entity	Perceived in network
Institutionalisation	*Régulation*	Conventions
Nature of networks	Stable, positional (*being*)	Unstable, processual (*becoming*)
Embeddedness	Varieties of Capitalism, states	Entanglements, multiscalar

In Table 2.2, the main differences between relational approaches and their structuralist counterparts are summarised. In the remainder of this chapter, the elements in Table 2.2 will be explored in further detail and applied to the food supply chain. First, the notions of embeddedness and the nature of networks in both approaches will be discussed in Section 2.2.1. Subsequently, the elements of institutionalisation and properties are assessed in Section 2.2.2. And finally, power, coordination and

interaction will be examined in Section 2.2.3. After this theoretical discussion, all the elements will be combined into a conceptual model for this research, which will be presented in Section 2.3.

2.2.1 Relational epistemology and ontology

According to Dicken et al. (2001, p. 91), networks have become the 'foundational unit of analysis' for our understanding of the contemporary global economy instead of firms, individuals, organisations or nation states that are at the core of many structuralist approaches. Dicken et al. (ibid., p. 92) especially appreciate the network analogy for its ability to analyse (1) the relational processes and structures through which power is exercised; (2) the multiple scales at which (socio-economic) phenomena manifest themselves simultaneously; and (3) the complex territorial embeddedness of economic activity. Nevertheless, networks also have some practical limitations. These problems are related to matters of description, epistemology and connections to other networks (Amin & Thrift, 2002). Firstly, the dynamic nature of networks poses challenges to the task of describing them. As soon as relationships are put into description, they lose some of their fluidity. Henceforth, the network metaphor is at risk of representing a fixed set of channels and nodes, that might give the impression that networks are themselves structural entities with predictable relationships and outcomes. Secondly, this fluidity also complicates the way we can know a network. Relationships constantly change and have the ability to reconnect to new entities. Therefore, networks possess the *potentiality* to become something else over time (ibid., p. 29). This is related to the third limitation, that networks are always interwoven with other networks to some extent. For the researcher, these complicated entanglements bring the practical challenge to determine where the network starts and ends, without missing out on important connections nor extending the network to impractical proportions (Miettinen, 1999). Dicken et al. (2001) acknowledge these limitations, but maintain that no elements in the network should be privileged *a priori* and an open approach to networks is the best way to grapple with their dynamics.

Thus, a relational interest in networks is preoccupied with the systematising functions that give a provisional ordering to social life, rather than the stabilising effects of the system itself (Latour, 1988, in Amin & Thrift, 2002, p. 3). In ontological terms, this implies that economic phenomena, like markets, do not simply exist *out there* as bounded analytical objects (cf. Farías, 2009). Rather, they are continuously *performed* – and thus (re)produced, stabilised, and broken down – by the actors related to it (Callon, 1998). Social phenomena are considered to be in a constant and unstable state of *becoming*, rather than residing in a fixed state of *being* (Amin & Thrift, 2002; Pratt, 1997). A relational ontology is therefore an ontology of encounter and togetherness, that creates emergent, multiple and processual realities (Farías, 2009; Amin & Thrift, 2002). Such realities are commonly

referred to as *agencements* (assemblages), a term that is also used by Callon (2016) to analyse the intricate dynamics of contemporary market interactions.

Callon's (2016) critique of markets addresses the dominant neoclassical view, that regards traded goods as a mere linking pin between supply and demand. In this view, the products or services that are exchanged on markets serve as *platform-goods* (ibid., p. 21), i.e. the good provides a temporary platform for suppliers and buyers to negotiate a certain price level. In this perspective, the price level will be negatively influenced when there are more competitors on the market. As a consequence, suppliers will engage in product innovation to escape competitors and to end up at a higher price level. Furthermore, from this reasoning it can be observed that supply and demand are regarded as two autonomous and separate blocs, that only converge around the platform-good at the moment of purchase. In market-agencements, however, traded products and services are regarded as *process-goods* (ibid., p. 24). In this perspective, the exchange of goods proliferates a variety of interconnected relations that extend both to the supply and demand side (if one can even speak of a strict separation between the two) (Callon, 1998). After all, product development is not solely driven by suppliers, but also has to take into account the preferences of the users for which the product is intended. Similarly, innovation cannot be regarded as an effect of competition, but rather it is the driver of competitive behaviour to bind as many customers to your product as possible.

Structuralist market approaches have been useful to assess the differences between various contexts, based on external properties such as the number of competitors (Boggs & Rantisi, 2003). However, these approaches miss out on the more micro-level dynamics and drivers of change. Within the market-agencement perspective, every sold product or service eventually becomes a singularized good, in that it ends up with one single customer. This singularized position allows for an evolutionary differentiation and diversification of markets over space and time that is driven by actors' preferences, concerns and values (Callon et al., 2002). This means that markets are multiple and easily adapt to specific contexts (Callon, 1998; Berndt & Boeckler, 2010). A practical example of this process can be observed in the emergence of Alternative Food Networks (AFNs) over recent decades (see Goodman et al., 2012). AFNs can be regarded as submarkets, where the exchange of food products is not only determined by price-quality trade-offs, but is also influenced by values like organic, local, or fair trade production and consumption (Sarmiento, 2017). Although structuralist approaches might account for the emergence of AFNs, for instance on the basis of social and institutional change, they provide little room for the role of consumers' knowledge and cultural associations in defining the meaning of food (Goodman, 2002, p. 271). Besides, a more actor-focused approach is required to assess the daily functioning – and reproduction – of these submarkets (Berndt & Boeckler, 2010). In order to address these two flaws, we need to introduce the concept of *qualification*, which will be discussed in the next subsection.

2.2.2 Economies of qualities

Apart from price, goods can be characterised by a range of properties, like quality, taste, appearance, availability, or consumers' knowledge about the product. These properties will be valued in different orders by different consumers, meaning that various consumers will make diverging decisions based on their own individual qualification. Callon et al. (2002, p. 198) comment on this process:

"In other words, goods can be defined by a combination of characteristics that establish its singularity. This singularity, because it stems from a combination, is relational. (…) Defining a good means positioning it in a space of goods, in a system of differences and similarities, of distinct yet connected categories. (...) These properties are not observed; they are 'revealed' through tests or trials which involve interactions between agents (teams) and the goods to be qualified."

The process of qualification can thus be described as the ordering of different product characteristics and comparing them with personal and external norms, values and experiences that give a certain meaning to the product. These external tests or trials might come in the form of advices, certificates, standardized experiments, or even advertisements, that provide more information about the product at hand. As Callon (1998) argues, the *homo economicus*, who makes rational decisions based mainly on price levels, does not exist. Rather, markets are characterised by *calculative agents*, who dynamically evaluate their (economic) actions based on the information that is available to them at a given point in space and time. Since this makes evaluations contingent and dynamic, it is important to note that product properties are also not fixed, but may shift as a result of detachments and re-attachments (Callon et al., 2002). Together, these evaluations constitute and reproduce meticulous economies of qualities, that bridge the neoclassical border between supply and demand.

Although the process of qualification illuminates the ways in which product properties are relationally constituted, it does not tell us much yet about the institutionalisation of these 'qualities' in wider economic interactions. For that we have to move to the meso-level theory of conventions, that is worked out in the seminal books by Boltanski and Thévenot (2006 [1991]), and Storper and Salais (1997). Boltanski and Thévenot address the way individuals justify their actions to others, and distinguish six main 'orders of worth' (*cités*) that can be employed to evaluate actions (see Table 2.3). These orders include market, industrial, civic, domestic, inspired, and opinion worth. However, in light of current challenges regarding sustainability, pollution, biodiversity, and climate change, some authors (e.g. Latour, 1998; Lafaye & Thévenot, 1993) have argued for a seventh order of worth that specifically focusses on the environment. Latour (1998) critiques the original framework for taking humanity as the measure of all things. Therefore, the attention to nature and the environment included in the previous six orders of worth (see Thévenot et al, 2000), will not be sufficient to truly

justify actions in terms of sustainability and environmental friendliness. Since food waste reduction is directly related to such justifications, the new order of 'green worth' is also included in Table 2.3. In this table, a set of underlying principles and effects is furthermore presented for each worth.

By making implicit or explicit references to one or more of the orders of worth, the principles that underlie them get embedded in sets of routines that are built up in given spatial and temporal arrangements (Parrott et al., 2002, p. 244). We can refer to these routinized agreements as *conventions*, which in turn contribute to the way we evaluate and perceive economic actions within the same spatio-temporal arrangement. Conventions can therefore also be defined as a "broad group of mutual expectations that include – but are not limited to – institutions" (Ponte & Gibbon, 2005, p. 6). Diaz-Bone (2016, p. 215) also stresses the difference between institutions and conventions, in that conventions are used to interpret the incomplete meaning of institutions in real situations. Conventions are thus broader than institutions and mainly entail interpretation schemes rather than rules for action. Whereas institutions are always collective and intentional, conventions can also involve emergent and unintended regularities (Ponte & Gibbon, 2005).

Table 2.3 Schematic overview of orders of worth. Adapted from: Thévenot et al., 2000, p. 241.

Worth	Mode of evaluation	Long term goals	Worth is authorised by…	Time formation	Space formation
Market	Price, cost	Market competitiveness	Market good/service, customer, consumer, merchant, seller	Short-term flexibility	Globalization
Industrial	Technical efficiency	Competence, reliability, planning	Project, method, plan, engineer, professional, expert	Long term planned future	Cartesian space
Civic	Collective welfare	Equality and solidarity	Patrimony, locale, heritage, family, equal citizens, solidarity unions	Perennial	Detachment
Domestic	Esteem, reputation	Trustworthiness	Authority, sovereign	Customary past	Local, proximal anchoring
Inspired	Grace, singularity, creativeness	Passion, enthusiasm	Emotionally invested body, God, creative being	Revolutionary, visionary moment	Presence
Opinion	Renown, fame	Popularity, audience, recognition	Sign, media, celebrity	Vogue, trend	Communication network
Green	Environmental friendliness	Sustainability, renewability	Wilderness, natural habitat, environmentalist	Future generations	Planet ecosystem

In short, economic interaction in any given spatio-temporal arrangement of production activities will be coordinated by a set of intentionally or unintentionally routinized conventions. Various conventions, or orders of worth, can be combined and/or prioritised within a given arrangement. For instance, economic action within conventional food networks is most likely justified using market and industrial worth, whereas domestic worth (local food), civic worth (fair trade) or green worth (organic, sustainable) will be more relevant within alternative food networks (Parrott et al., 2002). The main benefit of using convention theory is that it is capable of revealing multiple bundles of conventions that lead to the (re)configuration of various submarkets within the contemporary agrifood sector (Berndt & Boeckler, 2010; Murdoch & Miele, 1999). Many political economy approaches have failed to account for this fragmentation and diversity, since they were preoccupied with processes of globalisation and industrialisation, that almost exclusively attains to orders of industrial worth (Murdoch & Miele, 1999). On the contrary, convention theory is able to link together a broader range of aspects in the food supply chain and to consider a complex system of negotiations between various qualities (Murdoch et al., 2000). These negotiations will be considered in the next and final subsection of this literature review, before we move on to consider the conceptual model of this research.

2.2.3 Governing the supply chain

In the most basic model of a supply chain, a company has to be concerned with only two relationships. Upstream, it engages with suppliers for the delivery of raw materials or other inputs, and downstream it connects with buyers in order to sell their finished products or services. In neoclassical approaches, both of these relationships are transactional, in that they involve the exchange of a product or service in return for revenue, similar to Callon's (2016) notion of platform-goods (see Section 2.2.1). Supply chains, in this perspective, can be regarded as a sequence of autonomously operating companies that are connected to each other by market transactions. For neoclassicists, these transactions involve the negotiation of a price based on the convergence of supply and demand at a specific moment in space and time. In relational SCM approaches, market transactions entail more than the mere negotiation of a price between buyer and seller. Any exchange on the market involves and mobilizes a range of heterogeneous agents. Henceforth, Callon (2016) speaks of process-goods in this respect, in that the exchange of a product or service is inherently related to a meticulous and continuous process of qualification. Callon (ibid., p. 25) takes the purchase of a new car as an example:

"The [car] model in question starts its existence on a drawing board, or rather in the form of a 3D digital representation, and then moves on to become a list of specifications, a series of diagrams and maps in a design

department, a model on a platform, a still vague form of a concept car, a prototype, an image in glossy catalogues with technical attachments, a demonstration model in showrooms, described by the salesperson's explanations and rhetoric, and then an object of tests and comparative evaluations in magazines. Once the transaction has been concluded, the car continues to be requalified, to live a life that was not necessarily planned: it turns into an object of social distinction, it is lent, (re)sold as a used car (which its previous owner had anticipated by taking care of it and/or choosing a model with a high second-hand value), reduced to a wreck whose components are recycled in the form of scrap or spare parts, or re-manufactured as in certain developing countries so that it may have a second life on the market."

This example illustrates that market transactions reach far beyond the directly involved buyer and seller of a good. In the case of a car, not only a finished product of steel, glass, rubber and copper wiring is transferred, but also the previous decisions attached to it, made by its designers, constructors and test drivers. In turn, these decisions were shaped by an extensive range of safety standards, aerodynamics tests, fashion trends, et cetera, that are all instituted by various people and organisations. Besides, on the side of the buyer, the opinions of the salesperson, car magazine journalists and potential second-hand users are taken into consideration as well when purchasing the car. All these agents thus contribute to the qualification of the product and may play various roles across the supply chain.

The tangled networks of agents that surround market activities make it impossible for actors to make perfectly informed decisions. Henceforth, the rationality of economic agents is always contingent and subject to a high degree of uncertainty. To cope with this uncertainty, actors will usually base their decisions on routinized practices or sources of authority. Such routines are the basic premise underlying institutional economics (Groenewegen et al., 2010), and may take the form of rules, social norms, values, habits or conventions (Gertler, 2010). As was already expressed in Section 2.2.2, convention theory regards these routines as (emergent) agreements or regularities that are justified by referencing to certain orders of worth. However, it is not yet discussed how this position leaves room for the role of power in shaping such routines.

From a convention theoretical perspective, power can be conceived as the ability to construct standards and certificates (Boltanski & Chiapello, 2005). Stuart (2009, p. 113) illustrates this process, in that "supermarkets often use their quality criteria merely as a pretext for rejecting deliveries when they are not managing to sell as much as they expected. If there is strong demand, they will take a delivery, if they are not selling so much or so many, they will reject it." Note that, in order for these standards to be effective, they must be placed in shared orders of worth across the supply chain. This shared basis for justification stresses the importance of alignment between various actors. Here, the connection between convention theory and supply chain management becomes apparent.

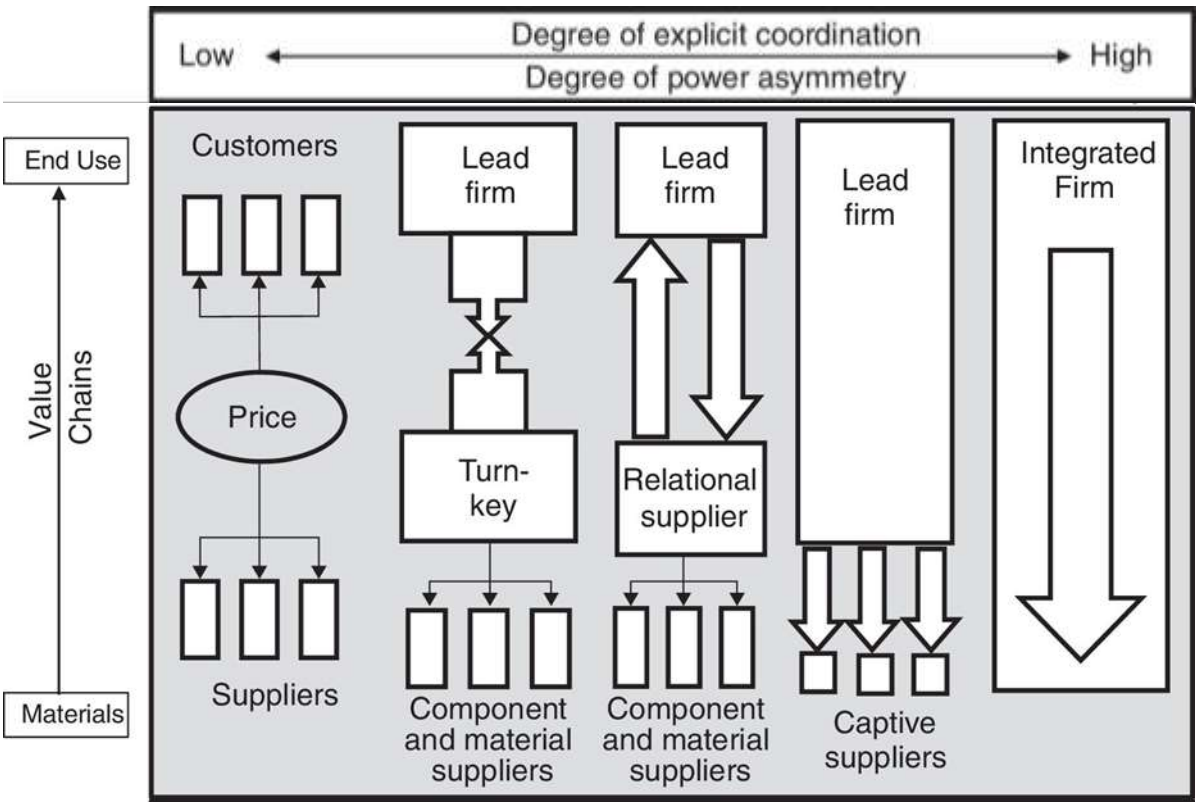
The alignment of actors in the supply chain is related to the concept of governance. Gibbon et al. (2008) distinguish three modes of governance in supply chains[3], viz. driving, normalisation, and coordination. Firstly, 'governance by driving' emanates from the supply chain structure. This mode of governance is divided into two ideal-type structures, viz. *producer-driven* or *buyer-driven* supply chains (Gereffi, 2014). Given the dominant power of supermarkets (see Devin & Richards, 2018; Stuart, 2009), the agrifood supply chain could be characterised as a buyer-driven chain. For example, farmers and manufacturers in the food supply chain are often SMEs that are reliant on only a few buyers (like supermarkets) to sell their products. This makes them very vulnerable to changes within supply chain relationships. The supermarkets, on the other hand, have many suppliers, which means that they can easily switch between them and will not be affected as much by changing configurations. Therefore, supermarkets have a better bargaining position to determine prices than most other actors in the food supply chain (Stuart, 2009). In relation to food waste, Devin and Richards (2018) observe that supermarkets also have the power to push back responsibilities due to this bargaining position. Despite these valuable observations, the dichotomy between producer-driven and buyer-driven chains appears rather deterministic and does not account for more intricate configurations and interactions that exist in contemporary supply chains (Gibbon et al., 2008).

Therefore, the two other modes of governance are better suited for this research. The 'governance as normalisation' principle is closely connected to convention theory, in that it also seeks to uncover the systematising practices – e.g. the routinized processes of qualification and certification of products by (external) experts, media, consumer groups and other organisations – that serve actors at specific points along the supply chain (Gibbon et al., 2008). Power, in this mode of governance, can therefore come from very diffuse and unexpected sources. This also implies that this approach to governance might be a bit too specific for this research. The systematising capabilities of conventions and qualification will be taken into account, but in order to trace the origins of power that these conventions bring with them, more detailed case studies are needed than the general supply chain approach that is employed in this research. For example, case studies around specific food products are better capable to give precise empirical insights in the dynamics of qualifying experts, institutions and other conventions, like previous research that has been conducted on tomatoes (Le Heron, 2004) and orange juice (Méadel & Rabeharisoa, 2001).

Finally, 'governance as coordination' is considered, which allows for more diverse supply chain structures, that can be distinguished on the basis of three variables: (1) the complexity of

[3] Gibbon et al. (2008) actually speak of Global Value Chains (GVCs), which relates to a prominent body of literature within economic geography and global political economy. However, in this research it is chosen to stick with the term supply chain to retain a more evident connection to Supply Chain Management (SCM) approaches and concepts.

information flows within the supply chain; (2) the ease with which this information can be codified; and (3) the capabilities of suppliers to meet the requirements of the transactions (Gereffi et al., 2005). Based on these three variable, five possible categories of supply chain governance can be distinguished, which are summarised in Figure 2.1. Again, this research does not aim to categorise the food supply chain as one of these five forms of supply chain structures. Agricultural and food products are too diverse for such an approach, which would require a focus on only one specific food commodity. However, the ability of firms to coordinate information flows and capabilities within the supply chain provides an interesting starting point to analyse responsibilities and sources of innovation in relation to food waste generation.



	Market	Modular	Relational	Captive	Hierarchy
Complexity of interactions	Low	High	High	High	High
Ability to codify	High	High	Low	High	Low
Supplier capabilities	High	High	High	Low	Low

Figure 2.1 Different categories of supply chain governance. Adapted from: Gereffi et al., 2005, p. 87; 89.

Modes of 'governance as coordination' have also been discussed in the supply chain management literature. In an upcoming publication by Arias Bustos and Moors (forthcoming), four modes of supply chain coordination are presented. These modes include information exchange, effective

partnerships, incentives alignment, and the adequate use of technology. These four modes represent clusters of innovative collaboration measures that can be taken to integrate supply chain actors and henceforth contribute to the reduction or prevention of food waste. The four groups are largely congruent with earlier research on SCM coordination, e.g. in the work of Simatupang et al. (2002). Instead of effective partnerships, they speak of collective learning with the objective to build a shared base of knowledge and capabilities among supply chain actors, and they define 'adequate use of technology' more broadly as logistics synchronisation, in which the use of data and technology plays an essential role. As these differences are mainly semantic, it is chosen to use the categories described by Arias Bustos & Moors (forthcoming) in this research, since their framework is specifically based on research in the food supply chain.

The framework of innovative collaboration by Arias Bustos & Moors (forthcoming) provides a more specified account of measurements that can improve collaboration and integration among the supply chain. Integration and collaboration are often emphasised as strategies to improve supply chain performances, but remain relatively hollow unless they are amended with specified targets. Among other things, close collaboration between supply chain actors has been related to lower levels of food waste, in that it promotes trust, innovation, better forecasting and the alignment of business activities (Mena et al., 2011; Arias Bustos & Moors, forthcoming). Subsequently, the framework of innovative collaboration can provide a more nuanced view to the ways in which companies can collaborate. Henceforth, this framework can also be related to innovation intermediaries, since they can also support the alignment of partnerships, incentives, information exchange, and use of technology. As was already stated in the introduction intermediary organisation have been ascribed a plethora of possible functions, but research has been reluctant so far to assess the precise ways in which intermediaries add value to processes of innovation and collaboration (Tran et al., 2011). This process is at the heart of this research and will be approached using the theories, models and frameworks that have been discussed in this chapter. In order to give a final overview of this literature study, a conceptual model is presented in the next section, together with the conjectures on each research subquestion.

2.3 Conceptual model and conjectures

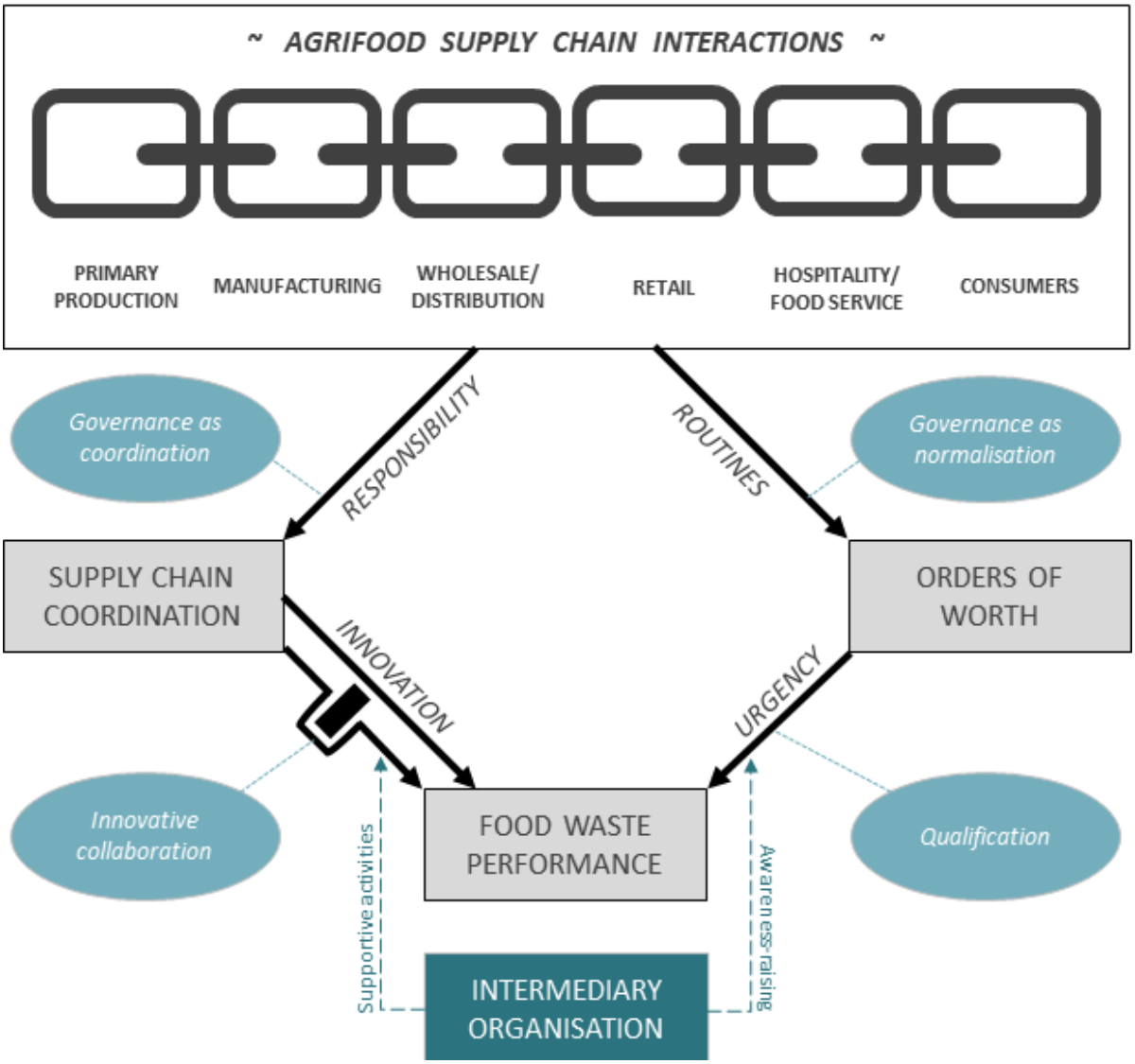


Figure 2.2 Conceptual model for this research.

The conceptual model presented in Figure 2.2 takes interactions in existing agrifood supply chain(s) as a starting point. Interactions are traced from individual companies within the supply chain, that might fall within one of the first five segments indicated in the box 'agrifood supply chain interactions'. Note that consumers are not investigated as a separate entity in this research, but are considered to have an indirect effect on other segments of the supply chain and are therefore included in this model. Throughout the supply chain, a certain amount of food loss and waste is produced, which is referred to as 'food waste performance'. The word 'performance' refers to the ways in which companies within the supply chain achieve goals and strategies to reduce or prevent food waste. The mechanisms through which supply chain interactions are related to a specific level of food waste performance is analysed using two main theoretical lenses. On the left side of the

model, relations are interpreted in light of *Supply Chain Management* approaches. On the right side, *convention theory* is employed to analyse relationships. Furthermore, both of these sides involve a descriptive-analytical approach to investigate the power structures that emanate from supply chain interactions (top), and an action-oriented side to analyse the ways in which food waste performance among the supply chain can be improved (bottom).

2.3.1 Urgency (research subquestion 1)

Most directly, food waste performance is influenced by the level of urgency that resides within the supply chain to mitigate the negative effects of food waste, and the ways in which companies in the supply chain are able to innovate and overcome barriers. The level of urgency is interpreted in light of the process of qualification as discussed by Callon (2016; Callon et al., 2002). This process in turn refers to the seven orders of worth that are discussed by Thévenot et al. (2000). The designation of dominant orders of worth that are used to justify qualification processes can give insights into the potential for change with regard to food waste reduction and prevention. This relationship between orders of worth and food waste performance forms the core of the first research subquestion.

Following Parrott et al. (2002) and Murdoch and Miele (2004), who address the role of quality in various food networks, it is expected that most companies' operations are assessed using orders of industrial or market worth. For companies operating in conventional food networks, efficiency and long-term competitiveness will be the most important measurements to assess the general firm performance. Food waste mitigation may occur in these measurements, if machine efficiency and/or product planning can be improved, and if the benefits of food waste mitigation outweigh the costs of adapting production processes. For firms that are part of more alternative food networks, food waste mitigation might be motivated on the basis of civic or green worth. The economic costs and benefits of measurements will be less important in this case, since social equality ('we cannot waste food if other people live in hunger') and environmental friendliness or circularity ('food waste is a waste of natural resources') are more prominent aspects in the product's qualification process. However, both justifications presume an awareness about the issues related to food loss and waste, which might not always be the case, both among conventional and alternative food networks.

2.3.2 Innovation (research subquestion 2)

A high level of urgency alone is not sufficient to bring about successful changes. Concrete actions have to be taken in order to come up with innovations that can help mitigate food loss and waste. Many barriers may be present before one is able to arrive at this point, which are represented in the conceptual model by the black bar in the bottom left corner. Companies have to find ways to cope

with these barriers, which will likely require collaboration with other actors from within or outside the supply chain. Therefore, the model of innovative collaboration as developed by Arias Bustos and Moors (forthcoming) will be employed to analyse relationships in this corner of the conceptual model. These relationships reveal the barriers and needs of companies in order to reduce or prevent food loss and waste, and therefore attain to the second subquestion of this research.

Given this research's focus on SMEs, challenges are expected to be mainly related to a lack of resources within the company (see Klewitz & Hansen, 2014; Bos-Brouwers, 2010). These resources may include financial means, but are definitely not limited to funds alone. The problem of insufficient resources can be (partially) alleviated by cooperation with other actors. However, such a strategy requires the alignment of actors with regard to information, technology, motivations and incentives. Henceforth, the success of innovative activities is expected to depend on the level of supply chain coordination that a single company or group of firms is able to achieve. When these abilities for coordination are low, a company is not very likely to succeed in its goals to enhance food waste performance. Conversely, when companies are able to either align their own goals with those of others, or to make other actors adapt to their goals, they are more likely to overcome barriers and create a stable basis for cooperation.

2.3.3 Responsibility and routines (research subquestion 3)

Apart from urgency levels and innovation practices in individual firms, wider connections in the supply chain are important to consider. These connections, in the top half of the model, involve routinized interactions and matters of responsibility, that are related to governance as normalisation and governance as coordination respectively. These properties are important to take into account, since they shape the power balances, opportunities and constraints within and across companies, that are analysed in the bottom half. Henceforth, both of the relationships at the top of the conceptual model relate to the third subquestion.

On the left side, there are relationships of responsibility that give a provisional ordering to the possibilities of supply chain coordination. A greater power differential between suppliers an buyers is expected to contribute to more food waste generation, since this gives the more dominant firm the ability to push back responsibilities, set prices and determine production standards in its own interest (Devin & Richards, 2018; Stuart, 2009). Of course, this dominance could also be employed to demand waste reduction strategies among suppliers and other partners. However, empirical evidence on this matter usually concludes in favour of the former situation. Therefore, the conjecture is that innovation is more likely to come from SMEs that are able to attain niche markets

(see Klewitz & Hansen, 2014) and subsequently find leverage points for supply chain coordination to make their innovations more salient to others.

In the top right corner of the model, the construction of routines is considered. Similar to the relations of responsibility, this section of the model also looks at power balances and is therefore jointly considered in the third research subquestion. On the right side, however, attention is shifted towards the power to construct agreements and standards among partners in the supply chain, that subsequently guide economic interactions. Note that standards might also be imposed by organisations that are not directly involved with the production, processing or trade of food commodities, e.g. government agencies, certification institutes or consumers (via preferences and product demands). These standards might also come in the form of obligatory trade norms or health and safety regulations. Although such (legal) standards will be considered in this research as well, it must be noted that the construction of routines also specifically focuses on the way in which companies deal with, interpret, and amend these regulations in their own operations. The expectation, in this regard, is similar to the conjecture on relations of responsibility, that SMEs need to find leverage point to jointly build up routines with their partners in the supply chain. Otherwise, they are likely to be governed by the standards and norms that are imposed on them by others, which will in turn limit their possibilities to improve food waste performance.

2.3.4 Intermediary organisations (main research question)

Finally, this research will look at the role of intermediaries in improving food waste performance along the agrifood supply chain. The role of intermediary organisations is typically discussed in innovation-oriented literature. In this literature, intermediaries have been ascribed a broad range of different functions. In this conceptual framework, intermediary functions are divided into two groups. On the side of supply chain management, intermediaries can perform supportive activities to assist companies with challenges they cannot face on their own. On the side of conventions, the role of intermediary organisations mainly lies in awareness-raising activities, in order to shift qualification frameworks among companies. These two types of activities are believed to strongly reinforce each other, hence a balance has to be found by the intermediary organisation in order to achieve the most valuable impact. The conjecture is that a too narrow focus on awareness-raising will not result automatically in effective actions, whereas a preoccupation with supportive activities will likely be insufficient to reach a broad range of companies and thus has limited effects.

3. Methodology

3.1 Operationalisation

The main analytical concepts that were presented in the conceptual model (Figure 2.2), are operationalized in Table 3.1. In this table, the most important indicators are also enumerated for each concept, in order to provide a more practical definition. These indicators were used as the basis for survey and interview questions, as well as coding schemes during the analysis phase. The survey and interview guide that were used in this research can be found in Appendix II and III respectively. The interview guide also includes a column of codes to illustrate how the analysis phase was constructed.

Most of the concepts in Table 3.1 have already been discussed in the literature review in the previous chapter. However, a concept that is not yet discussed is the scientific operationalisation of food waste itself. As has become clear in Chapter 1, the measurement of food waste is fraught with problems related to data availability and quality. In part, these problems are related to the complex operationalisation of food waste. Apart from measurement considerations like the expression of food waste in terms of weight or energetic value (Lipinski et al., 2013), one also has to consider what *waste* actually implies. The FAO (1981) defines food waste as the weight of wholesome, edible materials that would normally be consumed by humans. This definition is based on dry weight and excludes inedible parts of food, as well as food products that are intentionally fed to animals. Stuart (2009), however, argues that we should also include the edible parts of animal feed, as well as by-products of food processing that are not used for human consumption. These food products are also waste according to Stuart's reasoning (ibid.), since they could have been employed for human consumption and therefore compete for the same resources like land, water and energy. Whether or not we should include animal feed as food waste remains a controversial topic, since animal feed is indirectly used for human consumption in the form of meat or animal products. Therefore, by including feed in food waste estimates, some of the waste would be counted twice. The WUR Food Waste Monitor in the Netherlands follows the FAO definition and thus only includes food that was *intended* for human consumption, but did not end up as such (Soethoudt et al., 2017). Since the societal relevance of this research is based on data from the WUR Food Waste Monitor, their definition will be followed in this research as well.

A high level of urgency, i.e. the recognition of food waste as a problem in combination with the adequate matching of stadium and handling, is expected to be related to better food waste performance. In the findings, this conjecture can be observed by comparing survey question 1 ("How does your company currently treat food residues?") and survey question 2 ("In what stage is your company in terms of reducing food waste?"). The match between these two questions indicates how

self-aware companies are of their food waste activities and strategies, e.g. a company knows that biofermentation is not the optimal stage of food waste reduction and therefore strives to do more about food waste mitigation. In the interviews, this conjecture is examined more meticulously by the references to specific orders of worth that are made in this regards. For instance, does a company justify their food waste reduction strategies because they are good for the company (market or industrial worth), or is the motivation to reduce food waste build on environmental values (green worth), even if these do not contribute directly to the economic performance of the company? Furthermore, highly routinised interactions are likely to increase the possibilities for supply chain cooperation and therefore help to overcome barriers and/or facilitate in needs to bring about innovation. The survey findings mainly help to identify *what* barriers and needs are experienced by companies, whereas the interviews are aimed at elucidating *how* barriers and needs influence their business operations and where possible leverage points for change can be found.

Table 3.1: Operationalization of main concepts.

Concept		Description	Indicators
Main items	Agrifood supply chain	The whole set of entities and relations that are involved in the upstream and downstream flows of products, services, finances, and/or information from primary producers until end-consumers, that shape the production and distribution of a food commodity (Mentzer et al., 2001, p. 4)	Buyer-supplier relationships, centred around the sectors of primary production, manufacturing, wholesale/ distribution, retail, and hospitality/food service
	Food waste performance	Extent to which the company actively prevents or reduces food loss and waste as best as they can (Papargyropoulou et al., 2014)	Handling of waste and side streams (position on Moerman's Ladder)
	Order of worth	A set of principles that is used to justify an economic action, based on market, industrial, civic, domestic, inspired, opinion, or green worth (Thévenot et al., 2000)	References to key aspects of a specific order of worth (see also Table 2.3): • Competitiveness (market) • Efficiency (industrial) • Equality (civic) • Local (domestic) • Passion (inspired) • Fame (opinion) • Sustainability (green)

	Supply chain coordination	The concrete practices and organisational forms through which a specific division of labour between economic agents involved in the conceptualisation, production and distribution of food commodities is established and managed (Gibbon et al., 2008, p. 319)	Degree of cooperation and information exchange between two economic agents in the agrifood supply chain; Ability of an actor to align interests of suppliers and other partners with those of the own company
	Intermediary organisation	An organisation or body that acts as an agent or broker in any aspect of the innovation process between two or more parties (Howells, 2006, p. 720)	Activities performed by Food Waste Xperts
Relationships	Urgency of food waste	Goals or motivation of the company to (further) prevent or reduce food loss and waste	Self-stated stadium of food waste mitigation in relation to their handling of waste and side streams
	Routines	Recurrent courses of (economic) action in the agrifood supply chain, which might be unintentional/emergent	Agreements or regularities between two agents in the agrifood supply chain
	Innovation	Any adaptation in the firm's operations and/or supply chain interactions that contribute to the prevention or reduction of food loss and waste	Actions related to one of the categories of innovative collaboration: • Information exchange • Effective partnerships, collective learning • Incentive alignment • Adequate use of data and technology These factors are amended by barriers and needs, that might constrain or support innovative collaboration to happen
	Responsibility	Power of the company vis-à-vis other supply chain agents to control parts of the supply chain	Capacity of the company to set prices, impose standards, and negotiate agreements in their own interest

In international literature, the 'Food Waste Hierarchy' is often used as a framework to assess food waste mitigation strategies. This framework involves a hierarchy of waste strategies from least to most favourable, viz. disposal, recovery, recycle, re-use and prevention (Papargyropoulou et al., 2014). The general idea behind this hierarchy is that one extracts more of the initial value of food

products, when waste streams are higher up in the hierarchy. The food waste hierarchy has been refined in various forms. In the Netherlands, a version called “Moerman’s Ladder” is most commonly used in research and policies (see Soethoudt et al., 2017). Again, since this research is focused on the Netherlands, the framework of Moerman’s Ladder will be used to assess the value of different waste strategies. A version of Moerman’s Ladder is presented in Figure 3.1. At the bottom, regular waste disposal is found, e.g. in the form of incineration or landfills. This is the least desired tier on the ladder, since basically none of the value of the waste stream is put to use. Slightly above disposal comes energy generation and then composting. Note that these two tiers are sometimes presented in a reversed order. Here, however, composting is put higher on the ladder than energy generation, since compost can be used to fertilise land and therefore presents a more direct way to reintroduce some of the value, nutrients and energy of waste streams for human consumption. Bio-fermentation and energy generation might be conceived as generally good strategies, since at least you extract useful value out of waste streams. However, this is only true if you regard the input for bio-fermentation as absolute waste, because the energy you gain out of this process is much lower than the energy that was required to produce the food (Timmerman, in NOS, 2015). In the middle we find the extraction of raw materials, e.g. pigments, fragrances, or concentrates, to be applied in industrial products. Although this tier does not include human consumption, these applications are of relatively high economic value and can therefore be a favourable waste strategy. Next we find the application of waste in animal feed, which is the last tier that can officially be counted as ‘waste’ since the top three tiers are all intended for human consumption. However, even in these top tiers, some strategies are more favourable than others. The least value is extracted when leftovers are processed into other edible products, since the benefits of food recovery have to outweigh the costs of the extra processing steps. Therefore, it is more favourable to recover food products without much handling, such as redistribution by food banks. Nevertheless, the highest tier is the prevention of food waste and leftovers in the first place, so there are no waste streams that need recovery.

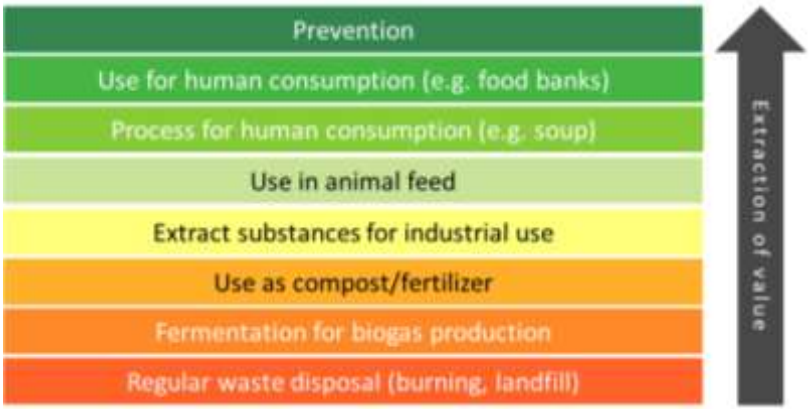


Figure 3.1 Moerman’s Ladder: a hierarchy of food waste reduction strategies.

3.2 Data collection

The general methodological strategy for this research is based on a mixed method design. There are various reasons why a combination of quantitative and qualitative research methods might be desirable (Bryman, 2006), but for this research the main drivers were triangulation and complementarity. With a complex and extensive matter like food waste, a merely quantitative approach would likely have missed out on the intricate dynamics of supply chain interactions, whereas a qualitative approach would have been too time-consuming to include the wide variety of businesses that is active within the agrifood sector. The integration of quantitative and qualitative data can happen at various moments throughout the research and in various ways (Fetters et al., 2013). Concerning data collection, an *explanatory sequential design* was chosen, which means that quantitative data was collected first, in this case to get a broad, initial overview of the urgency, barriers and needs of companies in the food supply chain to mitigate food loss and waste. This data was collected using a survey, which will be discussed in further detail in Section 3.2.1. Subsequently, the findings from the survey informed the qualitative data collection, in that in-depth interviews were conducted in order to interpret, refine and validate the quantitative results. The in-depth semi-structured interviews will be discussed in further detail in Section 3.2.2. Due to time constraints, however, the two phases were not completely sequential. The first interviews were already conducted before the official ending of the quantitative phase of data collection. On the level of sampling, the research design was based around 'connecting' and 'merging' databases from the quantitative and qualitative data collection phases (Fetters et al., 2013). Related to the sequential data collection design, connecting refers to an approach in which the database that is constructed during the first phase of data collection serves as a selection pool from which to sample respondents for the second phase of data collection. The initial idea was indeed to randomly contact respondents that had filled out the survey and invite them to an interview. However, due to a reluctance of most survey respondents to leave behind contact information, this strategy had to be adapted. Therefore, the sampling strategy was amended with 'merging', i.e. the combination of two unrelated datasets for the purpose of comparison and validation. In the end, 5 out of 12 interview respondents were sampled because they had participated in the survey before. These sampling strategies and data sources are described in Section 3.2.3.

3.2.1 Survey

The initial data collection phase of this research consisted of a survey, in which companies were asked to identify the ways in which they deal with waste streams, as well as the barriers they experience in their efforts to mitigate food loss and waste, and the aspects on which they would like to get external

support. These three question were further amended by two descriptive questions, one being the sector in which the respective company is operating, and another question to ask in what 'stadium' of food waste reduction the company would place itself. An earlier version of the survey also included other questions, e.g. to address the motivations behind food waste reduction and existing collaboration within the supply chain. Unfortunately, in a pilot phase of the data collection, this version of the survey appeared too long for respondents, after which it was decided to shrink down the survey to just five questions in order to boost response rates. Even though this meant that the collected data was less detailed than was initially planned, the strategy worked well in that the survey has finally yielded 138 responses. Additionally, people who shared their contact information received an infographic that summarised the survey findings, so they were able to comment on them.

The survey was distributed during a "Food Waste Event" on 21 March 2018, as well as at several other meetings during this month. In light of a local government campaign, March 2018 was denominated as the "Month against Food Waste". This thematic month helped to gain more momentum for my research and provided some easy distribution channels for the survey in the form of event, meetings and press releases. Besides, the survey was promoted on social media, both via my personal account, as via the accounts of some of the partners of Food Waste Xperts. The survey could be filled out online or in print. To get a higher response rate, the survey was also sent to personal email accounts, based a list of companies that was constructed in the preparatory phase of the research. Section 3.2.3 will elaborate on these sampling strategies in more detail.

The following five questions were posed in the survey (see Appendix II for the original Dutch questions and answer categories):

1. How does you company currently treat food residues?
2. In what stage is your company in terms of reducing food waste?
3. What barriers do you experience when trying to reduce food waste?
4. On what aspects would you like to receive support with regard to food waste?
5. In what part of the supply chain does your company operate?

Since food waste is a latent problem for many companies (diary 20-02-2018; see Section 1.2), all answer categories were pre-structured in the survey. This was done on purpose to make it easier for respondents by simply checking off possible barriers and needs for support. This reduced time for the respondents and avoided answer like 'I don't know' or 'none'. Moreover, the pre-structured answer categories were randomised for each respondent by the Qualtrics software, so the order in which barriers and supportive aspects were presented did not have an influence on the answering of the respondents.

3.2.2 In-depth interviews

In addition to the survey, in-depth semi-structured interviews were conducted with 12 companies (see Appendix III) in order to deepen and contextualize the findings from the survey. Henceforth, whenever possible, the survey answers of the respondent were used as input for their interview. For instance, when consumer demand was indicated as a barrier, the interview could focus on why the respondent sees this as a barrier, what their strategy is to cope with the situation, and where they would need additional support. In interviews with respondents that did not participate in the survey, general findings from the survey were presented and interviewees were asked to comment on them and compare the findings with their own experiences.

As was indicated before, many respondents of the survey did not fill in their contact information. As a consequence, the original plan to invite survey respondents for an interview only worked out for 5 out 12 of the interview respondents. In these five cases, survey answers provided the starting point for the interview. Because of this flexibility, interview questions could not be completely standardized. For Verschuren and Doorewaard (2007), this flexibility also epitomises the benefits of conducting qualitative interviews, in that they allow to slightly adjusting the speed, diversity, and direction of the collected data. However, the risk is that interview questions become too open and therefore divert from the original research questions (Bryman, 2004). To find a compromise between these two perspectives, semi-structured interviews were chosen for this research. This interview design allowed for enough openness to address emergent issues and discuss specific aspects in more detail, while also serving as a back-up to make sure that different interviews remain comparable and all connect with the original research questions.

3.2.3 Sampling strategy and data sources

Since respondents for both the survey and the interviews were mainly approached on events and meetings about food waste, the research sample possesses a clear *participant bias* of companies that are already aware of the issues related to food losses and waste. On the one hand, this is a problem, since it limits the possibility to reliably generalize results from this study to a wider population of companies in the agrifood sector. Therefore, in order to minimize this participant bias, more 'common' companies were addressed to fill out the survey. This was achieved in the most effective way by using publicly available email addresses of separate stores from a big Dutch supermarket chain, and a contact list of a major wholesaler/aggregator in the sector for fruit and vegetables. This organization had a portal that allowed you to directly contact their growers all around the Netherlands, which was used to distribute the survey for this research. In this ways, over 300

supermarkets and farmers were addressed directly to invite them for my survey. Because of this strategy, results in the sectors of retail and primary production contain the least participant bias.

With regard to the interviews, the aim was to get a minimum of two interviews per supply chain segment, and preferably more for segments that were underrepresented in the survey (see Table 4.1). In the end, all segments except for retail were covered by two or more interviews (Table 3.2). Nevertheless, the retail sector is also indirectly discussed in interview 6, in that this company developed an app through which supermarkets can sell their products that almost expire. Because of this app, interviewee 6 had a lot of experience in the retail sector. For the interviews, the participant bias is considered to be less relevant, since the goal of the interviews was specifically to get better insights in the barriers and needs related to food waste mitigation. Probably, these aspects could not have been revealed in companies that are not actively working on the reduction or prevention of their food waste, and thus have no practical experiences of barriers and needs.

Before moving onto the section about data analysis, it is important to note that data sources did not only include the formal participants of the survey and the interviews. Due to the close collaboration with Food Waste Xperts during this research, many smaller meetings and conversations were conducted in light of this research. Notes and observations on these meetings are recorded in a research diary, which, next to the interviews and survey data, will be referred to in the next chapter. Due to the often sensitive information that was discussed in these meetings, this research diary cannot be publicly included with this report. If access to the notes of this research diary is considered necessary, the author should therefore be contacted.

Table 3.2 Division of survey and interview respondents per sector.

Sector	Survey*	Interview	Percentage**
Primary production	41.33	3	29.9%
Manufacturing	14.42	3	10.6%
Wholesale/distribution	5.58	2	4.5%
Retail	20.75	1	15.0%
Hospitality/food service	10.92	2	8.2%
Other/unknown (incl. missing)	45	1	31.7%
Total	*138*	*12*	*100%*

* As respondents were able to give multiple answers, the values presented here are weighted for all responses.
** Respondents that participated in both the survey and the interviews are counted only once. Numbers do not add up to exactly 100% due to rounding.

3.3 Data analysis

At the level of analysis and interpretation, integration between the quantitative and qualitative methods is achieved by interweaving findings on a theme-by-theme basis (Fetters et al., 2013). For this *narrative*-construction, a process of relatively open coding is employed first. The basis for this

approach is formed by the so-called W-questions (Böhm, 2000): who, what, when, where, why, and in what way? In this initial step, an open approach is employed in order to allow for deviant findings to find their way into the analysis. Subsequently, findings from the survey and interview are compared and contrasted with each other in a more pre-structured order, using the codes and categories that were put forward by the literature review. These concepts were already discussed in the conceptual framework (Figure 2.2) and the operationalisation of main concepts in this chapter (Table 3.1).

By moving between open and structured coding, the analysis will also shift from a firm-centred approach towards the level of a supply level as a whole. These two steps were designed to make an easier transition from findings at the level of individual firms towards more abstract connections in the supply chain. The possibility to generalize the results of this research beyond the supply chain will, however, be difficult given the participation biases that are present in the data sample and the rather limited scope of the case study at hand. However, as Swanborn (2003) indicates, the generalisation of case studies should not be thought of in ways of sample-to-population relationships, but is far more a process of making analytical generalizations to a specific theory. In order words, the contribution of this case study should be sought in its elucidation of networks and processes that are at play in the reduction and prevention of food loss and waste, rather than making generalised claims about the extent of food waste in the food supply chain.

3.3.1 Case description: Food Waste Xperts

This research will focus around the case of innovation intermediary organisation Food Waste Xperts. This organisation is located at the circular innovation hub 'Three-Sixty' in the Dutch city of Veghel, although its operations are not limited to this region alone. The organisation consists of a small board which mainly performs administrative and marketing activities, and is furthermore surrounded by an extensive network of experts deriving from various partner organisations. These organisations mainly include consultancy bureaus in the agrifood sector as well as knowledge and research institutes – most notably the Wageningen University and Research Centre (WUR) and the HAS institute for higher education. The work method of Food Waste Xperts consists of four steps. Firstly, companies can contact the helpdesk of Food Waste Xperts to ask question related to food waste and food waste reduction within their company. Food Waste Xperts will subsequently decide if they – or one of the experts in their network – are suitable to work on the question that is addressed. If so, an intake might be organised to evaluate the firm's operations in more detail and to gauge the most fruitful aspects for change. The third step involves an in-depth workshop between representatives and/or employees of the company and relevant experts deriving from Food Waste Xperts' network. The composition of these workshops will thus differ from case to case, depending on the issues and

challenges that are addressed by the customer company. Besides, the workshop participant can become a member of the online 'food waste community', that is hosted by MVO Nederland, the main CSR organisation in the Netherlands. On this online platform, question can be posed as well, on which other members can react in order to jointly look for solutions.

Although there are plenty of food waste related initiatives in the Netherlands, Food Waste Xperts represents an interesting case. Many other initiatives focus on consumer food waste, or aim at specific products and/or sectors (Thijs, 2017). Food Waste Xperts, however, is one of the few organisations that specifically focuses on companies throughout the whole supply chain. Therefore, Food Waste Xperts has to deal with more diverse challenges than initiatives that only aim to alleviate food waste in one particular sector. On the other hand, these characteristics also come with a greater potential of Food Waste Xperts to address food waste mitigation on a systemic level, by incorporating all segments of the supply chain. From a methodological standpoint, Food Waste Xperts mainly provides for an opportunistic case, that allows for tracking new and unexpected developments (Creswell, 2013). From a theoretical perspective, the rather wide range of activities that Food Waste Xperts is involved in provides a useful case to assess the role of intermediary organisations in general. This open and flexible approach seems feasible given the infancy of Food Waste Xperts as an intermediary organisation and the fact that food waste reduction is still relatively low on the agenda in many companies.

4. Findings and results

"Actually, food waste is not an issue for me. Why not? I believe the real issue is how to make maximal use of the value of fruit, vegetables, herbs. (…) So I do not believe in solving food waste. Rather, I believe in reconsidering the value of products, since, in the end, waste is the result of a system." (interview 5)

Food waste points to a complex problem that involves many different actors, practices, causes and effects. This diverse palette of factors is hard to oversee all at once. Therefore, this discussion of the findings and results of this research will start at the level of individual agents and companies and gradually move up to the supply chain as a whole. In the conceptual model (Figure 2.2), this can be visualised as moving from the bottom to the top of the model. Firstly, the food waste performance among the survey's respondents will be assessed by using Moerman's Ladder. These findings will furthermore be amended and contextualised by findings from the interviews. Secondly, the urgency of food waste mitigation will be discussed, making use of concepts from convention theory, most notably 'orders of worth' and 'routines'. The findings in this part will mostly be drawn from the interviews. Thirdly, the barriers and needs for innovations within the supply chain will be examined. The basis for this part is formed by the survey questions, which are subsequently connected with elucidations deriving from the interviews. Fourthly, the firm-level findings from the previous parts will be situated in wider supply chain interactions and power balances, by discussing matters of responsibility and normalisation. Finally, all findings will be aggregated to provide short conclusions on each of the research subquestions. This final section provides the basis for the final conclusion on the role of intermediary organisations as well as practical recommendations for Food Waste Xperts, which are presented in the next and final chapter.

4.1 Food waste performance

Figure 4.1 shows how companies in the survey deal with their waste and side streams. Furthermore, Table 4.1 indicates how companies regard their own actions in terms of food waste reduction. Quite remarkably, when missing values are excluded, the two biggest groups in this figure are 'my company does not waste food' (19.8%) and 'my company is in a phase of optimalisation' (43.1%). However, the other findings from Figure 4.1 and Table 4.1 do not support these claims. For instance, of the companies that indicated that (part of) their waste streams go to regular waste disposal, 31.0% claimed to be in a stadium of 'optimalisation' with regard to food waste (weighted values; excluding missing values). Logically, the values in Table 4.1 should cluster around a line from the bottom left to the top right. However, most values appear to be clustered on the right side of the table, which indicates a social desirability bias to regard yourself as optimal.

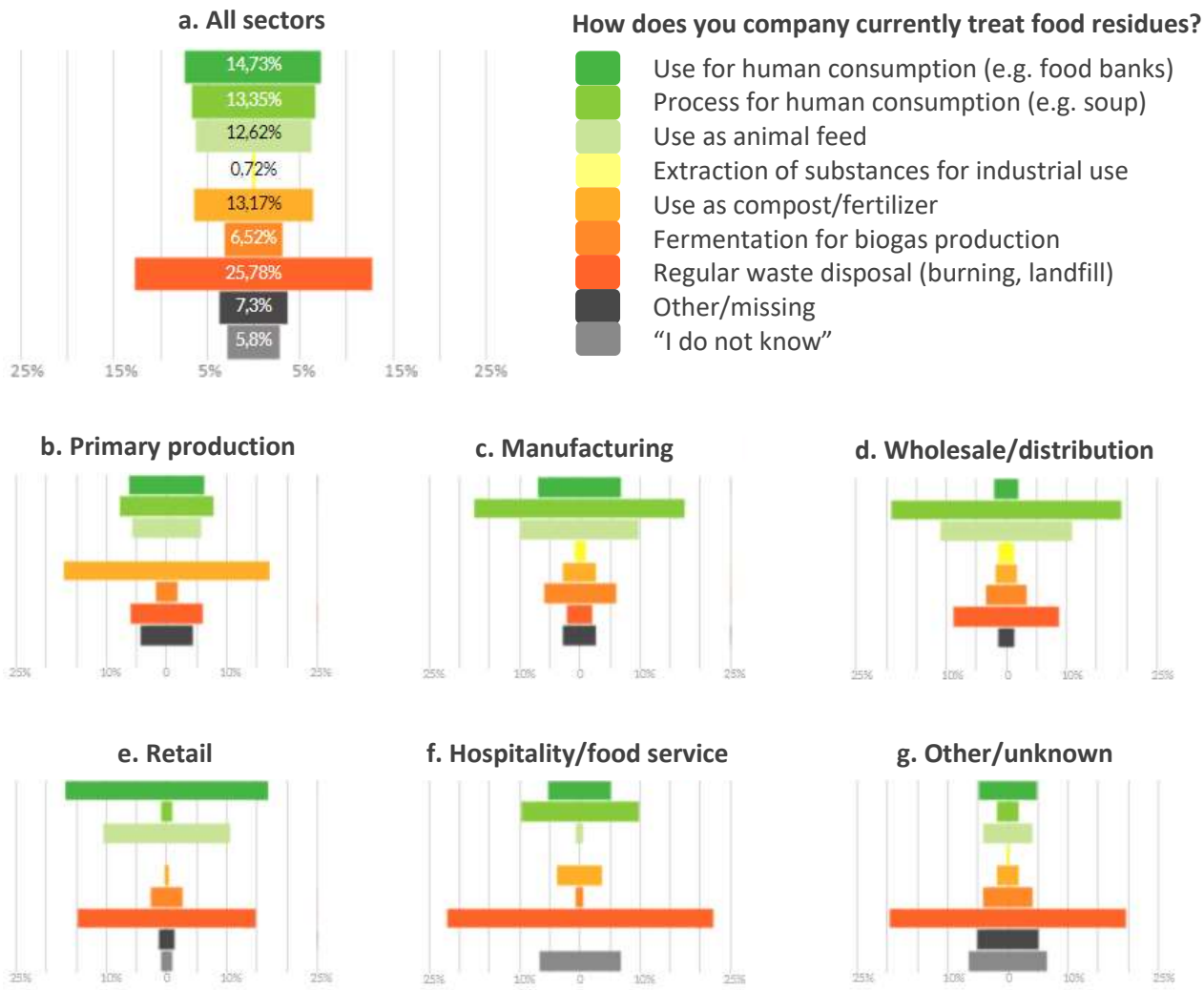


Figure 4.1 Findings from survey question 1: performance on Moerman's Ladder, total and per sector.
Respondents were able to give multiple answers, hence the represented values are weighted for the total number of respondents.

A comparison between Figure 4.1 and Table 4.1 indicates that food waste is not regarded as an urgent problem by a majority of the companies, either because they think they do not waste any food, or because they think they are already optimising. The answer category 'optimalisation' was especially chosen by retailers, who said to give away part of their leftover products to food banks. Furthermore, primary producers who compost their waste streams also claimed to be optimising more often. In Figure 4.1, it can be observed that delivery to food banks and composting occur frequently retail and primary production respectively. These two sectors also include relatively more 'common' companies, due to the sampling strategy (see Section 3.2.3). Therefore, it can be stated that food waste is not an issue for most companies in the supply chain. Henceforth, a lot can still be gained from increasing awareness and inspiration on how to reduce food waste. This view is shared by Food Waste Xperts (diary 20-02-2018) and the board of a regional platform for entrepreneurs (diary 17-04-2018).

Table 4.1 Comparison between survey questions 1 and 2 (weighted values).

Handling of side and waste streams	*Stadium of food waste reduction in company*							
	Never thought about food waste	Orientation	Idea	Implementation	Optimalisation	"I do not waste"	Not specified (missing)	Total
Human consumption (unprocessed)	-	2,75	-	0,33	9,08	4,67	3,50	20,33
Human consumption (processed)	-	1,25	-	3,58	11,75	1,83	-	18,42
Animal feed	-	2,00	0,50	2,58	8,50	1,83	2,00	17,42
Industrial substances	-	-	-	-	0,67	0,33	-	1,00
Compost	2,00	3,00	-	1,08	3,75	6,83	1,50	18,17
Biogas	-	0,25	-	1,25	5,00	2,50	-	9,00
Regular disposal	5,00	7,00	3,50	1,83	8,25	1,00	9,00	35,58
Other	1,00	1,25	-	0,33	2,50	4,00	1,00	10,08
"I do not know"	1,00	1,50	-	-	0,50	-	5,00	8,00
Total	9,00	19,00	4,00	11,00	50,00	23,00	22,00	138,00

4.1.1 Handling waste streams: what are we talking about?

The possibilities to climb Moerman's Ladder are not equal across products and sectors. For instance, regulations can determine whether or not a waste stream can be re-used for human consumption. Besides, a part of the total food waste is unavoidable, which makes recycling in the form of animal feed or compost the highest tier achievable (Papargyropoulou et al., 2014). In this light, a primary producer (interview 8) is convinced that our current system is so efficiently organized, that each waste stream has already found its most desirable outlet. "Do you really believe that the misshapen tomatoes, that do not end up in the supermarket, are thrown away? They just go to processing companies, who make soup out of it. So they are never wasted." The logistics manager of a wholesaler (interview 10) is also certain that each class of products will find a customer somewhere. He states that class II or III products[4] are usually bought up at auctions by (migrant) marketmen who serve the lower ends of consumer markets. Thus, also the lower-class products are used for human consumption and do not go to waste.

Since the survey results presented in this section rely on self-reporting, their numbers are contrasted with data gathered by the Wageningen University and Research Centre (WUR). The WUR has developed a *Food Waste Monitor* (Soethoudt et al., 2017) to assess the amount of food loss and waste in the Netherlands. In this monitor, the amount of food waste for each tier of Moerman's Ladder is expressed in kilotons. Data for the monitor derives from a variety of public sources, including the Dutch Statistics Agency (CBS), and sorting analyses performed by consultancy bureau

[4] Based on EU trade norms, fruits and vegetables are classified as class extra, class I, II or III, in which class extra indicates the highest (cosmetic) quality available and class III is the lowest (acceptable) quality grade.

CREM (Bos-Brouwers et al., 2015). In Table 4.2, data from the WUR Food Waste Monitor is used to calculate the relative size of each tier in Moerman's Ladder in the Netherlands in 2015. These percentages are contrasted with numbers resulting from this research's survey data and will be discussed jointly in the remainder of this section.

Table 4.2 Comparison of share in Moerman's Ladder between this research and the Food Waste Monitor of the WUR (Soethoudt et al., 2017, p. 8).

Category	Estimated range by WUR Food Waste Monitor	This research*
Food for human consumption (unprocessed; food banks)	0.36%-0.40%	20.2%
Animal feed	18.2%-20.1%	17.3%
Compost	18.1%-25.8%	18.1%
Bio-fermentation/biogas	12.1%-13.3%	9.0%
Regular (burning, dumping)	43.6%-48.1%	35.4%

* Note that the WUR Monitor does not include the categories "processed food for human consumption" and "extraction of industrial substances". To make results comparable, these two categories were left out and the percentages of the remaining categories in this research were recalculated to match the categories in the WUR Monitor more precisely.

Food for human consumption

The share of food waste that goes to food banks shows the most interesting deviation of this research in contrast with the WUR Food Waste Monitor. This difference is ascribed to a social desirability bias that is immanent to the self-reported data gathered in this research. When we compare the data in Table 4.2 with Figure 4.1, it becomes apparent that the percentage for food banks in this research largely comes from the retail sector. Of course, retailers can state that they give away (part of) their food waste to food banks, but that does not give any indication of the amount or percentage of the total waste stream that is given to food banks. Since the WUR data is based on kilotons, this data gives a more accurate representation of the total amount of food that actually ends up at food banks. It is clear that this is a considerably small number in relation to the many retailers who say to discard their left-overs to food banks.

Animal feed

Both from the results in Table 4.2 and the interviews (2, 4, 8, 9) it becomes apparent that animal feed is one of the major outlets for food waste. A primary producer (interview 8) even states that animal feed epitomizes the efficiency of our current food system, since basically any waste stream can be employed for animal feeding. Indeed, animal feed scores high on Moerman's Ladder, because food waste is in this form still indirectly used for human consumption. However, despite their relatively high value in Moerman's Ladder, these waste streams for feed are given away either for free (interview 2, 9) or for minimum prices (interview 4, 8). This is understandable since these food streams are regarded as waste, and hence have to be paid for if they go to the regular waste disposal.

For companies it is therefore interesting to give it away: “we get rid of our waste easily, and the farmer is very happy with it” mentions a wholesaler (interview 2).

Compost and bio-fermentation

A remarkable result is the high share of ‘compost’ in the primary production sector. With compost, many producers mean that the inedible parts of plants (such as leaves or roots) are put back on the land to provide nutrients for the next harvest (interview 4, 8). Apart from inedible parts, products that do not meet quality standards, e.g. because they have a rotten spot or are misshapen, are also put back on the land. These are the so-called class III products. As one primary producer explains (interview 8): “Manufacturers only want these products for free. In that case, I would rather put them back on my land, so at least I have the nutrients. Then I at least gain something out of it.” Composting thus seems to be common practice among producers, since it is so easy and brings no extra costs or risks compared with higher tiers in Moerman’s Ladder.

Regular waste disposal

The survey data confirms that regular waste disposal remains by far the most common category to discard waste streams. One caterer (interview 1) blames the configuration of our current system, which is fully focused on linearity, and hence on the production of waste. As a consequence, it requires constant awareness of your behaviour to reduce food waste (interview 1, 7). Otherwise, it is very easy to fall back in old habits (interview 7) or let something slip through your fingers (interview 1). The caterer (interview 1) therefore claims that food waste reduction should primarily come from personal persuasion for Corporate Social Responsibility, and less so for cost benefits. This view is shared by interviews 5 and 6. Nevertheless, in the end you need to make money in order to survive (interview 1), which makes food waste reduction are careful balancing act between moral beliefs and economic incentives. This balance can make it hard to ‘escape’ or ‘reshape’ the current system, which will be elaborated on in the next section and in Section 4.4.

4.2 Routines of waste generation

The interaction between companies in the supply chain leads to emergent routines and work practices. These practices can provide a valuable starting point for change, but they are also a barrier to implement radical solutions. The role of quality and status plays a role in this respect. Simply because companies do not want to be associated as a waste producer (interview 9, 12), but also because they want to provide a minimum standard of quality to their customers (interview 2, 4, 10). A wholesaler (interview 10) says, “we do not want class II or III products, because that is not what

our customers want. (…) The customers want to be able to distinguish themselves on price, which means we only deliver the highest quality to them."

Such an attitude has consequences for the generation of food waste. Upstream, strict monitoring makes suppliers more cautious to deliver the right products. One wholesaler (interview 10) has even put a fine on erroneous deliveries to decrease the amount of labour time and transport costs needed to process these mistakes. However, by only buying the highest quality products, demand is narrowed down to a fraction of all produce. What happens with the residual of lower quality products is unclear, since it lies outside the scope of the individual company. Literally, it is "not their business" (interview 10) whether or not class II or III products, that are rejected by the wholesaler, will find a customer elsewhere in the supply chain. A similar image arises from the other wholesaler (interview 2). The issue of quality standards also has effects downstream in the supply chain. In order to compete in the food market, buyers want to distinguish themselves on quality (interview 4, 11). Therefore, they set very high standards for their suppliers – some are even stricter than the official trade norms (interview 4) – which pushes the burden of food waste upstream in the supply chain.

Table 4.3 Orders of worth referred to by the interview respondents.

Order of worth	Interviews
Market (competitiveness)	2, 5, 8, 9, 10
Industrial (efficiency)	3, 4, 7, 8, 11, 12
Civic (equality)	1, 5, (9)
Domestic (local)	6
Inspired (passion)	1, 6
Opinion (fame)	(6), 12
Green (sustainability)	1, 4, 6

The examples presented here indicate that food waste reduction might lead to contradictory orders of worth. In Table 4.3, the orders of worth that each of the interviewees referred to in order to justify their own business operations are summarised. As expected, companies generally adhere to the orders of market and industrial worth, as they are primarily focused on achieving product efficiency and market competitiveness. However, most of the interviewees were also actively involved with the reduction of food loss and waste. This raises the question where food waste mitigation should be ranked in matters of urgency? Although some companies mention an intrinsic motivation to reduce food waste (interview 1, 5, 6, 12), for most others food waste reduction is primarily interesting in relation to optimising efficiency and improving competitiveness. "You must not be circular for the sake of being circular" explains one entrepreneur (interview 3). A fish processor (interview 11) elaborates: "striving for higher efficiency is inherent to production line thinking". The reason his company is involved with food waste reduction, is because it can help improve efficiency and

therefore increases the revenue on each gram they put into the production line. If it did not save money, the company would very likely not be involved. That food waste reduction is, for instance, also good for the environment is regarded more as a side effect. Similar positions were expressed in interview 7 and 12. Nonetheless, in terms of market competitiveness, the role of consumer preferences must also be stressed here. A wholesaler (interview 10) explains that, if more and more people start to demand a specific product or characteristic, you have to react. “Otherwise, you are losing customers because they will go to competitors. This could also happen with food waste.” Interview 2, 4, 6 and 12 already observe that customers are much more conscious nowadays about the effects of their purchasing and eating behaviour than a couple of years ago. Therefore, consumer preferences for ‘low waste products’ are likely to become more popular in the near future and will likely create incentives for agrifood companies to reconsider the issue of food waste.

It can be inferred that the urgency of food waste reduction must be grafted onto orders of market or industrial worth for most companies to deal with the issue. In this light, however, interview 6 warns that many companies merely use food waste as a marketing tool, without actually dealing with the issue. The company of interview 6 provides an app for supermarkets and other companies to sell products that are close to expiration. Based on his experience with supermarkets, he states that most managers are not very willing to use the app, because they have to adapt their own administration system to the app software and invest labour time in its functioning. Henceforth, the motivation to use the app on the side of the supermarkets generally fades over time. Food waste mitigation usually requires the adaptation of production processes. When these changes are initiated by the company itself, they appear relatively easy to pursue, albeit with strict monitoring (interview 1, 7, 9, 11, 12). However, adaptations might become more controversial when they have to be matched with the interests of other companies (interview 5, 6, 8, 9). It appears that companies do not like their internal workflow routines to be broken, since this challenges their order of industrial efficiency (interview 6; diary 17-04-2018). Especially companies that are used to having the power to impose standards, i.e. most notably the middle supply chain links of manufacturing, wholesale and supermarkets, appear reluctant to make adaptations. If companies are dependent on one of these actors, they have to find very specific leverage points to align their products or services with the interests of these companies (interview 3 and 5). These leverage points will be addressed in more detail in the remaining sections of this chapter. For companies that cooperate more on the basis of mutual dependencies, joint routines seem easier to be built due to more frequent and intimate information sharing and incentive alignment (interview 1, 2, 10, 11, 12). Especially for interaction between SMEs, this second mode of normalization appears to be more common.

4.3 Changes to the system: what cooperation do we need?

4.3.1 Companies in search of markets, logistics, and partners

Figure 4.2 presents the different barriers that are experienced by the survey's respondents. When statements are counted, logistics and laws appear to be the biggest barriers. However, weighted results show that insufficient demand for a product is the biggest barrier. Furthermore, although logistics and law are numbers one and two in terms of absolute statements, they are stated less as the single obstacle. When the obstacles that are chosen as the only answer category are taken into account, unfamiliarity with the possibilities ends up as the second biggest obstacle (see Table 4.4). In the interviews, the limits of laws are acknowledged (interview 1, 12), but it is also stressed that these laws help to guarantee a certain quality and safety and it would therefore be useless to try and fight them; you simply have to comply (interview 1, 2). The differences between weighted and unweighted results show some minor variations, but the top three barriers remain largely in place: demand for the product, logistics, and laws.

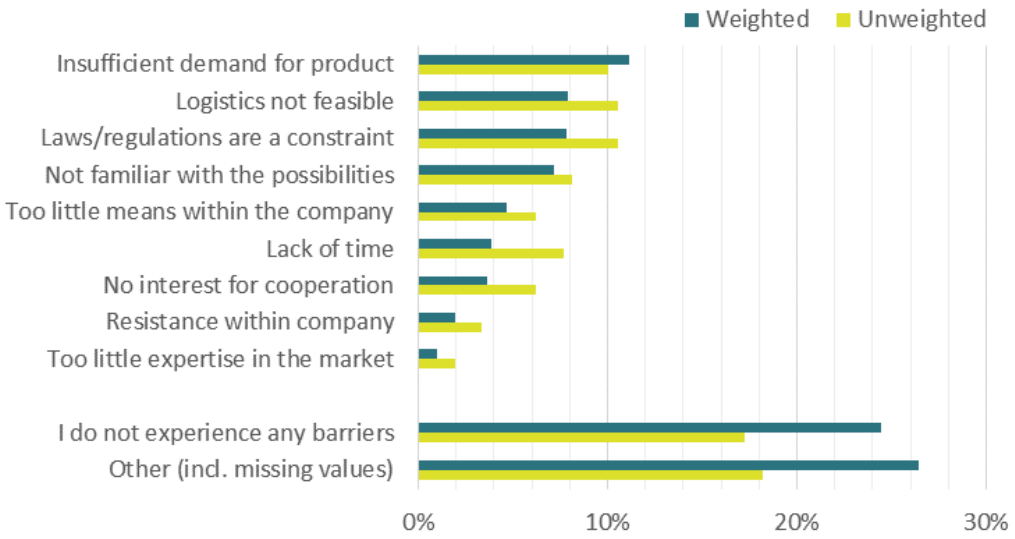


Figure 4.2 Findings on survey question 3: experienced obstacles by companies.

Table 4.4 Count of obstacles that were stated as single answer.

Obstacle	Stated as single answer
Insufficient demand for product	12
Logistics not feasible	5
Laws/regulations are a constraint	4
Not familiar with the possibilities	6
Too little means within the company	3
Lack of time	0
No interest for cooperation	0
Resistance within company	0
Too little expertise in the market	0
I do not experience any barriers	32
Other	1

Range: max. 4 answers categories were chosen together.

Figure 4.3 shows that cooperation and knowledge sharing are regarded as the most desired aspects, for which companies would like to get support. These findings fit well within the framework of Supply Chain Management. The numbers in Table 4.5, however, also show that these results are rather diffuse. A lot of companies stated that they do not need any support. These answers mainly came from the 'common' primary producers and retailers that were addressed for this survey. Again, these results therefore confirm that a lot can still be gained from increasing awareness among companies. This statement is also supported by the fact that 'knowledge sharing about best practices' and 'inspiration about the possibilities' ended up as the second and third most desired aspects for support.

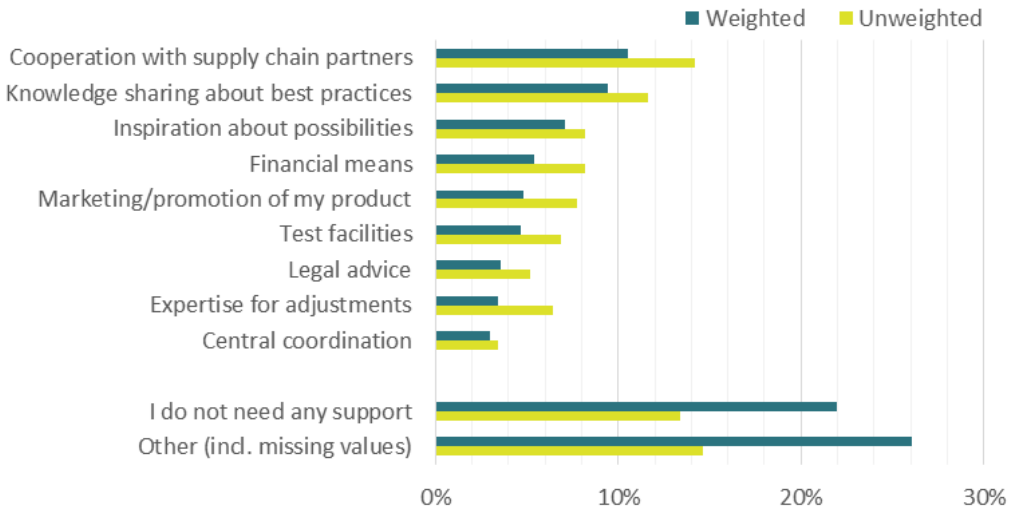


Figure 4.3 Findings on survey question 4: expressed needs for support.

Table 4.5 Count of needs that were stated as single answer.

Need	Stated as single answer
Cooperation with supply chain partners	5
Knowledge sharing about best practices	6
Inspiration about the possibilities	5
Financial means	2
Marketing/promotion of my product	2
Test facilities	2
Legal advice	2
Expertise for adjustments	1
Central coordination	2
I do not need any support	30
Other	0

Range: max. 7 answer categories were chosen together.

4.3.2 Innovative collaboration

Given the previous findings, the question remains on what aspects exactly companies in the supply chain should collaborate? As the obstacles from Figure 4.2 indicate, market access and logistics provide a good starting point. Two companies worked on that already very specifically. The first company (interview 3) processes orange peels to extract valuable substances, like pigments and fragrances for use in products such as cleaning supplies or paint. Since they need a lot of orange peels to extract a profitable amount of substances, they managed to sign a contract with a waste treatment organisation. This organisation already has the logistics in place and has access to some large suppliers of orange peels (e.g. supermarkets and hotels). Hence, the problem of scale was resolved and the company could resell their processed products back to these suppliers, which simultaneously created a stable customer base. Moreover, the orange peel processors and the waste treatment organisation were able to align incentives, in that orange peels burn very poorly and therefore 'contaminate' regular waste streams. Besides, orange peels are unfit for the production of biogas, since they would mask the gas odour in case of leakages. Therefore, separating orange peels from the regular waste stream provides a viable solution that is in the interest of both the waste treatment facility and the processor.

Similarly, a company that has developed a new processing technique for fresh produce works together with Unilever's R&D department to gain better market access. As their business developer (interview 5) explains, this takes a lot of extra time, but the advantage is that they have direct access to a large market when their product is finally introduced via Unilever. The examples of interview 3 and 5 show support the four modes of innovative collaboration that were identified by Arias Bustos and Moors (forthcoming), viz. information sharing, effective partnerships, incentive alignment, and the adequate use of technology (logistics synchronisation). These findings suggest that it is beneficial to find leverage points at dominant actors within the supply chain, who already possess market access and other resources. Especially for SMEs, the parties can amend the resources that smaller companies are lacking. Solution strategies that work 'backwards' in the supply chain are therefore more likely successful, i.e. to start with leverage points at dominant companies at the end of the supply chain and subsequently involve their suppliers in the process. As one business developer commented on this finding: "Supply chains have to be pulled, not pushed" (diary 31-05-2018). However, this process is not always successful, and largely depends on the willingness of both parties to engage in innovative collaboration processes.

4.3.3 The tragedy of being too efficient

As companies stated in the survey, a lack of demand for their (waste) products is the biggest barrier to successful solutions. A vegetable grower (interview 8) claims that the products that cannot be sold,

are really not desired by consumers, e.g. because they do not taste very well. A caterer (interview 1) also states that some food waste is inevitable, since you "cannot do anything with certain products, like paksoi or cauliflower waste." Besides, consumers do not always accept class III products, especially for soft fruits like strawberries (interview 4).

Since not every link in the supply chain delivers directly to end consumers, insufficient demand can also refer to demand from other actors in the supply chain. This is important since some products require processing before they can be sold to consumers. A fish processor (interview 11) contemplates: "You always have to ask yourself, can I do this myself or am I going to source this to someone else?" A primary producer (interview 8) adds that it might be possible to set up a new processing line yourself – even though this would require firm investments and a lot of risk-taking - but the real challenge lies in finding a market for your products, which takes a lot of effort for marketing and persuading consumers. First of all, this marketing has to balance the image between "waste product" and "good (normal) food". As a caterer (interview 12) puts it, "people must not get the idea that we only serve waste if they book catering with us". A mushroom grower (interview 9) experienced something similar. He gives away the stems of his portabella mushrooms to food banks, but some of their customers regard this product merely as waste and therefore do not want it.

Besides marketing, other aspects might constrain companies to successfully market their own waste products. First of all, as was mentioned before, setting up a new processing line is always a costly and risky decision. Moreover, processing food is not always a core business of the company that has a certain waste stream. Therefore, a company needs to have a lot of time available to invest in this new production line (interview 8), gain new knowledge (interview 4) or convince employees to create new work flows (interview 2, 7, 12). In part, these answers relate to some of the other barriers that were included in the survey (see Figure 4.2).

When processing is outsourced, companies also face barriers. The partner company has to see value in processing the waste food. Often, however, ideas are not economically viable, since it is very costly for processing firms to switch production lines to new products (interview 11), or volumes are too small and fragmented to spread out the additional costs for processing and distribution (interview 3, 8; diary 21-02-2018). Additionally, also the processor must find demand for the new product, which is not easily the case (interview 2). Apart from 'new products', also the processing of class III products in existing products is problematic. Processing machines cannot always handle 'misshapen' products (interview 12), or the 'spots' that are on these products require too much labour time to check for rotten items and/or cutting out spots before they go into processing. Due to these extra labour costs, it is cheaper for companies to buy class II or class I products, of which they know they can readily put them into processing machines (interview 2, 8, 10, 12). The price difference between class I and class III products is not big enough to make misshapen or spotted food products

economically interesting (interview 2, 8, 12). Nonetheless, for the hospitality sector, which works much more tailor-made and in small batches, class II products with minor colour anomalies or slightly offset shapes can be of interest (interview 2, 10, 12). These class II products do not differ from class I in terms of quality, only in terms of appearance. Since these products are sliced and processed into meals anyways, meaning you cannot see the original shape or colour in the end product, the price difference for these products is of interest. Especially since the financial crisis, the demand for these class II products has gone up in the hospitality sector, explains a wholesaler (interview 2), in that people started to be more conscious about price-quality balances.

Still, even if you can find a processor who is interested, logistics can be a next hurdle. Again, setting up a logistical structure by yourself is very costly and risky (interview 3, 5, 8). In combination with the fact that most processors only want 'waste products' for free or very low prices, this makes it even harder to sort out the logistical problems (interview 8). For companies that do have the logistics, however, products must fit in their system in order to be of interest, since they already have their own logistical costs and therefore do not want to make a lot of extra costs only to reduce 'someone else's' food waste (interview 2, 6, 12). These examples stress the importance for close cooperation between different supply chain partners, and the need to align responsibilities among various actors.

4.4 The politics of the food supply chain

4.4.1 A sense of responsibility

Apart from cooperation, simple contact between buyers and suppliers within the supply chain seems to be fruitful (interview 1, 2, 7, 10, 12). The interviews make clear that regular contact can help to resolve issues around food waste. For example, a wholesaler (interview 10) calls to his buyer (interview 2) to explain that he has a batch of a product which have some spots on it. The wholesaler asks if the buyer can still use it, so the buyer is now aware that there might be something wrong with the product, but he can also get good quality products perhaps with some discount. The buyer can also call his buyers (e.g. interview 7, 12) and ask if they can use the product. Or the buyer can decide to use the product for its own processing line, for which minor deformations are not an issue, since you cannot see it anymore in the end product. Besides, the wholesalers (interview 2, 10) can keep contact with their buyers in case some of the orders is incomplete. They negotiate how urgently the product is needed, if it can wait until the next delivery, or if they are willing to buy the product themselves if they need it soon (e.g. in the local grocery store; interview 2). In this way, via close contact, waste – also of transport – can be reduced. Negotiations with supplier are also beneficial to

create tailor-made deliveries with use of very specific demands for amounts instead of standard portion packages (interview 1, 12).

Also employees should be involved in the process of finding solutions (interview 2, 7, 11, 12). As the commercial director of a fish processor remembers (interview 11): “The knowledge for solutions predominantly came from our employees. They all held a piece of the solution, it just had to be put together.” A fish store (interview 7) also involved its employees in finding a solution. “[The employees] appeared to have good solutions, which made them alert on each other and speak up about the behaviour of colleagues.” Besides intrafirm relations between managers and employees, companies should also look at interfirm relations to find solutions for food waste reduction. The fish processor (interview 11) brought their fishermen to the workshop at Food Waste Xperts. This turned out to be a smart move, since the fishermen felt more involved with the decisions of the processor to reduce food waste and were more willing to cooperate when new ideas were proposed after the workshop. Nonetheless, interview 7, 11, and 12 also stress that awareness should be stimulated constantly, otherwise the enthusiasm for solutions will wane over time. An app for consumers to buy discounted products at supermarkets (interview 6) has similar experiences: “When supermarkets stop scanning [to put products in the app], you also loose the customers.”

4.4.2 Prevention over reduction due to regulations

In the survey results, it can be observed that laws and regulations become increasingly constraining throughout the supply chain (see Figure 4.1). Especially retail and hospitality cannot always move up Moerman’s Ladder. Although retailers might want to give away part of their left-overs to food banks, this approach is heavily constraint by economic and legal considerations. As one employee of a fish specialty store explains (interview 7): “To give away food might be nice in terms of social responsibility, but you have to be careful because these products do cost money for the store. Therefore, it is more valuable if you can sell these products commercially. But then if you cannot sell them anymore, you really have to throw it away, because it has surpassed the expiration date and hence you are not allowed to give it away anymore.” A similar response was given by a spokesperson of CBL, the branch organisation for supermarkets in the Netherlands (NOS, 2015): “Dutch supermarkets do not throw away any food, except for meat that has expired – that is obligatory under European law. The rest is converted to energy via bio-fermentation or is reused as animal feed.” Both responses show that safety regulations and laws on expiration dates are a constraint for retailers, especially when meat and fish are concerned. Because of these regulations, supermarkets and other actors in the supply chain are not always allowed to give away food to food banks. Prevention is therefore a more feasible solution than revaluing waste streams.

This prevention can be achieved through stricter administration of sales and purchases. For instance, the fish store (interview 7) puts up administrative files on a bulletin board every day, so their employees have a better insight in the remaining stock and the expiration dates of their products. Besides, they have regular meetings with the team to discuss food waste performance and address each other's behaviour. Also a caterer (interview 12) decided to include food waste performance in job evaluations, and started to keep track of their waste streams (and who was responsible for them) more precisely. A wholesaler (interview 10) stated that they send out daily price lists to their sales managers, so they have accurate insights in the stock and products that are approaching their expiration date. Sales managers in this company then get the task to sell these products as soon as possible, e.g. by giving discounts or promotions. This reduces waste, but as the logistics manager of this wholesaler explains, it is mostly because it costs the company a lot of money to dispose of these products otherwise. Such measures have to be constantly updated and pursued in order to remain effective. As interview 7 makes clear, when monitoring is loosened, waste figures rise immediately.

4.5 Results: back to the research questions

Finally, the findings that are presented in this chapter are interpreted in light of the conceptual model (Figure 2.2) and the conjectures that were presented in Section 2.3. This will be done by drawing short conclusions on each of the relationships in the model. These conclusions will be discussed per research subquestion, and subsequently more general conclusions will be drawn in the final section of this chapter.

4.5.1 Research subquestion 1

To what extent is food loss and waste an issue for companies in the agrifood sector?

The findings indicate that food loss and waste are no big concerns for most companies. Companies usually refer to orders of industrial worth, by stressing how efficient the current food system already is. This efficiency leads to a qualification of misshapen or bruised food products as economically irrelevant, since the time it would take to process these class II or class III products outweighs the benefits that can be gained from using the product. This is also related to a market order of worth, that evaluates food products on the basis of their price. Since food is so abundant in the Netherlands, the generally low price levels for potatoes, vegetables and fruit (AGF) and the minor price differences between class I, II, and III products do not create an incentive to work with suboptimal food products. If a product does not comply with quality standards, it is cheaper to buy other class I products than to invest extra time in the processing of class III. There is thus a lot to gain in terms of awareness. This change does not only focus on the 'superficial' aspects of revaluing or re-using certain products,

but also on a more systemic level, a revaluation of food sources in environmental, social, and economic terms is needed to enable durable changes.

As was expected before (Section 2.3.1), companies that evaluate their business performance using orders of industrial and market worth tend to see less incentives for the mitigation of food loss and waste. However, also companies that incorporate other orders of worth, such as inspired (passion) or green worth (circularity), find themselves confronted with the other regimes of justification that are employed by other actors in the supply chain. Since these companies do not always have the resources or motivation to invest in the alignment of justifications among suppliers and buyers, many food waste reduction strategies are limited in their scope and reach. Effective reduction strategies thus do not flow automatically from a specific order of worth. Rather, food waste performance is influenced by a general awareness about the issue. Subsequently, companies will interpret this problem in light of their own justification framework to decide on actions. For efficiency-focused firms, this might include the adaptation of production processes, whereas marketing and persuasion might be more feasible for passion- or circularity-driven companies. Henceforth, on the level of the supply chain, the challenge predominantly lies in the (re)construction of adequate routines that can bring different justification frameworks closer together.

4.5.2 Research subquestion 2

What challenges do SMEs that want to reduce or prevent food loss and waste face, and what do they think they need to cope with these issues?

SMEs mainly face problems of market access and logistics. For a small company or new product, these two aspects are the biggest barriers to overcome. Market access in part relates to consumer preferences, but big food processors and distributors play an intervening role here, since they determine whether or not to introduce a new (waste) product to the market. An overarching problem is the dominant idea in many companies that they have to reduce food waste on their own. This firm-focused mindset limits the capacity to oversee the supply chain as a whole and to identify the most promising leverage points for change. Without these leverage points, it will be much harder to achieve a sufficient level of supply chain coordination in order to make an impact on food waste performance. At certain points, information needs to be exchanged and incentives between various supply chain segments have to align, in order to make innovations salient to others.

The findings show that innovative collaboration can best be aimed at the alignment of incentives to find common markets and develop new supply chain links. Furthermore, the adequate use of technology and information sharing can help to streamline existing supply chain interactions. Intermediary organisations can connect to these issues by focusing on collaboration networks across

the supply chain, that provide a platform to negotiate the costs, benefits and responsibilities of food waste mitigation measures. Particularly for SMEs, collaboration is essential to reach successful results on food waste performance. The reduction of food waste might require costly investments and production techniques that fall outside of the company's core activities. Therefore, collaboration can fill these gaps to make food waste mitigation more practical and manageable in smaller companies, as long as these SMEs do not get stuck in their daily practices of firm survival. Moreover, the flexible organisation of many SMEs also allows for localized collaborative network, that can stretch across the supply chain and therefore provide opportunities for situated forms of supply chain coordination.

4.5.3 Research subquestion 3

How are supplier-buyer relationships organised throughout the food supply chain and how does this affect the possibilities to reduce food loss and waste as a whole?

Cooperation among chain links is stressed excessively in the Supply Chain Management literature and is supported by the findings from the survey. However, how and what has to be cooperated largely remains an open question. In the food supply chain, with many actors at both the beginning and end of the chain and only a few in the middle, intermediary organisations like Food Waste Xperts can provide valuable resources, since they have – more than individual SMEs - the capacity to oversee the supply chain as a whole and make connections at different levels from chain, to market, to regulatory schemes. The intermediary can also take over certain coordinating roles, especially towards primary producers and the hospitality sector, to create awareness and link companies to each other for new concepts and supply configurations. Such changes are not readily expected of the bigger wholesale and retail actors in the food supply chain, since they are still mainly focused on quality standards and product norms that do not include food waste related factors. A shift in these norms and standards, however, seems to be underway.

More important than national laws and regulations, the implicit conventions that exist within the food supply chain are an important contributor to food waste. In an attempt to beat competitors, many companies try to set high quality standards for themselves. As a consequence, these quality standards inherently come with a bigger share of total food production that cannot meet the stringent requirements. This pushes food waste upstream in the supply chain; unwanted products are sent back to suppliers and they have to deal with it. Nonetheless, in a competitive market that operates very efficiently, competition on the basis of standards appears as a feasible economic strategy. By setting certain product standards, companies in the agrifood supply chain aim to achieve their own niche market, e.g. one that is catered to high quality products or one that aims to provide cheap nutrition. Although in theory, these niche markets could all occupy their own range of available

qualities, the nature of food production poses some serious logistical challenges to this idea. Still, the fragmentation of the agrifood sector also provides opportunities to find or construct new niches, in which especially SMEs can establish new standards. This mechanism can already be observed in the rise of Alternative Food Networks. Subsequently, however, the challenge to expand these routines to wider supply chains must be addressed. Here, matters of responsibility, coordination and power come into play again. To conclude, these results show that the connection that was postulated in this research, between routines and mechanisms of justification on the one hand, and responsibility and supply chain coordination on the other hand, provides a valuable framework to study supply chain interactions in relation to the outcomes – 'performance' in this case – they produce.

5. Conclusion and reflection

5.1 Moving ahead with food waste innovation

The challenges of the contemporary food system are often framed in Malthusian terms. The world population is expected to rise to the threatening number of 9 billion people by 2050, which all have to be fed in one way or another. Such assertions make the immanent suggestion that there currently is not enough food available for such a large number of people. The fact of the matter is, however, that the world is perfectly capable of sustaining a world population of 9 billion people. This can already be observed by the fact that the amount of global food waste involves enough calories to feed all the people that currently live in hunger.

This position is not new, and has led others to conclude that the real challenge of feeding a growing world population is a distribution problem instead of a matter of quantity and production methods. Although the author agrees with this position to a large extent, the distribution of food also involves very practical challenges that cannot be solved as easily. For instance, food waste numbers are highest among developed countries in the Western world, whereas hunger is prevailing in the least economically developed countries of the world. A simple reduction of food waste in developed countries will not automatically lead to the eradication of hunger in less developed countries. The shipment of surplus foods to areas with hunger is also a utopian and impractical idea.

The ultimate challenge for the future of food is therefore not a problem of overpopulation nor one of distribution. Rather, the problem lies in the fact that a growing number of people around the world is adopting a 'Western lifestyle', as their economies grow and develop over time. This lifestyle includes more wasteful eating and procurement habits, which among other things include the increased consumption of meat and abilities to retain stocks. These developments are related to Engel's law, which states that as income rises, the proportion of income that is spent on food falls. As a result of this mechanism, food acquires a lower level of relevance and urgency in people's daily livelihoods, meaning that the waste of it also becomes less troublesome.

Thus, the issue of feeding 9 billion people is in itself not a problematic one. What is more challenging is the way in which these people value their eating habits, and how this will subsequently affect economic activities, as well as social and environmental outcomes. The orders of worth as developed in the work of Thévenot et al. (2000) and Boltanski and Thévenot (2006 [1991]) provide a useful framework for analysis in this respect. Nevertheless, the seven orders of worth that are identified now should not be conceived as being mutually exclusive. Related to the supposed dualism between conventional and alternative food networks, orders of market and industrial worth are commonly perceived in opposition to the other orders of worth. However, one could criticise the

actual scope and potential of this dichotomy and question whether the ontology of AFNs truly remains one of 'alterity'. This concern is reflected by many scholars who have worked on the integration of alternative and mainstream food systems. Market competitiveness and industrial efficiency are not intransigent properties, but rather, they are constantly revalued within economic interactions. Impactful changes and innovative trajectories should therefore be modeled on making new connections between the various orders of worth. Such an approach is fruitful, since it considers natural dialectical paths of development. The resulting evolution of the contemporary food network to escape the contradictions inherent to both the conventional, industrial systems of production and alternative networks, seems a more durable and realistic trajectory than the radical overturning of established practices of food consumption and production. The so-often criticized neoliberal food regime has helped to solve the issue of food security, especially in Western Europe, in the aftermath of food scares related to the Second World War. It cannot be denied that this system has also put considerable stresses on local and global environments, but that should not be regarded as a sufficient argument to do away with this system as a whole and turn back to localized, artisan food networks.

As is so often the case, the solution must thus be sought in a compromise between alternative and conventional food networks. Such a solution can be achieved through renegotiations of the product qualifications in localized contexts. Such localized contexts can be bounded by shared systems of justification and their resulting standards of quality. Although this might sound paradoxical, given the fact that quality standards are also designated as major contributors to food waste, one should be attentive to the practical implications that a more localized food system will bring about. Quality standards are also employed as a means of control, which prioritize certain products over others and therefore serve as a protection measurement against competing food networks. Here, the creation of new markets can be observed, which also leads to the assertion that one cannot speak of 'the supply chain'. Rather, the agrifood sector consists of a tangle of interrelated networks and supply chains and any solution strategy should take this diversity and fragmentation of the sector into consideration.

5.2 Recommendations

For Food Waste Xperts as an intermediary organisation, some specific and practical recommendations can be made:

1) Inspiration is still essential to make new companies aware of their food loss and waste and to stimulate creative thinking and public involvement. A very big challenge for the future is how to stimulate intrinsic value or – on the other hand – create sufficient other incentives to reduce food waste. After all, the most eager companies are already working on it.

2) Inspiration, however, has to find a balance with practicality. Not all solutions are feasible, since companies do not always have sufficient resources to implement ideas or struggle to persuade their supply chain partners for cooperation. In theoretical terms, the order of inspired worth has to be balanced with existing dominant orders of market and industrial worth in order to be effective.
3) Market access and logistics appear to be major constraints. Food Waste Xperts should therefore function as a connection point between various links of the food supply chain, so interested buyers and suppliers can come into contact with each other and develop new business models and/or supply chain configurations. In extension of this recommendation, each company should also clarify for itself what its contribution and strength is within the supply chain: does it possess a specific product, network or expertise? Be also mindful of existing power relations within the supply chain and try to work with those. For Food Waste Xperts, the connection with innovation hub Three-Sixty and the Taskforce Circular Economy in Food should be employed to foster connections between various actors, supply chains, SMEs and bigger companies, and between conventional and more alternative food networks.
4) Aftercare is an important aspect to keep people involved and create routine behaviour out of initial ideas and plans. It is important to do this systematically, by appointing specific tasks to specific people and make them responsible for the progress. Aftercare can also help to divide big changes into smaller manageable steps with short control check points in between.

In general, intermediary organisations balance between awareness-raising and supportive activities. On the side of awareness, it is most useful to address orders of market or industrial worth, since these fit with the justification frameworks of a majority of companies in the sector, especially in supply chains that can be characterised as 'conventional food networks'. The intermediary has to demonstrate how food waste mitigation can contribute to optimising efficiency or market competitiveness, even if the initial adaptations might require extra labour costs, investments and/or the persuasion of customers. To smoothen this process of constructing new qualification schemes, the intermediary organisation cannot do without supportive activities that are aimed at supply chain coordination. As a platform of diverse agents, experts and institutes, the intermediary organisation can bring together various supply chain segments to align interests and exchange information. The intermediary organisation should thus mainly act as a bridge between individual companies and the supply chain or food system as a whole. When individual companies face problems, the intermediary organisation can serve as a node of referrals to other agents, which can help the company to find leverage points for cooperation. For a complex sector like agriculture and food, with many SMEs and a wide variety of products, production methods, and qualification schemes, such a central 'superintendent' can actively help to catalyze new innovations and reconfigure existing supply chains.

5.3 Limitations and options for future research

This research was based on a survey with 138 respondents and 12 interviews. Although a relatively equal representation of different supply chain links was strived for, this was hard to obtain in practice due to practical problems such as agenda's and willingness to cooperate. Especially the hospitality sector is underrepresented in this research's sample. Therefore, future research could try to focus more on the issues that are specific to a particular link in the supply chain. In part, such studies have already been conducted, but not for all links in equal measure, and especially not for the first few links in the supply chain (before retail). On the other hand, sectors could also be investigated in relations to each other, e.g. in the form of focus groups with representatives of different segments. Such a group session was also aimed for in this research, but could not be organised within the available time frame. Therefore, future research is encouraged to employ more interaction-based methods in order to scrutinise supply chain interactions in more detail and foster discussions about (shared) responsibilities and capabilities to innovate on food waste performance.

Furthermore, this research chose to focus on SMEs in the Netherlands, which affects the validity of these results for the whole agrifood sector. Since SMEs do not have many resources to experiment with new products or techniques, they form a very specific group in terms of food waste. Forthcoming research could thus dive deeper into the differences between SMEs and big companies in terms of the barriers they experience and the support they desire. Additionally, specific supply chains or links could be selected for further analysis. In this research, some results were probably not revealed sufficiently due to the overall perspective that this study was striving for. When research is conducted on one specific commodity, the relations and capabilities of specific actors can be examined in more detail. However, a trade-off between more generalizable results and insight in specific supply chain mechanisms has be considered. Given the relatively scarce amount of research that has been conducted on supply chain interactions in relation to food waste generation, this research chose to focus on getting a more general overview of the whole supply chain first, before more specific topics and issues can be addressed.

The research results are not without biases. In part, these biases were consciously chosen and/or accepted. For instance, out of practical considerations this research was situated in a Western context, and mostly included companies that were actively working on food waste reduction. In the researcher's opinion, these biases do not distort the results in any impermissible way, but simply have to be kept in mind when assessing the results of this study. For future research, attention could also shift towards food waste in the context of developing countries, or to look into why cases have failed to address food waste, instead of focusing predominantly on successful examples.

Another bias in this research was not consciously decided but is more of an emergent nature. Most of the issues discussed and studied in this research were related to the sector of potatoes, vegetables and fruit (AGF in Dutch). Interestingly, this bias is also reflected in the literature review. This raises the question if food waste mitigation plays out differently in the sector for meat, dairy or other product types. Although this research did include a processor of fish products, a fish specialty store and two caterers that also deal with other food waste apart from fruit, vegetables and potatoes, this research gap can be filled or explored in more detail. Most limitations of this research must be considered in light of the complexity and dynamics of the agrifood sector. The sector entails a very broad range of actors, products and supply chains which are all intricately connected. This convoluted nature provides considerable challenges to any researcher that wants to investigate food-related issues and trade-offs have to be made on sector- versus product-focused approaches, whole supply chains or specific segments, various location and time frames, big or smaller companies, et cetera. Henceforth, the research agenda on food waste provides enough issues to be scrutinised in the upcoming years.

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Appendix I – Articles used in literature review (Table 2.1)

Reference	Supply chain segment	Data collection	Geographical coverage
Betz et al. (2015)	Hospitality and food service	Case studies at 2 companies, incl. waste stream analysis	Switzerland
Canali et al. (2016)	Whole supply chain *(7 sectors: primary production, processing of agricultural staples, packaging and processing of food commodities, wholesale and logistics, retail, food service, households)*	Literature review	Europe
FAO (2011)	Whole supply chain	Literature review	Global (developing vs. industrialized countries)
Garrone et al. (2014)	Whole supply chain *(5 sectors: agriculture and fishing, manufacturing, retail, food service, households)*	Interviews with 20 companies and 10 experts	Italy + international companies
Garrone et al. (2016)	Manufacturing	Literature review + 4 case studies	Italy
Gunders (2012)	Whole supply chain *(8 sectors: farming, post-harvest and packaging, processing, distribution, retail, food service, households, disposal)*	Literature review + statistical data	United States
Halloran et al. (2014)	Whole supply chain *(7 sectors: primary sector, food processors, wholesalers and retailers, commercial kitchens, consumers and households, food waste processors)*	Literature review + statistical data	Denmark
Heikkilä et al. (2016)	Food service	Focus groups with a total of 34 participants (staff and managers)	Finland
Lebersorger & Schneider (2014)	Retail	612 cases, incl. waste stream analysis	Austria
Lewis et al. (2017)	Wholesale, supermarkets, food rescue organisations, waste service providers	Literature review + interviews and focus groups with managers and civil servants	Australia
Luitjes (2007)	Restaurants	Interviews with 50 companies	Netherlands
Mena et al. (2014)	Whole supply chain *(4 sectors: abattoirs, fruit and vegetable suppliers, wholesale, retail)*	101 interviews related to 15 food commodity networks	United Kingdom

Mirabella et al. (2014)	Manufacturing *(3 sectors: fruit and vegetables, dairy, meat and derivatives)*	Literature review	Unspecified
Papargyropoulou et al. (2016)	Hospitality and food service	Literature review + case study in 1 company	Unspecified (literature review) + Malaysia (case study)
Parfitt et al. (2010)	Whole supply chain *(3 sectors: post-harvesting, retail, consumers)*	Literature review	Global (developing vs. industrialized countries)
Pirani & Arafat (2014)	Hospitality and food service	Literature review	Europe, North America, Asia
Pirani & Arafat (2016)	Hospitality and food service	Interviews with 45 hotels + waste stream analysis at 1 canteen and 'various events'	United Arab Emirates
Priefer et al. (2016)	Whole supply chain *(5 sectors: agricultural production, manufacturing, distribution and wholesale/retail, hospitality industry and catering, households)*	Literature review	Europe
Sargent et al. (2000)	Harvesting, packaging, transport, storage	Assessment of methods and techniques for handling and storage	Florida (US)
Stuart (2009)	Whole supply chain *(3 sectors: farming, manufacturing, retail)*	Diverse	Global
Teller et al. (2018)	Retail	28 cases from 5 retail organisations, incl. waste stream analysis + interviews with 12 experts	Western Europe
Verghese et al. (2015)	Packaging, distribution, retail	Literature review	Australia
WRAP (2013)	Hospitality and food service	Surveys, interviews and waste stream analyses	United Kingdom

Appendix II – Survey questions

Original Dutch questions:

Quickscan voedselverspilling (5 vragen)

1. **Hoe gaat uw bedrijf momenteel om met overgebleven voedsel(resten)? (Meerdere antwoorden mogelijk)**
   □ Weet ik niet
   □ Gaan naar de reguliere afvalverwerking
   □ Worden gebruikt als compost
   □ Worden vergist voor biogasproductie
   □ Worden verwerkt to industriële grondstoffen (bv. kleurstof)
   □ Worden verwerkt in veevoer
   □ Worden verwerkt to andere voedingsmiddelen voor menselijke consumptive (bv. soep)
   □ Worden verspreid via andere kanalen, zonder bewerking (bv. naar de voedselbank)
   □ Anders, namelijk _____

2. **Op wat voor manier is uw bedrijf bezig voedselverspilling te verminderen?**
   - Nog nooit over nagedacht/niet mee bezig
   - Mijn bedrijf verspilt geen voedsel
   - **Oriënterend:** kijken wat de mogelijkheden zijn
   - **Idee:** kijken hoe mijn ideeën uitgevoerd kunnen worden
   - **Implementatie:** ik heb al een plan/business case en ben bezig met de uitvoering
   - **Optimalisatie:** het verminderen of verwaarden van voedselverspilling is al onderdeel van mijn bedrijfsvoering

3. **Welke barriers ervaart u bij het verminderen van voedselverspilling? (Meerdere antwoorden mogelijk)**
   □ **Onbekendheid** met de mogelijkheden
   □ Te weinig **expertise** in de markt
   □ Onvoldoende **vraag** naar mijn product/dienst
   □ Te weinig **middelen** in het bedrijf (geld, expertise, overig) voor uitvoering
   □ **Weerstand** binnen het eigen bedrijf
   □ Gebrek aan interesse voor **samenwerking** bij andere partijen
   □ **Wetgeving** werkt tegen
   □ **Tijdsgebrek** om bedrijfsprocessen aan te passen
   □ **Logistiek** niet haalbaar
   □ Ik ervaar geen barrières
   □ Anders, namelijk _____

   [Geef eventueel een toelichting op uw antwoord]

4. **Op welke aspecten zou u graag ondersteund worden m.b.t. voedselverspilling? (Meerdere antwoorden mogelijk)**
   □ **Juridisch advies** over de wettelijke mogelijkheden om anders met voedsel om te gaan
   □ **Financiële middelen** om plannen uit te voeren
   □ **Inspiratie** over de mogelijkheden
   □ **Kennisdeling** over best practices
   □ **Samenwerking** met andere bedrijven in de keten

□ **Expertise** om bedrijfsprocessen succesvol aan te passen
□ **Centrale sturing** in plaats van losse projecten
□ **Faciliteiten** om nieuwe technieken te testen
□ **Marketing en promotie** van mijn product/dients
□ Ik behoef geen ondersteuning
□ Anders, namelijk _____

[Geef eventueel een toelichting op uw antwoord]

5. **In welke sector is uw bedrijf actief?**
□ Input toeleverancier
□ Boerderij/primaire productie
□ Voedselverwerking
□ Verpakkingsbedrijf
□ Distributie/groothandel
□ Retail
□ Horeca/catering
□ Anders, namelijk _____

Hartelijk dank voor het invullen van de enquête. Bent u bereid uw antwoorden nader toe te lichten? Of bent u geïnteresseerd in de resultaten van dit onderzoek? Laat dan hieronder uw contactgegevens achter.

Onder de deelnemers zal een toepasselike "No Waste" prijs worden verloot!

[Naam, bedrijfsnaam, e-mail en/of telefoon (niet verplicht)]

English translation of questions:

1. How does you company currently treat food residues?
2. In what stage is your company in terms of reducing food waste?
3. What barriers do you experience when trying to reduce food waste?
4. On what aspects would you like to receive support with regard to food waste?
5. In what part of the supply chain does your company operate?

Appendix III – Interview respondents and interview guide

List of interview respondents (type of company, *function of interviewee*):

1) Caterer and provider of cooking workshops, *owner*
2) Wholesaler of potatoes, vegetables and fruit (AGF), predominantly to restaurants, *owner*
3) Processor of waste streams to retract industrial elements, *owner*
4) Producer of strawberries, raspberries, and leek, *communications manager and owner*
5) Processor of food, predominantly fruit and vegetables, *business developer/strategic manager*
6) App to sell wasted products, predominantly for supermarkets but also restaurants, *owner*
7) Specialty store for fish and seafood, *general store manager*
8) Producer of various vegetables, predominantly iceberg lettuce and pumpkins, *owner*
9) Producers of mushrooms, *owner*
10) Wholesaler of potatoes, vegetables and fruit (AGF), predominantly to big buyers, *logistics manager*
11) Producer of fish products, *commercial manager*
12) Caterer, *QHSE manager* (not an SME)

Interview guide (translated from Dutch)
Preparation: bring own survey answers to discuss during the interview (if applicable)

Questions: *(relevant codes)*

1. Can you briefly describe you business operations? *(sector, position in supply chain*, *type of activities, type of supply chain interactions)*
2. What does food waste mean to you? *(dominant order of worth, motivation)*
3. What do you do to reduce or prevent food waste within your company as much as possible? *(reduction strategy, stadium of food waste reduction)*
4. When did you start reducing food waste? What triggers/triggerd you to reduce food waste? *(dominant order of worth, motivation)*
5. Can you describe the process of implementing measures to reducre food waste? What obstacles had to be dealt with, what was easy and what difficult, did you experience anything unexpected, did you get assistance from others, what would you do differently now? *(barriers, needs, innovation process, collaboration)*
6. How would you further adapt your business operations in the future? What obstacles do you expect to find in this process, how are you going to cope with those obstacles, can you do that alone or do you need help, do you know who to turn to for help? *(barriers, needs, innovation process, collaboration, power)*
7. Are you familiar with Food Waste Xperts, Three-Sixty, BioBOost, FoodTech Park Brainport, MVO Nederland, Food from Food, etc.? If applicable, what is your relation to these initiatives, how do you think of them, do you know other companies that are connected to these initiatives, would you use these networks to find help? *(collaboration, supply chain coordination, intermediary functions, power, responsibility)*
8. SPECIFIC QUESTIONS FOR EX-PARTICIPANTS OF FOOD WASTE XPERTS WORKSHOPS:
   How did Food Waste Xperts help you to reduce food waste, to what extent are the ideas from the workshop (still) applied in your company, can you elaborate on the implementation of these ideas, what expectations did you have, how would you evaluate the process from preparation to aftercare? *(intermediary functions, collaboration, responsibility)*
9. Snowballing: do you know other companies that might be relevant for this research? *(supply chain interactions)*