SCHOOL OF
ECONOMICS AND
MANAGEMENT

Master's Programme in Innovation and Global Sustainability

The Role of Too Good To Go in Addressing Food Waste in Sweden

A review of Drivers and Barriers for Food Waste Prevention and Reduction with the MLP framework

By

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Abstract

Food Waste is a global issue concerning the environment, resources, social justice and economy. Despite being so pressing, around one-third of food produced is discarded worldwide. Meanwhile, food waste is incredibly complicated, requiring collaborations of all stakeholders and various innovations. Too Good To Go (TGTG) utilizes technology to bridge consumers and food business and save food waste from ending in the bins. Exploring how TGTG contributes to food waste reduction and driving the sustainability transition of food chains in Sweden, this thesis employs a Multi-level Perspective (MLP) framework adapted for the food sector to analyze the roles of the relevant actors, their motives, the barriers and drivers for food waste prevention and reduction. A qualitative approach is conducted with the support of document reviews, qualitative data collected via interviews with TGTG and food business partners and an online survey of Sweden consumers. The main findings of the thesis show that TGTG helps fill the gap in food waste reduction left by the conventional food redistribution methods in an efficient, scalable and economical way. Like its strategy in other EU market, TGTG can contribute to driving consumer behaviors and industry standards through collaborations with business, education and legislators. Besides, biological treatment of waste has long been prioritized over prevention and redistribution. Governance on food waste in Sweden urgently needs to be put in place to remove the economic and regulatory barriers for addressing this issue. The public foodservice sector can be a focal area for the governments to push for progress.

Keywords: Food surplus prevention; Food Waste Reduction; Sustainable transition; Multi-level perspective; Sweden; TGTG

Programme Code: EKHS35
Master's Thesis (15 credits ECTS)
June 2021
Supervisor: Cristián Ducoing
Examiner: Jutta Bolt
Word Count: 15425 words

Acknowledgements

First and foremost, a huge thank must go to my supervisor Cristián Ducoing, for months of invaluable guidance, support and enthusiastic encouragement on my research, inspiring me to continue this thesis in situations of doubts. I would like to express appreciation to all interviewees and survey respondents, who contributed their time and insights on this topic with great patience, openness, and friendliness. Their enthusiasm and concern for sustainability give me hope for a better world and fuel me to do more for our marvelous planet.

I am very grateful for Professor Cristina Chaminade, who leads me into the field of sustainability as well as provides the theoretical tools and critical but inclusive thinking to analyze problems. It is really a pity that I could not have more courses from Cristina.

Also thank my beautiful, smart and warm friends in Lund and Geneva for staying with me during this tough period and providing me advice as well as physical help for my relocating under the COVID-19 restrictions. I would not have such a wonderful experience without you all. Thank you! Denise, Mats, Ariel, Nino, Guan and Zijiao!

My course mates at the University of Geneva, Tessa, Ana, Valentina, Shauna and Matteo, should not go unmentioned as they gave me the inspiration on this topic so that I could put it into practice. Special thanks to my friends Amber and Shaun for trying to connect me with the interviewees.

Many thanks to my friend Sen and Haochan for chatting with me online even though we are in different time zones. You always know how to make me feel good about myself.

Most importantly, I would like to thank my family for their endless and unwavering support. You are always my sources of strength, even I could not go back and stay with you all now. As usual, thanks to my dear sweet little friends Xiaoguai and Luna, who accompany me everywhere and give me their full trusts and love (Even though they do get a little annoying sometimes)!

This thesis will mark the end of these two incredible years, but it will also be a start, fueling my ambitions and reminding me to make the world a better place.

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1 Introduction

Food waste has gained increasing attention in recent years due to the significant environmental, social, and economic impact. Though facing the pressing food security issues, one-third of produced food around the world is lost or wasted together with the resources and energy consumed across the food supply chain, accounting for 25% of total agricultural water and about 8%-10% of total anthropogenic greenhouse gas emissions every year (FAO, 2013, WWF, 2020, Shukla et al., 2019, Searchinger et al., 2019). The calories contained in food wastage is enough to feed three billion people (WWF, 2020). Besides, it is also a major contributor to land degradation, global water consumption, and biodiversity loss (FAO, 2013). According to The World Bank (2017), over 70% of the annual freshwater supply is used by global agriculture. Meanwhile, it also results in 80% of deforestation worldwide, destroying 60% of the biodiversity of the global ecosystems.

Radically addressing food waste issues at their roots can help mitigate global climate change, environmental degradation, and food insecurity. Around 815 million people worldwide suffer from undernourishment (Unicef and WHO, 2017), while billions of tonnes of quality food are thrown into trash bins in rich countries (Kummu et al., 2012). 20% of the produced food in the EU is wasted and costs 143 billion euros annually of wasted resources and environmental impacts (IPES, 2019). In 2014, more than 1,288,000 tonnes (average 134kg person) of food waste were generated along the food value chain in Sweden except for processing and wholesale, with over 70% produced in the household (Stenmark et al., 2016). The volume of food waste in the downstream phases of the food supply chain (FSC), including processing, distribution and consumption, are higher in high-income countries than low-income regions (Godfray et al., 2010, Shukla et al., 2019). In low-income countries, a large share of food waste is generated at post-harvest, primary production and processing stages due to poor infrastructure, while food waste is mainly produced in retail, service and consumption stages, primarily due to consumer behavior (Godfray et al., 2010, FAO, 2013). Given that the world population is estimated to reach 9.6 billion by 2050, preventing and reducing food waste has become an urgent need to address the environmental and food security crisis (Godfray et al., 2010).

In the last decades, many international, regional, and national initiatives have been raised to address the food waste problem. The UN's Sustainable Development Goal (SDG) 12.3 *On Food Loss and Waste* proposes all countries, "*(b)y 2030, 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*". The European Council confirmed their commitment to SDG12.3 in June 2016, and developed the details in the Council conclusions on the EU action plan for the circular economy (Wunder et al., 2018). In 2017, the European Union adopted a binding food waste reduction target of at least 30% by 2025 and 50% by 2030 throughout food chains and require all Member States to take actions for food waste reduction (European Commission, 2018b, Environment, 2017).

Founded in 2015, the social impact company Too Good To Go (TGTG) aims to both inspire and empower people to fight food waste by establishing a marketplace (mobile application) to connect consumers and food providers such as bakeries, restaurants, and grocery stores, who can sell their food surplus at a reduced price and avoid throwing it away at the end of the day. So far, 37.4 million users have used TGTG and saved 71.7 million meals across 15 countries (TGTG, 2021a). Their ambitions are not limited to reducing food waste through a mobile application but trying to promote a behavioral and cultural shift in food waste by working hand in hand with consumers, civic groups, food business, and policymakers through the *Movement Against Food Waste* (TGTG, 2021c). As a "win-win-win" innovative initiative, TGTG claims to bring economic gains to business partners and customers while reducing the extraction of natural resources and GHG emission by reducing the food surplus and waste. Besides, TGTG has already launched several campaigns and joint initiatives in several EU countries to raise public awareness on food waste and date labelling. However, it is unclear if TGTG can drive the radical change in food production and consumption and address the food waste issue. After all, food waste is a complicated problem that involves multiple actors and is affected by economic, technological, social and cultural factors (Hartikainen et al., 2018, Spaargaren et al., 2012). Therefore, understanding TGTG's role in food waste prevention and reduction requires a systemic review of the existing food value chains and network.

1.1 Research Problem

This paper aims to investigate how to address the food waste problem throughout the whole food supply chain by driving the sustainability transition of the food industry. To achieve this goal cannot just rely on a single actor of the food industry but needs a systemic change in the food production and consumption pattern, involving the relevant regulations and standards, technologies, infrastructure, business model, cultural meanings, and practices of all actors of food value chains and networks. Understanding the barriers and drivers for the sustainability transition will help provide some implications to researchers, policymakers, and entrepreneurs who work on social changes.

Sweden has consistently ranked in the top group in sustainability due to environment and nature conservation, low pollution rate and extensive innovations and initiatives. In the newest Reports, Sweden ranked first in the Sustainable Development Index globally (Sachs et al., 2020) and the 8th in the Environmental Performance Index (Wendling et al., 2020). In terms of food waste, more than 1,288,000 tonnes (average 134kg per person) of food waste were generated along the food value chain in Sweden (Stenmark et al., 2016). Even though Sweden has better performance in food waste during production, retail and foodservice sectors (no available data for processing and wholesale), the food wasted at the consumption stage is higher than the average value of all EU countries and takes up over 70% of the total food waste in Sweden (Stenmark et al., 2016). So what causes the less impressive performance of Sweden in food waste, and how to improve it to achieve the SDG 12.3 in the context of an increasing environmental crisis?

As a business model innovation that emerged in 2015, TGTG did not enter into Swedish Market until early 2020 even they had achieved success in other European markets, such as UK, France, Italy and Denmark. Therefore, it becomes a case study for analyzing the food waste prevention and reduction in Sweden and exploring how to drive the transition towards a more sustainable food production and consumption pattern.

1.2 Aim and Scope

The conceptual framework of this paper is grounded in the Multi-Level Perspective (MLP) theory, a mainstream framework to explore how socio-technical transitions to sustainability may happen by understanding the mechanisms underlying the interplays of landscape, socio-technical regimes and niche innovation (Geels, 2005, Elzen et al., 2004, Geels, 2002). In this paper, the landscape represents the pressing environmental crisis, growing world population and the COVID-19 pandemic at the global level ,and TGTG is the niche innovation that aims to prevent and reduce food waste in Sweden by changing the current practices in food production and consumption system which is regarded as the regime in the MLP framework.

The alignments of technologies, scientific knowledge, industrial network and structures, the established culture and symbolic meanings, markets and user practices, policies and infrastructure form the socio-technical regime, which coordinates and guides activities of the associated actors and social groups in the system (Geels, 2005, Geels, 2012, Elzen et al., 2004). Meanwhile, the established regimes show path-dependent and remain dramatically stable because of the techno-economic, social and cognitive, institutional and political lock-in mechanisms (Norton et al., 1998, Geels, 2019). Therefore, to explore the role of TGTG in food waste prevention and reduction in Sweden and how it contributes to the sustainable transition of the food system, the following questions need to be answered:

- *What are the roles of different actors in food waste reduction?*
- *What are the motives for different actors to address food waste?*
- *What are the barriers and drivers for food waste reduction in Sweden?*
- *How does TGTG contribute to food waste reduction and a circular food value chain in Sweden?*

In order to answer the aforementioned research questions, a combined analysis of academic research, the insights of TGTG and the feedback from business partners and individuals has been conducted. Even though the MLP framework has been widely applied to analyze the transitions of socio-technical systems relating to green technology, energy or mobility, it is criticized for being a descriptive method to structure empirical research on the social-economic

or social-cultural systems, such as the food sector. Employing the conceptual model developed by Spaargaren et al. (2012) on the grounds of the general framework of MLP to accommodate the peculiarities of the food system, this thesis focuses on analyzing the existing food production and consumption system in Sweden from the cultural, technological and governance dimensions, aiming to understand the barriers and drivers for food waste prevention and reduction. It will contribute to the application of the MLP framework in empirical study on the sustainability transition of the food system. Meanwhile, the research results might be of interest to policymakers, entrepreneurs or practitioners who work on food waste prevention and reduction.

1.3 Outline of the Thesis

This thesis comprises seven sections. Following this introduction, Section 2 provides a comprehensive review of the theoretical framework and relevant literature. After that comes Section 3, giving a description of TGTG and what it has achieved in other markets. Section 4 explains the methodological approach, followed by a description of the online survey and interviews. The profile analysis of the online survey respondents will also be displayed in this section. Section 5 presents the results of the data collection based on document reviews, the online survey and interviews. Then a discussion of the results and some implications can be found in Section 6, and finally, Section 7 concludes the thesis with the limitations of the research and suggestions for further research.

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2 Theory

2.1 Food Waste and Food Waste Hierarchy

More concerns have been given to food waste in recent years due to the intensive consumption of valuable and scarce resources such as water, arable land, and the pressure of the growing global population (Mourad, 2016, Rutten, 2013). According to The World Bank (2017), over 70% of the annual freshwater supply is used by global agriculture. Meanwhile, it also results in 80% of deforestation worldwide, destroying 60% of the biodiversity of the global ecosystems. Alongside food production, the other chains from processing, transportation, storage, retail, consumption till disposal all require additional input of resources and energy and generate carbon and methane emissions. However, studies show that one-third of produced food around the world is lost or wasted together with the resources and energy consumed within the food supply chain, accounting for 25% of total agricultural water and 8% of global greenhouse gas (GHG) emissions every year (FAO, 2013, WWF, 2020, Shukla et al., 2019, Searchinger et al., 2019). Food wastage is enough to feed three billion people (WWF, 2020).

In addition to the environmental impacts, economic and social pressures of food waste should also draw enough attention. Around 815 million people worldwide suffer from undernourishment (Unicef and WHO, 2017), while billions of tonnes of quality food are thrown into trash bins in rich countries (Kummu et al., 2012). 20% of the produced food in the EU is wasted and costs 143 billion euros annually of wasted resources and environmental impacts (IPES, 2019). On the other hand, the portion of the population in need in the developed European countries cannot be neglected in term of balanced nutrition intake rather than minimum calories. In 2017, 22.4% of the EU population lived in households at risk of poverty or social exclusion, which reached 17.7% in Sweden (Eurostat, 2019). Given that the world population is estimated to reach 9.6 billion by 2050, a multifaceted and linked global strategy has become an urgent need to tackle the food crisis (Godfray et al., 2010)

Therefore, one of the most promising approaches to improving food security and reducing resources input and environmental pollution is to prevent food loss and waste (Kummu et al., 2012, Kantor et al., 1997). The established food system is questioned for unsustainable practices, which are blamed for environmental pollution, biodiversity loss, and societal inequality and requires a transition to more sustainable production and consumption pattern (Spaargaren et al., 2012, Atkins and Bowler, 2001, Sassatelli, 2007, Shove et al., 2009, Roep and Wiskerke, 2012). Kummu et al. (2012) suggest that a more efficient food supply chain can reduce approximately half of the food crop losses. The UN's SDG Target 12.3 aims 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" (Flanagan et al., 2018).

Food Supply Chain (FSC) comprises five stages: agricultural production, post-harvest activities, processing and manufacturing, retail and wholesale, consumption and services (Teigiserova et al., 2020). Food waste is generated at each stages of FSC (FAO, 2015, European Commission, 2018b). With globalization, food supply chains have also been stretched over time and space, shaping the practices of the local and global food production, provision, retail and consumption (Spaargaren et al., 2012). Thus, fighting with food wastage has become a global issue in economic, social and environmental dimensions, relying on the coherence of the whole value chains. Meanwhile, the growing consciousness of food quality and safety accompanied by social movements concerning animal well-being, environmental protection, and climate changes play a critical role in the sustainable transition of the food sector (Spaargaren, 2003, Spaargaren et al., 2012). They are able to influence the directions of change in food chains through the food catering and retail sectors, which attempt to appeal to eco-conscious consumers. Gereffi et al. (2005) and Spaargaren (2003) argue that the power of organizing and shaping the food value chains and networks has primarily shifted from producers at the upstream side ,such as farmers in the food sector, to retailers and consumers at the downstream end in recent years. Nevertheless, the rising awareness about food and sustainability and the change in power relations among the actors of value chains are still far from fundamental changes in food production and consumption patterns (Spaargaren et al., 2012). Besides, the disposal of unsold food products is likely to increase with the rising market power of retailers over suppliers due to Take-Back-agreements or last-minute cancellations (Peitz and Shin, 2013, Ghosh and Eriksson, 2019).

Building a more sustainable, resilient and equal food system necessitates efficient quantification and a thorough understanding of the causes of food surplus and waste produced across food value chains and networks. However, unclear distinction and category of common terminologies, such as food surplus, food waste and food loss, in the circular context also hinder the development of research on food waste management (Bernstad Saraiva Schott et al., 2013, Xue et al., 2017, Teigiserova et al., 2020). The wide range of definitions results in limitations of comparability for food waste estimates (Bellemare et al., 2017). Thus, it becomes challenging to accomplish quantitative assessment and provide decision support for regulatory or institutional measures to drive the systemic transition (Corrado et al., 2019, Hartikainen et al., 2018).

Introduced by the EU (European Commission, 1989), the waste hierarchy (Figure 1) provides a guide to prioritize the End-of-Life (EoL) treatments in term of material and energy conservation (European Parliament Council, 2008). The inconsistent use of the unspecified terms shown in the hierarchy causes different interpretations of how to apply them for effective waste management (Teigiserova et al., 2020). To develop a close loop of food chains through material recycling and nutrient recovery, Teigiserova et al. (2020) clearly define the scope of food waste categories as well as some related terms commonly used in waste management and then map them into the proposed food waste hierarchy extended from the version of Papargyropoulou et al. (2014) and Garcia-Garcia et al. (2017). Figure 2 shows the Food Surplus and Waste Hierarchy of six categories on the ground of edibility and possibility of avoidance proposed by Teigiserova et al. (2020), as well as examples of feedstock and treatments for each category.

Figure 1 Waste Hierarchy. Adapted from European Parliament Council (2008)

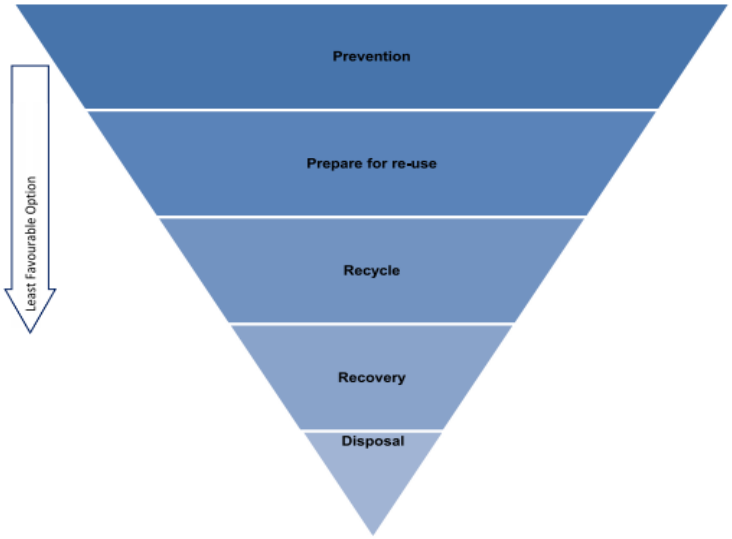
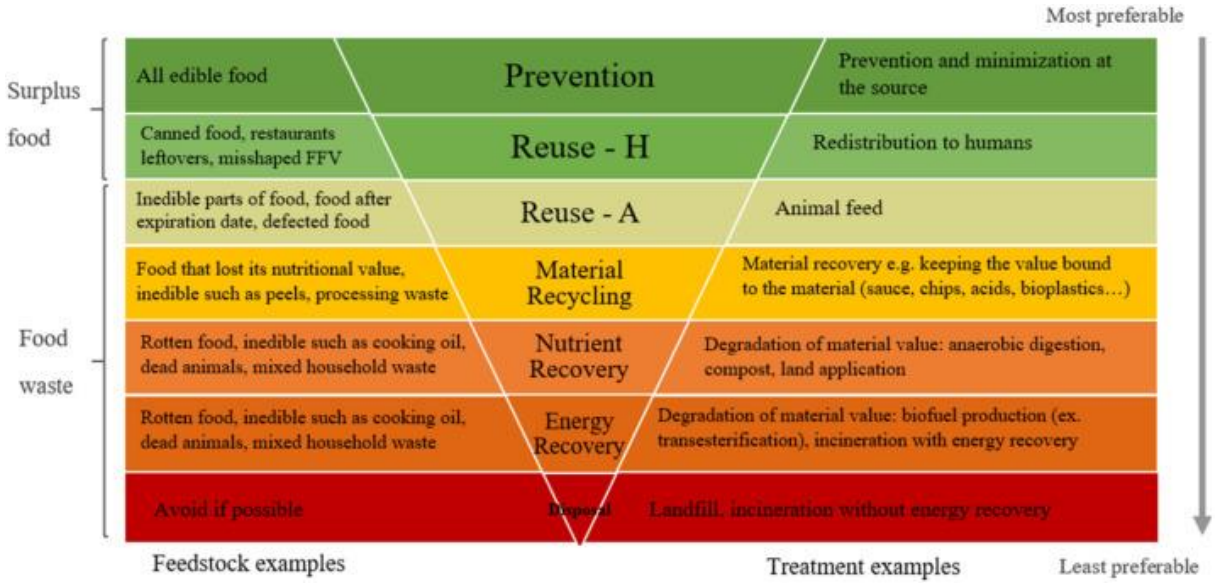


Figure 2 The Food Surplus, Waste and Loss (FSWL) Hierarchy Framework (Teigiserova et al., 2020)

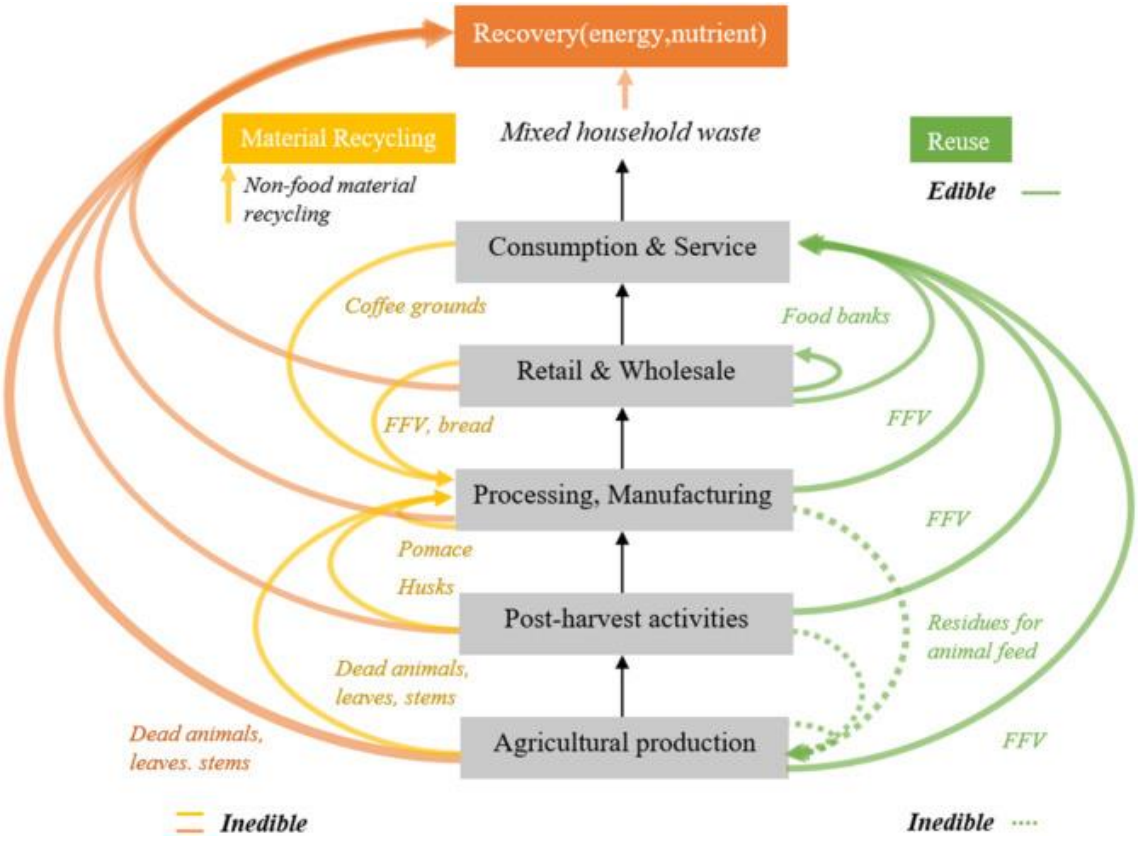


Teigiserova et al. (2020) distinguish food surplus and food waste based on whether it is edible. Food prevention is prioritized on the top of the FSWL pyramid to reduce the loss of nutrition and energy embedded in the edible food, which has consumed a lot of energy and resources for production, manufacturing, processing, logistics, especially those resource-intensive food categories such as dairy product or red meat (Teigiserova et al., 2020). The following lower levels are reuse for human consumption (food surplus), four categories of food waste (reuse

for animal feed, material recycling, nutrient recovery and energy recovery) and food loss. *Food wastes* in the hierarchy framework of Teigiserova et al. (2020) refer to all **inedible** categories due to various reasons. Moreover, *food loss* is defined as those "not accounted for" during the food streams because of accounting discrepancies or other reasons. Compared to the Waste Hierarchy (Figure 1) introduced by European Parliament Council (2008) , the new FSWL hierarchy framework (Figure 2) clearly separate the category "re-used" into two parts as "redistribution for humans" and "animal feeds" according to edibility.

The clear categories of food surplus, waste and loss (FSWL) allow Teigiserova et al. (2020) to develop a circular economy framework to form a close loop for FSWL (Figure 3) across the whole food supply chains. This framework is believed to help identify the specific strategies and measures to prevent avoidable food waste or maximize economic and environmental benefits from recovering or recycling different categories of food waste (Teigiserova et al., 2020).

Figure 3 Circular economy framework for FSWL in the food supply chain (FSC) (Teigiserova et al., 2020)



Aside from some unavoidable reasons, including food edibility, perishability, and unpredictable factors such as sudden weather change or plant pests, lack of resources, inappropriate operation or negligence, also prevent efficient management of food across the whole FSC process (Schneider, 2013, Teigiserova et al., 2020). In the developed countries, substantial food surplus is also caused by the designed high food supply (Papargyropoulou et al., 2014), the unpredictability of catering and retailers on demand (Mourad, 2016, Buzby and Hyman, 2012), confusion of various food date labels (Williams et al., 2012, Eriksson et al., 2012), food appearance specifications (Schneider, 2013) as well as consumption habits and perceptions such as the overconsumption driven by sales promotion, the expectations of fully stocked shelves with a wide variety of products (O'Donnell et al., 2015, Aschemann-Witzel et al., 2015, Szulecka et al., 2019). Despite many policies measures and initiatives at all levels to change wasteful practices, Mourad (2016) points out that a systemic shift of the food chain requires the intentional transformation of formal and informal institutions as well as the alignment of regime actors.

Circular Economy provides a framework for FSWL along food value chains and promotes new business opportunities through product, technological, market or business model innovations (Strati and Oreopoulou, 2014, Teigiserova et al., 2019, Ghisellini et al., 2016, Brown et al., 2019). In the EU, food waste is one of the five priority sectors of the Circular Economy Action Plan (European Commission, 2015). Thus, a wide range of legislative proposals on mobilizing the actions for prevention and reuse of FSWL has been implemented at the national or the European levels, including investment in physical assets to improve storage conditions (IPES, 2019), promoting "Circular Bioeconomy" to substitute fossil-based energy and resources in production system by biomaterials (European Environmental Agency, 2018), tax deductions for food donation (Stenmark et al., 2016, European Economic and Social Committee, 2014), updating guidance and public education on food labels (Wunder et al., 2018) and facilitating the establishment of food banks and other services for food redistribution (Searchinger et al., 2019, Lipinski et al., 2016).

It should be noted that this thesis will apply the definition of FUSIONS (Östergren, 2014) for ***food waste*** rather than the one used by Teigiserova et al. (2020), which only refers to inedible categories. According to FUSIONs, ***food waste*** is "*any food, and inedible parts of food, removed from the food supply chain to be recovered or disposed (including composted, crops ploughed in/not harvested, anaerobic digestion, bio-energy production, co-generation,*

incineration, disposal to sewer, landfill or discarded to sea)". This definition is more widely used in daily life and includes both edible and inedible food that is discarded for any reason. Thus, food waste prevention should be prioritized over food waste redistribution/reuse for human (food waste reduction) and then reuse for animal feed, material recycling, nutrient and energy recovery (e.g., biofuel production, incineration).

2.2 Multilevel Perspective Framework

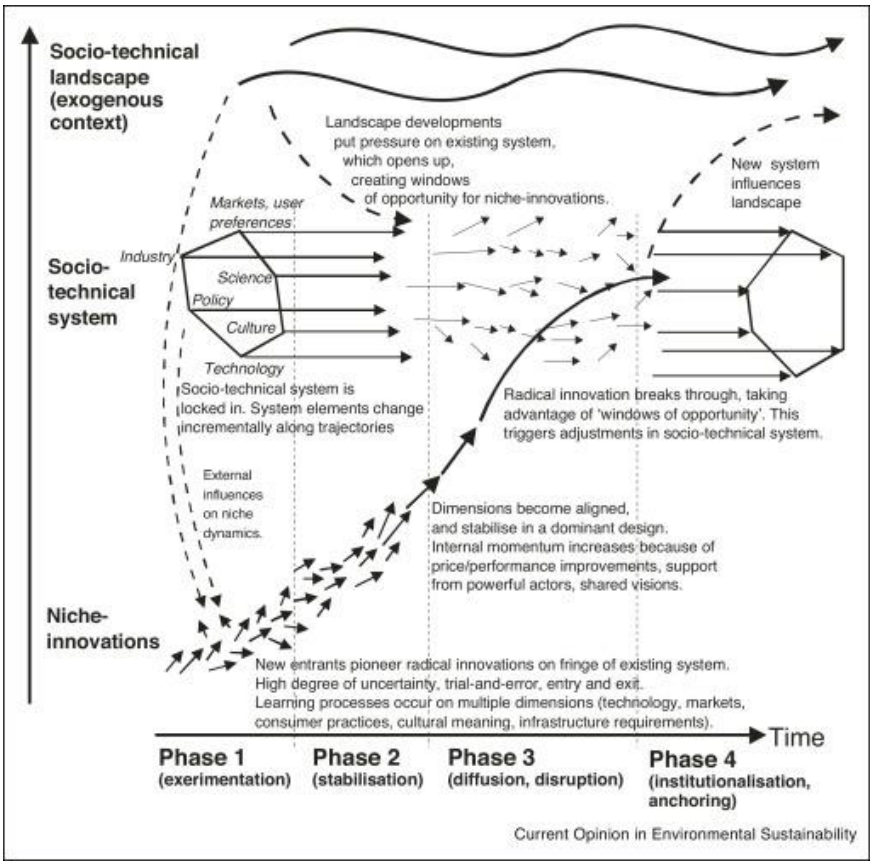
Rooted in Evolutionary Economics and Science and Technology Studies (STS), the Multi-level perspective (MLP) framework also combines ideas of Neo-Institutional Theory and Sociology of Innovation (Geels, 2004, Fuenfschilling and Truffer, 2016, Markard and Truffer, 2008, Spaargaren et al., 2012). MLP comprises three interrelated levels: landscape, socio-technical regimes and niche (Geels, 2005, Elzen et al., 2004, Geels, 2002), proposed to explore how socio-technical transitions to sustainability may happen by understanding the mechanisms underlying their interplays. The landscape represents the exogenous context at the macro level, including all slow-changing developments of demographics, macro-economic trends, political ideologies or some external shocks (e.g. wars, oil price shocks, accidents, global pandemics) (Verbong and Geels, 2007, Geels, 2002, Geels, 2005). The alignments of technologies, scientific knowledge, industrial network and structures, the established culture and symbolic meanings, markets and user practices, policies and infrastructure form the socio-technical regime, which coordinates and guides activities of the associated actors and social groups in the system (Geels, 2005, Geels, 2012, Elzen et al., 2004). Meanwhile, the established regimes show path-dependent and remain dramatically stable because of the techno-economic, social and cognitive, institutional and political lock-in mechanisms (Norton et al., 1998, Geels, 2019). Due to sunk investments in technologies, people, and infrastructure, the vested interests resist and hinder the transitions through various strategies, including but not limited to political lobbying, financial supports for research or media influence (Geels, 2012). Incremental changes within the existing regime are allowed to strengthen configuration under the pressures of landscape factors.

On the other hand, the radical innovations of technology, business model, social structure or infrastructure tend to emerge at the niche level at the periphery of existing regimes, pushed by entrepreneurs, activists, scientists, start-ups or other outsiders (Geels, 2019). Niche

innovations, emerging inside or outside the existing regimes embedded within a broader landscape, are crucial for social transitions as they provide the seeds for systemic changes even the incumbent actors usually resist them. The dynamic interactions between niches, regime and landscape, may create windows of opportunities for scale-up and diffusion of radical innovation, which can challenge and disrupt the dominant regimes and result in a socio-technical transition eventually, especially when the external landscape pressures exert enough forces to weaken or destabilize the existing regime (Geels, 2005, Geels, 2012, Geels and Schot, 2007). Furthermore, Geels (2012) points out that transition is not caused by a single driver or cause. Instead, it should be a circular process of mutual reinforcement, alignment, knock-on effects, co-evolution of all actors on multiple dimensions and at different levels. Thus, niche innovations may suffer setbacks and fail in breaking through the deadlocked situation.

As a mainstream framework for analyzing socio-technical transformations and exploring how innovations drive sustainability transitions, the MLP has been tested and advanced in a large number of theoretical and empirical studies of mobility (Geels, 2005, Hynes, 2016, Geels, 2012, Tuama, 2015), mobile payment (Lepoutre and Oguntoye, 2018) or energy transitions (Verbong and Geels, 2007, Hölsgens et al., 2018), providing policy recommendations to drive systemic changes or innovation management (Smith, 2003, Kemp and Loorbach, 2006). Some scholars criticize that the majority of transition theory literature overemphasizes the role of technological innovations and socio-technical transitions while downplaying social, business model and institutional innovations and lacking understanding of social-economic or social-cultural systems (Bui et al., 2016, Grin et al., 2010, Avelino et al., 2019, Temper et al., 2018, Smith et al., 2010). Therefore, the generalization and operationalization of the MLP framework for seeking the proper transition paths for various industries and systems face the challenges of unclear conceptualization of niche, regime and landscape or insufficient attention on the role of human actors in transition processes (Spaargaren et al., 2012, Van Amstel et al., 2012).

Figure 4 Multi-level perspective on socio-technical transitions (Geels, 2019)



Spaargaren et al. (2012) and El Bilali (2019) suggest that, especially for the food sector, the practices around food management and handling across the value chains should be placed at the heart of transition analysis, including all relevant regulative, normative and cognitive elements such as laws, standards, beliefs and values, visions, power relations, lifestyle, or cultural frames. Apart from main actors in food production and consumption systems, civil society organizations also play an essential role in facilitating knowledge building, diffusing innovations, destabilizing existing regimes, and building up sufficient momentum to steer sustainability transitions (Hajer et al., 2015, Schot and Geels, 2008, El Bilali, 2019, Bui et al., 2016). Spaargaren et al. (2012) collect a series of empirical studies of changes in food consumption practices, retail and production in the European countries and develop a conceptual model on the grounds of the general framework of MLP to accommodate the peculiarities of the food system and analyze sustainability transitions. Instead of seven regime

agents originally raised by Geels (2002), including Industrial networks, market and user practices, culture and symbolical meaning, policy, techno-scientific knowledge, technology and infrastructure, Spaargaren et al. (2012) emphasize the cultural, technological and governance dimensions of practices and institutions in analysis of transition processes.

3 Case Description

This research comes from the interest in addressing food surplus and waste and how innovations drive private sectors to integrate sustainability into their strategies and operations. TGTG was chosen as a relevant case because it is the largest B2C marketplace for addressing food waste in the world (TGTG, 2021e). It has business across 15 countries of Europe and North America and is still expanding rapidly in geography and across the food value chains (Schuler, 2019). As one response to SDG 12.3 "halve per capita global food waste at the retail and consumer level, and reducing food losses along production and supply chains (including post-harvest losses) by 2030", TGTG provides technological solutions to connect consumers to the local food providers such as restaurants, groceries, hotels or bakeries who can sell unsold surplus food at a reduced price rather than throwing them away. The food providers offer surprise bags with unsold surplus food on the app at the end of the day. Meanwhile, people search available Surprise Bags nearby, purchase them at a great price on the apps, and then pick up the food within the given time. Usually, users have no idea what food they can get in the Surprise Bags before picking them up from the restaurants, café or groceries. Some providers may mark if they are vegan or gluten/milk-free. This "win-win-win" initiative is believed to benefit all actors involved as consumers can do something good and enjoy nice food at a good price, businesses recover sunk cost and get exposed to new customers, and the planet suffers less from resource depletion and emission of greenhouse gas by reducing food surplus (TGTG, 2021e). As a business company, TGTG charges a certain amount of transaction fee on the settled orders as their primary source of revenue. So far, 37.4 million users have used TGTG and saved 71.7 million meals across 15 countries (TGTG, 2021a).

Furthermore, TGTG's ambition goes beyond reducing food surplus at the retail stage through digital solutions. The webpage (TGTG, 2021d) shows that TGTG endeavors to launch a global movement against food waste and go hand in hand with all stakeholders across the value chain to change unsustainable practices and make real impacts on the food system by working on awareness and better food education, carrying out joint actions at all levels, inspiring and driving relevant policies and regulations. The market coverage, the impacts as well as TGTG's ambitions for addressing food waste issues at all levels of the food supply chains make it a

good entry point to study how a business model innovation can drive the transition towards a more circular and sustainable food system in the existing regime. Researchers of Wageningen University carried out a project in 2019 to explore how TGTG impacted consumer behavior and food waste reduction and proposed some possible improvements in the app or product features for a greater influence based on focus group discussions and an online survey (van der Haar and Zeinstra, 2019). This study aims to gain a holistic understanding of how TGTG can contribute to food waste reduction and a systemic change of the present food industry through the lenses of the MLP framework by analyzing the roles of different actors and their motives as well as the drivers and barriers for food waste reduction in Sweden.

Founded in 2016 in Copenhagen, TGTG did not enter into Swedish Market until early 2020 even they had achieved success in other European markets, such as UK, France, Italy and Denmark. What prevented this company step into Sweden, which has always been at the forefront of sustainable development, arouse the author's interest in Swedish food surplus and waste issues. As the first country to pass an environmental act in 1967 (Swedish Institute, 2021a), Sweden has consistently ranked in the top group in sustainability due to environment and nature conservation, low pollution rate and extensive innovations and initiatives. In the newest Reports, Sweden ranked first in the Sustainable Development Index globally (Sachs et al., 2020) and the 8th in the Environmental Performance Index (Wendling et al., 2020).

4 Research Methods and Data

4.1 Research Methods

This thesis utilizes qualitative approaches. As discussed above, the food waste problem is incredibly complex as it occurs at each stage of food supply chains and is affected by social, economic, technological, institutional and cultural factors. Thus, to explore how TGTG contributes to food waste reduction by driving a transition to a more sustainable food chain requires a full understanding of the interplay of agents in the system. A qualitative approach will be more appropriate than the quantitative method to get deep insights into the transition of a system by analyzing the barriers and drivers in the given context (Yin, 2017).

The limitation of the qualitative approach is the risk of a preconceived opinion in designing data collection or interpreting the results. Thus data triangulation can avoid "wild guesses" and enhance credibility by utilizing multiple data sources (Yin, 2017).

4.2 Data

Combined with the review of the secondary sources such as government reports, publicly available company documents, TGTG's and similar initiatives' website visits, the primary qualitative data was gathered through an online survey of the Swedish Public and six semi-structured interviews with TGTG's representatives and business partners.

4.2.1 Interview

The interview guidelines were developed based on the literature review and the preliminary framework. During the interview, the researcher would try to probe the interviewees to gain more details or an explanation on the theme when possible, to extract more information. Some changes to the questions would be made after each interview according to the feedback of interviewees. The reference version of the interview guidelines can be found in Appendix A

and Appendix B at the end of this thesis. Given the COVID 19 pandemic, 5 interviews were conduct online through online conference tools. All interviews have been recorded for the following data analysis with the consent of interviewees.

The potential interviewees of TGTG and its business partners were identified and reached out through company websites, LinkedIn and the apps. A targeted selection rather than a random choice of interviewees means that there may be bias as they all have a certain connection with TGTG and knowledge concerning food waste and surplus to some degree. However, this bias is not seen as an issue for this study which requires the interviewees have experience and knowledge of this niche innovation and food surplus so to answer the designed questions regarding the factors of the transition in the food industry. Besides, a snowballing technique was applied for interviews with TGTG's representatives. That is, the identified interviewees share the contact information of other people they know for the later interviews (Creswell and Creswell, 2018).

Table 1 Interviews list

Interview #	Organization	Interviewee	Method	Date	Duration
I1	Bistro restaurant	Manager	In person	2021.05.03	35 min
I2	Supermarket	Store Manager	Online (MS Teams)	2021.05.05	40 min
I3	Food Provider of frozen meals	Business Development and Digital Strategy	Online (MS Teams)	2021.05.12	45 min
I4	TGTG	Business Development	Online (Zoom)	2021.05.04	50 min
I5	TGTG	Business Development	Online (Zoom)	2021.05.06	33 min
I6	TGTG	Marketing and Communication	Online (Google Meet)	2021.05.07	47 min

I1: A classic bistro restaurant serving burgers, Swedish food and lunch buffet, has been operating for over two years and started cooperating with TGTG from October 2020. Mainly providing surplus food of lunch meals, such as pulled pork, coleslaws, etc.

I2: A store of ICA, providing all sorts of food, mainly packed food, but also unpacked bakery products, such as bread. Has been partnered with TGTG for three months.

I3: The business development and digital solution manager of a company that provides packed snacks, meals and drinks along with fridges or freezers to offices. Have a partnership with TGTG for about six months.

I4: A Business Developer of TGTG, who works to "get as many partners on the app as possible and help as many restaurants as possible and foods places and services to start saving Foods."

I5: A Business Developer of TGTG, also focusing on the research of food waste in Sweden.

I6: Working in marketing and communication of TGTG Sweden, familiar with the business strategy and development of the Swedish market.

4.2.2 Online survey

Online surveys are a practical and efficient alternative to interviews when the research needs to collect responses from a sufficient number of people. This approach is also less affected by physical distance and the tense situation of the COVID-19 pandemic. Admittedly, it is hard for an online interview to explore further based on the responses and gain as rich details as what can be achieved by interviews. As a crucial aspect of the qualitative method, open questions in the surveys allow the respondents to reply to the questions without the constraints and the effects of options. Research has shown that there is little evidence suggesting a significant difference between the findings of online survey and paper-based surveys (Bryman, 2016) page232. Nevertheless, triangulation of various data sources and research methods can address the potential model effects and bias of a single data source or single method (Yin, 2017).

The survey aims to understand people's attitudes and ideas about food surplus and waste, TGTG and its role in the transition to a more circular food system. Therefore, the target respondents are not limited to TGTG's users or someone who knows this application, but the general public in Sweden. To diversify the respondents, the researcher posted the survey in different Swedish public groups with various themes on Facebook in addition to circulation through their network. Considering the author's network is primarily university student groups, a specific question was set to distinguish if the respondent was a student to compare the results of two different groups further. Before the full launch of the survey, the pilot version was sent to a small group for feedback on the survey design and collection of answer options.

The survey comprised three parts: introduction of survey and consent, multiple-choice questions and open-ended questions. To receive a higher response rate, the researcher kept the

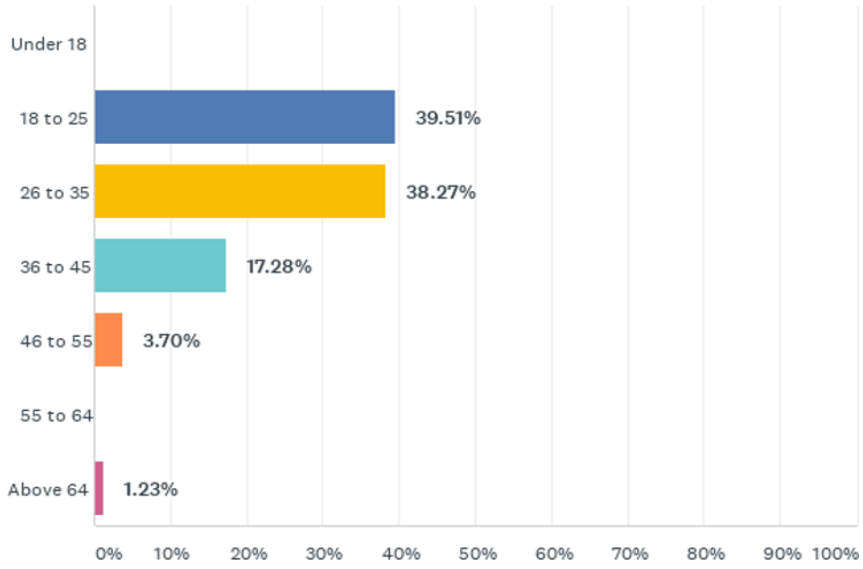
survey as short and straightforward as possible and avoided the use of open questions unless necessary (Creswell and Creswell, 2018). The multiple-choice questions were for understanding the participants' profile, their knowledge about TGTG as well as their views about food waste. The answer options were displayed in a random order to eliminate the order bias. Some questions were set to skip according to the respondents' answer. For example, people who had not heard about TGTG or used it would not be asked questions regarding user experience. Then, the open-ended questions asked respondents about the role of TGTG in reducing food waste and driving a more circular food system. The complete survey question list can be found in Appendix A.

The author used SurveyMonkey to design, monitor and analyze the online survey. SurveyMonkey is a specialized online tool with relatively rich functions for survey design, data analysis, results comparison, and presentation. This automation eliminated the errors in manual data entry and saved time for statistics and charting. Additionally, it also marks the words recurred in the text responses and do statistical analysis based on the added tags. A subscription was required for access to these features of SurveyMonkey, which was a disadvantage of this tool. SurveyMonkey can block the repeated responses from the same IP address. Nevertheless, this does not apply to the mobile device versions.

One limitation of an online survey is that the distribution of participants may be affected by social media habits, the level of interests in the topic, the channels to circulate the survey. In order to reduce the impacts, the researcher also separates the samples by certain conditions and compare the results, which will be discussed in later sections.

83 people participated in the online survey and 2 quit from the first question. Of 81 participants who completed the survey to some extent, 80% (65) were female, 17% (14) were male, and the remaining 3% preferred not to disclose. Figure 5 shows the age distribution of the respondents, with over 75% falling into the age group between 18-35, according to the anticipation of the limitation of online surveys. In order to reduce the impacts, the survey data of this age were separately analyzed and compared with the overall data. In addition, 60% (48) responses came from students, while non-students answered 40% (33). Of the respondents, 57% (46) knew TGTG, and the rest, 43% (35), had not idea about this app.

Figure 5 Survey Question: How old are you?


Under 18
18 to 25
39.51%
26 to 35
38.27%
36 to 45
17.28%
46 to 55
3.70%
55 to 64
Above 64
1.23%
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%

5 Results of Case Study

Food surplus and food waste have long been comparatively neglected, and FSWL prevention and reduction has been added into the EU and international agenda only since 2010 (Wunder et al., 2018). To deliver the commitment to the target of UN SDG12.3, the European Union has adopted a binding food waste reduction target of at least 30% by 2025 and 50% by 2030 throughout food chains as an integral part of the EU Action Plan for the Circular Economy (European Commission, 2018b). Meanwhile, legislative proposals and practice guidelines have been developed to help the EU Member States develop their national plans to reach this target. In the latest version of the milestone targets for Sweden's environmental objectives, the Swedish Government sets the goal to reduce at least 20% of total food waste by weight from 2020 to 2025 (Swedish Environmental Protection Agency, 2021).

In June 2018, the Swedish National Food Agency developed the action plan "More to do more" together with the Swedish Board of Agriculture and the Swedish Environmental Protection Agency to reduce FSWL throughout the whole food chain (Swedish Food Agency, 2018). Before that, Sweden had not a specific national strategy or plan for food surplus and waste reduction. Targets for food waste management and reduction are mainly included in other national plans regarding waste management or environmental targets, such as the Swedish Waste Management Plan 2012-2017 and the Swedish Waste Prevention Programme 2014-2017 (FUSIONS, 2016).

The "More to do more" is a long-term action plan by 2030 for national food waste reduction to ensure that Sweden could fulfil the commitment to UN SDG12.3 and achieve Circular Economy. It is a vital part of the government assignment on Sweden's food loss and food waste between 2017 and 2019, which is a continuation of the Food Waste Reduction project 2013-2015 of three government agencies (Swedish Food Agency, 2018). Based on input from stakeholders and experiences from the previous assignment, this action plan proposes 42 measures to guide the relevant authorities and other players to prevent and reduce FSWL at different stages of the food chain.

Table 2 Food Waste at different stages in Sweden

	Production (kg food waste / tonne of food produced)	**Retail** (kg / person / year)	**Service** (ton/€million) PPP adjusted	**Household** (kg / person / year)	**Sewer** (kg / person / year)
Sweden	8.8	7.3	18.7	71.5	23.4
Highest	17.4	29.8	29.9	129.6	24.4
Lowest	7.4	3.9	10.1	43.7	6.2
Average (mean)	10.4	9.4	19.6	70.9	14.9

Created based on the data of (Stenmark et al., 2016)

In 2014, more than 1,288,000 tonnes (average 134kg person) of food waste were generated along the food value chain in Sweden except for processing, wholesale and logistics (Stenmark et al., 2016). Compared with the average number of some other EU countries, Sweden has better performance in food waste during production, retail and foodservice sectors (no available data for processing and wholesale) while household food waste is higher than the average value (Stenmark et al., 2016). The statistics show that food waste in Sweden decreased by 4% between 2014 and 2016 (Statistics Sweden, 2020). There is still a way to achieve a food surplus and waste reduction of 20% within 5 years. Identifying the role of the stakeholders of food chains and other institutional actors, as well as the barriers and drivers for food surplus and waste reduction in Sweden is essential for understanding the role of TGTG in the transition towards a more circular food system.

5.1 Role of different actors and their motives to address food surplus and waste in Sweden

Industry stakeholder

Food industry stakeholders include all actors across agricultural production, post-harvest activities, processing and manufacturing, retail and wholesale, and services. The data shows that food waste produced at the stages of primary production (7%), central kitchen (6%), food

service (6%), grocery stores (8%) and food industry (3%) takes up 30% of total food waste in Sweden, except for wholesale due to no available data (Naturvårdsverket, 2021). The average food waste of these stages reaches 38 kilos per capita per year in 2018 (Statistics Sweden, 2021). Meanwhile, around 90% of food waste generated in retail is unnecessary, while this percentage for restaurant and catering service is 62% and 52% (Swedish Environmental Protection Agency, 2014).

It is worth mentioning that food retailers, especially the grocery chain, have a significant impact on food waste generation of food suppliers and manufacturers through cosmetic specifications, order cancellation, contract-related overproduction (Wunder et al., 2018, Garrone et al., 2014). Meanwhile, as the direct-to-consumer chain, retail trade also affects consumer behaviors and indirectly causes household food surplus and waste through marketing techniques including strategic product placement and sales promotion scheme (such as “buy one get one”), which may encourage impulsive buying and cause food waste instead. A survey was conducted by European Commission to understand the EU citizens’ attitudes and perception of food waste in 2015, and 66% of Swedish participants believed that industry plays a role in preventing food waste, lower than the average for all EU countries (EUROBAROMETER, 2015). Four interviewees (I3,4,5,6) emphasize the needs for industry players to collaborate with other actors to improve food management, standardize the use of date labelling, find common measures to redistribute surplus food and reduce the total food waste.

Meanwhile, some food businesses have already taken actions to address food surplus and waste. The grocery giant ICA with over 50% market in Sweden, has set a target of halving food waste reduction by 2025 compared with the base year of 2016 and reported it in the group’s sustainability report (ICA Gruppen, 2019). Except for discount sales of products nearing the expiration date in shops or vis the app Karma, some ICA retail stores also donate food to charity groups like the lavation Army, City Mission AND Food2Change (Molthe, 2019). Besides, they also apply new techniques to extend food shelf life and use "imperfect" food or leftover ingredients to develop circular products (ICA Gruppen, 2019). Another grocery retail group Axfood opens Sweden’s first social supermarket to provide good and sustainable food to people in need and avoid throwing away food (Axfood, 2021, Stockholms Stadsmissions, 2021). Furthermore, Axfood also developed an industry guideline for food donation to social groups, providing instruments to ensure quality and efficient processes (Gram-Hanssen et al., 2016). In addition to technological and logistical development in the food supply chain, the application

of the food waste management hierarchy can prevent and reduce FSWL and increase resource efficiency, for example, prioritizing human food over animal feed and energy recovery (National Food Agency Sweden, 2020).

The motives of industry players to participate in food waste reduction can be divided into economic, social and environmental dimensions. Reducing the environmental impacts is the first motives mentioned by business partners (I1,2,3) and TGTG (I4,5,6). As I2 said, "(W)e don't have to throw it away in the garbage […], we have to save resources for the future." Before the partnership with TGTG, they had other ways to deal with surplus food, e.g., leaving own personnel to take them away (I1,3) or sending them to the council to feed animal which is prohibited now (I2). In addition, economic gains can be regarded as another significant motive for these businesses to sell food surplus via TGTG, as it can help them reduce cost (I1,2,3). "(I)t's rather expensive. We always want to make sure that we don't lose money on it […]" (I1). "We get some of the money back through customers on TGTG, […]" (I2). Additionally, interviews (I1, I2) mentioned that TGTG is a good way to explore new customers. For social factors, an environmentally friendly image is what businesses expected to show to the public, especially "as a grocery store in a city like Lund, where people are very knowledgeable, and then you have the university and people really care about the environment, […]" (I2). "(B)ecause the customers are seeing that we do something good for the environment and that's good for the store" (I2).

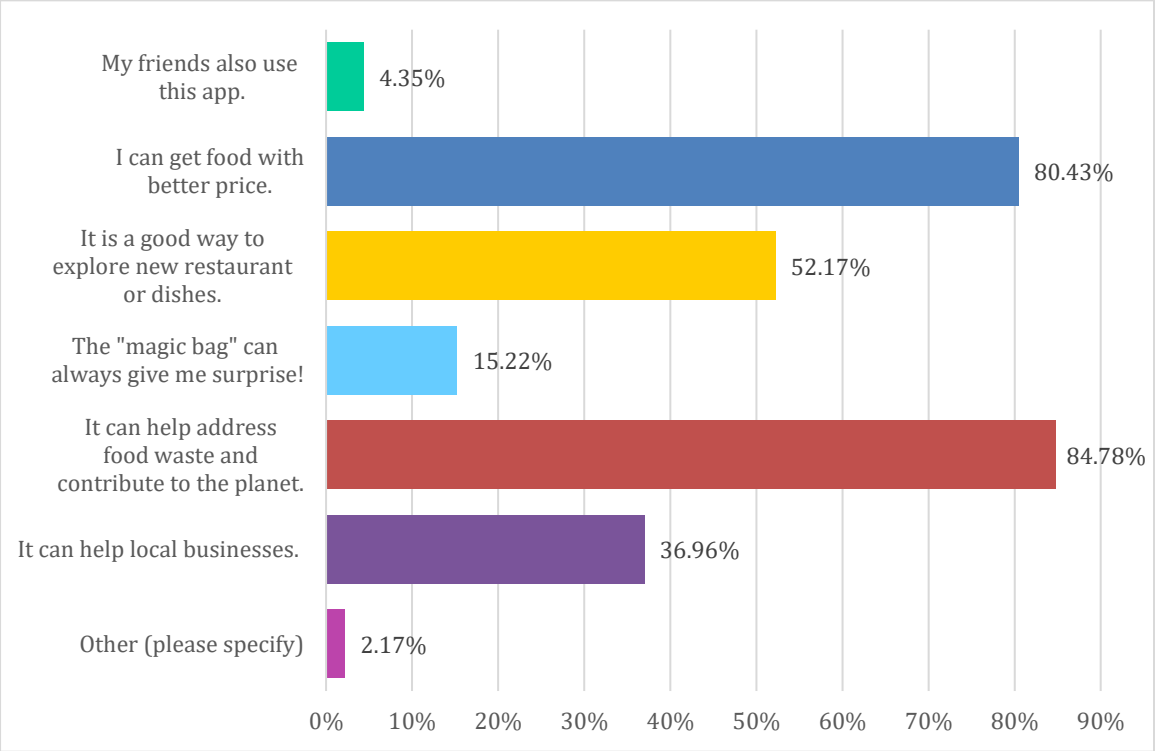
Consumer

Like all other developed countries, consumers play a major role in food waste issue (I1,2,3,4,5,6). In the EU's survey, 88% of respondents suggested that consumers should play a role in preventing food waste, and that ratio for the EU-28 was 76% (EUROBAROMETER, 2015). According to Swedish Environmental Protection Agency (Naturvårdsverket, 2021), household contributed to around 70% of total food waste in Sweden. In 2018, 917,000 tonnes of household food waste (the equivalent of 95 kilograms per person) were generated in Sweden, while 420,000 tonnes (corresponding to 45 kilograms per person per year)of edible food ended up in the bins (Naturvårdsverket, 2021). Thereinto, one-third of household food waste in Sweden can be connected to date labelling as people lack knowledge about the differences

between “best before” and “use by”, as well as information about how to identify if the food is edible (National Food Agency Sweden, 2016). Dietary habits, cooking and shopping pattern, awareness and perception of food waste all affect consumer behavior as regards food waste (I2,3,4,5,6). For example, “you have to plan your purchases in different way. You can buy things every day instead” (I2) and “people waste food is because we can, we can afford to, we want the best freshest,[…]” (I5).

Apart from household food waste, I5 and I6 also emphasized the role of consumers in the whole food supply chain. The preference for cosmetics qualities (such as “perfect fruit”) or fully stocked shelves with various products also drive unnecessary waste at production, distribution and retail stages, as those “ugly” or unsold food end up in the bin before being served on the table (National Food Agency Sweden, 2016, Grewal et al., 2019). Consumer behaviors are also liked to food waste in restaurants and canteens when they eat there (National Food Agency Sweden, 2020). On the other hand, consumers can contribute to reducing food waste in other stages of the food chain, such as purchasing food nearing the expiry date or buying leftover meals in the stores or apps at the end of the day (I2,3,4,5,6). In addition, rising consumer awareness can create pressures on industry players and enable them to make changes (I6).

Figure 6 Survey Question- Reasons that people would like to use the app



In the survey, environmental concerns ranked the top motives (84.78%) for respondents to purchase food on TGTG, followed by good price (80.43%) and discovery of new restaurants (52.17%). When looking into different groups, 94.12% of the app users chose the environmental concerns and 88.24% for reduced prices. Helping local businesses became the third (58.82%) motives for TGTG's users. For the student group, same number of participants (81.48%) chose the environmental impacts and a better deal. About the reasons that people unlikely to buy surplus food through TGTG, the majority of people concerned about some product features while one didn't want to "waste time on it". The interviews also found the same results that cost-saving and environmental gains were mentioned by all interviewees (I1,2,3,4,5,6). Two (I4,6) also believed that the fun element of magic bags was one motive for people to use them. I1 said people, especially students, might like to share new things with others.

Government

The Swedish domestic government is made up of three levels: national (central), regional (county) and local (municipal) levels (Swedish Institute, 2021b, Emilsson, 2015). Even though the central government exercises powers at three levels, the regional and local authorities own autonomous powers and responsibility on business and service of their own districts, such as taxation and health care (Emilsson, 2015). While the national government's role in allocating resources across the country and directing the activities and operations of the executive entities by providing economic guidelines and legislative framework, the municipalities take the main responsibilities for a broad range of local affairs, including facilities and services such as public welfare, elderly care and childcare, health and environmental issues, urban planning and sanitation (Emilsson, 2015, Swedish Institute, 2021b). This allows the municipal councils to have a large degree of flexibility to determine the priority of the political agenda and allocate funding and resources accordingly.

Given the complexity and significance of the food waste issue, it requires a full understanding of food waste at each stage as well as diverse and tailored governance measures to address the problems. Therefore, government authorities play a key role in setting up national strategy and the generation goal on food surplus and waste prevention, providing a framework for

implementation of effective regulations and market-based instruments, encouraging collaboration between different actors, supporting social innovation, changing consumer bahaviors through communication and campaigns (FUSIONS, 2016, Wunder et al., 2018). In the EU's survey (EUROBAROMETER, 2015), 58% of Swedes expect the public authorities to take more responsibility in address food waste. As I3 said in the interview, "it needs to educate business and the public about the impacts of food waste, also the measures to reduce it." All interviewees (I1,2,3,4,5,6) were unaware of any specific policy or regulation as regards food surplus and reduction, e.g., "I haven't heard about any, at least I don't know […]" (I3), and "To be honest, I have no idea about this. I mean, there are some training for catering staff to tell us how to run business in a sustainable way, […] or some leaflets in the post box sometimes" (I1).

The recommendations of the EU suggest that all Member State should develop a national strategy and roadmap/action plan for food waste reduction(EU Platform on Food Losses and Food Waste, 2019). In Sweden, food waste reduction has always been integrated into other environmental strategies such as the Swedish Waste Management Plan, the Swedish Waste Prevention Programme and Swedish environmental policy, without a specific national strategy or legislative framework (FUSIONS, 2016). At the municipal level, reducing food waste is often included in the targets of CO2 emission reduction (Szulecka et al., 2019). At the national level, the Swedish National Food Agency is responsible for coordinating the synthesis work to drive the implementation of the proposed measures in the national action plan "More to do more" together with Swedish Board of Agriculture and the Swedish Environmental Protection Agency (National Food Agency Sweden, 2021). This action plan emphasizes a national goal, and governmental coordination is crucial to motive private and public players to work on this issue. Apart from the legislative framework pertaining to food waste reduction, policies and regulations of other areas can influence food waste generation, prevention and valorization (e.g., food safety and hygiene, on-pack product information and date labelling, food donation and waste management strategy), so it is also essential for the authorities to ensure policy coherence and coordination (Wunder et al., 2018).

Another key role of government is to enable food waste reduction in the public meal sector, contributing considerably to the issue. In Sweden, meals in all public institutions, including preschools, schools, hospitals and elderly homes are public provision supported by authorities at different levels (Livsmedelsverket, 2021). According to a nationwide survey on food waste

of public catering service in 290 municipalities (with 211 voluntarily responses), average 34 tonnes of serving food waste (excluded those left in the plates) in schools alone is unnecessary thrown away, and that means 5.5 kilograms per pupil per year (Livsmedelsverket, 2020). However, it is estimated that the food waste in schools is the lowest (Livsmedelsverket, 2020).

Unlike some other EU countries, which are mainly driven by both social and environmental motives, Sweden has always included food waste issue as part of waste management and CO2 emission reduction. Recently, food loss and waste prevention targets have been added into the national milestone targets for Sweden's environmental objectives, which aims to tackle the major environmental problems so as not to pass on to future generation (Swedish Environmental Protection Agency, 2021). By 2025, food waste reduction throughout the whole food supply chain should be reduced by at least 20% by weight on the basis of 2020, while the level of food loss reduction at the production levels is not set yet (Swedish Environmental Protection Agency, 2021).

Civil society actors

Social actors here refer to NGOs, charity groups, academia, not-for-profit social enterprises, professional associations and food redistribution facilitators (including business companies). These actors play a significant role in providing solutions to prevent and reduce food surplus and waste occurring in the food sector (I1,2,3,4,6) and enhance social security (Nordic Council of Ministers, 2017, EU Platform on Food Losses and Food Waste, 2019). Food redistribution is regarded as a superior way to animal feed and biogas production to ensure the highest value use of food resources, in line with the FSWL hierarchy framework (Gram-Hanssen et al., 2016, Nordic Council of Ministers, 2017). Meanwhile, various business initiatives and social innovations contribute to connect the industry players at all stages of the food chains, reduce logistics costs, facilitate information sharing and knowledge development (Gram-Hanssen et al., 2016). Additionally, these activities, as well as academic research and public discussions, can bring the issue on focus and make positive impacts on the awareness of society (I1, 2, 4). As mentioned by I1, "people are more aware of food waste now, especially in a city like Lund with a lot of students and professors caring about this. […] there were another two students who came to us before, […] I can see more people are doing the research on this topic. That's

good!" On the other side, research institutions and universities play a crucial role in understanding the causes and impacts of food waste, providing recommendations or measures to the authorities and industry players, and communicating information to the public (I3,5).

Redistributing surplus food through food banks or charity organizations is highlighted by FAO (2015) and the EU (Wunder et al., 2018) as a significant mitigation measure to food security and detrimental impacts on the environment, contributing to the shift towards a circular food system. As the most common food redistribution practice, the primary aim of food banks and charity organizations is to alleviate food poverty by receiving food donation and serving or handing our food bags to people, most often social clients (Gram-Hanssen et al., 2016). As most of the donated foodstuffs are products approaching the expiration date, returned due to contract cancellation, or with problems such as mislabeling, damaged or incorrect packaging, this model can also prevent the edible food from being thrown away and reduce the environmental burden of food waste. Apart from the food donors, the operation of these organizations mainly depends on public or sponsor funding and volunteer workers (Gram-Hanssen et al., 2016). In addition, there are other actors in food redistribution such as social canteens/enterprises, business companies, community initiatives, and logistics centers or redistribution terminals, which support transporting food from donors to a warehouse or directly to food-serving actors such as food banks and charity groups.

Given the social aspects, most of these food redistribution organizations only provide service to eligible members rather than the public. In contrast, business companies and other organizations with the main purpose of reducing the environmental impacts of food waste are open to everyone.

5.2 Barriers and drivers for food waste reduction in Sweden

Based on the analysis of interviews, surveys and relevant documents, the drivers and barriers that might influence food waste prevention and reduction or the scale-up of TGTG will be disclosed and discussed in this part. It should be noted that some barriers or drivers for food

waste reduction may facilitate TGTG's business instead. For example, no financial incentives for food donation may discourage restaurants and grocery stores from donating food but driving them to partner with TGTG for certain cost recovery. As this paper aims to explore how TGTG can contribute to the transition towards a circular food chain, so the pros and cons of its business model will not be discussed in detail. Spaargaren et al. (2012) suggest the analysis of the transition processes should focus on cultural/social, technological and governance dimensions. However, economic/market-related factors also hinder or encourage the relevant actors to get engaged in reducing food surplus and waste. Therefore, the results are structured on the basis of these four dimensions and different actors, namely, consumers, food industry players, authorities, and civil society actors. Table 3 provide the details.

Technical and Infrastructural Dimension

To start from the technical and infrastructural dimension which focuses on the product features of TGTG and the development of the food industry. Flexibility to decide what to be put in the magic bags (I1,2,3,6) and to cancel the orders (I1,2,3) is the key driver for TGTG's partners to use this app as it can solve the pain point of restaurants and grocery stores: difficulty in predicting exactly how much and what kinds of food will be left by the end of the day (I1,2,3). However, globalization and long supply chains bring challenges to reduce food waste in each sectors of the food industry. Instead, it increases the likelihood of waste during long-distance transportation, storage and distribution (I4). Another key barrier frequently being discussed is the confusion of date labelling ("best before" and "used by") and unclear product information as regards storage condition and shelf life (I4, I5, I6; Wunder et al., 2018).

Meanwhile, the definition of food waste in Sweden is blurring. As I5 stated, "(y)ou have two different words that mean 'food waste'. One that is 'matavfall', that is considered waste as things you throw away that is food. And then there is 'matsvinn', which is food, that could be eaten, that is wasted [...] It can be very confusing for the general public." This makes it difficult to collect data, measure and analyze the problem, as well as the impacts across the chain.

Furthermore, the data on food waste is also incomplete, especially for food wasted during the wholesale and processing stages (Stenmark et al., 2016, Statistics Sweden, 2020). It is

considered to be influenced by the high national investment in biogas infrastructure and the prioritized biological treatment for food waste in existing waste management practices (Gram-Hanssen et al., 2016). Initiated by the Swedish Environmental Protection Agency, SaMMa (Swedish Collaboration Group for Reduced Food Waste) has been established to promote collaboration among the authority agencies, food industry players, research bodies and civil society (Naturvårdsverket, 2013). This broad network facilities the ideas and information exchange, and knowledge sharing and drives food waste prevention and reduction throughout the food chain. Another driver from civil society is various innovative initiatives and solutions, like TGTG, Karma, Food Cloud, Olio, occurring along with technology and digitalization (I1,3,5, survey). These solutions "fill the gaps between different stages of the food supply chain" (response from survey) and tackle problems in an efficient and relatively economical way.

TGTG is friendly to the group who have already get used to and enjoy all kinds of mobile applications, while being unappealing to certain groups, as mentioned in I1 ("maybe like my father, a fifties year-old man, working in the construction, will not have interests in this.").

Social and Cultural Dimension

Consumers play a crucial role in food waste in the developed countries, mainly affected by social and cultural factors (I5; Wunder et al., 2018). In Sweden, the general public has high-level awareness of sustainability (I2,3,4,5,6), and this will facilitate social interactions, discussions, information exchange on food waste prevention and reduction. Meanwhile, the increasing public discussions on food waste also bring this issue on focus (I2,3,4,5,6). However, a lack of sufficient knowledge of the causes and mechanism (I6) as well as environmental and social impacts of food waste (I1,3,6) pose a hindrance to changing consumers food practices and preventing food surplus. One reason is that there are many different topics around sustainability, so no everyone is aware of the food issue (I6). Furthermore, many people are confused by the date labelling as "best before" (a date that advises about food quality) and "used by" (a date relating to food safety), and they just throw away that food past the date marks without checking if they are still edible (I2,4,5,6).

Table 3 Drivers and Barriers for food waste reduction

Agency	Consumer	Food Industry	Authorities	Civil Society Actors
Technical / Infrastructural	Appealing to someone likes technology (I1)	Magic bags: give flexibility to deal with surplus food (I1, I2, I6)	Network initiated by authority agencies	Various innovations to tackle the problems (I5)
	Unappealing to certain groups (I1)	Able to cancel the order if not enough surplus food (I1, I2, I3)	Unclear definition of food waste (I5)	Digitalization (Survey)
		Easy to start up (I2)	Lack of data (Stenmark et al., 2016; Statistics Sweden, 2020)	
		Long supply chains (I4)	Difficult to measure the environmental impacts (National Food Agency Sweden, 2016, National Food Agency Sweden, 2020)	
		Different date labels and unclear information as regards to storage (I4, I5; Wunder et al., 2018)		
			Existing waste management practices (Gram-Hanssen et al., 2016)	
Social / Cultural	Magic bag: fun element (I4, I6, survey)	Social responsibility (I1, I2)	Have some understanding of food waste problem in Sweden (National Food Agency Sweden, 2016, National Food Agency Sweden, 2020)	More research on addressing FSW (I1, I2, I4, I5)
	Glad to share new things with peers (I1)	Pressure from consumers and public (I6)		Insufficient collaboration between the public and civic society (I5; National Food Agency Sweden, 2020)
	High public awareness of sustainability (I2,I3,I4,I5,I6)	Preference for beautiful food (I2, I4, I5)		
	More public discussion on FW (I2,4,5,6)	Dietary pattern: lunch buffet (I1, I4)	Several public driven campaigns (FUSIONS, 2016)	
	COVID-19 results in awareness increase (I4)	Need to keep stocks on shelves for customer retention (I2, I4, I6, National Food Agency Sweden, 2016, Grewal et al., 2019)	Wealth states, less social needs (Skopelitis, 2018, Bergström et al., 2020)	
	Knowledge-action gap (I4)			
	Magic bag: concern about the taste (survey)	Tendency to produce more to meet consumers need (I4)	No voluntary agreement between the industry and the government (National Food Agency Sweden, 2020)	
	Magic bags: concern about food allergy (I2, 3,4)			
	Not everyone cares about sustainability that much (I1, survey)	Staff lack of knowledge and information as regards FW (I6)		
	Insufficient knowledge of date labelling (I2,4,5,6)	Strive to deal with the pandemic, less focus on FW (I2, I4, I6)		
	Previous education about food passing expiry date (I2)	Not familiar with Circular Economy (I1, I2, I3)		
	Misinterpret of the purpose of magic bags (I2)			
	Cautious about safety and hygiene of FSW (I3, I4)			
	Overconsumption (I3, I4, I5)			
	Undervalue food waste (I4)			
	Shopping frequency (I2)			
	Many sustainability topics (I6)			

	Consumption attitudes (I5)			
	Insufficient knowledge of environmental/social impacts of FSW (I1, I3, I6)			
	Lack of information as regards the causes of FSW (I6)			
	Less willingness to pick up food during the COVID pandemic (Survey)			
legislative / regulatory	***Not identified***	Restrictions on feeding animals with food waste (I2)	An action plan for FSW reduction (I5; Swedish Food Agency, 2018)	Lack of financial incentives for food donation (Szulecka et al., 2019)
		No specific policies or regulations to encourage or prevent food waste reduction (I1, I2, I4, I5)	All EU countries are required to report food waste (Naturvårdsverket, 2021)	Traceability requirements for food donation (Szulecka et al., 2019)
			The EU's binding food waste reduction target (European Commission, 2018)	
		Strict interpretation of EU food security regulations (I2, I4)		
			Lack data to support legislation (Swedish Food Agency, 2018; Statistics Sweden, 2020)	
			The priority varies among municipal authorities (I5)	
			Independent decision-makers (I5; Swedish Institute, 2021b)	
			Prioritization of treatment for food waste (Gram-Hanssen et al., 2016)	
			No specific regulations or practices on FW reduction (I5)	
			Attention to FSW varies among municipalities due to many factors (I5, Livsmedelsverket, 2020)	
Market / Economic	More cautious about their spending bacause of COVID-19 (I4)	Marketing tactics: new customers (I1, I2)	Huge number of public meals (I5; Livsmedelsverket, 2021)	Shortage of money and funding sources (I6; European Economic and Social Committee, 2014, Gram-Hanssen et al., 2016)
		Other companies tackling FSW (survey, I1, I2)	Budget capacity of different regional and municipal government (I5)	
		Axfood develop guidelines for retailers/wholesalers for food donation (Szulecka et al., 2019)		Pick-up capacity (I3, Gram-Hanssen et al., 2016)
				Lack of national food bank causes low efficiency (Gram-Hanssen et al., 2016)
		High concentration of grocery retail market (Molthe, 2020, I4)		Small charities lack of bargaining powers with food companies (Gram-Hanssen et al., 2016, European Economic and Social Committee, 2014)
		Covid-19 pandemic made business more causious about cost control (I1, I3)		
		Covid-19 pandemic made it harder to predict food demand (I1, I2)		Small amount of FW from individual retailers (I3)
		Lack of cold and heat chains to meet the relevant regulations (Gram-Hanssen et al., 2016)		Food may be discarded due to food donation process (Alexander &Smaje, Gram-Hanssen et al., 2016)
		Sell at a discount (Swedish Food Agency, 2018)		Challenge to handle many small donators (Gram-Hanssen et al., 2016)

		Additional cost for logistical facilities and transportation (Gram-Hanssen et al., 2016)		Small charities lack of capacity and resources for promotion (Gram-Hanssen et al., 2016, Pettersson, 2015)
				Lack of storage facilities (Gram-Hanssen et al., 2016)

Another barrier is the knowledge-action gap, which means that people know what to do but not to do it (e.g., “even though there is knowledge. It doesn't really mean that there is an action to conduct by everyone to reduce it”, I4). This can also be seen in many other social movement or sustainability areas. It is partly attributed to people’s attitudes towards food or consumption, as outlined by I5, “people waste food is because we can, we can afford to, we want the best freshest, whatever food […] I throw it away because I can buy”, and I4, “We really do buy too much, we buy more than we need. So that kind of gives a driver to the food production to produce more.” Besides, shopping habits (I2,4,5, responses from survey), including buying in bulk, doing a “big shop” once a month without good planning or impulsive buying of products on promotions, all unconsciously cause household food waste. Instead, it is suggested that “you have to plan your purchases in a different way […] have to buy things every day, not keep that much food in this fridge” (I2).

About not buying food surplus, the concern about food safety and hygiene was mentioned in both survey (15.15%) and interviews (I3,4) as a barrier for people to use TGTG or purchase food surplus and waste. Especially the idea of “magic bags” received different responses in the survey, with 15.22% regarding it with fun element and some expressing concerns about the taste and food allergy. The low frequent shopping model also reduces consumers’ willingness to purchase products with short shelf life (I2). COVID-19 pandemic results in increasing awareness of environment and resources, with a driving force on food waste reduction in the long term (I3,4). But in a short time, people are less willing to go to pick up food in restaurants, thereby hindering the rapid scale-up of TGTG in Sweden.

Turning to the food industry, the pressures from consumers and the public drive industry actors to take actions to change their practices and prevent food surplus and waste across the chain (I6). Meanwhile, more companies would like to initiate change and show their social responsibility to consumers (I1,2). The social and cultural barriers for the food industry raised in the interviews are related to consumer perception of perfect food (I2, 4, 5) and expectation of fully stocked shelves with a wide range of products (I2,4,6; National Food Agency Sweden, 2016, Grewal et al., 2019, causing abundant “imperfect” fruits and vegetables and unsold but perfectly edible products ending in the garbage. In order to cater to consumer preference for more choices, grocery retailers and bakeries tend to keep stocks on shelves by the end of the day, more than the actual demand (I2, I6). A further barrier in Sweden is the lunch buffet (I1, I4, I6), which is quite common in both public and private restaurants and canteens. Compared

to cooking upon orders, buffets have to be prepared in advance but are challenging to predict the amount as “it is easily affected by many external factors such as weather”(I1). Catering service or grocery staff without sufficient knowledge about how to manage food (materials) correctly and efficiently also pose a barrier to food waste prevention (I6).

When it comes to the drivers relating to the authorities, after two governmental assignments from 2013-2015 and 2017-2019, the Swedish authorities have a general review of food waste across the food supply chain in Sweden and reach a consensus on food waste reduction with other actors (Swedish Food Agency, 2018). Meanwhile, several national and municipal campaigns (such as Stoppa matsvinnet) were launched to raise public awareness of food surplus and waste. The social and cultural barrier is the relatively underdeveloped food donation system, which is regarded as an effective method for food redistribution in some other EU countries. As a welfare state, the need for centralized food banks in Sweden is not strong (Bergström et al., 2020, Skopelitis, 2018). Therefore, the existing food banks or similar organizations are scattered and small.

For civil society, more research on FSWL results in a better understanding of this issue (I1,2,4,5). In the brief review of the Swedish National Food Agency, insufficient civic engagement and lack of collaboration between the public sector and social actors were identified as a barrier for systematically addressing food waste, also being highlighted in the interviews, e.g., “it's hard to approach the public sector, but there's a lot of private schools as well” (I5). Civic engagement can facilitate the communication and education of the public so as to reach the national goal sooner.

Legislative and Regulatory dimension

In the legislative and regulatory dimension, the prohibition of feeding animals with food waste is an indirect driver for businesses to seek a more efficient way to reduce food waste, in line with the food waste hierarchy (I2). Interviews (I1,2,4,5) and documents (Szulecka et al., 2019, National Food Agency Sweden, 2020) reviews all revealed that no specific policies, regulations or financial instruments (in terms of tax reduction, subsidy or penalty) to food waste prevention and reduction is the key barrier to encourage food business operators to get engaged in preventing and reducing food waste. On the other side, the financial incentives such as subsidies

for investment in biogas infrastructure may result in prioritizing energy or nutrient recovery over food surplus prevention and redistribution (Gram-Hanssen et al., 2016). Another regulatory barrier for food industry is the stringent interpretation of the EU legislation, such as, the VAT Directive or requirements on food traceability of food business operators (Gram-Hanssen et al., 2016). This pose hindrance for industry players to donate food to charity groups or food banks.

The development of the national action plan for food waste reduction is considered a significant milestone for Sweden in food waste reduction governance as it aims to drive the fulfilment of SDGs 12.3 through 42 measures (I5; Swedish Food Agency, 2018). At the EU level, the binding food waste reduction target has been agreed upon, guiding the Member States to take actions to realize the target (European Commission, 2018a). Food waste and food surplus prevention feature high in the EU Green Deal and the future Farm-to-Fork Strategy, emphasizing preventing food waste at the sources and not just recovering the resources (FOODDRINK EUROPE). In addition, the requirement of all EU countries to report food waste data from 2020 (Naturvårdsverket, 2021) promotes the progress of data collection, measurement and research on this issue. One legislative and regulatory barrier for the authorities is the lack of data to support policymaking and design tailored instruments, which are still ongoing (National Food Agency Sweden, 2020). A further regulatory barrier is that attention on FW varies across municipalities due to capacity, priority, knowledgeable people and different understanding (I5, Livsmedelsverket, 2020). The municipal governments have considerable flexibility to decide how they would like to allocate the resources (I5; Swedish Institute, 2021b), as outlined in I5, “It's a personal preference just have the person who happens to be working there. So it was very different levels of what they've been doing”. The long-term prioritization of biological treatment of food waste poses obstacles for different actors to change the current practices (Gram-Hanssen et al., 2016), especially when the relevant food waste reduction regulations and incentive measures are still absent (I5).

For social actors, food producers, wholesalers or retailers lack of motivation to donate food to food banks or charity groups as they may need to pay Value Added Tax if the value of goods is not zero (Szulecka et al., 2019). This has been identified as a hurdle for food redistribution through the charities, so some other EU countries allow to report the donated food with a value close to zero or use other financial instruments to encourage food donation. Moreover, the strict traceability requirements also form a barrier for food donation, especially for those small and

independent charity groups who may have no capacity to afford the facilities (Szulecka et al., 2019).

Market and Economic Dimensions

The high concentration of the grocery retail market in Sweden can be considered an advantage to promote food redistribution and other initiatives like TGTG in terms of cost and efficiency, compared to some other countries where most groceries are small and independent (Molthe, 2020; I4). Moreover, the industry guideline for food donation developed by grocery company Axfood streamlines the process for retailers to donate food to social organizations with no much extra time or work (Szulecka et al., 2019).

As for the economic and market barriers, one is the extra costs for logistical facilities or transportation for food donors. This burden may further hinder food companies (especially the small ones) from redistributing food but choosing to throw surplus food into the bins. Besides, the price promotion may also cause food waste as consumers may be induced to buy something they do not necessarily need (Swedish Food Agency, 2018). This kind of practice is a common method for retailers to pass food waste to consumers.

One key economic and market driver for the authorities is the massive amount of publicly provided meals in Sweden, including all public schools, the elderly home, hospitals and the central kitchen (I5; Livsmedelsverket, 2021). This allows the authorities to adopt an effective means of scaling up actions to prevent food waste in this sector. However, one challenge of the municipal authorities is the different budget capacity resulting in large variations in food waste between the municipalities.

Funding is regarded as the key hindrance for social organizations, including food banks, charity groups, social canteens, as their operation mainly depends on food donation, public or private funding and volunteer workers (I6; European Economic and Social Committee, 2014, Gram-Hanssen et al., 2016). The shortage of money or funding sources limits these organizations' ability to scale up or meet the requirements of food donors, for example, everyday pick-up (I3, Gram-Hanssen et al., 2016), logistics and storage capacity (Gram-Hanssen et al., 2016). This

makes it difficult to receive donations from small and individual restaurants or stores, given the costs (I3). In turn, these food providers are not likely to deliver food to the charity organizations by themselves, as mentioned above. In addition, limitation on the type of food further impedes the coordination between small food businesses and food banks as most of these organizations do not receive perishable goods for food safety and hygiene reason (Gram-Hanssen et al., 2016).

The model of food banks or charity groups also does not allow them to take in perishable goods for hygiene and food safety.

The absence of the central food banks or redistribution operators causes the small charities to lack bargaining powers with large food companies (Gram-Hanssen et al., 2016, European Economic and Social Committee, 2014 and operate in a less efficient way (Gram-Hanssen et al., 2016). It is noted that food redistribution through food banks still throw away part of the donated food (Alexander &Smaje, Gram-Hanssen et al., 2016).

5.3 How TGTG contribute to food waste reduction and drive the transition towards a circular food value chain?

TGTG's strategy in Sweden

TGTG claims that they aim to tackle the food waste issue not only by reducing food waste through the marketplace (mobile application) but also by preventing food waste at its source through a global food waste movement (TGTG, 2021d), which was also underlined by interviewees, e.g., "[…] try to stop it at source, up the chains. Our movement, which is working with consumers, with education, with governments, with political action, with other businesses to actually stop it at the source.", I5; "[…] a social impact company and our overall goal are to decrease food waste in any way we can in everywhere basically […] Our commission consists basically of what we do for direct and indirect impact.", I6).

The movement comprises 4 pillars, including households, business, schools and public affairs. It means that TGTG also collaborates with food industry players and the authorities to prevent food waste upstream of food supply chains, and impacts regulations and policies as regards food waste (Schuler, 2019). In other EU countries, TGTG has started to extend the solutions to food producers or service providers such as Metro AG, Unilever Food Solutions (Schuler, 2019). Besides, a series of joint initiatives and campaigns regarding date labelling has been launched in Denmark, France, Belgium, Switzerland, and Germany to drive changes in both industry and consumers (TGTG, 2021b, Schuler, 2019). Realizing the significant impacts of consumer behaviors on food waste in the Global North (I5), TGTG also works with schools and universities and provide a range of free educational tools and resources for the younger generation (TGTG, 2021c).

When it comes to TGTG Sweden, as I6 introduced, "we invest both in terms of the growth of the platform, but also in terms of our mission in communicating and inspiring everybody to fight food waste together basically. […] TGTG has a role to play both when it comes to talking and explain to the public how it works". However, interviewees also stated (I4,5,6) that TGTG Sweden so far still focuses on the marketplace as this market is still quite new. Meanwhile, they have "have collaborated with some NGOs and foodbank in Sweden, plan to explore more collaboration in other cities in Sweden" (I6).

Opinions of Business Partners and Consumers

In the online survey, 5 of 34 people without knowledge about TGTG chose not to use this app after a brief introduction as they have "similar apps" (2 responses), "do not want to waste time on it" (1 response), or they live in outskirts or small cities where TGTG has not a business yet (2 responses). It is noted that two participants mentioned that they would like to try it, but they had no actual needs because of "planning food in advance".

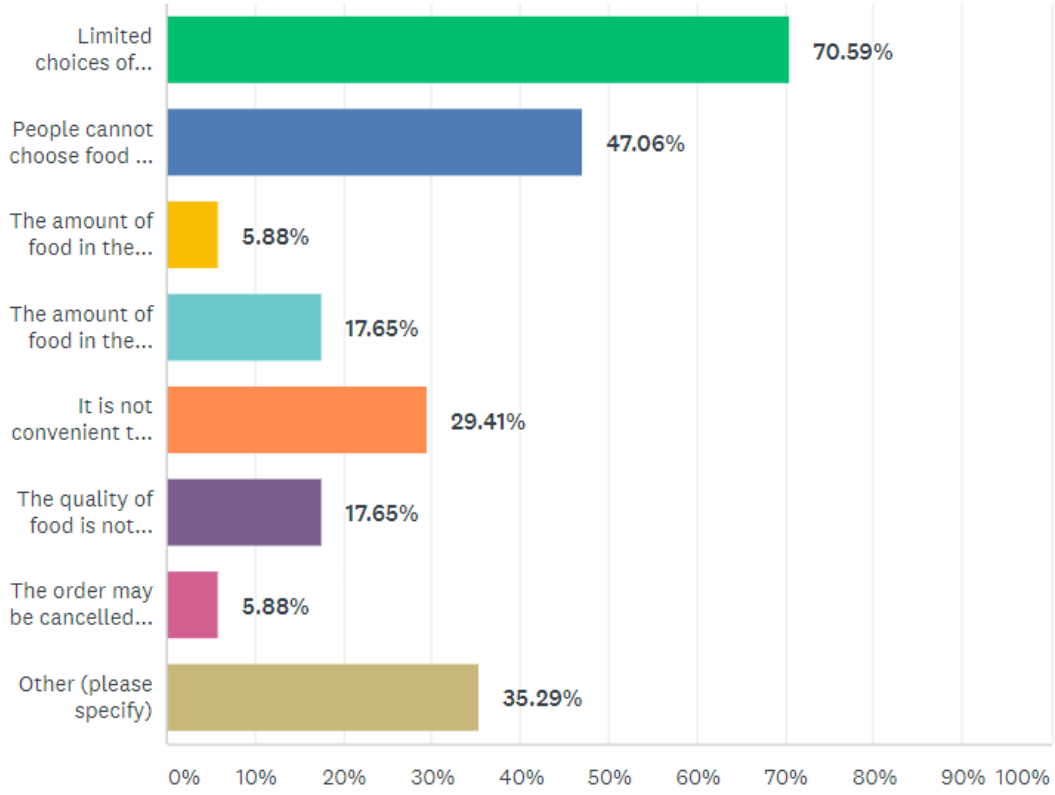
When asked the problem with TGTG, the top three responses were "limited choices of restaurants" (70.59%), "people cannot choose food" (47.06%) and "it is not convenient to pick up within a fixed time" (29.41%), not taking "other" into account. This shows that nearly half of users cannot fully accept the idea of "magic bag" because of the concerns of food allergy, taste and vegan options. One participant highlighted that "some restaurants do not follow it.

They use it for marketing and suggested to make sure that "it's actually food that would go wasted".

About TGTG's role in tackling food surplus and waste, 11 of 14 were positive, but 5 participants also mentioned the impacts were "limited". One questioned that if it can attract those who were "wasting food themselves". Regarding how TGTG changes their views of food waste, 3 responses criticized the model for the "limited impacts" on food waste and no contributions to "social sustainability". Two participants indicated no impacts.

Relating to TGTG's contribution to the transition towards a circular food system, two underlined the strategic agenda and governance, and one mentioned that other actors such as industry and government should do more.

Figure 7 Survey Question- What are the problems you face now on TGTG?



The interviews reflected business partners' views about TGTG to some extent. All three interviewees (I1,2,3) indicated that the partnership with TGTG helped them in business, "it's it was a test, but it was a lot more successful than we could ever imagine." (I2), "I can save a lot

of money and not throw away my waste, and people can do good for the environment […] It's great, absolutely" (I1). Besides, as emphasized in I2, "(w)e have Facebook, Instagram and stuff like that. But to reach more customers through the TGTG app than we do through our regular channels. Yeah. So that's we didn't really expect that. But that's a great thing […] That's good for the promotional side of the business." Meanwhile, I3 also pointed out, "this is just one small way that we can contribute to it all".

TGTG Sweden's long-term ambition is to "be present with our platform, with our app, our direct impact everywhere in Sweden" (6). Apart from business development to get more business on board, another task for them is to "communicate and elevate the (food waste) problem to the public, business and authorities in Sweden" (I6), including campaigns on date labelling issue (I4,5) and educating the public how to prevent throwing away edible food (I5,6). Besides, TGTG is also "looking to build more collaborations with food banks in Sweden. […], cooperate with producers to reduce waste in their production" (I6).

6 Discussion and Implications

The objective of this thesis is to understand the role of TGTG in tackling food waste in Sweden and how it can contribute to the transition of the food system towards a more circular model. Applying the MLP framework, the analysis of the roles of different actors, their motives, as well as the barriers and drivers in the existing regime corroborates that food waste is a complicated problem.

At the landscape level, the increasing environmental pollution, resources depletion and the global population expansion have posed pressures on the existing global food systems and required all countries to change the unsustainable practices or seek solutions to reduce food waste and loss along the food supply chains. Various initiatives, legislative framework and collaborations at international, national or regional levels all reveal the responses from the regime to the pressure at the landscape. For Sweden, this pressure also comes to the EU's target on food waste and loss, which also provides the legislative framework and implementation guidance to all Member States, including annual reporting data from 2020 (FOODDRINK EUROPE). The pressure from the macro-level pushes the regime actors to make changes. Another example is the COVID-19 pandemic, which enhances the public awareness of the environment and enables people to become more cautious about consumption out of economic concern, as mentioned in the results.

At the regime levels, the interactions between actors or the inter-linked regimes may create barriers and drivers for changing the existing practices or niche innovations. For the food sector, these barriers and drivers can be identified from three dimensions (technical, social and cultural, and governance dimensions) based on the adapted MLP framework of Spaargaren et al. (2012). However, the researcher adds an economic and market dimension into the analysis as it shows significant impacts on different actors in food waste prevention and reduction. For example, the economic gains of TGTG for users and business partners, the logistic costs and VAT liability for food donators, or inadequate financial capacity of small charities and regional food banks. From social and cultural dimensions, the influence from the landscape can be seen from the public's awareness of food waste.

Another should not be neglected is the interaction between consumers and food businesses. Although consumers are regarded as the main responsible for food waste in the developed countries, it should be noted that consumer attitudes and behaviors are shaped by social, cultural and economic factors, including their perception of the problem, social norms, other related practices (e.g., shopping frequency) and alternative solutions (Spurling et al., 2013). This is why Spaargaren et al. (2012) stress human agents and social relations at the central position in analyzing the transitions of the food sector. Joint efforts of industry actors, the public agency, academia and civil society are essential to shift consumer's mentality and attitudes and "nudge" them to make changes. Apart from the top-down tools and measures, bottom-up initiatives should be encouraged to drive mass civic engagement and champion innovative solutions.

To overcome the existing barriers requires collaborations of all actors and different innovations. Thus, as one of the redistribution methods to reduce food waste, TGTG uses technology and economic incentives to unite more consumers and small food businesses to engage in the food waste movement. The advantages in both cost and timeliness enable it to scale up nationwide and help restaurants and grocery stores reduce food waste in an efficient way that other conventional methods cannot provide. Besides, TGTG's ambition to build the global movement against food waste also distinguishes it from other similar players or initiatives. It can make a bigger impact on food waste prevention by changing consumer behaviors, improving industry standards and inspiring national regulations and policies in a broader way. This also provides it with a possibility to extend the technological solutions to preventing food waste at other stages of food chains and drive a systemic transition of the food system in Sweden. However, as a niche innovation, TGTG also faces barriers coming from the existing regimes such as the consumer's perception of food waste and lack of knowledge of date labelling.

Furthermore, the thesis also finds that Sweden lags in the governance of food waste reduction due to its long-term waste management practices, which prioritize the biological treatment (energy recovery category) of waste over prevention and reuse. Even the milestone target for food waste was finally set in 2020 on the basis of the release of the national action plan "More to do more" in 2018, there is still an urgent need to build a legislative framework to align all regulations and policies relating to food waste and provide guidance and support for municipalities, remove the economic and regulatory barriers for other actors or the upscaling of new regimes. Besides, the results also indicate that economic incentives and market-based

instruments can play a significant role in driving behavioral change (e.g., food donation) or create the internal momentum to break the lock-in of existing practices (e.g., food waste treatment).

Obviously, the massive public food service can be a focal area for the Swedish government to push for progress in food waste prevention and reduction by implementing educational and political intervention and providing guidance and support for municipalities on tackling this issue.

Although MLP theory provides a framework to conceptualize the interactions between multiple regime actors at three levels during the complex process of sustainability transition and uncover the barriers and drivers to transitions, it has limitations in comprehending the interplay of different inter-related regimes and identifying barriers to behavioral change. To overcome the weakness of the MLP, scholars suggest combing the MLP with concepts or theories from other disciplines to analyze socio-economic or socio-cultural transitions, such as coevolutionary perspective (Foxon and Steinberger, 2013), social practices (Spurling et al., 2013) or social movement. More transdisciplinary research based on the MLP theory is required to understanding and fostering sustainability transition.

7 Conclusion

Food waste is an incredibly complicated global issue, so it requires the collaboration of all stakeholders at international, national and local levels. Applying the adapted MLP framework for the food sector, this thesis gains a review of the food waste problem in Sweden through the case study of TGTG, an online B2C platform for food waste reduction. The role of different actors in food value chains and their motives, the barriers and motives for food waste prevention and reduction are analyzed to have a better understanding of how TGTG contributes to addressing food waste in Sweden and what else we can do to drive sustainability transition of the food industry in Sweden.

The following findings are identified. Firstly, TGTG's marketplace is an addition to the existing food redistribution system in Sweden in reducing food waste, filling the gaps left by food banks and charities in an efficient and cost-saving way. It also has the possibility to extend its solution to other stages of food chains. For food waste prevention, TGTG can contribute to driving consumer behaviors and industry standards through collaborations with other actors as what they have done in other EU countries. The second finding is that the governance of food waste prevention and reduction is still at the beginning in Sweden despite its leading role in waste management practices. The specific regulations, policies or market instruments regarding food waste are still absent. Thirdly, the market and economic dimension should also be considered when tackling the problems in the food sector as they can nudge the actors to take actions or remove the barriers coming from the existing regime so as to break the lock-in effects.

Fighting food waste is an ongoing topic and the related research in this area is undergoing development. This thesis is an exploratory research on food waste prevention and reduction in Sweden, providing a snapshot of the current situation of food waste problem in Sweden, and the role of TGTG and other actors. One limitation is the lack of direct input from other actors such as the experts in food consumption, the authorities and food banks even though the various secondary sources, including government reports, press release, and academic research, have been applied and analyzed. Another limitation is the results of the online survey, which may be unable to represent the attitudes of the general public of Sweden due to the surfing habits,

interests in the topic and the channels to circulate the survey. However, it still provides some valuable information regarding the attitudes of different groups towards food waste, which can be further explored in the future. Consumer behavior is key for addressing food waste in the developed countries, so the effective methods to trigger the behavioral and cultural shift requires further and continuous research.

Technology has proved its power in many sustainability areas. It is with great anticipation to see how technology empowers every one of all abilities to prevent and reduce food waste and provide efficient, scalable and economical solutions to the industry. This requires close collaboration from all stakeholders, including us all.

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Appendix A: Interview Guide for TGTG

Opening questions:

1. What is your role in TGTG? Your responsibility.
2. Could you introduce the core business of TGTG?
3. How did the idea come about?
4. Who are your main (business) partners? (followed by the questions: what are the main reasons they would like to be TGTG's partners in your experience?/ What is the type of business partners with the largest number (bakery, restaurant, supermarket or others) in Sweden? Is there any difference from other market in the partner structure?
5. Could you introduce the idea of surprise bag? Can users choose the food they want? Why not?
6. Do supermarkets take up a big part in TGTG's portfolio in Sweden? How do you feel about the role of supermarkets in coping with food redistribution? (How do you feel about the relation between supermarket and TGTG?)
7. What are the main reasons that users would like to use the app in your mind? (What are the main profile of the users? Students? Age groups? Professions)
8. How the general public in Sweden feel about food waste as you know? What factors come to your minds that may affect people to use TGTG or get engaged in this way to reduce food waste? Are there any cultural meaning, value or perception affecting the public to purchase food surplus or waste?
9. How do you feel about the role of food bank or similar organizations (companies or NGOs) in the food redistribution scene? (followed by questions regarding their collaboration with charitable orgs and NGOs, TGTG's advantages or disadvantages compared to those orgs)
10. What are the criteria for TGTG to choose the new market? (Followed by why TGTG didn't enter Sweden until 2020?)
11. What are your short-term/long term goals in Sweden?
12. What are the biggest challenges/barriers you are face now in your role in TGTG?

13. What are the biggest challenges/barriers TGTG faces now in Sweden? Not from operational or any financial aspects, more around food waste movement or impact the practices of other actors?

14. What/who can help overcome these challenges in your opinion?

15. How do you feel about the impacts of government policies, practices with regards to food industry and food waste on TGTG's business in Sweden (any legislative obstacles)?

16. What criteria you use to evaluate the performance/impacts of each market generally?

17. What are the reasons for different strategies in different market, if there is any difference? Such as the targeted partners,

18. How can TGTG contribute to the transition towards a circular food system in your opinion? (what else does TGTG do to achieve this goal? 4 pillars, when did this strategy be proposed? Collaboration with schools, businesses, involvement in public affairs. Educational toolkit, any plan to cooperate with schools in Sweden? Are there opportunities to cooperate with education authorities to support the knowledge development of the students or kids?

19. What do you think is the optimal solution to reduce food surplus and waste across the whole value chain?

20. So about the movement against food waste, apart from public awareness, food services and providers any potential to work together with other kinds of stakeholders in food chains, such as wholesalers, producers, or even NGOs, using TGTG's digital solutions?

Wrap-up (TGTG):

- Thank you. I really appreciate your time and patient for my interview. Once again, I would like to remind you that the recordings and notes of this research will be stored securely and be presented with complete confidentiality. Is there anything you would like to add?

Appendix B: Interview Guide for Business Partners

Opening questions:

1. What restaurant do you represent?

2. What is your role at the shop/restaurant?

3. What kind of food/services does your restaurant/store provide to the customers?

4. What kind of food do you offer the most on TGTG? Can they choose what they want when they come to pick up the food? How many different choices of the surprise bags you offer to consumers (vegan or gluten/nut free for example)? How do the consumers feel about these magic bags in your knowledge?

5. How long you have partnered with TGTG? How did it begin? They came to approach you or someone introduced it to you?

6. What are the main reasons you decide to cooperate with them? (followed by: before the collaboration, how did you cope with everyday food surplus? / How much extra revenue/ new customers does TGTG can bring?)

7. What are the challenges or problems you have faced now on TGTG, if there is any?

8. What are your other ways to cope with food surplus now? Do you know any other ways for restaurant/catering providers/food wholesalers to deal with food waste?

9. Who should be responsible for food waste in Sweden? Consumers, production and processing, retail and catering, government or others?

10. What do you know about the Circular Economy? How can the Circular Economy cope with food surplus in retail and consumption in food value chains?

11. What do you feel about the impacts of TGTG on circular economy?

12. Do you know any regulations and policies that impact food waste in Sweden, either increase or reduce? Do you know any government practices to reduce food waste in Sweden? (training, policies, financial support, punishment…etc.)

13. How do you feel about the impacts of government regulations or policies concerning food surplus and waste on addressing the issue? (Followed by: Are there any policies or regulations causing food waste or any financial support or punishment on food waste for restaurants, groceries and the whole value chains? From perspective of food providers/suppliers, such as taxation, subsidies or any other financial support/penalties)

14. What can TGTG do to contribute more to circular economy or sustainability in your opinion? Apart from the app, what else TGTG may help your restaurant and other food retailers and catering service to prevent food surplus and waste in your view?

15. How TGTG impacts the knowledge or understanding about food waste of you or someone you know?

Conclusion:

Thank you. I really appreciate you taking time out of your day to help me with the research. Once again, I would like to remind you that the recordings and notes of this research will be stored securely and be presented with complete confidentiality. If you are curious as to the findings, I can send you an abstract of the final paper.

Is there anything you would like to add?

Appendix C: Online Survey Question List

Introduction and consent

Thank you for taking the time to complete this survey. My name is Xiao YANG and I am a master's student at Lund University in Sweden, studying Innovation and Global Sustainable Development. The intention of this thesis it to gain a greater understanding of the app Too Good To Go in Sweden. The survey should not take more than 15 minutes to fill out.

By proceeding past this point shows that you understand that:

• you voluntarily agree to participate in this research thesis

• you may withdraw from the survey at any time or refuse to answer any question

• you can withdraw your data from this survey within two weeks of taking it

• you have had purpose and nature of the thesis explained to you

• participation may involve answering some questions about your experiences purchasing on TGTG

• participation does not involve having to reveal any sensitive information

• all information from this survey will be treated and stored confidentially

• in the results of this research, your identity will remain anonymous as you are not asked to provide your name

1. If it's all right with you, we will move on to the survey

a) yes b) no

2. What is your gender?

a) Female b) Male c) Prefer not to say

3. How old are you?

a) Under 18 b) 18 to 25 c) 26 to 35 d) 36 to 45 e) 46 to 55 f) 55 to 64 g) Above 64

4. Are you still a student?

4. Do you know Too Good To Go?

a) yes b) no

5a. (if yes for Q4) Have you used it?

a) yes b) no

5b. (if no for Q4) Too Good To Go is an anti-food waste smartphone app that connects consumers to surplus food from local stores and restaurants. So the store doesn't throw away food anymore and where people can save food while getting three times the value of what they paid for. So far, Too Good To Go has saved 70.1 million meals since 2016 and is currently operating in 15 different countries, including the U.S. Would you like to try it? Would you like to try it?

a) Yes b) No

6a. (if yes for Q5a) How frequent you use this app?

a) More than twice a week b) once a week c) more than once a month d) less than once a month

6b. (if no for Q5a and Q5b) What are the reasons you do not want to use it?

a) You are using other similar apps or website.
b) Concerns about food safety and hygiene
c) Limited choices of food or restaurants/stores
d) There's better way to fight against food surplus and waste.
e) Food surplus and waste is not a big issue in Sweden.
f) Concerns about the taste
g) Other (please specify)

7. (also applied for yes for Q5b) Why would you like to use this app? (three options at most)

a) My friends also use this app.
b) I can get food with better price.
c) It is a good way to explore new restaurant/bakery or dishes.
d) The "magic bag" can always give me surprise!
e) It can help address food waste and contribute to the planet.
f) It can help local businesses.
g) Other (please specify)

8. What will come to your mind when talk about food waste? (last questions for 6b)

a) Food security and hygiene
b) A better deal
c) A symbol of affluence
d) Climate change and a detrimental impact on ecosystem
e) Inappropriate management

f) Food waste can make the prices higher as the cost gets passed on to consumers.
g) Starving people
h) Disrespectful attitudes to food
i) Other (please specify)

9. What are the problems you facing now on TGTG? (open questions)

10. How TGTG can improve in your opinion?

11. How can the Circular Economy address food surplus and waste issue in your experience?

12. How do you feel about TGTG's role in tackling food surplus and waste?

13. How does TGTG impact your view of food surplus?

14. How do you feel about TGTG's contributions to the transition towards a more circular food chains in Sweden?

14. You can leave suggestions for the survey here.