

From Theory to Practice: Food Waste Reduction Strategies in Literature and a Case Study of Municipalities in Skåne, Sweden

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Master Thesis Series in Environmental Studies and Sustainability Science,
No 2019:020

A thesis submitted in partial fulfillment of the requirements of Lund University
International Master's Programme in Environmental Studies and Sustainability Science
(30hp/credits)



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Submitted May 14, 2019

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Abstract:

Food waste is recognized as a major global issue that currently lacks sufficient political and legislative action in order to understand or address it adequately. Skåne County, Sweden's southernmost county, has highly ambitious climate action goals, and reducing municipal food waste could help them meet these goals. I wanted to better understand what research already exists, where research gaps lie, and how food waste is being reduced in a practical setting. To accomplish this, I performed a literature review of strategies to reduce food wastage on a municipal level, adapted a framework from my research, and conducted interviews with district representatives to gain the understanding of the practical implementation. From my literature review, I identified a seven-stage framework of the food system: Planning, Purchasing, Storage, Preparation, Consumption, and Disposal, which I then used to classify every strategy which the literature mentioned. I then interviewed all of the municipalities in Skåne which had answered a survey from the County Administrative Board, reporting that they were working at the "highest level" as a municipality to reduce food waste, in order to understand what they considered to be this 'highest level' of food waste reduction. All of the Skånsk municipalities which I interviewed have implemented waste reduction strategies to some extent in their school systems, performing a minimum of 19 out of 41 strategic criteria from my framework (46.3%) and a median of 30.5 (74.4%) and they utilize strategies from a minimum of five out of the seven stages in my framework, an average of over six. This is a positive confirmation of my literature review and framework being practically implemented, bridging the gap from academia and literature to tangible results. In order to continue reducing food waste in Skåne, the next steps should be to adapt specific strategies for food waste reduction, continue working to share ideas and strategies between the different municipalities, and expand to further sectors within the municipality, such as elderly care, and implement overall policy plans.

Keywords:

Climate change, sustainability science, food waste reduction, consumer food waste, municipal food waste, municipal policy

Word count: 13,717

Sammanfattning:

Matsvinn är ett stort globalt problem som för närvarande saknar tillräckliga politiska och lagstiftande åtgärder för att förstå och hantera problemet. Skåne län, har ambitiösa och högt satta klimatmål, där minskat kommunalt matsvinn kan vara ett sätt för att uppnå dessa mål. Jag ville bättre förstå vilken forskning som redan existerar, var forskningsbrister ligger och hur matsvinn reduceras i verkligheten. För att uppnå detta och genomförde en litteraturstudie av strategier för att minska matsvinn på kommunal nivå, utvecklade ett ramverk anpassad från min forskning och genomförde intervjuer med distriktsrepresentanter för att bättre förstå den praktiska implementeringen av matsvinns reduktion. Med min litteraturgranskning som grund utvecklade jag ett ramverk av mat systemet bestående av sju-steg: Planering, Inköp, Lagring, Förberedelse, Konsumtion, Avfallshantering, och Utbildning, som jag sedan använde för att klassificera varje strategi som litteraturen nämnde. Jag intervjuade alla kommuner i Skåne som först besvarat en undersökning från länsstyrelsen och rapporterade att de arbetade på "högsta nivå" som kommun för att minska matsvinn för att förstå vad de ansåg att det arbetet innebar. Detta är den högsta nivån av minskning av matsvinn. Alla de skånska kommuner jag har intervjuat har implementerat någon form av strategi för att minska matsvinnet i sina skolsystem och utför minst 19 av mina 41 strategiska kriterier från mitt ramverk (46,3%), i genomsnitt 29.8 (72.5%) och en median av 30.5 (74.4%), och använder strategier från ett minimum av fem ut av de sju i min ram, i genomsnitt över sex. Det här är en positiv bekräftelse på att min litteraturgranskning och mitt ramverk implementeras i praktiken och överbryggas klyftan från akademien och litteraturen till konkreta resultat. För att fortsätta minska matsvinnet i Skåne bör nästa steg vara att anpassa specifika strategier för minskning av matsvinn, fortsätta arbeta med att dela idéer och strategier mellan olika kommuner och expandera till ytterligare sektorer inom kommunen, såsom äldreomsorg och genomföra övergripande policyplaner.

Nyckelord: hållbarhet, klimatpåverkan, sustainability science, minskning av matsvinn, konsumtionsmatsvinn, kommunalt matsvinn

Acknowledgements

This thesis is, plainly put, the acute culmination of 19 years of formal education and nearly 26 years of 'lifetime education' on this miraculous planet that we are all lucky to share. This undertaking sprouted from the continuous moments of love and appreciation and awe for the beauty of every sunset, flower, and wonderful humans (and animals) that I am beyond lucky enough to have making up my everyday life: fuelling my passion and drive to do everything in my own power to protect our Earth.

This acknowledgement section, or any words really, will never truly capture the emotions behind this process. I cannot possibly fully express my gratitude for the experience: for the knowledge gained and shared, and for the bonds formed. It has been the most taxing, exhausting, frustrating, and unbelievably rewarding experience. It has tested my drive and motivation and the limits of my own capabilities. And in doing so, it has helped me realize the full extent of my personal drive, motivation, and capabilities, while providing me with the strongest sense of community and friendship possible.

Thank you, thank you, thank you.

Thank you to my ever-supportive family: my pillars of constant encouragement, constant love, and constant joy. Everything I am and everything I could ever hope to be is because of you, and the foundation of curiosity, wonder, and enthusiasm which you have provided me for life. You have been with me every step of the way, through all of my emotional ups and downs, never-wavering. You have provided me with my roots and my wings. To let your child chase her crazy dreams across the world is brave and selfless and inspiring. I love you is not enough.

Thank you to my support system of amazing friends at home. It really isn't easy to live my life apart from you all. I am lucky to have a busy and beautiful life here that distracts me, but I would give anything to live with you all again and spend every single one of my days with you. Thank you for visiting me here when I chose to move far away from you, and thank you for making home home.

Thank you to my beautiful network of humans here in Sweden. Thank you for making this land of dark and cold ceaselessly bright and warm. Thank you for making this crazy transition nearly seamless. Thank you for allowing me to build an amazing life in a place far, far away from California.

Thank you to LUMES. This has been a crazy two years of undeniable ups and downs. I end my time here with only love and overwhelming pride and bliss in my heart. There is no network that can compare to this. This mashing of so many nationalities, educational, and cultural backgrounds and perspectives is the most beautiful thing I could possibly imagine. It is how the whole world should be. You are my people, and I cannot imagine the rest of my life without you all in it. You inspire me every single day, you give me hope for the future, and you make my heart *sing*. I am so damn proud of us all. Despacito and Flagler Beach till the end of our days.

Thank you to my Bros for providing constant laughs and joy and fun and everything good. You are my guiding light. You make every damn day better. I love you more than Tuesday nights at Kalmar (maybe).

Thank you to my Swedish guides: Fitzwilliam, Julia, Tina, Pphilip, LlamaPatrik, HeiHeiDaniel, PantsHatJohn, and Queen Henriette for proofreading and giving me constant confidence in a language I would never have in my wildest dreams believed I would be living my life in.

Inga ord kan fånga kärleken jag har för dig, min bajsfru, Anna. Mängden glädje du ger mig i livet är ouppnåelig. Alla förtjänar en vän som dig. Tack för att har gjort Sverige mitt sanna hem. Du är min själsfrände, och du gör mitt hjärta så lyckligt.

Thank you, Chieu-Chieu, for your consent form framework and for constant dank memes, and thank you Victoria for reading through my head musings and for your constant positivity. You are both amazing.

Thank you DasJensi for helping me with all the parts of my thesis that I wasn't confident in. Thank you for the spontaneous gatherings and couch parties and constant, constant, constant laughter and warmth. You are one of my soul people.

Tack så, så mycket Dagmara och Susanne för att ni har gett mig denna fantastiska möjlighet och för all er support och uppmuntran. Det har varit en erfarenhet för resten av livet.

Tack till alla kommunala representanter för att ni har varit så entusiastiska, stöttande och hjälpsamma i denna process. Jag är så imponerad av allt arbete ni har gjort hittills, för era egna kommuner och för jorden.

Thank you to the Lord of the Rings soundtrack, which in my darkest and most frustrating moments (and nearly 20 times more) provided the necessary drive and inspiration that nothing else can. "There's some good in this world, Mr. Frodo, and it's worth fighting for." — Samwise Gamgee

And last but most certainly not least, thank you Kim for being the absolute supervisor of dreams. I am confident that I would not have been able to complete this process without your support and encouragement. LUCSUS, and the planet, are so lucky to have your strength and knowledge and passion. Thank you for believing in me when I certainly did not believe in myself. You are an inspiration.

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1 Introduction

1.1 An Overview

Food waste is a significant, growing, and complicated global issue. The issue not only negatively contributes both to world food security concerns and food distribution discrepancies (Papargyropoulou, Lozano, Steinberger, Wright, & Ujang, 2014), it is additionally one of the most significant contributors to global climate change (Lang & Heasman, 2016). It is a combined social, humanitarian, environmental, and economic concern, on the individual, local, and global level. Unfortunately, as with many environmental issues, significant action has only begun to be taken more recently. Depending on the economic situation of the area and/or country, the way the problem is dealt differentiates, and therefore, it must be addressed differently (Venkat, 2012). Further complicating matters, many different and competing definitions of the problem exist (United Nations Environment Programme, 2014). As a result, there has been a lack of political and legislative action to understand or address food waste and the issues surrounding it. In turn, the absence of clear and binding policy leaves too much room for interpretation and subsequent action, leading to additional confusion surrounding food waste and how to further tackle the problem. In countries of the “Global North” (traditionally countries which industrialized earlier), most of the food wastage occurs in the consumer area of the food supply chain (Venkat, 2012). This is therefore where the bulk of efforts should be aimed when dealing with food waste of the Global North.

Sweden, a country of the Global North, has been a world leader when it comes to environmentalism and sustainable policy as it has presented and implemented a progressive and ambitious climate agenda (Lundgren, 2010). Skåne County, Sweden’s southernmost county, has particularly proactive goals and policies (Persson, 2016). One of Skåne’s five major areas of focus, as highlighted in its Regional Action Program for Environmental Quality (*Skånska åtgärder för miljömålen - Regionalt åtgärdsprogram för miljö kvalitetsmål*), is Sustainable Consumption (*Hållbar konsumtion*) (Persson, 2016). Within this area, there exists the opportunity for a specific concentration of the reduction of food waste, namely municipal food waste located in the municipal kitchen area such as governmental central kitchens, public school kitchens, and senior living facilities.

In this thesis, I researched and performed a literature review of strategies to reduce food wastage on a municipal level, particularly in Sweden. I then used this literature review to identify and develop a framework to better organize the literature-identified stages and strategies to reduce food waste. I then interviewed the municipalities in Skåne which had reported back to the county that they had

implemented some form of food waste reduction strategy. I used my framework as a basis to conduct interviews with district representatives, in order to compare how literature strategies compare to programs in practice. Through these measures, I have been able to demonstrate and paint a better picture of where and how food waste is occurring and how to best move forward within the sector.

1.2 General Background on Global Food Waste

1.2.1 Definition

The Food and Agricultural Organization of the United Nations (FAO) has defined the term food loss as any variation occurring to edible material which prevents it from being consumed by people, be it a change in its availability, edibility, or quality (FAO, 1981). “Food waste” in this thesis can be specifically defined as any food which ends up leaving the food supply chain, when it was originally intended for human consumption (Östergren et al., 2014).

There is a general distinction between “unavoidable” and “unnecessary” food waste (Livsmedelsverket, 2016). Unavoidable food waste is the baseline of ‘inedible’ parts of food such as bones and coffee grounds, whereas unnecessary food waste is food that was perfectly edible but was not consumed for other reasons (Livsmedelsverket, 2016). In general, it is assumed that “unavoidable” waste is essentially a sunk cost, so efforts to reduce food waste are typically concentrated on the “unnecessary” waste category (Livsmedelsverket, 2016). However, there are also alternative ways to deal with “unavoidable” waste, owing to the fact that society has set the standards of what is “waste” (Scholz, 2013). For example, potato peels are typically considered “waste”, but they can be left on potatoes or used in other dishes. Unavoidable waste is also not evenly distributed throughout the supply chain, so it makes up different portions of the total food waste, depending on where in the process it is.

1.2.2 The Problem

The issue of food waste presents a multifaceted problem. Decomposing food waste firstly emits the potent greenhouse gases methane (CH₄) and nitrous oxide (N₂O) (Solomon et al., 2007). These gases, according to the Intergovernmental Panel on Climate Change, possess the heat-trapping ability over 25 and 298 times, respectively, of the commonly discussed greenhouse gas, carbon dioxide (Solomon et al., 2007). Furthermore, the food processing system is environmentally invasive and impactful, resulting in many negative ecological effects, from acidification and ecotoxicity to eutrophication and loss of biodiversity (Sörme et al., 2016). When food is needlessly wasted, all of the resources that were

used and all of the preceding greenhouse gases, pollution, and other waste products produced throughout the food production process, essentially occur in vain (Lang & Heasman, 2016). In addition, the collection and treatment of the waste is another added unnecessary environmental and economic cost (Stenmarck, Hansson, Silvennoinen, Katajajuuri, & Werge, 2011). As the United States Department of Agriculture (USDA) (2019) puts it, all of “the land, water, labor, energy and other inputs used in producing, processing, transporting, preparing, storing, and disposing of discarded food is wasted” (USDA, Natural Resources, para. 2). The total carbon emissions and environmental impact of food waste is a combination of all of those from farm to fork: land use change, deforestation, agricultural, fertilizer, transport, manufacturing, processing, storage, cooking, disposal and landfill, and then all of the resources expended including water, land and energy, as well as monetary losses (Hanson, Lipinski, Friedrich, O’Connor, & James, 2015). Additionally, food waste from animal products has a significantly bigger climate impact than of vegetarian options due to the resource requirements of livestock (Poor & Nemecek, 2018).

In general, in nations of the Global South (traditionally later-industrialized countries), the majority of food waste transpires in the production sector, mostly due to the absence of adequate infrastructure such as suitable transport and storage systems and techniques (Vermeulen, Campbell, & Ingram, 2012). On the contrary, countries of the Global North tend to waste the bulk of their food in the consumption sector, evidently as a result of a prosperous culture focusing on overindulgence, the financial ability to do so, and other factors of ignorance and indifference such as a lack of understanding of food labelling (Vermeulen et al., 2012). Much of this waste of the Global North can be attributed to unnecessary cosmetic and other excessive quality standards, which unfortunately means that a lot of disposed-of food is perfectly edible at the time of disposal (Scholz, 2013). Additionally, the unfortunate reality is that the further down the line in the process the food is wasted, the more significant the loss of the production resources and creation of waste products is (Bajželj et al., 2014). Food waste which occurs in the consumption phase has nearly double the carbon footprint of waste which occurs earlier in the supply chain (FAO, 2015). Therefore, the per-capita carbon footprint of food waste in countries of the Global North is more than double that of countries of the Global South, even when the actual volume is similar (FAO, 2015).

United Nations Sustainable Development Goal 12

Food waste has been recognized formally as a critical issue on the global scale by being named in the United Nations Sustainable Development Goal number 12: “Ensuring sustainable consumption and production patterns”, which specifically has an explicit food waste reduction goal: it aims to, “by 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” (United Nations, 2017, Target 12.3). Being recognized on this level helps to solidify the global understanding of the severity of the problem.

1.2.3 General Food Waste Statistics

Over a third of food produced for human consumption globally is wasted, approximately 1.3 billion metric tons annually, 670 million tons of which occurs in the Global North (FAO, 2019). This massive amount would be enough to provide sustenance for every single undernourished person in the world, numerous times over (World Wildlife Fund, 2019). This waste is a problem, in itself, but it also has further negative impacts, such as greenhouse gas emissions, and water, land, and money wastage.

Greenhouse Gas Emissions

This global waste produces 4.4 GtCO₂ equivalents annually (FAO, 2015). This figure is staggering, representing over 8% of all anthropogenic greenhouse gas emissions (FAO, 2015). If it were a country, food waste by itself would be the third largest producer in terms of total greenhouse gas emissions, surpassed only by China and the United States (FAO, 2015). This amount is nearly equivalent to the total global road transport emissions (FAO, 2015). It is equivalent to 700-900 kilograms of CO₂ equivalents per capita, per year in Europe (FAO, 2013).

Water footprint

The water footprint of global food waste is around 250 km³, which is equivalent to more than 38 times the total water footprint of all US households (FAO, 2013).

Land footprint

The land-usage footprint is 1.4 billion hectares, close to 30% of the total global agricultural land area (FAO, 2013). The land-usage footprint figure is for the agricultural land used specifically, and does not even include the negative environmental impacts of land-use change in order to procure this agricultural land, such as deforestation, greenhouse gas emissions, other pollution, and biodiversity loss (Watson et al., 2000).

Economic footprint

This global waste costs nearly \$1 trillion every year (FAO, 2019). This monetary value is equal to the Gross Domestic Product (GDP) of the Netherlands or Indonesia (FAO, 2015). Food waste mitigation is thereby a noteworthy example of an environmentally beneficial undertaking that is also economically beneficial and should therefore be a favorable and straightforward task legislatively.

1.2.4 Food Waste in the Global North

Consumers alone in the Global North waste 222 million tons of edible food, nearly equal to the whole food production output of the entirety of Sub-Saharan Africa (FAO, 2019). In addition, 69% of the global economic cost of food waste is incurred by countries of the Global North (FAO, 2019). The majority of food loss can be subsequently linked to consumer behavior such as overbuying and over preparing food, as well as not keeping food in the proper storage conditions (FAO, 2019). Some consumers may not even either understand, or care about, the negative environmental and economic impacts of food wastage, or may lack the resources and access to educate themselves. For countries of the Global North then, the most logical and effective way to halve their food waste would be to focus efforts where the impact is greatest and most significant – the consumer sector.

1.3 Food Waste in Sweden

Swedish consumer food waste totals more than 1.2 million metric tons annually, even while excluding primary production waste (Livsmedelsverket, 2016). This is equivalent to 127 kilograms per person, annually (Naturvårdsverket, 2013). Swedish food waste creates 2 MtCO₂ equivalents, 3% of Sweden's total greenhouse gases (Naturvårdsverket, 2013). The gross economic benefit of reducing food waste by only 20% in Sweden is estimated to be as high as 10 to 14 billion Swedish kronor (SEK) per year (Persson, 2016). The amount of liquid household food waste, the waste disposed of down the drain rather than in tradition waste bins, is often overlooked and much more difficult to assess due to the absence of physical waste to weight. The drain waste in Sweden was estimated to be 224,000 metric tons, which is 26 kilograms per person per year or 0.5 kilograms per person per week (Sörme et al., 2016). The liquid waste is broken down in Figure 1 below.

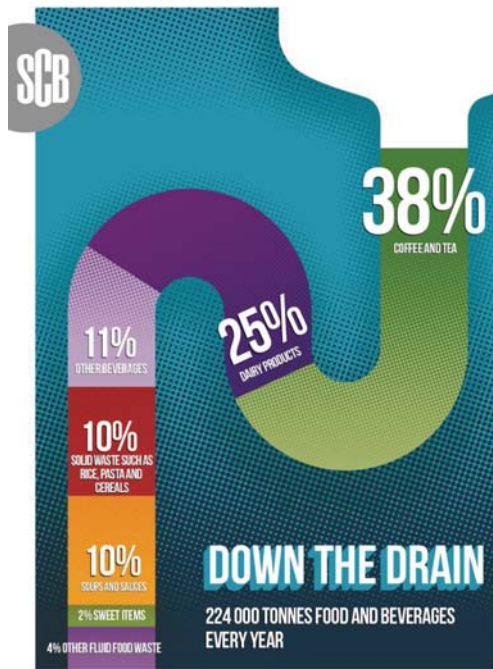


Figure 1. Annual Swedish liquid waste statistics. (Sörme et al., 2016)

1.4 Background: Sweden & Skåne -- Sustainable Policy; Food Waste

1.4.1 Sweden's Environmental Policy

Sweden has consistently had a history of progressive environmental policy with an established Environmental Protection Agency (*Naturvårdsverket*) since 1967 and specified national "Environmental Quality Objectives" [*Miljö kvalitetsmålen (Miljömålen)*] since 1999 (Oscarsson, 2019). Presently operating alongside of achieving the United Nations' 17 Sustainable Development Goals, the 16 current *Miljömålen* span from "Reduced Climate Impact" (*Begränsad klimatpåverkan*) to "A Rich Diversity of Plant and Animal Life" (*Ett rikt växt- och djurliv*) (*Naturvårdsverket*, 2019). However, none of the 16 *Miljömålen* specifically address food waste (*Naturvårdsverket*, 2019).

Historical Efforts in Sweden

There are several actors, committees, and other efforts that have and are currently working to reduce food waste in Sweden. In 2005, a landfill ban on organic waste was introduced (*Avfall Sverige*, 2017). Reducing food waste, as well as refining and improving the resource efficiency within the general food supply chain, is a priority focus area of Sweden's National Waste Plan (*Nationella avfallsplanen*) (*Naturvårdsverket*, 2013). Food waste as a waste stream is also prioritized by *Naturvårdsverket*, as highlighted in its Waste Prevention Program (*Avfallsförebyggande programmet*), and it is thus regularly reported on their website (Sörme et al., 2016). There are special national targets aimed at

reducing the waste (Sörme et al., 2016). The Swedish Environmental Emission Data (SMED) (*Svenska MiljöEmissionsData*) has compiled data on national food waste, to report to and on behalf of *Naturvårdsverket* (Sörme et al., 2016). This committee is a combination of Statistics Sweden (*Statistikmyndigheten SCB*), the Swedish University of Agricultural Sciences (*Sveriges lantbruksuniversitet*), the Swedish Environmental Research Institute (*Svenska Miljöinstitutet*) and the Swedish Meteorological and Hydrological Institute (*Sveriges meteorologiska och hydrologiska institut*), incorporating over 80 experts and scientists (Sörme et al., 2016). The goal of the committee is to support *Naturvårdsverket* and the Swedish Agency for Marine and Water Management (*Havs- och vattenmyndigheten*) in their process of gathering, analyzing and assembling Sweden's environmental statistics (Sörme et al., 2016). *Naturvårdsverket* also works with another Swedish food waste-reduction action-group: SaMMA (*samverkansgruppen för minskat matavfall*), which has also partnered with the hospitality sector (Naturvårdsverket, 2013, Marthinsen, 2012).

Livsmedelsverket's Current Plan

Currently, a comprehensive Swedish governmental commission to reduce food loss and waste has been proposed and undertaken by the Swedish National Food Agency (*Livsmedelsverket*), in collaboration with *Naturvårdsverket* and the Swedish Board of Agriculture (*Jordbruksverket*) (Livsmedelsverket, 2018). The project, an action plan titled "More do more" ("*Fler gör mer*"), aims to reduce food waste along the entire food chain over three years (2017-2019), and move towards a circular economy (Livsmedelsverket, 2018). Many Swedish municipalities have taken their inspiration from this model. The plan uses Sweden's previous research and experiences with food waste in all sectors along the processing chain, from primary production to consumption, as well as combining and collaborating with those of other countries' (Livsmedelsverket, Jordbruksverket, & Naturvårdsverket, 2018). The proposal lists 42 proposed strategies in nine action stages, as well as four prerequisites for successful implementation (Livsmedelsverket et al., 2018). The measures range from keeping communication, collaboration, and information knowledge sharing and education open through all industry players to setting international, national, and local regulations, standards, and financial support (Livsmedelsverket et al., 2018). The measures span both the public and private sectors and cover different stages of the food supply chain (Livsmedelsverket et al., 2018).

European Union Efforts

On a higher scale, which still pertains directly to Sweden, is the European Union joint project "Food Use for Social Innovation by Optimising Waste Prevention Strategies" (FUSIONS). Sweden takes part in the project, which focuses specifically on food waste prevention (FUSIONS, 2016). Sweden's associates

in FUSIONS are the Swedish Institute for Food and Biotechnology (*Institutet för Livsmedel och Bioteknik*) and the Swedish Environmental Research Institute (*Svenska Miljöinstitutet*) (Naturvårdsverket, 2013). FUSIONS has helped design agreed-upon overarching definitions of food waste, which have now been used in Sweden when reporting waste statistics (Sörme et al., 2016). FUSIONS has ranked Sweden as a country on the second-to-highest tier of dealing with food waste, due to its high performance and few data gaps (Stenmarck, Jensen, Quested, & Moates, 2016).

1.4.2 Funding

The public finance system in Sweden affects how funding and studies will be allocated for projects and efforts, such as those regarding food waste. The Swedish public sector consists of a three-tier system: state level, regional/county council level, and municipal level (Forss & Nyreod, 2011). The regional and municipal levels actually are responsible for two-thirds of public services, quite independent of the state level (Forss & Nyreod, 2011). Municipalities are responsible for the “Environment” in terms of waste and water treatment and local issues (Forss & Nyreod, 2011). Therefore, they are free to allocate funding and resources, autonomously from the state and regional levels, though the forms of government tend to work in agreement. 69% of their revenues come from locally generated tax revenues, which allows for a large degree of flexibility (Forss & Nyreod, 2011).

1.4.3 Skåne

General

Skåne consists of 33 municipalities (Nurmi, 2017). It covers 3% of Sweden’s total land area but comprises 13% of Sweden’s population, the third most populous county in Sweden (Sveriges National Atlas, 2004). There is a combination of governing bodies where most environmental and sustainability matters are addressed: *Klimatsamverkan Skåne*, a team of efforts between Skåne’s County Administrative Board (*Länsstyrelsen Skåne*), its County Council (*Region Skåne*), and its Energy Office (*Kommunförbundet Energikontoret Skåne*). For this thesis and project, I have worked directly in partnership with *Länsstyrelsen Skåne’s* Environmental Strategy Unit (*Miljöstrategiska enheten*).

Länsstyrelsen Skåne

In Sweden, the *Länsstyrelsen* system is responsible for implementing and overseeing domestic policy decided by the national parliament (*riksdagen*) on the regional level. *Länsstyrelsen Skåne’s* mission is to create social benefits through community building, investing in rural areas, and protecting the environment (Persson, 2016). They focus on these areas in order to do the best for Skåne as a county

and to contribute to favorable living conditions and sustainable development to preserve cultural and natural values and equality (Persson, 2016). The idea is to, in partnership with the national “generational” goal, ideally hand over society to the next generation with the major environmental problems already solved (Persson, 2016; Ek, 2018).

The *Miljöstrategiska enheten* is currently around 20 people, consisting of environmental, climate, and energy strategists. The unit will, with a long-term perspective: promote, coordinate, and lead the regional work on realizing the government's policy regarding energy conversion and reduced climate impact. Right now, the unit's role is to coordinate various actors in the county to implement measures within the action program for the environmental goals.

Currently in the midst of their environmental policy implementation (*Miljömålen*) for 2016-2020, the county has aimed to become fossil-free by 2030 (Persson, 2016). *Länsstyrelsen Skåne*'s first ideas for a climate action plan began in 2003 and have since been revised multiple times (Persson, 2016). They currently work with 15 of the 16 national *Miljömålen*, addressing one less due to the fact that one of the 16, “A Magnificent Mountain Landscape” (*Storslagen fjällmiljö*) is not relevant to the predominantly flat, agricultural plains of Skåne (Persson, 2016). In the most recent report on the environmental measures which *Länsstyrelsen Skåne* will be taking, they have further focused down onto five main goals:

1. Sustainable transport (*Hållbara transporter*);
2. Consideration of sea, lakes, and waterways (*Hänsyn till hav, sjöar, och vattendrag*);
3. Management of land and water resources (*Hushållning med mark och vattenresurser*);
4. Preservation of natural and cultural values (*Skydd av natur- och kulturvärden*); and
5. Sustainable consumption (*Hållbar konsumtion*) (Persson, 2016).

Of those five, they now, from 2018 forwards, have further narrowed down to focusing primarily on Sustainable Transport and Sustainable Consumption (Dagmara Nawrocka, personal communication, April 15, 2019). This thesis will be focused on the final *Länsstyrelsen Skåne* goal of Sustainable Consumption, within the first Swedish national goal of Limiting Climate Impact.

1.5 The Project

1.5.1 Research Gap

It is important to understand what works to reduce food waste, what can be done by which actors, and at what level to reduce it. Firstly, there exists a gap in the field on ways to reduce food waste. Most

studies involving food waste focus on which behaviors increase food waste and how, but not how to curb these practices. Food waste is identified as a problem and why it is one but less so how to deal with it. An additional research gap exists in linking the research that exists with specific practices in the outside world. There are studies which list methods and ideas in order to reduce food waste and of what practices exist in the field, but little connecting the two. The problem needs to be made practical to actually be effectively and thoroughly addressed. To complicate matters, every country and corresponding system operates differently and methods which work for one may not always easily transfer over to another; however, some will work, and it is necessary and important to realize and understand the distinction. In general, there are literature reviews and other frameworks, but they all have stayed either in the academic field or focused on the practical field, not merging the two. A recent comprehensive framework by do-Carmo Stangherlin (2018) is very promising, spanning a wide range of areas, but being very new, it has not been further optimized or operationalized. The do-Carmo Stangherlin paper's purpose is to identify the major drivers and barriers to consumptive food waste reduction and analyze ways to prevent wasteful practices. It completes a systematic review of 84 articles about food waste, but does not transfer these ideas directly to a specific practical field of implementation. The review does not do a practical study itself in order to test these strategies, therefore not combining the two aspects of literature and practice.

1.5.2 Contribution to Sustainability Science

By combining problem-driven research, knowledge to action, assessment, and application, this thesis contributes to the underlying principles of the field of Sustainability Science (Kates et al., 2001). This process has taken a concrete problem: food waste, and contributed to bridging a gap between literature from academic studies and the practical application of said information, in the physical field. A cornerstone of Sustainability Science is the simultaneous combination of scientific exploration and practical application (Kates et al., 2001). This thesis, as per Sustainability Science, combines multiple angles, linking global and local perspectives by taking a worldwide issue and addressing it on a local level, that can nevertheless end up being amplified to a larger scale (Clark & Dickson, 2003).

1.5.3 Why This Level

I focus on municipal food providers of the 33 municipalities which make up Skåne County. The municipalities oversee several different civic food providers for the public sector, including central municipal kitchens, public school kitchens, and senior living facility kitchens (Persson, 2016). Municipalities are responsible for the above areas of the public sector in Sweden, whereas hospitals and health centers are the responsibility of the Regional government, and prisons and the military are

National responsibility (Marthinsen, Sundt, Kaysen, & Kirkevaag, 2012). Focusing on the municipal level is important due to the fact that food waste increases along with the size and complexity of the food-service operation, such as in municipal kitchens (Ofei et al., 2015). There are typically three types of food waste in this setting: preparation waste, which occurs and stays in the kitchen; serving waste, which includes any leftover food that has already been served in the food cafeteria but not taken by consumers; and plate waste, which is food that had been taken by consumers and not eaten.

Municipalities are a good level to focus on in Sweden specifically due to Sweden's method of governance where the municipal government has primary control over the food and meals which all public schools in Sweden provide for free to students; senior care is state-run, with meals provided for residents; and central kitchens provide further meals within the municipality (Livsmedelsverket, 2019). Municipal kitchens are set up in one of three ways: with food preparation directly in the kitchen onsite, prepared food being received from another kitchen to be heated and served onsite, or a combination of the two (Marthinsen et al., 2012).

Further justifying why this is an important level and sector to focus on practically and impact-wise, particularly in Sweden, is backed up by Norden, or the Nordic Council (*Nordiska rådet*), the formal organization for official inter-governmental cooperation and collaboration between the Nordic countries. Norden has assessed that of the 1.4 billion portions served annually in Sweden, a fifth is in the hospitality sector, a fraction which is expected to increase in the future (Marthinsen et al. 2012). 260 million of the annual portions are served in schools (Marthinsen et al., 2012). 3 million meals are served daily within the public hospitality sector, 1.4 million of which are specifically at schools (Marthinsen et al., 2012). Swedish catering facilities in particular produced around 58,000 metric tons of food waste (6 kilograms per person) in 2012, and school canteens specifically generated nearly three quarters of the total food waste, 43,000 metric tons (Naturvårdsverket, 2013). Over 50% of the total food waste was categorized as unnecessary food waste (30,000 metric tons) (Naturvårdsverket, 2013). Due to these factors, Norden recognizes and recommends that public food services, namely school kitchens, be a focal area for initiatives and progress in food waste prevention (Marthinsen et al., 2012).

1.5.4 Objective & Research Questions

The objective of this thesis was to conduct a literature review outlining and understanding possible steps and stages of a range of strategies to reduce food waste on a municipal level; analyze and understand the progress which the Skånsk municipalities have made in terms of food waste reduction; determine and record the municipalities' current situations and future plans; and present further options and opportunities for additional progress to be made based on the literature review,

framework, and interviews.

1. What stages and strategies exist in literature to reduce food waste in the consumer sector, on the municipal level specifically, which could be particularly practical in Sweden?
2. Which of these stages and strategies have actually been undertaken so far by municipalities in Skåne, Sweden?
3. What progress have these municipalities already made in reducing their own food waste?
4. What are these municipalities' future goals and plans to further reduce food waste?
5. What stages and strategies can municipalities adapt from my literature review framework and from collaboration with other municipalities which I have also interviewed?

The goal was to understand what actions and policies can be undertaken in a practical setting, in order to reduce food waste on a municipal level.

2 Research Design & Methods

2.1 Literature Review

I began my project by conducting a literature review to better understand and help outline general and specific strategies, policies, and outcomes of food waste reduction on a municipal governmental level in government-run facilities for large-scale food preparation. As I was aware that examples already existed on this level in Sweden, I decided to begin my search more narrowly, by first analyzing reports, articles, and papers on municipal efforts in Sweden and then continue by broadening outwards and internationally. I searched the Lund University library database, LUBsearch, trying with the keywords "municipal food waste reduction Sweden". I conducted the search for both English and Swedish (variations of "*minskning matavfall Sverige kommun*") articles, though the articles I found most useful and relevant were primarily in English, due to most higher-level papers and reports being translated to English for ease and breadth of distribution. I subsequently searched "municipal food waste reduction" and "food waste reduction" to expand my range. I understood that it was helpful and necessary to recognize and consider ideas and actions taken outside of Sweden, as well as at least assess and have an idea of how individual/household/private consumer-level efforts (both within and outside of Sweden) could be relevant when finding and assessing strategies on a municipal level. More general strategies could also extend beyond a single focus, such as on the governmental facility level. It was also interesting to observe and note the differences between the sectors.

I read over 50 articles that I found which fit my search criteria above, 20 of which proved to be specifically relevant and helpful for my project. I determined their relevance based on if they had

suggestion(s) of concrete strategies to reducing food waste that could be applicable in the consumer, specifically public, sector. I further determined what was ‘relevant’ due to the conditions presented by following the framework which I created and followed along the way in order to classify the various waste-reduction strategies at different stages in the food supply chain. I based the foundation of my framework on the framework introduced by do-Carmo Stangherlin (2018), a paper about the drivers and barriers to food waste reduction on a global scale.

My framework breaks down the issue of where food waste can occur and how to address it, based on strategies that were mentioned within the papers I analyzed. Similarly to the do-Carmo Stangherlin (2018) framework, my framework consists of seven concrete stages along the consumption chain: Planning (*Planering*), Purchasing (*Inköp*), Storage (*Förvaring*), Preparation (*Förberedelse*) Consumption (*Konsumtion*), Disposal (*Avfallshantering*), and Education (*Utbildning*), along with a stage, Other (*Osv*), for strategies and ideas that did not fall clearly under any of the previous specific categories (Figure 2). I began by having these categories listed on a grid on a large pad of paper while reading each article and then taking notes on where each paper’s suggestions would fall into (Appendix 1). I noted and highlighted where the same strategies were mentioned for each stage. Within the 20 documents that met my criteria, I read and analyzed a wide array of literature, ranging from official reports from Swedish governing bodies and the Organisation for Economic Co-operation and Development, to global reviews of food waste, to specific case studies within and outside of Sweden, listed in Appendix 2.2.

After analyzing all of my relevant articles, I compiled them into a more concrete version of my framework in Microsoft Excel. I listed all of the suggested methods/strategies under each stage. I then recorded all of the articles that I used as a checklist and marked which ones mentioned which strategies. I also translated the framework list into Swedish for use in my interviews. Once I compiled my framework, I was ready to begin the interviews because I planned to use the framework directly, in order to systematically monitor and analyze each municipality’s progress in reducing food waste.



Figure 2. The seven stages of my framework, plus another stage, “Other”, for methods which did not clearly fall under the seven rigid categories. Own creation.

2.2 2018 Survey

In 2018, *Länsstyrelsen Skåne* performed a follow-up inquiry at the halfway mark of Skåne's current climate plan in order to assess progress and stimulate action as a region as well as understand the individual municipal progress. This follow-up consisted of updating the measures to the 11 most pressing areas within the Sustainable Transport and Sustainable Consumption goals and creating a survey that was sent out to 70 responsible bodies in the region, including the 33 municipalities. The survey was completed by every municipality between May and December of 2018. The survey data was then collected, and further action was determined within the categories. For this thesis, I focused on one of the specific questions from the survey, explicitly pertaining to the management and reduction of food waste.

The survey consisted of 13 two-part questions, the first part asking a specific question about the areas of sustainability focus and having each municipality grade themselves on a scale of substantial action (having been implemented in the area) to no action had begun in the area (see Table 1). The question pertaining specifically to food waste stated: "Are you working on reducing food waste in your business? Give an overall assessment of how well the measure is implemented based on the scale in the list below." (*"Arbetar ni med att minska matsvinn inom er verksamhet? Ge en samlad bedömning av hur väl åtgärden är genomförd utifrån skalan i rullistan nedan."*) The second part of the questions allowed for free response within each category, in order to clarify what had, or had not, been done in the area. In the case of the food waste-specific question, the second part allowed for each acting body to explain their actions in the realm of food waste reduction.

Table 1. The rating system for the survey sent out by *Länsstyrelsen Skåne*. Own creation.

letter	definition	in Swedish
G	Action has been implemented, mainly implemented, or is ongoing.	Åtgärden är genomförd, i huvudsak genomförd eller pågår kontinuerligt.
H	Action is halfway or more completed.	Åtgärden är genomförd till hälften eller mer.
P	Action has begun, but it not yet halfway implemented.	Åtgärden är påbörjad, men ännu ej genomförd till hälften.
E	Action has not yet been implemented.	Åtgärden är ej genomförd.
X	The measure is not relevant to the operator.	Åtgärden är ej relevant för aktören.

2.3 Interview Setup

When deciding how to undertake my research, in understanding how to reduce food waste on a municipal kitchen level, I decided to contact and interview the Skånsk municipalities which had rated themselves with a "G", the highest rating on the sustainability survey, due to the fact that they reported awareness and having already undertaken at least some measures to address and reduce their food waste. I was interested in finding out how their strategies and experiences compared to my literature review and framework. Doing so would determine how closely the two related to one

another: academic suggestions vs. practical implementation. I figured that these municipalities would therefore more likely have a more-definite reduction understanding, plan, and subsequent implementations. These front-running municipalities would also have an idea of what had been more or less effective so far. Speaking to municipalities which had not at all begun to address the issue, were unaware of their own progress, or had barely started programs would be much more difficult to assess and understand the effectiveness. Thus, I opted to only interview these “G” municipalities.

It was important to have an idea of what each of the municipalities considered to be the highest rating and understand why they felt justified giving themselves the highest grade possible. Overall, out of the 33 municipalities, 13 graded themselves with a “G”, the highest rating. Of those 13, however, only seven went on to explain in the subsequent discussion question what they had been implementing in order to reduce food waste, to justify this high self-rating. Aiming to get a positive response and enthusiasm about further research and an interview, I decided to first contact and interview these seven municipalities, since they had each initially been willing to clarify a bit on their specific plans and would hopefully therefore have distinct well-developed plans that they could be interested in and open to sharing. I subsequently contacted the six other municipalities which had given themselves the highest rating but had not given an open response, in order to expand my number of interviews, since they did nevertheless rate themselves with the highest mark possible.

To contact potential interviewees, I received the contact information of those who had answered the survey through my liaison at *Länsstyrelse Skåne*, Dagmara Nawrocka, their Environment and Climate Strategist. She emailed all of the relevant municipal environmental managers, explaining the next step in the regional food waste reduction project and that I would be contacting them about setting up an interview. I thus sent out requests to the 13 front-running municipalities, highlighting my project, asking them to assemble any relevant data on their projects, goals, and reduction progress, if possible. I also urged them to forward my information on to more-relevant representatives if they themselves were not the best person to talk to. I received responses from all of the municipalities and scheduled interviews with 10 of the 13: Helsingborg, Burlöv, Malmö, Svedala, Lomma, Lund, Trelleborg, Skurup, Östra Göinge, and Klippan, listed in Table 2.

Table 2. The 10 municipalities in Skåne, Sweden from which representatives were interviewed for this research, ranked by population size. Own creation.

Municipality	Population (2018)
Malmö	339,313
Helsingborg	145,415
Lund	122,948
Trelleborg	44,902
Lomma	24,763
Svedala	21,576
Burlöv	18,360
Klippan	17,900
Skurup	15,759
Östra Göinge	14,915

My theory that the municipalities who had gone on to explain their programs in the follow up question would be more open to being interviewed proved correct, as six out of those seven consented to be interviewed. However, although I heard back from every municipality, three of the 13 were unfortunately unable to expand upon their programs and results, either due to lack of data, lack of program(s), or their programs were not as advanced as they had initially thought and reported on. In addition, unfortunately two of the ten municipalities which I did indeed interview were unable to fill out my framework, so my evaluation of them is incomplete.

My process of contact began by contacting each municipal representative to schedule an in-person interview. All correspondence: email, in interviews, and any contact thereafter, was conducted in Swedish.

Once I had scheduled interviews, I began to prepare for them. I designed an interview consent form for my interviewees to read and sign (Appendix 3) based on a similar consent form devised by my co-student Mathieu Mal and translated this to Swedish. I also fashioned a list of interview questions: inquiring about the municipality's goals and approaches to reducing food waste as a whole, and what areas they had/have been/will be focusing on and why (Appendix 4). During the interviews, after I let them explain their processes, systems, and strategies themselves, I then had them look over and consult my framework. I had them check off which methods on the list that they as a municipality had been doing and then which ones they would be specifically continuing with/focusing on/beginning to undertake in the future, with room to describe in writing anything they deemed worth further clarifying for each strategy (Appendix 5). Each stage of the framework also had an "other" line, where they could add any other methods or strategies that I may have missed in my literature review, that

they as a municipality had specifically been focusing on, if they deemed them specifically relevant and/or effective.

3 Results

3.1 Literature Review Results (Research Question 1)

There are many different stages and strategies which exist in literature to reduce food waste in the consumer sector, on the municipal level, specifically in Sweden. The literature acknowledges and explains what has been done so far in Sweden, on different levels, as well as what exists and works elsewhere. In order to better organize all of the strategies which I found, I structured them into my 7-Stage framework, with the outlying strategies falling under an “Other” stage. In my literature review, I identified 41 distinct food waste reduction strategies (Appendix 2.2). I have all of the strategies listed, organized by each stage, and how many papers out of 20 mentioned each stage, in Figure 3.

Some papers contained as many as 25 out of the 41 strategies (Norden, 2012), whereas others presented as few as one strategy.

3.1.1 Planning

Nearly every paper (18 out of 20), outlined strategies which would fall under “Planning.” There were three tactics that were most commonly mentioned in the literature that constituted “Planning”, each noted by more than half (10) of the papers which contained “Planning” strategies. One of these Planning strategies was to **record and keep data** on food waste, evidently in order to compare and determine progress over time; the second was to have a method to **control portion number and/or size**, including the ability to **adapt quickly**, i.e. in the case of student absences, so the extra food would not go to waste and less food is served; and the third was to have **education** about how to plan in a manner which better reduces food waste. The other strategies were: to ensure **good or more careful** planning, in order that food waste is reduced; to plan in a way where food waste is **prevented** in the first place, the most effective method; to **trace the entire supply chain** in a way to better determine where and how exactly food waste is occurring; to **adjust buffets** in ways such as having fewer or smaller plates, or smaller serving spoons, so patrons will take less food at a time and therefore reduce plate waste; to have specific **menu planning**, so food orders can be more exact; having **targets** for food waste reduction; having **specific policy or guidelines** in regards to food waste; making sure kitchen staff has a clear **awareness of the food stock** so that they do not order unnecessarily; having **less perishable foods** so that they can last longer; **not estimating** food orders to avoid over-ordering; and **ensuring that there is proper funding for future studies** in order to continue reducing food waste.

3.1.2 Purchasing

The “Purchasing” strategies were **not overbuying, including impulse and routine or less frequent purchasing**, basically to buy only when precisely necessary; and **not cancelling orders last minute**, where the supplier may have to dispose of ordered but unused food. Overall, nine papers mentioned some type of strategy which would fall under the Purchasing stage.

3.1.3 Storage

Overall, nine papers mentioned some type of strategy which would fall under the “Storage” stage. The most common strategy, mentioned by six papers, was to **understand and ensure proper conditions of storage of food, such as the right temperatures, humidity, freezing** etc. for each type of food. The other Storage strategies were **wrapping** food to lengthen viability, using **technology to extend the shelf-life**, and having **high visibility** of food stock in order to keep track of it.

3.1.4 Preparation

The “Preparation” strategies were **understanding and using optimal handling methods and foods** in order to reduce food waste, **utilizing leftovers** in the future, **not over-preparing** food, having **kitchens onsite** rather than having offsite preparation kitchens sending food to facilities; ensuring that kitchen staff have **optimal cooking skills** to minimize accidental food wastage due to negligence; and **cooking in stages**, so food waste can be clearly understood and then reduced step-by-step. Overall, 11 papers mentioned some type of strategy which would fall under one the Preparation stage.

3.1.5 Consumption

“Consumption” had only one specific strategy which fell under it: **ensuring enough time to eat**, which was the least of any stage, and only three of the 20 papers mentioned it.

3.1.6 Disposal

The “Disposal” strategies were **composting**; converting food waste to **biogas**; using food waste as **animal or pet feed**; **donating** the food waste; letting **staff or customers take leftovers**; **separating** types of waste to make the food waste more noticeable and clear; focusing on a **circular economy** to overall minimize food waste and make the most of resources; and to **distinguish between solid and liquid waste** to better understand how much waste is actually unwittingly disposed of down the drain. Overall, 18 papers mentioned some type of strategy which would fall under the Disposal stage.

3.1.7 Education

Overall, 10 papers mentioned some type of strategy which would fall under the Education stage. The most common “Education” strategy was to have **consumer education and awareness campaigns and encourage people to “enjoy food”**, in an effort to have people eat more slowly and carefully, which was mentioned by eight of the 10 papers which mentioned strategies which fall under Education. The other two Education strategies were to have education surrounding **expiration dates** since they are often misunderstood and followed unnecessarily and to have education specifically about the **environmental impact** of wasting food, to increase awareness and subsequently hopefully action.

3.1.8 Other

The strategies which did not follow under any of the specific categories were to increase and encourage **communication, collaboration, and knowledge sharing** between actors and on different levels; to **make food waste not socially, morally, or ethically acceptable**; and to have **routine monitoring** at facilities in order to determine that the strategies are actually being followed.

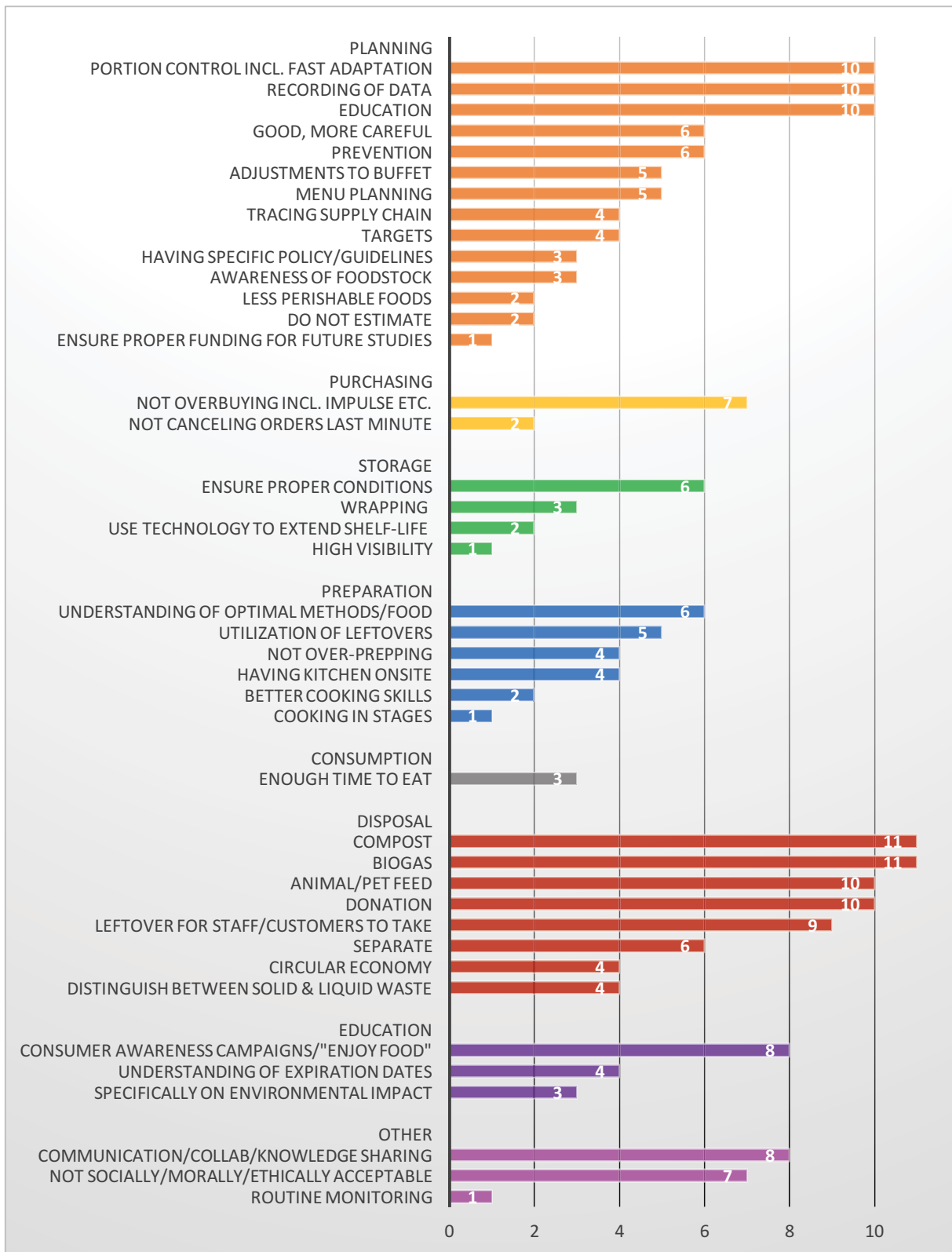


Figure 3. The literature review strategies and how many papers out of 20, mentioned each strategy, broken down by stage. Own creation.

3.2 Interview Results (Research Questions 2, 3, 4)

All of the interviewed municipalities were proud and enthusiastic about their programs. Every municipality which I included in my framework uses strategies which fall under at least five of the seven stages of Planning, Purchasing, Storage, Preparation, Consumption, Disposal, and Education, with an average of over six. In addition, every single municipality employs at least one of the strategies from the “Other” stage. Only four of the municipalities employ the Consumption strategy of ensuring enough time to eat, though one more, Helsingborg, is planning to do so in the future, and many others mentioned that limited meal time is indeed a clear problem. Seven of the municipalities use one or both of the two Purchasing strategies. The condensed findings are summarized in Table 3 and Figures 4, 5, and 6.

Table 3. The municipalities, the totals of each stage, and total stages undertaken by each municipality. Own creation.

Municipality	Planning	Purchasing	Storage	Preparation	Consumption	Disposal	Education	totals/7 stages
Malmö	x	x	x	x		x	x	6
Helsingborg	x	x	x	x		x	x	6
Lund	x	x	x	x	x	x	x	7
Lomma	x	x	x	x	x	x	x	7
Svedala	x	x	x	x	x	x	x	7
Burlöv	x	x	x	x		x	x	6
Skurup	x		x	x		x	x	5
Östra Göinge	x	x	x	x	x	x	x	7
totals/8 municipalities	8	7	8	8	4	8	8	
number of strategies in Literature	14	2	4	6	1	8	3	
Literature totals / 20	18	9	9	11	4	18	10	

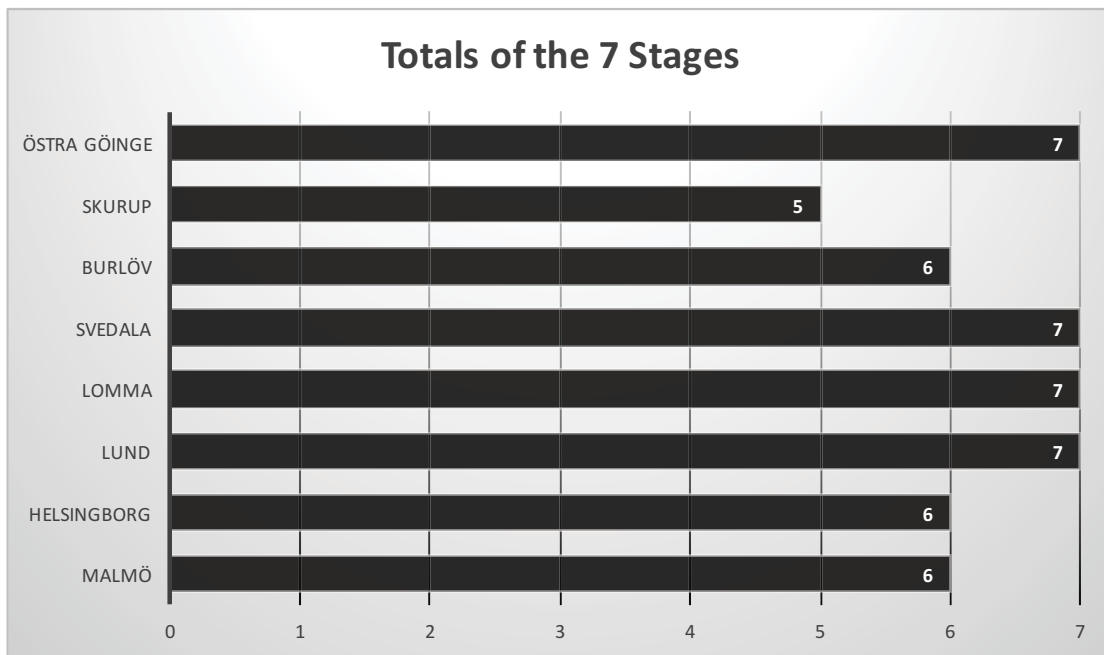


Figure 4. The number of food waste reduction stages undertaken by each municipality, out of the seven possible stages. Own creation.

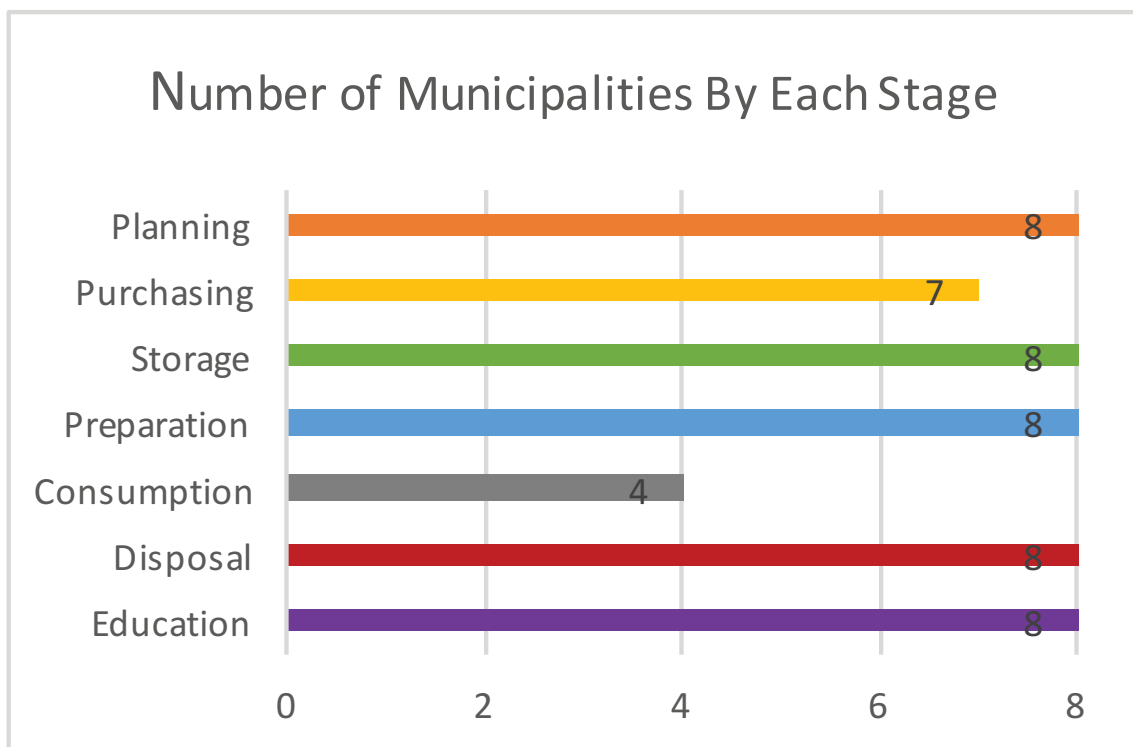


Figure 5. The number of municipalities which include each stage, out of the eight possible municipalities. Own creation.

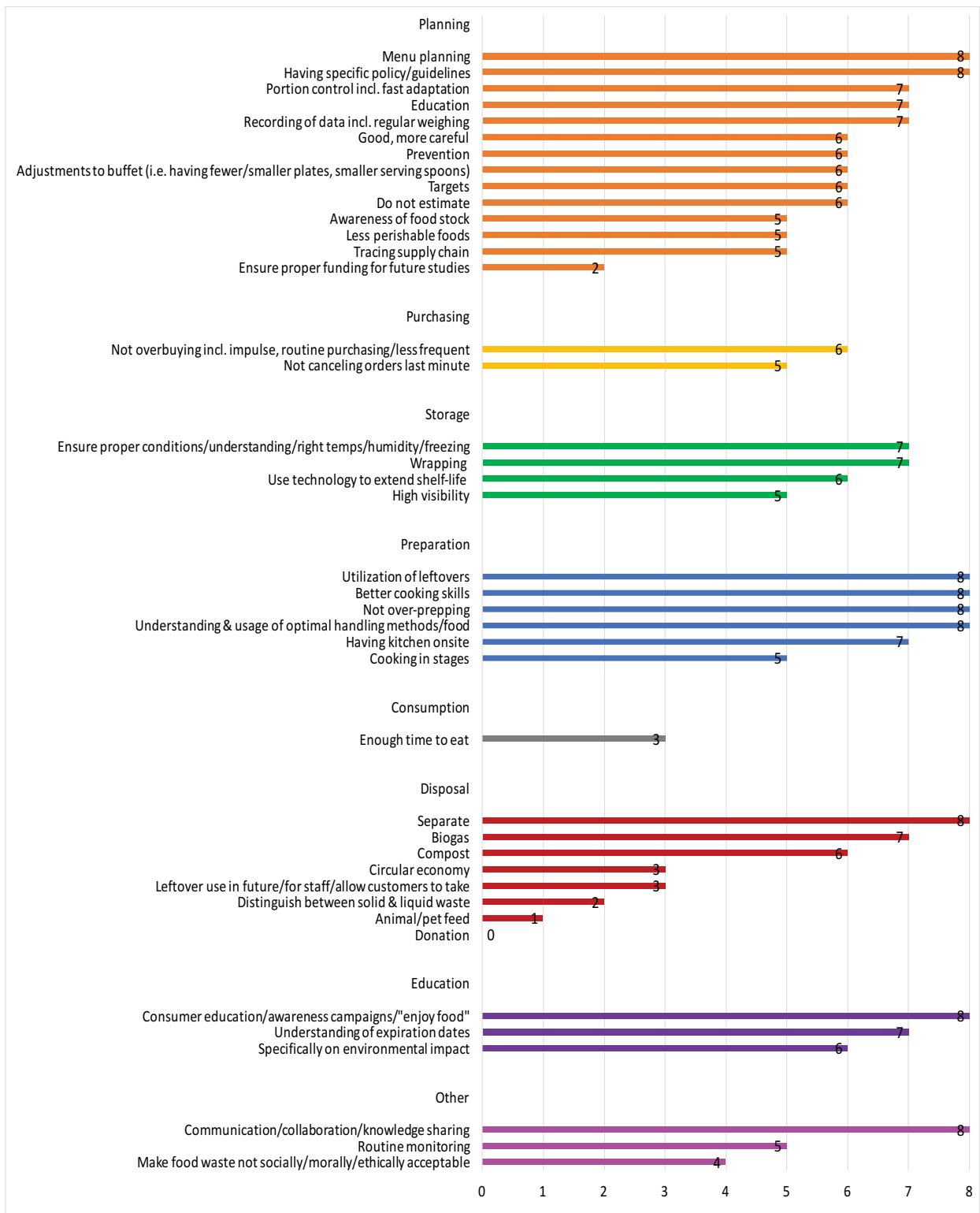


Figure 6. The interview results strategies, and how many municipalities out of eight have undertaken each strategy, broken down by stage. Own creation.

Despite the fact that attempting every strategy is not necessary or expected, every single municipality had undertaken at least 19 out of the 41 total strategies (46.3%), though this was even an outlier, the average was 29.8 (72.5%) and the median was 30.5 (74.4%) (Figure 7 and Appendix 6). The highest number was in Lund municipality, which had 36 out of 41 (87.8%). In terms of future plans, the

minimum number was 20 (48.8%), the maximum being 35 (88.6%), the average being 31.3 (76.2%), and the median being 32.5 (81.3%).

All municipalities mentioned making tangible progress in reducing their own food waste since beginning to address the problem. Every municipality also has concrete plans to make further future progress, with most focusing on doubling down and continuing certain strategies and efforts that they have already begun.

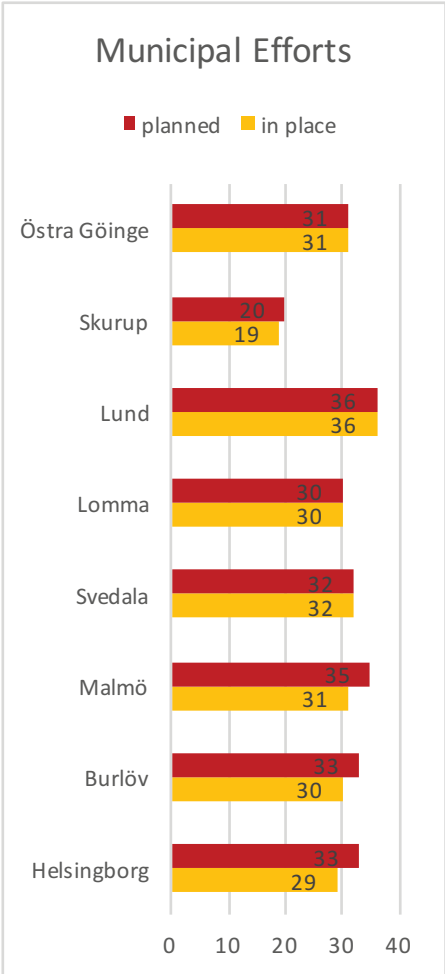


Figure 7. The number of total strategies, out of 41, undertaken by each municipality, those currently in practice (yellow) and those planned in the future (red). Own creation.

In terms of more specifics, every municipality has been focusing at least some effort on reducing food waste within at least some schools. Three have also begun projects in senior living facilities and two have also both begun municipality-wide efforts of having all-encompassing rules, goals, and guidelines for all municipal kitchens (Table 4).

Table 4. The municipalities, ranked by population size, and their areas of focus. Own creation.

Municipality	Schools	Senior Housing	Other
Malmö	x		
Helsingborg	x		
Lund	x	x	
Lomma	x		
Svedala	x	x	x
Burlöv	x	x	x
Skurup	x		
Östra Göinge	x		
totals/10	8	3	2

Overall, most of the municipalities are working in partnership or have some kind of cooperation or collaborative effort with at least a handful of other Skånsk municipalities, in order to work together/share ideas/plans/success stories. This coincides with also commonly being mentioned in the literature.

There were several other specific strategies that multiple municipalities notably used. One was that half of the municipalities mentioned the recent *Livsmedelsverket* “More do more” model, which they take inspiration from (Table 5). A second commonality was that the eight southernmost Skåne municipalities which I interviewed (Table 5), are all a part of owning Sysav, South Skåne Waste Company (*Sydsånes avfalls aktiebolag*), along with the six other southernmost Skåne municipalities (Table 5) (Sysav, 2018). Sysav collects municipal food waste and generates it into biogas (Sysav, 2018). Many municipalities also mentioned the loosening of certain strict rules which cause unnecessary food waste, such as expiration dates and leftovers. Multiple mentioned doing specific projects with leftovers such as having special days where only leftovers are served (Table 5). Four municipalities also mentioned specific consumer awareness campaigns which included having signs in the food halls, notifying patrons about the existence of waste/prevention strategies/current situations (Table 5). Most municipalities use a form of online measuring and recording system or application, the most common specific application being “Mashie”, which is used by three of the municipalities (Table 5). Mashie specifically, headquartered in Malmö, is an IT support system for restaurants and catering in the Nordic region (Mashie, 2019). It allows suppliers to calculate and deliver custom food and designing menus, along with understanding and balancing nutrition, price, and timing (Mashie, 2019).

Table 5. The municipalities and which ones use a few specific, reoccurring methods. Own creation.

	Malmö	Helsingborg	Lund	Trelleborg	Lomma	Svedala	Burlöv	Skurup	Östra Göinge
Livsmedelsverket model	■		■		■	■	■		
Sysav	■		■	■	■	■	■	■	
Leftovers		■	■	■				■	
Signs		■	■	■				■	
Mashie					■	■	■		

3.2.1 Interview Results: Lund

As a large municipality, Lund does not have a municipality-wide overall food waste-reduction strategy, but they have managed to undertake a wide range of many strategies to address and reduce their food waste, with different internal goals for different areas.

Lund's Food Waste Specifics

Lund has focused mainly on school food waste, in a number of preschools, secondary schools, and high schools, with internal goals in different sectors; however, they have also worked a bit with food waste reduction in senior housing, where food is prepared onsite. They began measuring food waste in a portion of schools in 2012. They aim to measure preparation, serving, and plate waste; however, they do not focus on preparation waste as it has not been a specifically predominant problem. In 2018, they aimed for a maximum of 15% of food to go to waste, and the goal for 2019 is to reduce that already ambitious number to only 10%, divided to a maximum of 5% of serving waste and 5% plate waste. Overall, Lund has addressed the most strategies of any municipality, already undertaking 36 of them and is planning to focus specifically on 7 strategies throughout the food system chain in the future.

Lund's Food Waste Reduction Strategies

Lund has several sustainability programs, including the overarching “LundaEko II”, where one of its priority areas of focus is sustainable consumption for the municipality as a whole, though it does not have a specific goal for food waste. They use an app in order to report daily plate waste as well as web ordering with specific portions and notes and statistics kept in order to report to *Livsmedelsverket*. Lund works specifically alongside *Livsmedelsverket's* new policy in all areas. They have certain ordering policies such as ordering two weeks early, without the option to cancel the order, so careful and

accurate planning is necessary. Lund has found it harder to tackle plate waste, as it is not necessarily as logical or straightforward to address. In order to do so, they figure that they should work with educators, which can have very different strategies and opinions. Lund finds that some statistics can be hard to compare due to the fact that they are measured differently, whether in weight vs percentage vs cost, and some are not measured at all, especially since every kitchen has developed their own action plans. They attempt to keep dialogue up between the different kitchens and areas in the municipality, as well as among other municipalities, in order to reduce confusion and raise awareness and action. Lund has education and workshops for all staff members, with a production leader from every kitchen. They also have taken part in a joint project, "Meal Media" (*Måltidsmedia*) in order to better connect students with a bigger picture, including staff, the outside world, and the food processing chain. It is a collaboration between several players, including educators, kitchen staff, and students. Lund renovated the cafeteria and used signs, posters, and other decorations in order to raise awareness and report on food waste, highlighting the negative effects of wasting food, imploring students to take less food each time, with the opportunity to come back and take more, and to spread knowledge and awareness among patrons. They highlighted results and emphasized the importance of reducing food waste. Lund found that doing so did reduce plate waste.

Lund also found that what ended up being especially effective is the mealtime schedule. Mealtimes which are too rushed are stressful for both staff and students and result in more of all types of food waste. They found that attempts to raise awareness and create a culture of less food waste is easier with younger students before more negative peer pressure exists. Even if older students understand the consequences and importance, they are less likely to make significant changes. This must be solved by working continually with students of all ages and coming up with different strategies and activities to inspire them to care and do so. For example: Lund has staged competitions to reduce food waste among the four large high schools. They use leftovers for future recipes as well as having a Friday buffet of leftovers, while keeping track of the popularity of certain recipes in order to avoid less favorable dishes and prepare more accurate quantities. Lund also has put food waste in students' own hands in order to engage them further, such as having them come up with questions and answers relating to food waste and learning reduction techniques in classes such as Home Economics. They also are setting up opportunities to try food before taking a larger portion.

Another project Lund took part in was adjusting the light and atmosphere in the cafeteria based on different meals and factors, in order to see and understand if and how it affected food consumption/attitudes/actions. However, there already was so little food waste from the project, there was not much of a difference.

They have also begun to address food waste in senior living facilities and certain cultural tendencies to overindulge, such as the Swedish “*fika*” culture of an abundance of coffee and pastries which often results in a lot of waste.

Lund has also made efforts in their own municipal offices as well, raising awareness with signs.

3.2.2 Malmö

Malmö also does not have an overall strategy for the entire municipality, but they have many different ideas and campaigns, which are very ambitious and have already proven successful. They do also have a specific guide of tips for municipal kitchens.

Malmö’s Food Waste Specifics

Malmö started food waste reduction programs in schools as early as 2005, the first of any of the municipalities I interviewed, though methods have varied over the years, with originally only some kitchens participating, though now all school kitchens are included. Malmö works specifically in school restaurants, and since 2018 have had more consistent routine reporting. Some school restaurants have measured food waste specifically regularly since 2013, and since 2017, all measure food waste in percentages, broken into preparation, serving, and plate waste. These three areas are combined into two major fractions: the waste the kitchens themselves are responsible for, kitchen waste, and waste that they have less control over: guest waste. They have four different measurement weeks per school year, and in between these data collection weeks, they attempt to find methods to further reduce waste. These four weeks may not be perfectly representative of the food waste situation, but they provide valuable insight, especially in understanding which specific kitchens or areas need to be focused on. They have managed to reduce the percentage of food waste in both fractions by about 1% per year, though progress is relatively slow. The latest measurement, from February of 2019 has a combined prep and serving waste percentage of 12% and plate waste of 12%. However, there are large differences between different kitchens. They may attempt to address the problem a bit differently in the future, though nothing specific has been determined. Malmö has undertaken 31 of my strategies, with another four planned in the future. In 2019, all areas will measure food waste, minimum once a week, and raising awareness and educating kitchen staff.

Malmö’s Food Waste Reduction Strategies

Overall, Malmö currently has the “Climate Smart Food Program” (*KlimatSmartMat*). *KlimatSmartMat* has two main goals: to decrease the climate impact of food that is bought, such as serving less animal

products and reducing food waste. *KlimatSmartMat* is slightly different at every preschool (*förskola*), but the basic idea is an awareness campaign to make food wastage obvious and understand the negative impacts of it, starting the conversation, especially when kids are young. They can discuss what did or didn't work and how and attempt to foster an emotional connection to the problem, in order to increase caring and hopefully thus responsiveness.

Malmö too is working with and taking inspiration from *Livsmedelsverket's* model, specifically with the new rules which allow more flexibility with leftovers and expiration dates, which can also allow for purchases at reduced prices. Some areas have worked specifically with liquid waste – reducing the amount of coffee waste, an often-overlooked loss.

Malmö has been working with the other municipalities which are a part of Sysav in order to work on brainstorming ideas on food waste prevention. They now also have had a food waste festival, in association with the annual Malmöfestivalen citywide festival, in order to further raise awareness. A main focus for them in the future will be on the idea of a circular economy: "*Cirkulära Malmö*", as well as sustainable nudging.

3.2.3 Svedala

Svedala's Food Waste Specifics

Svedala is part of several networks of municipalities which work together to reduce food waste. They have also focused on school kitchens and began to weigh and record daily food waste during the 2015-16 school year. They began with primary schools (*grundskolor*) and high schools (*gymnasier*) and have since expanded to preschools, now expanding to *all* municipal kitchens, measuring preparation, serving, and plate waste in order to determine economic losses and environmental impacts of their food waste. They have found that the preschools, which receive their food from an offsite kitchen, produce more waste, both serving and plate waste. They too have found plate waste to be most prevalent, though not significantly more, and also the most complicated to measure. In the senior housing, they do not measure plate waste. Overall, Svedala already address 32 strategies on my framework.

Svedala's Food Waste Reduction Strategies

Svedala has found that keeping statistics on food waste can be complicated due to many kitchens using their own individual methods. In the school year 2017-18, they took part in "The Top Step" (*Översta steget*), a sustainability project with several other municipalities to collaborate, share, and work

together. It was a coaching system with project goals, seminars, and staff workshops on how to reduce waste, not just food waste. They also use “Mashie” to understand standard portions, avoid preparing too much food, and adjust based on experience, where each kitchen and their subsequent stats are registered. They can also calculate how much money is lost and the environmental impact due to food waste totals. They have additionally focused on educating kitchen staff and cooks in order to best reduce kitchen food waste. As with Lund and Malmö, Svedala also uses *Livsmedelsverket’s* new model.

3.2.4 Östra Göinge

Östra Göinge’s Food Waste Specifics

Östra Göinge works with their school system and have measured food waste since 2010, the first municipality that I interviewed to do so. They measure both plate and serving waste but focus on and keep the most consistent statistics on serving waste. Starting in 2018, they now weigh waste and report it in kilograms, where the goal of reduction is a percentage. They track the statistics by kitchen, so a certain kitchen’s progress can be tracked over time. Their goals for 2019 was for the preparation kitchens (*tillagningskök*) average waste to be 5% and receiving kitchens (*mottagningskök*) to have 25%. The results were 6.5% and 23.6% respectively. Östra Göinge has undertaken 31 of the framework strategies. In 2019, their major focus will be measuring what their serving waste is equivalent to in CO₂ emissions.

Östra Göinge Food Waste Reduction Strategies

Östra Göinge has a program to keep track of the popularity and waste from specific recipes and have certain days where the students can specially request certain meals or recipes. As with Lund, they have found that the older students waste more food. They also have been using and following Gothenburg’s successful and renowned city-model guide for reducing food waste (Appelqvist et al., 2016). Some interesting ideas which they have had for reducing food waste have been introducing tasting spoons for students to try food dishes before they take a larger portion and also staging competitions between schools to assess which school can throw away the least amount of food.

3.2.5 Lomma

Lomma’s Food Waste Specifics

Lomma began working with reducing food waste in 2013 and has the ambitious goal of maintaining and only allowing 15% of food to go to waste. In spring of 2019, when they most recently measured, food waste in schools was already only 16%, down from 17% a year previously. They work with both

preschools and secondary schools as there are no high schools in the municipality, measuring twice a year, once a term. They weigh both serving and plate waste. Some schools continually measure plate waste. They address 30 strategies from my framework.

Lomma's Food Waste Reduction Strategies

Lomma currently takes part in "School Food Sweden" (*SkolmatSverige*), a web-based system to evaluate their food system, are working under *Livsmedelsverket's* plan, and using the planning program Mashie. They are aiming to continue focus on having specific policy and guidelines for dealing with food waste, specifically with understanding and predicting exactly how many patrons are expected, numbers which are much more easily and accurately understood in preschools with fixed enrolment.

3.2.6 Helsingborg

Helsingborg's Food Waste Specifics

Helsingborg has focused on their school kitchens and school system when addressing food waste, due to the high capacity of food preparation within the school sector. They started their food waste reduction program in the fall 2017, measuring waste every day, and have since already halved their food waste as of the end of 2018. Their next ambitious goal is to halve waste again in 2019. They have concentrated on and measured the three main areas of food waste throughout the process: preparation waste, serving waste, and plate waste. They found that students' plate waste was by far the biggest culprit and thusly focus on it most directly. Helsingborg has undertaken 29 out of the 41 strategies and plan to add four more in the future.

Helsingborg's Food Waste Reduction Strategies

Helsingborg has worked explicitly with having specific goals and policies, adjusting the buffet system in cafeterias, and working with leftovers. They have started a specific focus campaign within the school district, "Smart Food Helsingborg" (*SmartMat Hbg*). Through *SmartMat Hbg*, they can focus on plate waste through campaigns and signs posted every day in the cafeteria, reminding students about food waste, with daily goals and totals. They have also found that more problems lie with older students, in the higher-level schools vs the preschools. The high school level schools have certain days where they serve a combination of leftovers, "leftover party" days ("*restfest*"), which have proven popular. The preschools have a "food waste week" ("*matsvinnsvecka*") in an attempt to raise awareness and educate children from an early stage. They noticed that the moment that the issue of food waste was

mentioned and began to be addressed, there was an immediate pointed difference in attitude, behavior, and results.

3.2.7 Burlöv

Burlöv's Food Waste Specifics

Burlöv also has a very intensive food waste-addressing program. They began attempting to pointedly reduce food waste in 2016, and at the beginning of 2017, they began measuring waste. After only a year, in January of 2018, they had already reduced their waste from 22 metric tons by 10 metric tons. In 2019, they have started weighing guest waste every day and attempting to get consumers more involved and informed. They also have every kitchen report their results every week. They have three major areas of focus: serving waste, plate waste, and preparation waste. A smaller municipality, they have been able to address several different areas within their jurisdiction, specifically schools and senior living facilities. They have undertaken 30 out of 41 strategies and have future plans for adding three more.

Burlöv's Food Waste Reduction Strategies

Burlöv did a full self-analysis of many areas of their food system and process in order to better understand the progress and areas of improvement. Alongside measuring food waste, they have a renovation and education program. All municipal kitchens have received materials in the form of a central "action plan" to help with reducing food waste, including a list of conditions and recommendations, particularly with how to prep, store, and serve food with food waste in mind, and a full packet of educational information. Burlöv has several different campaigns in motion, one being "The Perfect Lunch" (*Perfekta lunchen*), a campaign aimed at how to serve food and another, "Think About the Waste" (*Tänk på svinnet*). One specific area of focus has been attempting to use as much of the products as possible in the kitchen, especially being creative in using parts that are traditionally thought of as unavoidable waste, such as fruit and vegetable peels.

Emphasizing the environmental importance of reducing food waste has been important for both staff and patrons. They have also noted how presenting food can be different when trying to appeal to different focus groups: children/students vs. elderly people. For example, they have found that elderly people care more how exactly food is presented, on what serving dishes, etc. On the higher level, they too are following *Livsmedelsverket's* plan and use the data measuring and reporting app Mashie. Their future food waste reduction plans include testing vacuum sealing food that is to be stored, in order to help it last longer, and a municipal individual composting system, essentially "Earth to Earth" ("*Jord till*

jord”), a step further than the “farm to table” ideology.

3.2.8 Skurup

Skurup’s Food Waste Specifics

Skurup also focuses on their school system and kitchens. Their current sustainability plan began talks in March of 2018, working to reduce their food-chain carbon footprint by 40%. They have begun a specific and ambitious campaign to reduce food waste to 9% by 2030, and it currently already lies around 15%. Skurup has undertaken 19 strategies.

Skurup’s Food Waste Reduction Strategies

Skurup works to educate and inform both the educators and kitchen staff in their municipality and provide information and education. They want to build stronger relationships and understanding between players. The methods to achieve their carbon-reduction goals have been by decreasing the amount of meat offered and focusing on reducing food waste. They also believe that education is the best way to address sustainability issues, especially with young people. They have signs in the cafeteria about food waste and about not taking too much food at once, encouraging multiple trips to the buffet etc. They also have worked in partnership with other municipalities in order to share understanding, knowledge, and strategies as well as taking part in different awareness campaigns. One tactic is also having leftover days in some schools to use up leftovers, which have been quite successful, and which they will be specifically working with in the future. Another area of focus has been to have an obligatory lunch time where every student must be present and eat at least something in the cafeteria. This tactic has multiple perceived benefits: it aims to give the students a strong opportunity to eat the food provided and not have it go to waste, and to decrease students’ interest and ability to go to nearby stores and shops later, purchasing less healthy food, in a less supervised/controlled atmosphere. Currently the designated lunch period for secondary schools is only 22 minutes, which can be stressful for both students and staff, causing rushing, worse planning, and resulting in more food waste. A final concept Skurup is also working with is sustainable nudging.

3.2.9 Trelleborg

Trelleborg’s Food Waste Specifics

Trelleborg has focused efforts on its high school, concentrating on education, collaboration, and awareness.

Trelleborg's Food Waste Reduction Strategies

Trelleborg combines different values in order to have a personal connection to sustainability for the students, working specifically in their one high school. They have signs posted in the cafeteria informing patrons about the food waste, and they work to combine student and senior efforts, to foster a broader community and understanding alongside environmentally sustainable efforts. They have a leftovers project cooking competition, "The Leftovers Chef" (*Resterkocken*) for students in order to educate them about using leftovers and food that would otherwise be thrown out and wasted. They are also working to create a circular economy action plan to reduce climate impact. Trelleborg has been a part of *Glokala Sverige*, a project working toward the Agenda 2030 goals, with an extra focus on Sustainable Consumption. The project enables a wider perspective of global thinking, while working strategically. In addition, they have taken part in "Save the Food Skåne" (*Rädda Maten Skåne*), a challenge conference raising awareness and understanding about food waste, with the 2030 goal of halving global food waste through activities and experience exchanges.

The entire municipality of Trelleborg has a sustainability plan and works specifically with sustainability within education and development of this education. In 2019, they won the Sustainable Development Skåne scholarship (*Hållbar Utveckling Skånes stipendium*). A major focus is the idea of lifelong learning and education and developing action and communication skills. The action and communication skills are developed in both the classroom and through practical work in the cafeteria. Specifically, Trelleborg works with a local restaurant to connect students with the food system. They have a sponsored pizza which is vegetarian and donates a portion of proceeds to UNICEF in order to educate impoverished children. The project helps students and patrons understand the importance of organic and local food, why they should not waste food, and what they as individuals and consumers can do. A major focus in the municipality is the fact that everyone should be involved, especially from a young person's perspective, since it is their own future at stake, which helps signify and justify why sustainability is important, and that they should therefore absolutely be involved in planning. Trelleborg also attempts to foster and build relations between community members, specifically young and old people: building meeting places, lunches, and emphasizing learning for your whole life.

Trelleborg's Limitations

Although I was able to give a full interview to Trelleborg and through this was able to get a good perspective and understanding of what they have been doing specifically in schools to reduce food waste, I was unable to be informed on the overall workings of the municipality as a whole, and for that, was unable to have them fill out my framework. Through the interview I was able to determine

a couple strategies from my framework which Trelleborg has employed, but it is unfortunately not all-encompassing. Because of this, I did not include Trelleborg in my framework interview data.

3.2.10 Klippan

Klippan's Food Waste Specifics

Klippan has focused on their own production and on food waste in both schools and senior living facilities. They specifically have attempted to better understand and predict the number of patrons and meals, with daily planning for production and ordering of meals. They also have worked with kitchen storage effectiveness.

Klippan's Limitations

I was able to give a short phone interview with Klippan, but unfortunately it was not sufficient enough to gain full information about the progress of the municipality, or fill out my framework. Again, I did not include Klippan in my framework interview data because of this limitation.

4 Discussion

4.1 Overview & Answers to Research Questions

The objective of this thesis was to understand what actions and policies can be undertaken in a practical setting, in order to reduce food waste on a municipal level. Through my research I found that there are many stages and strategies which exist in literature in order to reduce food waste, specifically in the consumer sector, and more specifically on the municipal level in Sweden. Through a literature review, I established seven specific stages and 41 concrete strategies for helping to reduce food waste under these specifications and adapted them into a resulting framework. The municipalities of Skåne which I interviewed, those which have “implemented action” in regard to food waste, have employed each of these stages, as well as every individual strategy, other than donation of food that would be otherwise thrown away, which is due to legal restrictions. Every municipality that was interviewed has noted making some form of progress in reducing their food waste since deciding to focus on food waste reduction, and they all have future goals in order to start or continue certain waste reduction strategies. Other municipalities can essentially adapt any of the steps and strategies which I have outlined, due to the fact that nearly all have been undertaken previously and are therefore at least somewhat feasible on the municipal level.

4.2 Discussion: Literature Review

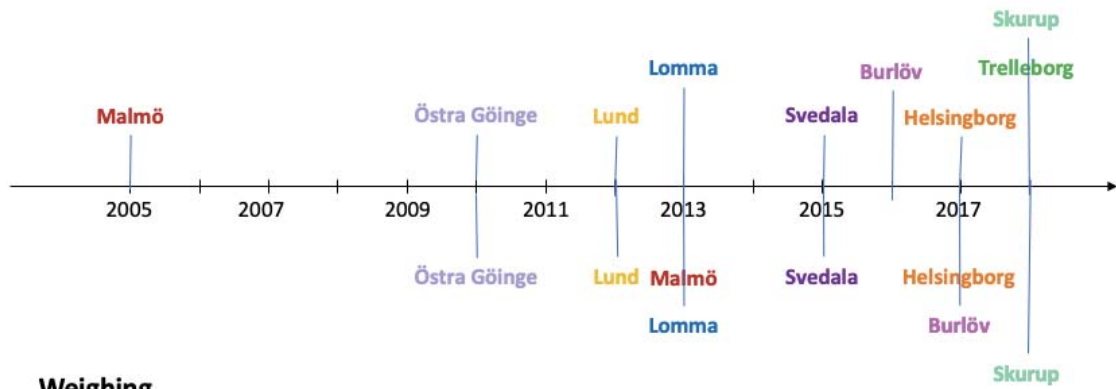
From the literature review, I outlined the seven different distinct stages in reducing municipal food waste, in order to make the process more straightforward, simple, and therefore ideally more achievable for future actors to replicate. The range of ideas in addition to the frequency in which they were stated was interesting to note, since food wastage is such a multi-faceted issue. There were specific parallels and commonalities, through a variety of strategies. The breadth was important in order to understand this range. For example, in the case of a systematic review in Saudi Arabia, the scope was large scale, intended to be utilized by a range of actors within the entire country (Baig, Al-Zahrani, Schneider, Straquadine, & Mourad, 2018). Some strategies were not relevant on a Swedish and/or a municipal scale, but there were nevertheless examples of strategies which fell under nearly every stage of my framework (Baig et al., 2018). By considering that within this range, there exists so much overlap, it displays how relevant the same strategies can be. This wide range of literature was then condensed down into concrete points and conclusions, to ensure understanding and ease.

Due to the fact that there was only one distinct strategy that fell under Consumption, it is logical that there would be considerably less papers which mentioned the strategy (only 2). It is also understandable then that the three stages that had the most types of strategies: Planning with 14, Disposal with 8, and Preparation with 6, would therefore be mentioned most (18, 8, and 6, respectively).

4.3 Discussion: Interview & Boundaries

Each municipality had their own plans, strategies, and depth of undertaking. Interviewing each different municipality gave interesting insight into the similarities and differences each had in relation to the literature review and to each other. All of the municipalities started their food waste reduction programs at different times and also began measuring and weighing their food waste at different times (Figure 8). In addition, because each municipality has completely different programs and there are no overarching food waste-reduction guidelines, goals, or strategies for the county as a whole, it proves difficult to compare data directly. Some municipalities document their data, progress, and goals in percentage of reduction, others in kilograms (Table 6). Some record their progress in comparison to previous years and some based on their goals. Some municipalities have split the food waste statistics up into the different types of food waste: preparation vs serving vs plate waste (Table 7). All of these competing factors contribute to making it very difficult to directly compare situations and progress between municipalities.

Food waste reduction



Weighing

Figure 8. The timeline of every municipality and when they began addressing food waste as a problem and when they started physically weighing their food waste. Own creation.

Table 6. The municipalities, ranked by population size, and the units in which they measure their food waste progress and goals. Own creation.

	unit of measurement
Malmö	%
Helsingborg	kg
Lund	%
Lomma	%
Svedala	kg
Burlöv	kg
Skurup	%
Östra Göinge	%

Table 7. The types of waste measured by each municipality, ranked by population size. Own creation.

	Preparation	Serving	Plate
Malmö	█	█	█
Helsingborg	█	█	█
Lund	█	█	█
Lomma	█	█	█
Svedala	█	█	█
Burlöv	█	█	█
Skurup	█	█	█
Östra Göinge	█	█	█

It is not necessary for each and every municipality and actor to have undertaken every single one of the strategies listed, especially since some would likely be more effective and more cost-efficient than others. As with the literature review, the municipalities had a smaller likelihood to have taken the stages that have fewer strategies which fall under them. In addition, the interview data frequency of occurrence often followed that of the literature review frequency, with the fewest municipalities also implementing the Consumption strategy (4) and the most also implementing Planning, Disposal, and Preparation, as with the literature (10, 10, and 9). Strategies which were mentioned less often in the

literature, such as having full awareness of the food stock inventory, which was only stated by two articles, is also only practiced by five of the municipalities, the second-least common Planning strategy. Having the kitchen onsite is practiced by seven municipalities, the least frequent Preparation strategy, and it is also one of the least common in the literature review, with only three articles mentioning it. As was mentioned by the literature, which did bring it to attention, distinguishing between solid and liquid waste is a significant barrier, as even when food waste is diligently measured, most programs do not have this distinction and therefore the large quantity of drain wastage is ignored or often not even realized. It was specifically mentioned by the literature that it is an often overlooked, yet critically important strategy (Naturvårdsverket, 2013). This distinction was only stated by four articles and accordingly, only two municipalities.

Many of the municipalities noted the range of factors which contribute to different types of food waste. Multiple municipalities noted how much less waste is generated with onsite kitchens, vs prepared food being sent, backing up the claim made by my literature review, specifically where onsite kitchens produce 42% less waste (Eriksson, Osowski, Malefors, Björkman, & Eriksson, 2017). The better the communication and education is among kitchen staff, outside employees and educators, and outlying actors, the less food waste is found to occur. Another interesting point is the fact that patrons, especially students, typically serve food to themselves, which can potentially positively or negatively affect food waste volumes. On one hand, some people may serve themselves a more accurate/smaller portion than what another person could give them. However, some people, may overserve themselves when they have the option, not necessarily understanding their own appetites.

An interesting point made by many municipalities was about one of the literature recommendations, about stocking less perishable food in order to prolong the shelf life and reduce food waste due to spoiled food. Multiple municipalities noted that they had made concentrated efforts to do the opposite – to stock food that was about to expire and use it immediately, to sit on the shelf as little as possible and to save food that would otherwise have been soon thrown away by suppliers. I thought that this was a very good and valid point. Some combination of the two would be ideal for a balance.

Further, a specific observation was the not necessarily logical point that often the *more* popular dishes and recipes produce more plate waste, since people take more than they can eat, due to the fact that they like it. In addition, when deciding where to focus efforts on, there were different methods and strategies, some with opposite results. For example, in general, any food that has been served and not consumed must be thrown away, it cannot be reused, by law. Therefore, many municipalities focus on reducing this serving waste, since it is avoidable and more so in the hands of staff. Furthermore, some municipalities made pointed arguments that reducing plate waste would be much more difficult and

complicated because it cannot be regulated as easily by kitchen staff/guidelines, especially when working with young students. However, in municipalities which focused on education about food waste, particularly for students, the plate waste was actually a more favorable option to focus on. Helsingborg for instance found that plate waste was the largest culprit and contributor to their schoolwide food waste, so they have focused their campaigns and efforts on this, in an effort to stimulate behavioral change.

In general, it is much more effective and valuable to stop or minimize the waste from happening at all. In fact, it is roughly 10 times more efficient to prevent the occurrence of food waste in the first place, than to even use it for biological treatment (i.e. compost, biofertilizer, or biogas, not merely landfilling it) (Hansen, 2011). Interestingly enough, FUSIONS does not consider leftover food that is given to animals and livestock as food waste, under the current definition, since it has been consumed, though not by humans (Stenmarck, 2016). However, concentrating energy on disposal methods in particular is less desirable because at that point, the food has already become 'waste'. It is important to not merely dispose of food, mixed with other waste, into a landfill to off-gas, and disposal methods where the waste is being used 'productively' such as for biogas or compost are clearly more beneficial, especially in the cases where the 'waste' is substituting for virgin materials such as crops for biogas and chemical fertilizers. In addition, some food disposal strategies are less available or out of the municipalities' control. For example, due to legal requirements, no municipalities were legally allowed to donate food to sectors outside of their system, such as donating to the homeless. On the other hand, due to Sweden's laws, all food waste is required to be separated, so all 10 municipalities did so. It should be pointedly noted, therefore, that not all of the stages are 'equal' in terms of their effectiveness, ease, or impact. Again, in addition, every stage has a different number of associated strategies within it, anywhere from only one, Consumption, to as many as 14, Planning. Therefore, having representation in each "stage" is not entirely indicative of the breadth or thoroughness of a municipality's food waste reduction program. It is also the case that depending on the size and resources that the municipality has, some may have all efforts concentrated in one area, some may have lesser efforts spread out over a larger area or multiple sectors, and some could have a much broader and in-depth scope across all areas.

Specifically, several municipalities also mentioned the notion of sustainable "nudging": guiding people and behavior towards more environmentally friendly choices, and how they hope this could help reduce their municipal food waste (Mont, Lehner, & Heiskanen, 2014). This concept could have positive impacts in reducing food waste; however, since none of the municipalities have actually undertaken the effort, and I did not find it specifically mentioned in my literature review, it is hard to

say much more about it.

4.4 Further Research

This study has narrowed down strategies to what can potentially be specifically undertaken by other Skånsk municipalities. Therefore, interviewing the rest of the Skånsk municipalities would be helpful for understanding the overall regional progress. More research also needs to be done in order to actually determine *how* effective certain strategies are. By breaking food waste down into particular categories, such as preparation, serving, and plate waste, it can be more easily assessed where the problem is largest and therefore where efforts can be targeted. It would also be helpful and interesting to do further studies to understand exactly which food is wasted most in each municipality and stage.

5 Conclusion

Food waste is a significant, growing, and complicated global issue. Focusing on the municipal level of food waste for a Global North country such as Sweden, can be a successful way to reduce consumer food waste, due to Sweden's method of governance where the municipal government has primary control over the food and meals. Through a literature review, I identified a seven-stage framework of the food system in order to organize the range of strategies for reducing food waste. I then interviewed the municipalities in Skåne, Sweden that already had indicated that they had undertaken measures to address food waste. All of the Skånsk municipalities which I interviewed have implemented waste reduction strategies to some extent in their school systems, performing a minimum of 19 out of 41 strategic criteria from my framework (46.3%), an average of 29.8 (72.5%) and a median was 30.5 (74.4%) and they utilize strategies from a minimum of five out of the seven in my framework, an average of over six.

This a positive confirmation of my literature review and framework being practically implemented, bridging the gap from academia and literature to tangible results. In order to continue reducing food waste in Skåne, the next steps should be to adapt specific strategies for food waste reduction, continue working to share ideas and strategies between the different municipalities, and expand to further sectors within the municipality, such as elderly care and overall policy plans. Through a combination of stages, along the food production line, food waste can be successfully combated on this municipal level.

6 References

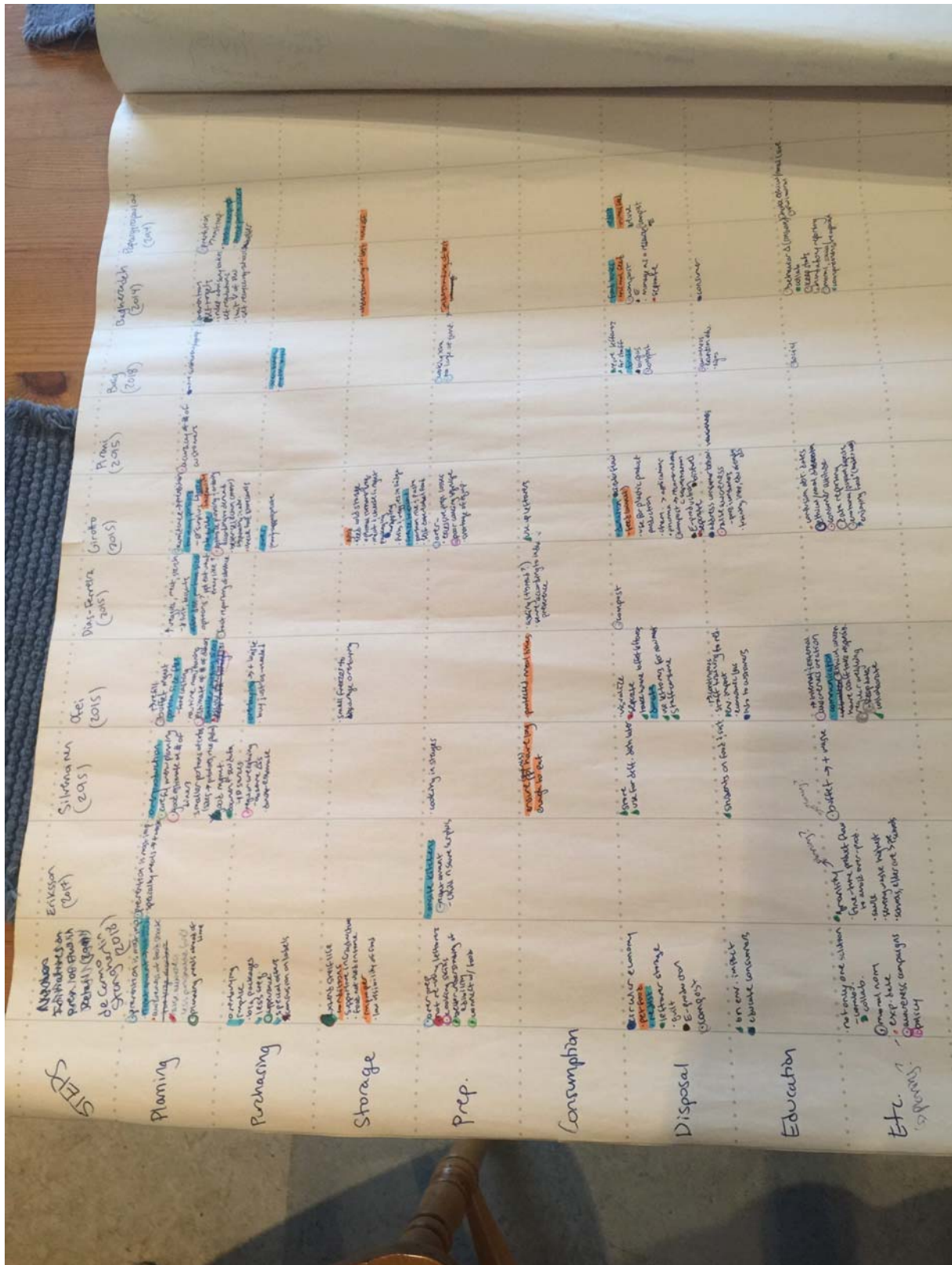
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Appendix 1. The original layout of my framework on paper

Papers	Variables
Marthinsen, Sundt, Kaysen, & Kirkevaag (2012)	1
do Carmo Stangherlin & de Barcellos (2018)	2
Pirani & Arafat (2016)	3
Girotto, Alibardi, & Cossu (2015)	4
Livsmedelsverket (2016)	5
Östergren & Holtz (2017)	6
Bagherzadeh, Inamura, & Jeong (2014)	7
Ofei et al (2015)	8
Silvennoinen, Heikkilä, Katajajuuri, & Reinikainen (2015)	9
Papargyropoulou, Lozano, Steinberger, Wright, & Ujang (2014)	10
Baig, Al-Zahrani, Schneider, Straquadine, & Mourad (2018)	11
Eriksson, Osowski, Malefors, Björkman, & Eriksson (2017)	12
Naturvårdsverket (2013)	13
Stenmarck, Jensen, Quested, & Moates (2016)	14
Dias-Ferreira, Santos, & Oliveira (2015)	15
Jain, Newman, Cepeda-Márquez, & Zeller (2018)	16
Franke (2013)	17
FAO (2013)	18
Hauser (2017)	19
Livsmedelsverket, Jordbruksverket, & Naturvårdsverket (2018)	20

Appendix 2.1 Abbreviations for the literature review articles.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	totals
Planning: portion control incl. fast adaptation	x	x	x	x	x	x	x	x	x	x	x	x	x	x							10
Planning: recording of data incl. regular weighing	x	x	x	x	x	x	x	x	x	x	x	x	x								10
Planning: targets	x	x	x	x	x	x	x	x	x												4
Planning: tracing supply chain				x	x																4
Planning: education	x	x	x	x	x	x	x	x	x	x	x										10
Planning: good, more careful	x	x	x	x	x					x	x										6
Planning: adjustments to buffet (i.e. having fewer/smaller plates, smaller serving spoons)	x	x	x	x	x	x	x	x	x	x											5
Planning: menu planning	x	x	x	x																	5
Planning: prevention	x	x	x	x	x	x	x	x	x												6
Planning: awareness of food stock	x	x	x	x																	3
Planning: having specific policy/guidelines	x	x	x																		3
Planning: ensure proper funding for future studies													x								1
Planning: less perishable foods																					2
Planning: do not estimate																					2
Planning	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	18
Purchasing: not cancelling orders last minute	x	x	x	x																	2
Purchasing: not overbuying incl. impulse, routine purchasing/less frequent	x	x	x	x																	7
Purchasing	x	x	x	x	x	x	x	x	x	x											9
Storage: ensure proper conditions/understanding/right temps/humidity/freezing	x	x	x	x	x	x	x	x	x												6
Storage: wrapping																					3
Storage: use technology to extend shelf-life																					2
Storage: high visibility																					1
Storage	x	x	x	x	x	x	x	x	x	x											9
Preparation: understanding & usage of optimal handling methods/food	x	x	x	x	x	x	x														6
Preparation: having kitchen onsite	x	x	x	x																	4
Preparation: utilization of leftovers	x	x	x	x	x																5
Preparation: not over-prepping	x	x	x	x																	4
Preparation: better cooking skills	x	x	x																		2
Preparation: cooking in stages																					1
Preparation	x	x	x	x	x	x	x	x	x	x	x	x	x								11
Consumption: enough time to eat	x	x																			3
Consumption	x	x																			4
Disposal: animal/pet feed	x	x	x	x	x	x	x	x	x	x	x	x	x	x							10
Disposal: donation	x	x	x	x	x	x	x	x	x	x	x	x	x	x							10
Disposal: leftover use in future/for staff/allow customers to take	x	x	x	x	x	x	x	x	x	x	x	x	x								9
Disposal: compost	x	x	x	x	x	x	x	x	x	x	x	x	x	x							11
Disposal: biogas	x	x	x	x	x	x	x	x	x	x	x	x	x	x							11
Disposal: separate	x	x	x	x	x	x	x	x	x	x	x	x	x								6
Disposal: circular economy	x	x	x	x																	4
Disposal: distinguish between solid & liquid waste	x	x	x																		4
Disposal	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	18
Education: understanding of expiration dates	x	x	x	x	x	x															4
Education: specifically on environmental impact	x	x	x	x	x	x															3
Education: consumer education/awareness campaigns/"enjoy food"	x	x	x	x	x	x	x	x	x	x	x	x	x								8
Education	x	x	x	x	x	x	x	x	x	x	x	x	x								10
Other: communication/collaboration/knowledge sharing	x	x	x	x	x	x	x	x	x	x	x	x	x								8
Other: make food waste not socially/morally/ethically acceptable	x	x	x	x	x	x	x	x	x	x	x	x	x								7
Other: routine monitoring																					1
totals:	25	24	23	22	17	16	15	13	12	11	10	7	6	6	3	3	2	2	1	1	

Appendix 2.2 The literature review framework.

Intervju för mastersuppsats av Halley Rainer för Lunds Universitets International Master in Environmental Studies and Sustainability Science (LUMES)

Forskarens inledning: Forskningens arbetstitel är: "How can municipal kitchens effectively reduce their food waste?: A case study in Skåne, Sweden" ("Hur kan kommunala kök effektivt minska sitt matsvinn?: En fallstudie i Skåne, Sverige"). Mitt mål är att förstå de nuvarande förfarandena som genomförs av de olika kommunerna i Skåne för att minska matsvinnet på en kommunal nivå för att hjälpa Skåne län att nå sina miljömål för år 2020. Målet med uppsatsen är att analysera och förstå de framsteg som de skånska kommunerna har gjort, undersöka sina nuvarande situationer och presentera ytterligare alternativ och möjligheter till ytterligare framsteg.

Samtycke att delta i forskning som beskrivs ovan:

- Jag samtycker om att delta i denna forskningsstudie.
- Jag förstår att även om jag håller med om att delta kan jag dra tillbaka min medverkan när som helst eller vägra att svara på någon fråga utan några konsekvenser av något slag.
- Jag förstår att jag kan dra tillbaka tillstånd att använda data från min intervju inom två veckor efter intervjun, i vilket fall materialet kommer att raderas.
- Jag har tagit del av förklaringen och syftet med studien, och jag har haft möjlighet att ställa frågor om studien.
- Jag förstår att jag inte kan dra nytta direkt av att delta i denna forskning.
- Jag samtycker till att min intervju är ljudinspelad för det enda syftet att transkriberas.
- Jag förstår att utdrag från min intervju kan citeras i avhandlingen eller relaterad forskningsartikel.
- Jag förstår att jag har rätten att få tillgång till den information jag har lämnat när som helst medan den är i lagring.
- Jag förstår att jag är fri att kontakta någon av de personer som är involverade i forskningen för att söka ytterligare förtydliganden och information.

Deltagares underskrift

Datum

Jag tror att deltagaren ger informerat samtycke att delta i denna studie.

Undersökarens underskrift

Datum

Kontakt: Halley Rainer, Tel. +46 79-335 68 25, E-post: halleyrainer@yahoo.com

Appendix 3. My interview consent form, in Swedish.

Intervjufrågor

1. Vad har varit din/eran övergripande filosofi / strategi för att minska matsvinn som en kommun?
 - a. Hur?
2. Vad har dig/ni gjort för att minska matsvinn inom centrala kök/skolor/äldreomsorg?
3. Vad fick dig/er att klassificera din/eran kommuns insatser för minskning av avfall som "G" ("åtgärden är genomförd, i huvudsak genomförd eller pågår") för att minska matsvinn?
4. Varför har du/ni valt de specifika strategierna för att minska matsvinnet (i kommunen och i de 3 sektorerna)?
5. Här är en lista från min forskning om några vanliga strategier. Kan du/ni vänligen markera några av dessa som du/ni använder dig/er av?
6. Har du/ni särskilda framtida planer för att ytterligare minska matsvinnet?
 - a. Vilka är dem?
 - b. Kan du/ni kategorisera dem i tabellen?

Appendix 4. My interview questions, in Swedish.

Matsvinn:	nu	förläring	framtiden	förläring
Planering: delkontroll inkl. snabb anpassning				
Planering: inspelning av data inkl. regelbunden vägning av matsvinn				
Planering: har särskilda mål				
Planering: spårning av försörjningskedjan				
Planering: utbildning				
Planering: bra/aktsamt				
Planering: justering av buffé (dvs med färre/mindre tallrikar, mindre serveringsskedar)				
Planering: menplanering				
Planering: förebyggande				
Planering: medvetenhet om livsmedel (foodstock)				
Planering: med specifikt policy / riktlinjer				
Planering: säkerställa korrekt finansiering för framtida studier				
Planering: mindre lättförärliga livsmedel				
Planering: uppskattar inte				
Planering: andra?				
Inköp: avbryter inte beställningar sista minuten				
Inköp: inte överbeställa inkl. impuls, rutininköp / mindre frekvensen				
Inköp: andra?				
Förvaring: rätt förutsättningar / förståelse / temperatur / tuktighet / frysning				
Förvaring: förpackar för förvaring				
Förvaring: använd teknik för att förlänga hållbarheten (shelf-life)				
Förvaring: hög synlighet				
Förvaring: andra?				
Förberedelse: förståelse & användning av optimala hanteringsmetoder / mat				
Förberedelse: ha kök på plats (onsite)				
Förberedelse: utnyttjande av rester (leftovers)				
Förberedelse: förbereder inte för mycket (over-prepping)				
Förberedelse: bättre matlagning (skills)				
Förberedelse: laga mat i steg				
Förberedelse: andra?				
Konsumtion: tillräckligt med tid att äta				
Konsumtion: andra?				
Avfallshantering: djur / husdjur mat				
Avfallshantering: donation				
Avfallshantering: användning av rester i framtiden / för personal / tillåta kunder att ta med				
Avfallshantering: kompost				
Avfallshantering: biogas				
Avfallshantering: separera avfallet				
Avfallshantering: cirkulär ekonomi				
Avfallshantering: skilj mellan fast & flytande avfall				
Avfallshantering: andra?				
Utbildning: förståelse av utgångsdatum				
Utbildning: specifikt om miljöpåverkan				
Utbildning: konsumentutbildning / medvetenhetkampanjer / "njut av mat"				
Utbildning: andra?				
Osv.: kommunikation / samarbete / kunskapsdelning				
Osv.: gör matavfall inte socialt / moraliskt / etiskt acceptabelt				
Osv.: rutinemässigt övervaka				

Appendix 5. The version of my framework which I had the municipalities fill out.

Matsvinn:	He		Bu		Ma		Sv		Lo		Lu		Sk		Ös		totals			
	now	fu	now	fu	now	fu	now	fu	now	fu	now	fu	now	fu	now	fu	now	fu		
Planning: portion control incl. fast adaptation	x		x		x		x		x		x		x		x		x		7	7
Planning: recording of data incl. regular weighing	x		x		x		x		x		x		x		x		x		7	7
Planning: targets	x		x		x		x		x		x		x		x		x		6	7
Planning: tracing supply chain			x				x					x					x		4	5
Planning: education	x		x		x		x		x		x		x		x		x		7	7
Planning: good, more careful			x				x					x					x		6	6
Planning: adjustments to buffet (i.e. having fewer/smaller plates, smaller serving spoons)	x		x		x		x		x		x		x		x		x		6	6
Planning: menu planning	x		x		x		x		x		x		x		x		x		8	8
Planning: prevention			x				x					x					x		6	6
Planning: awareness of food stock			x				x					x					x		5	5
Planning: having specific policy/guidelines			x				x					x					x		8	8
Planning: ensure proper funding for future studies	x		x		x		x		x		x		x		x		x		2	2
Planning: less perishable foods	x		x		x		x		x		x		x		x		x		5	5
Planning: do not estimate			x				x					x					x		6	7
Purchasing: not cancelling orders last minute			x				x					x					x		5	6
Purchasing: not overbuying incl. impulse, routine purchasing/less frequent			x				x					x					x		6	7
Storage: ensure proper conditions/understanding/right temps/humidity/freezing	x		x		x		x		x		x		x		x		x		6	6
Storage: wrapping	x		x		x		x		x		x		x		x		x		6	6
Storage: use technology to extend shelf-life	x		x		x		x		x		x		x		x		x		5	6
Storage: high visibility	x		x		x		x		x		x		x		x		x		6	6
Preparation: understanding & usage of optimal handling methods/food	x		x		x		x		x		x		x		x		x		8	8
Preparation: having kitchen onsite	x		x		x		x		x		x		x		x		x		8	8
Preparation: utilization of leftovers	x		x		x		x		x		x		x		x		x		8	8
Preparation: not over-prepping	x		x		x		x		x		x		x		x		x		8	8
Preparation: better cooking skills	x		x		x		x		x		x		x		x		x		8	8
Preparation: cooking in stages	x		x		x		x		x		x		x		x		x		6	6
Consumption: enough time to eat			x				x					x					x		4	5
Disposal: animal/pet feed																			1	1
Disposal: donation																			0	0
Disposal: leftover use in future/for staff/allow customers to take	x				x				x								x		3	4
Disposal: compost	x		x		x		x		x		x		x		x		x		6	6
Disposal: biogas	x		x		x		x		x		x		x		x		x		7	7
Disposal: separate	x		x		x		x		x		x		x		x		x		8	8
Disposal: circular economy	x		x		x		x		x		x		x		x		x		3	4
Disposal: distinguish between solid & liquid waste					x														2	2
Education: understanding of expiration dates	x		x		x		x		x		x		x		x		x		8	8
Education: specifically on environmental impact	x				x				x				x				x		6	7
Education: consumer education/awareness campaigns/"enjoy food"	x		x		x		x		x		x		x		x		x		7	7
Other: communication/collaboration/knowledge sharing	x		x		x		x		x		x		x		x		x		7	7
Other: make food waste not socially/morally/ethically acceptable	x		x		x		x		x		x		x		x		x		4	4
Other: routine monitoring	x		x		x		x		x		x		x		x		x		6	6
	29/41	33/41	30/41	33/41	31/41	35/41	32/41	32/41	30/41	30/41	30/41	36/41	36/41	19/41	20/41	31/41	31/41			
	70.7%	80.5%	73.2%	80.5%	75.6%	88.6%	78.1%	78.1%	78.1%	73.2%	73.2%	87.8%	87.8%	46.3%	48.8%	75.6%	75.6%			

Appendix 6. The interview results compiled into the framework.