TALLINN UNIVERISTY OF TECHNOLOGY
School of Business and Governance
Ragnar Nurkse Department of Innovation and Governance

Aliine Lotman

BETTER POLICIES, LESS WASTE:

Policy Optimisation for Reduced Food Loss and Waste

Master's thesis
Technology Governance and Digital Transformation

Supervisor: Professor Wolfgang Drechsler

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Aliine Lotman ……

(signature, date)

Student code: 162895HAGM

Student e-mail address: aliinelotman@gmail.com

Supervisor: Professor Wolfgang Drechsler

The paper conforms to the requirements in force

……

(signature, date)

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ABSTRACT

Preventing the generation of food loss and waste (FLW) is widely considered one of the key factors of achieving a sustainable food value chain, reducing greenhouse gas emissions and unnecessary strains on natural resources. The thesis at hand looks at FLW in Estonia and proposes that its prevention and reduction policies and food hygiene policies and marketing standards need not be in collision, or less so than the current situation suggests. In doing so, it relies on using a Pareto Optimality in Policy Analysis framework. While analysing FLW reduction and food hygiene policies and marketing standards in the EU (and, correspondingly, in Estonia), it suggests a course of action for improving policies of both objectives and their implementation in a Pareto-Optimal way. Best Practice policies are introduced and policy recommendations given.

Keywords: Estonia, Food Loss, Food Waste, Waste Prevention, Sustainability, Food Safety, Policy, Pareto Optimality

INTRODUCTION

In the European Union, food worth 143,000,000,000 euros goes to waste annually – that is 88 million tons (FUSIONS 2016). To say that this is a problem would be an understatement. Reducing the loss of food could mean a drastic reduction of wasted resources (arable land, fertilisers, clean water, and fossil fuels used for farming and logistics all along the food value chain), of unnecessary greenhouse gas emissions from bio-waste degradation in landfills, and of other sustainability issues linked to food production (such as the effects of nitrate- and phosphate-rich fertilisers, pesticides, herbicides, and so-called cash cropping on biodiversity). It is not only a problem in the EU – according to the United Nations Food and Agriculture Organization (FAO 2011), an estimated one-third of all food produced globally ends up as waste.

A 2014 communication from the EC titled *Towards a Circular economy: A zero waste programme for Europe* calls upon the Member States to "develop national food-waste prevention strategies and endeavour to ensure that food waste in the manufacturing, retail/distribution, food service/hospitality sectors and households is reduced by at least 30% by 2025" (European Commission 2014, 12). Whilst some Member States have shown a proactive attitude and delivered, the majority of EU countries lack a comprehensive food waste strategy. Among the latter is also Estonia. In the framework of global Sustainable Development Goals (SDGs) defined by the United Nations in 2015, food losses are addressed under target 12.3, phrasing the goal to be reached by 2030 as: "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 2015). In interviews and discussions conducted with Estonian policymakers as part of the groundwork for this thesis, an awareness of these goals and also a will to achieve the proposed targets emerged. Yet, a comprehensive strategy is missing, and the lack of an over-arching view of the matter inhibits progress.

Until today, the situation with food loss and waste in Estonia has been thoroughly mapped only by the Stockholm Environment Institute (SEI) in Tallinn (Moora *et al.* 2015a, 2015b), a study commissioned by the Ministry of Environment. As the two studies form an important baseline for this thesis, a short introduction is needed. SEI Tallinn forms a part of SEI International, a research and policy consultation non-profit, that aims to "connect science and decision-making to develop solutions for a sustainable future for all" (SEI 2018). Four researchers were involved in the FLW studies by SEI: Harri Moora, Evelin Urbel-Piirsalu, Kerlin Õunapuu, and Triin Viilvere. During the writing of the work at hand, the author found some inconsistencies in the texts and consulted the authors *via* phone calls and e-mails, where possible. A meeting with one of the authors also laid the foundation for the research in this thesis. Although the author remains skeptical of some aspects (e.g. the difference in defining FLW in the studies), the studies by SEI are key texts in terms of exploring the theme of FLW in Estonia and thus provide groundwork for further research. A more thorough overview of the two studies will be given in chapter 1.

The Ministry of Environment has also mapped bio-waste (which includes FLW but does not specify the amounts) quantities in its general waste handling analyses (Ministry of Environment 2014), based on data from the Environmental Agency's Waste Reporting Info System's Waste Registry. The data from the reporting system has also been used by Moora *et al.* in the two studies mentioned. Food loss and waste research and analyses from other countries, including Member States of the EU, are plenty. A more thorough overview of studies from Estonia and abroad will be given in chapter 1.

One of the main conflict points for reducing FLW is food-hygiene policies and marketing standards of the EU. According to Moora *et al*. (2015b), 61% of foodstuffs discarded by shops and supermarkets in Estonia were fruits, vegetables, and meat products – the reasons of discarding largely entailing food-hygiene policies and marketing standards. The cause of this may be either too strict regulations from the EU or the interpretation by Member State officials. As anecdotal evidence of the problem, the Head of Food Department of the Food and Veterinary Board tried to end a discussion on food donations at an FLW-themed open hearing in the parliament, declaring that there is no room for discussions when it comes to food safety regulations. After a thorough overview on how the "use-by" date on foodstuffs had been significantly increased by freezing them by the local food bank in the Netherlands, all stakeholders present at the hearing seemed to agree that actually, there was plenty of room for discussions related to food-safety regulations (Riigikogu 2018). The thesis at hand aims to

analyse food-hygiene policies and marketing standards in relation to the newly-adopted EU Waste Package in order to prove or refute the hypothesis that FLW reduction and food-safety policies need not be in collision – or at least less so than presently.

For the reader to better understand this thesis, a few notes of reflection may be appropriate. During the writing of this thesis, the European Parliament surprisingly decided to accept FLW-related amendments to the EU Waste Package on 18 April 2018. These amendments will strongly support the aspirations towards SDG 12.3 and stipulate a process of FLW reduction and reporting by the Member States. After the fact that the amendments greatly impact FLW in the EU, a realisation how the renewed legislation would affect this thesis was quick to arrive. The author of this thesis was then left with the necessity to rely partially on legislation that had not yet been officially confirmed by the Council, was not yet in force and thus lacking the wider policy context – how will the Member States implement, what will be the discourse leading up to possibly binding FLW regulations, etc. Hopefully, the contingency of all this is compensated by the timeliness of this contribution – it will be one of the first academic analyses of the renewed Waste Package – to a topic that in the coming years is bound to shape the work of many EU policymakers, food business operators, charities, and the lives of EU citizens and beyond.

The work is structured into three chapters. The first chapter of the thesis will give context to the analysis, reviewing current academic studies on FLW and policies related to it. The chapter begins with an overview of the several significant studies on FLW, after which a review of studies on FLW's effects on the society and environment is given. An overview of studies of FLW in the Estonian context and of FLW-related policies will follow. The final paragraphs focus on the methodology and framework of this thesis. The second chapter analyses the two opposing policy structures at the heart of this thesis. Firstly, the renewed Waste Package is discussed and secondly, food hygiene policies and marketing standards. A discussion on possible conflict points sums up the chapter. In the third chapter of the thesis, possible courses of action are mapped and analysed based on their feasibility. The main framework used is Pareto Optimality. Although an ideal Pareto Optimal status is nearly impossible to achieve, a possible course of action towards it will be discussed. The thesis ends with policy recommendations by the author to mitigate collision points between the analysed policies in order to reduce FLW.

CHAPTER 1: LITERATURE REVIEW AND FRAMEWORK

It is difficult to grasp the nature of overproduction in our societies. After all, one of the defining characteristics of waste is the need to separate it from non-waste, to remove it, to get it out of sight. The will to not witness waste, to reject matter, has been described even in biological studies of ants, not to speak of mammals with a high tendency to categorise, such as humans (Keskpaik 2004). The need not to see waste, not to interact with it, leads the society to be in denial about its influence on the world as such. Any statistic about waste production today will show that our economies are overproducing and over-consuming. Yet, as we have so skilfully removed rejected matter from our lived spaces, the statistics seem to be empty numbers. After all, how can one image 88 million tons of food thrown away? Only after a person oversteps the societal taboo of the abject to look inside a garbage bin are they able to grasp that every single day, garbage bin after garbage bin after garbage bin is filled with bread, yoghurt, cookies, fruits, ice cream, salami, eggs – **food**.

The author has tackled this general issue since 2009, culminating in her BA thesis, "Encountering Disgust: Dirt, Food and Garbage Bins in a Barcelonan Squatter Community" (Lotman 2013). During the half decade that has passed, academic, public and political interest in food waste has grown immensely. Now, for the first time, studies have been dedicated to food loss and waste in Estonia (Moora *et al.* 2015a, 2015b). On the global scale, the United Nations has dedicated one of the targets of the Sustainable Development Goals to halving food waste. In academia, too, the abundance of studies has laid a framework for a whole new field of food waste studies. The following paragraphs will look into the current situation of food waste studies to contextualise the current thesis.

1.1. On Global Food Loss and Waste

The majority of studies on FLW start off by quoting the study "Global food losses and food waste" by the United Nations Food and Agriculture Organization, based on research conducted by The Swedish Institute for Food and Biotechnology during 2010–2011. It is this study that the phrase "one-third of the world's food is wasted" derives from:

> Roughly one-third of the edible parts of food produced for human consumption, gets lost or wasted globally, which is about 1.3 billion ton per year. Food is wasted throughout the FSC [food supply chain], from initial agricultural production down to final household consumption. In medium- and high-income countries food is to a great extent wasted, meaning that it is thrown away even if it is still suitable for human consumption (FAO 2011, abbreviation clarification by the author).

But as the authors emphasise, the study suffers from large data gaps and thus has its limits. Although trailblazing in terms of a global overall view, the study was not the first to expose what TED talker Tristam Stuart calls "the global food waste scandal" (Stuart 2009) – previous studies on national food economies had already paved the way. In the following paragraphs, some more significant studies from the EU and the US will be discussed to give a better idea of the scope of the issue and the context of this thesis.

In the US, one of the first major studies on food waste was conducted by Kantor *et al.* in 1997. The authors estimate that at the time, edible food lost in the US amounted to 27% of all food available – two-thirds of which were "[f]resh fruits and vegetables, fluid milk, grain products, and sweeteners" (Kantor *et al.* 1997, 3). While it is highly possible that during a decade the amounts of wasted food have increased significantly (see upcoming paragraphs for new data on FLW in the US), the authors also note that the work is intended to be a starting point for upcoming analyses, as some data used in their source materials might have been imprecise or out-dated. This is a problem many authors struggle with to this day.

According to WRAP (Waste and Resources Action Programme) from the UK, their study *The Food We Waste* (Ventour 2008) was the first of its kind – analysing specifically food wasted in UK households. "When WRAP started working on food waste in 2004 there was very limited

information about the amounts and types of food waste produced," the researchers write. "To address the knowledge gap, WRAP launched a major research programme in 2005, believed to be the first of its kind in the world, to quantify the nature, scale, origin and causes of post-consumer food waste" (Ventour 2008, 12). The research conducted included a variety of methods, from ethnographic studies and food waste diaries to compositional analysis techniques of household waste. The authors of the WRAP study implemented an "avoidability rating", assessing whether food wastage was "unavoidable", "avoidable" or "possibly avoidable" and concluding:

> Most of the food we throw away (4.1 million tonnes or 61%) is avoidable and could have been eaten if it had been managed better. Truly unavoidable food waste, like vegetable peelings, meat carcasses and teabags, accounts for 1.3 million tonnes a year or 19% of the total, with the remainder being 'possibly avoidable' food waste – items such as bread crusts that some people choose not to eat and potato skins which can be eaten when food is prepared in certain ways but not in others (Ventour 2008, 4).

This classification system or ones constructed upon it have been used in several studies afterwards. Some studies, such as "The Climate Change and Economic Impacts of Food Waste in the United States" (Venkat 2011) consider the categories of avoidable and unavoidable, but skip the classification of "possibly avoidable". Both WRAP and Venkat use the classification only for consumer-related or post-consumer waste. In the study by WRAP, this is clear as the research only focused on consumers. Venkat, on the other hand, includes retailer and distribution waste (but not production waste) in his calculations, without, however, making a difference of avoidability. The study by Venkat is an outlier as it is one of the very few that do not limit calculating the value of avoidable food loss only in currency, but also in the effects on climate change – concluding that avoidable food loss in the US produces 113 million metric tonnes of CO_2 annually, the equivalent of 2% of overall national emissions. A year earlier, Cuéllar and Webber (2010) aimed to calculate the energy used for FLW production and concluded that the energy embedded in FLW also constituted approximately 2% of the overall annual energy usage in the United States. This figure, the authors emphasise, is conservative – the data used did not include several steps of the FLW chain such as FLW disposal, energy used by consumers to shop for food, energy embedded in FLW from fisheries, on farms, and during processing. Nor did the study include the "avoidability" classification of FLW.

A year later, a study commissioned by the Natural Resources Defence Council of the United States claims that 40% of food in the US is wasted, with the amount wasted by consumers 50% larger than in the 1970s (Gunders 2012). The author of the study criticises the haphazard methodology used for FLW data collection, including the fact that data from USDA (used by Venkat, Cuéllar and Webber and many others as a basis) is non-comprehensive and out-dated: "A comprehensive report on food losses throughout the U.S. food system is needed to characterize the problem … and provide more detailed and accurate data. A similar study, completed by the European Commission in 2010, was an important first step in establishing reduction goals" (Gunders 2012, 16).

The study Gunders mentions is "Preparatory Study On Food Waste across EU 27", published in 2010, conducted to fill the data gap on EU FLW (Monier *et al*. 2010). Although it is more accurate than previous accounts, the data in this study again omits agricultural FLW, and it can be assumed (the authors fail to specify) that also data on the FLW from the fishing industry is not exhaustive. The data used in the study derives from EUROSTAT and available national data from Member States, with the authors again pointing to the relative unreliability of available statistics. The study claims that around 90 million tonnes of FLW are generated in the EU each year – 179 kilos per person. A similar estimate is given by FUSIONS (2016) – based on EUROSTAT data, inquired data from Member States and estimates where data was missing, the researchers claim that in 2012, the EU produced 88 million tonnes (±14 million tonnes) of FLW, 173 kilos per person.

The majority of the studies on FLW, if not all, note that the data used in the research might be inconsistent or unreliable in other ways. Data collected is often haphazard, including and excluding various stages of the food supply chain. Another element to add to the confusion is the definition and wording of FLW. While some researchers focus on only avoidable food waste, others include data of both avoidable and unavoidable losses (sometimes also including the "possibly avoidable" category), and some do not specify which approach is used. This situation makes it difficult to compare national studies or compile supra-national overviews of FLW. Chaboud and Daviron (2017) have provided an excellent overview and critique of the different definitions and approaches used by FAO and the European Commission (mainly in the research by FUSIONS). The renewed Waste Package is also historical in the aspect of defining FLW – never before has the EU had a common definition for regulations and research. Unfortunately, this definition is rather toothless and leaves a lot of room for interpretation.

1.2. On Why FLW is a Problem

As briefly mentioned in the last subchapter, FLW embeds large amounts of wasted energy and contributes majorly to greenhouse gas (GHG) emissions (Venkat 2011, Cuéllar and Webber 2010). This subchapter will take a closer look at studies of social, environmental and economic issues connected to FLW to provide the reader with a better understanding of the context and why policy optimisation is recommended.

1.2.1. Food Security and Societal Impact

Historically, the custom of gleaning has provided a way to reduce FLW and increase food security at the same time: "And when ye reap the harvest of your land, thou shalt not make clean riddance of the corners of thy field when thou reapest, neither shalt thou gather any gleaning of thy harvest: thou shalt leave them unto the poor, and to the stranger" (Leviticus 23:22). With the increasing level of complexity of the food supply chain, gleaning is not as straightforward as it was in the Biblical days. The world population is growing, leading to a further decrease in food security. Additionally, the growth of welfare and changing dietary patterns in so-called developing countries may lead to an increased demand for food and thus a further strain on the food supply chain. Due to these two factors, it is estimated that global food demand will be on the rise for the next 40 years, all the while being undermined by effects on climate change and overexploitation of natural food resources, such as oceans, arable land, etc. (Godfray *et al.* 2010). According to the FAO, 11% of the world population is currently suffering from hunger and the number of people living in a food insecure situation is growing – from 777 million in 2015 to 815 million in 2016 (FAO *et al.* 2017). Simultaneously, a third of the food produced is surplus that goes to waste. It seems at first that the complexity of the food value chain does indeed encourage us to act by the words of the Bible, not wholly reaping the corners of the field, yet at the same time inhibiting the access of "the poor and the stranger" to surplus food. Being highly critical of the contemporary food supply chain, Cloke (2016) draws a connection between food (in)security and FLW:

> Food security … is increasingly dependent on the internal structures and processes of a diminishing number of corporate food wholesalers and retailers … Critically, food waste is not just some regrettable side effect of these systems that will be taken care of by technical, regulatory, and organizational fixing; it has become a core component of the way these systems have developed – waste speeds up the profitable through-flow of food and is an increasing part of the profit mechanism (Cloke 2016, 100).

Cloke's outlook aside, several authors (see for example Godfray *et al*. 2010 and Foley *et al.* 2011) see FLW reduction as one of the key areas that could improve food security; Kummu *et al*. (2012) claim that if FLW were to be halved globally, approximately one billion people could be fed more than currently, enough to provide nutrition to the population growth by 2025.

1.2.2. Economic Losses

As noted in the introduction, the food wasted in the EU amounts to a loss of approximately 143 billion euros (FUSIONS 2016). Globally, the loss is roughly 756 billion euros (FAO 2015). In the Estonian food-trade sector there is unsold food amounting to a value of 22 million euros per year (Moora *et al*. 2015b, 11), in households 63 million euros are lost per year, and 2.2 million in schools (Moora *et al*. 2015a, 17, 19). Although the elimination of FLW definitely entails its proper costs, it has the potential of a very high return on investment. Hanson and Mitchell (2017, 2) claim that out of the 1200 business sites they analysed, 99% made a positive return on investment after reducing FLW – half of the sites earning a more than 14-fold return on investment. The authors also look at a country case study: the financial effects of the five-year initiative *Love Food Hate Waste* in the UK. During the five years, the initiative cost approximately 26 million GBP, whilst helping UK households save 6.5 billion GBPs on reduced FLW and government authorities 86 million GBPs on FLW disposal costs (*Ibid*., 8).

1.2.3. Environmental Impact

Food production has one of the largest environmental footprints of all human activities (Gonzáles *et al*. 2011, 562). From farm to fork, the food supply chain is riddled with environmental issues ranging from the depletion of non-renewable natural resources used for agriculture, such as phosphorus derived from phosphate rock (Cordell *et al*. 2009), the amount (approximately 10%) of global greenhouse gases emitted by livestock (Winkler and Aschemann 2017), the "food miles" an item travels to reach the fork (Kissinger 2013), and many, many other

problems. Food production is one of the main drivers of erosion, water depletion, and deforestation, and it is also one of the main emitters of greenhouse gases (Winkler and Aschemann 2017). It comes as no surprise then that the amount of food wasted, too, has a very direct impact on the environment.

The land mass occupied by food grown to be wasted is 1.4 billion hectares – 30% of the land used for agriculture globally. In a world where groundwater reserves are diminishing (Richey *et al*. 2015), one-quarter of freshwater is used to produce wasted food. Further damaging our waterways and depleting global mineral reserves, one-fifth of fertilisers used in food crop production is used to produce FLW (Kummu *et al*. 2012). If we imagine FLW as a country, it is the third largest contributor to climate change through greenhouse gases (GHG), outperformed only by the US and China (FAO 2013a). In the US, FLW contributes 113 MMT CO_2e/year – 2% of national greenhouse gas emissions (Venkat 2011). As a comparison, the oil-producing country of Nigeria's total national emissions were 102 MMT CO_2e in 2016 (Global Carbon Project 2017). It is not only FSC that produces GHG – a major concern connected to FLW is the emission of methane gas (CH_4) from landfills where biological waste is deposited. As the majority of countries in the EU do not sort or recycle food wastes, landfilling is the most widely spread method for disposing of FLW (Montoneri 2017), and in landfills, FLW-consuming bacteria produce a mixture of gases where the main player is methane – a GHG 21 times more potent than CO_2 (Houghton 1996, 22).

Environmental impacts are rarely, if ever, stand-alone issues. Geologists have now proposed that the age of Holocene has ended, giving way to the sinister-sounding Anthropocene (Zalasiewicz *et al*. 2008). Humans as a species now are considered to have considerable effects on the geophysical world, mostly through our production and wastage patterns. Environmental impacts have direct consequences on so-called environmental services that allow for the system as a whole to exist in a sustainable way. FLW prevention and reduction have the potential to reduce the exploitation of environmental services, allowing for a more sustainable usage. Thus, reducing FLW impacts most certainly not only benefit the environment, but also our societies: "[I]n the twenty-first century, we face scarcity in critical resources, the degradation of ecosystem services, and the erosion of the planet's capability to absorb our wastes. … The Anthropocene is a reminder that the Holocene, during which complex human societies have developed, has been a stable, accommodating environment and is the only state of the Earth System that we know for sure can support contemporary society" (Steffen *et al*. 2011, 739).

1.3. On FLW in the Estonian Context

The only country-specific reports on FLW in Estonia have been conducted by the Stockholm Environment Institute (SEI) in Tallinn, thus this subchapter will focus solely on these reports. The two existing studies were commissioned by the Ministry of Environment (MoE) and are as follows: *Toidujäätmete ja toidukao teke Eesti kodumajapidamistes ja toitlustusasutustes*[1] (Moora *et al*. 2014; Moora *et al*. 2015a) and *Toidujäätmete teke Eesti kaubandus- ja toiduainetööstusettevõtetes*[2] (Moora *et al*. 2015b). The former study has been published twice and according to the researchers, only the formatting changed (Piirsalu 2018). For clarity, in this thesis, only the reference "Moora *et al.* 2015a" will be used to refer to the study *Toidujäätmete ja toidukao teke Eesti kodumajapidamistes ja toitlustusasutustes*. Whilst the former analyses FLW in Estonian households and catering institutions, the latter focuses on FLW in Estonian food retail and production enterprises.

For *Toidujäätmete ja toidukao teke Eesti kodumajapidamistes ja toitlustusasutustes* (Moora *et al*. 2015a) thorough research has been conducted, using a variety of methodologies from food diary to weighing actual food waste. In developing the research methodology, the authors refer to a study conducted in Finland (Silvennoinen *et al.* 2012) as the main exemplar. As can be expected, the results of the study are thus also most similar to results of the Finnish study and not so much to other FLW studies – the authors also note that this can somewhat be due to the chosen methodology (Moora *et al*. 2015a, 9). In the case of households, the sample used can be considered sufficient, but in the case of catering institutions, the sample is rather small (3 restaurants, 3 pubs/bars, 3 cafeterias, 4 buffets, 3 school dining halls, 3 kindergarten dining halls, and 1 hospital). It is clear that in a small country like Estonia, not many research locations are needed, but it is not likely that research in 3 restaurants could give an overview of the FLW practices of Estonian restaurants in general. Fast-food enterprises have been omitted, as the researchers claim that the FLW produced in these is too small. Without explanation in the study, event-catering enterprises have also been omitted – surely not due to too small amounts of FLW,

[1] "The production of food waste and losses in Estonian households and catering institutions" (translation by the author).
[2] "The production of food waste in Estonian food trade and food processing enterprises" (translation by the author).

as anyone who has ever witnessed a catering enterprise do their clean-up after an event can assure. After consulting the authors for the reasoning of omitting catering services, it emerged that firstly, catering enterprises were not a part of the project commissioned by MoE and secondly, researching catering enterprises would have needed a different methodology and more time (Piirsalu 2018). Based on the research, the authors claim that the average Estonian household produces 130.4 kilos of food waste per year, out of which 36% (46.9 kilos) is labelled as food loss or avoidable food waste. According to the research, a total of 96,000 tons of FLW per year is being produced by households in Estonia and 22,000 tons of FLW per year by catering institutions (excluding event-catering and fast-food institutions).

In the second study, *Toidujäätmete teke Eesti kaubandus- ja toiduainetööstusettevõtetes*, Moora *et al*. analyse food trade and production enterprises, but before going further it must be noted that the definition of food loss in the two studies is very different, making it nearly impossible to compare the two sets of data. The two contrasting definitions are:

> Food loss or wasted food consists of food and foodstuffs that for some reason remains unconsumed. Food loss is all food ingredients that could have been eaten when consumed earlier or stored or processed differently. For example food that is spoiled, that has passed the use-by date, stored or processed using wrong methods, food that is left over from serving or eating, etc., will be considered food loss[3] (Moora *et al*. 2015a, 22, translation by the author).

> Food loss or wasted food – any kind of food or foodstuffs meant for human consumption that has been discarded from the food supply chain for economic or aesthetic reasons or has passed the use-by date, but is still edible and suitable for human food[4] (Moora *et al.* 2015b, vii, translation by the author)

In the second case we see that food loss for trade and production institutions still has to be edible and suitable for human food, whilst for the consumers and catering institutions, there is also the inclusion of foodstuffs spoiled or inedible in other ways. In the second study, other terms are also introduced, such as food waste (*toidujäätmed*) and unsold food (*müümata jäänud toit*); although the aim of the study was to estimate the amount of food waste (*toidujäätmed*) in

[3] "Toidukao ehk raisatud toidu all mõistetakse toitu ja toiduaineid, mis mingil põhjusel jääb tarbimata. Toidukadu on kõik toidu koostisosad, mida oleks saanud varem tarvitades või teistmoodi säilitades või käideldes veel süüa. Toidukao alla kuuluvad näiteks riknenud, kasutustähtaja ületanud toit, vale hoidmise ja käitlemise tulemusel kasutamata jäänud toit, toidu serveerimisel või söömisel ülejäänud toit jms."

[4] "Toidukadu ehk raisatud toit – mis tahes algselt inimtarbimiseks mõeldud toit või toiduaine, mis on toidutarneahelast majanduslikel või esteetilistel põhjustel või tarbimistähtaja ületamise tõttu eemaldatud, kuid mis on veel söödav ja inimtoiduks kõlblik."

Estonian food-trade and food-processing enterprises, the authors note that it is "not possible to unequivocally determine the amount of food waste produced in food trade enterprises"[5] (*Ibid*., 8, translation by the author) and focus on unsold food. According to their research, the authors conclude that 12,000 tons of food remains unsold in the food trade sector, of which "[a] big part can be classified as food loss"[6] (*Ibid*., 9, translation by the author) – but it is left undetermined how much a big part is. In the latter part of the research, where results are compared with results from other EU MSs (Finland, Sweden, Germany, and the UK), the data compared from trade is not "unsold food" but "food waste", and the amount compared is 6271 tons (*Ibid*., 34). It is possible that the rest is then seen as food loss, but the authors do not clarify.

It is clear that like other researchers, Moora *et al*. also struggle with the lack of a clear definition of FLW and its sub-definitions. Additionally, the lack of a clear methodology for estimating FLW has created a situation where it is very difficult to compare or benchmark FLW reduction efforts. Due to the confusing terminology, it is also nearly impossible to compare the two studies conducted in Estonia; thus to address causes of FLW production, one must have a clear understanding of the nuances and differences of definitions used.

Leaving terminology and methodology aside, the main finding for this thesis was from the second study – namely, the reasons for food waste (*toidujäätmed*) production in food trade enterprises. Firstly, the authors estimate that the main foodstuffs that form food waste in trade enterprises are fruits, vegetables and meat products (Table 1). Secondly, when asked for the reasons behind food waste in different categories, the following reasons were given by shop employees for relevant foodstuffs (*Ibid*., 15):

a) Fruits and vegetables:
    a. Shopping patterns and habits of consumers
    b. Marketing standards for fruits and vegetables
    c. Problems with supply and transport
b) Meat and fish products:
    a. Shopping patterns of consumers
    b. High price of food products
    c. Food safety and hygiene regulations

[5] "Kaubandusettevõtetes tekkivate toidujäätmete kogust pole võimalik üheselt määratleda."

[6] "Suur osa sellest võib lugeda toidukaoks." (*sic*)

Table 1. Average percentage of foodstuff types in unsold food of Estonian food trade enterprises

	Average weight percentage	Average price percentage
Fruits	23%	11%
Vegetables	22%	6%
Meat products	16%	24%
Fish products	2%	3%
Baked goods	13%	15%
Dairy products	10%	8%
Ready-to-eat foodstuffs	10%	23%
Dry goods (flour, pasta, etc.)	2%	1%
Other	1%	3%
All together	100%	100%

Source: Moora *et al.* (2015b, 12)

Thus, more than half (61% in weight) of FLW produced by Estonian food trade enterprises consists of fruits, vegetables and meat products. Although the price equivalent of FLW of the three categories is less than half (41%), meat products alone cause nearly one-quarter (24%) of the whole amount. There is no calculation of the GHG equivalent of FLW produced in Estonia, but taking into account studies from other countries (see subchapter 1.2.3.), it can be claimed that the large percentage of meat products in the FLW of Estonian food trade enterprises has a significant environmental footprint. Among the main reasons for this majority of FLW, two are directly influenced by EU policies: marketing standards for fruits and vegetables and food safety and hygiene regulations. Although the exact amount of FLW influenced by these policies is hard to define (as data is not concrete), it is clear that these policies have a large impact on Estonian food trade enterprises and the FLW they produce.

1.4. On FLW Reduction Policies

There are not many studies conducted on FLW reduction policies. Although there have been some attempts at mapping, not many studies dare to analyse such policies, as there are still few, and those that exist have been implemented rather recently. Schanes *et al*. (2018, 986) provide a short overview of policy options proposed by the academia: a) economic instruments such as taxes, subsidies, and fees such as "pay-as-you-throw" or PAYT schemes; b) new regulations and the review and elimination of past regulations with a negative impact on FLW; c) awareness raising and education programmes. Lucifero (2016) points to legal aspects of FLW reduction in the EU, including the fact that some previous legislative acts may be deterring FLW reduction. The research group FUSIONS provides an analysis on all the EU legislative acts with implications on FLW generation or reduction (Vittuari *et al.* 2015), a study that will be discussed further in chapter 2. Additionally, FUSIONS has produced two guidelines for the EU and its policymakers with regard to FLW and policies: *Food Waste Policy Evaluation Framework* (Vittuari *et al.* 2016a) and *Recommendations and guidelines for a common European food waste policy framework* (Vittuari *et al.* 2016b).

With regard to policy planning, Thyberg & Tonjes (2016) provide an analysis of policy approaches that would be most effective for FLW reduction. They point out that the preferred policy approach would be a multi-faceted policy package that would touch upon three main policy categories: values, skills, and logistics. The first aspect could be addressed through education and awareness programmes that emphasise the morally problematic nature of FLW and the financial loss created by it; the second aspect could be addressed through education and awareness programmes that give consumers a clearer understanding of FLW reduction methods (smaller portions, proper storage of different fruits and vegetables, etc.); the third aspect could be addressed through a variety of policies directed at the private and public sectors, such as tax incentives for FLW reduction, waste-system reforms, etc. (*Ibid*., 119, 120).

Based on what Lorek & Fuchs (2013) define as "weak" and "strong" actions towards achieving sustainability, Mourad (2016) analyses the two approaches by France and the USA on FLW reduction. According to Mourad, most of the applied policies and programmes both in the USA

and France are examples of "weak" prevention – prevention that aims to streamline and tweak the system in a way that would increase efficiency and reduce FLW. These policies often entail raising awareness among customers, sharing best practices and producing toolkits, hiring external consultants or making use of innovations such as improved packaging or apps. The opposite, "strong" prevention activities, would be policies that approach the systematic reasons for FLW – overproduction of food, too strict food safety and quality criteria, systematic exclusion of certain foods ("ugly vegetables"), the globalisation of food value chains, etc. Mourad categorises only the efforts of the French to change the importance of the aesthetic value of vegetables as an example of a possible "strong" prevention activity. Still, as the long-term effects of these campaigns for "ugly vegetables" are yet to be seen, it might not bring about a real systematic change of how and why aesthetic standards arise in the first place (*Ibid*., 468, 469). Overall, Mourad criticises existing actions in both countries as being cosmetic and more directed towards changing the image, not the system itself and mainly being occupied with dealing with the already produced surplus, instead of addressing the causes of this surplus.

1.5. Framework, Methods & Sources: Pareto Optimality

The core of this thesis is policy analysis based on Pareto Optimality. The thesis will look at the interplay between two "sides" of policies – FLW reduction on the one hand and food hygiene and marketing standard regulations on the other hand. By analysing the points of connection and conflict, the thesis introduces possible Pareto Improvements, whereas neither of the "sides" will have a negative impact on achieving the respective policy objectives, but the overall gains for FLW reduction policies are enhanced. Pareto Optimality can be defined as a situation where "no one can be made better off without making someone else worse off" (Luc 2008, 482). The principle is named after the Italian economist Vilfredo Pareto (1848–1923) and gained wider popularity in several social sciences fields from the 1970s on (*Ibid.*). Although in the field of economics, Pareto Optimality is a more rigid term with complex connotations and thus often debated (see, e.g., Pazner, Schmeidler 1974, Kanbur 2005 among others), in the context of this thesis, Pareto Optimality will merely be used as a chassis for public policy analysis in order to mitigate possible tensions between policies. Thus, in the context of this text, a Pareto Optimal situation would be where EU policies with impact on FLW would be in such a balance that no

policy instrument could be repealed without impeding the feasibility of achieving the objectives of said policy.

The interplay between policies has been researched under a number of terms – although often the objectives and outcomes of these studies are similar, the definitions and frameworks vary. According to Tosun & Lang (2017), there are mainly two directions in studying policy interplay: government-centred (such as "comprehensive planning", "policy coherence", "holistic government", etc.) and governance-centred (such as "horizontal governance", "holistic governance", "policy mainstreaming", etc.). Essentially, both approaches are aimed at ensuring for policies not to contradict each other or undermine the objectives of other policy domains. As to the question why the naming of the different frameworks of the two approaches varies, Tosun & Lang (2017, 554) answer that it is "due to the fact that policy integration concepts stem from the 'practitioners' world", whilst the academia could gain from making the terminology unified. The thesis at hand will use a concept proposed by Tosun & Lang – policy integration – and take a government-centred approach. The main method, document analysis, is used to answer the following questions:

a) What are the objectives of the legislative acts?
b) What is the politico-economic context that possibly has influenced the development of these acts?
c) Are there aspects of these legislations, or their implementation, that are in conflict with the objective(s) of other policies analysed? If so, could these aspects of the named legislations, or their implementation, be Pareto Improved (amended with the limitation of not reducing the possibility or ease of achieving the objectives of any of the analysed policies)?

To supplement document analysis where needed and to provide better context, the author has conducted informal semi-structured interviews and consulted stakeholders *via* phone calls and e-mails. According to Johnson, semi-structured in-person interviews provide better insight for exploratory studies and in cases of complex processes that need "in-depth understanding of reactions to various experiences and/or the reasons for holding particular attitudes" (2002, 90). Semi-structured interviews allowed the author to be flexible towards the interviewees and gain exploratory information on unforeseen aspects. The author conducted semi-structured interviews (lasting 45–75 minutes) with the following stakeholders:

- A representative of a food business operator (Rimi Eesti);

- A representative of the Food Bank of Estonia;
- A waste expert official from the Ministry of Environment (*via* phone call).

Additional, shorter consultations *via* phone call or e-mail were conducted where clarification was needed: namely, with a market organisation expert from the Food and Veterinary Board of Estonia and a food-waste researcher from Stockholm Environment Institute Tallinn. Furthermore, the author attended an open hearing in the Parliament on 23 January 2018, which was attended by most stakeholder organisations of FLW reduction in Estonia. The interviews, consultations and the open hearing influenced the formation of the questions that are elaborated on in this thesis and provided context for the work.

The thesis is applied policy research, implying that the analysis and findings of the thesis can reasonably be expected to be applicable to real-world policymaking. Yet the research is independent in the aspect that it has not been commissioned by any policymaking body, nor has it received financial support from any such body.

CHAPTER 2. DEFINING THE POLICY PROBLEM

In 2016, the European Court of Auditors issued a special report on the actions of the EU in terms of combating food waste. The report concludes that despite ambitious plans to combat food waste identified in the Roadmap to a Resource Efficient Europe in 2011, the European Commission had not lived up to its own expectations:

> [W]aste reduction targets have been lowered, the obligation for Member States to report on food waste has been delayed, the deadline for the Commission to adopt an implementing act to establish a common methodology for measuring food waste has been repeatedly postponed and there is still no EU-wide definition for food waste. Together with this, a baseline (a reference level for a given year) from which to target reduction in food waste has never been defined (European Court of Auditors 2016, 20).

The auditors emphasise that it is not only the fact that the Commission ignored or took lightly the repeated requests of the Parliament or even the Member States to address the issue more concretely, but also the fact that "[m]any of the potential improvements do not require new initiatives nor more public funding, but rather involve a better alignment of existing policies" (European Court of Auditors 2016, 7), which leads them to conclude that the EU was not efficiently combating FLW in the food supply chain. Whether due to the damning report by the Court of Auditors or the continuous advocacy work by activists and policymakers from the Member States, it seems that the EU is now taking steps towards reducing the amounts of FLW produced. Simultaneously with the writing of this thesis, the European Parliament decided to amend Directive 2008/98/EC on waste with clear indications on the reduction of FLW.

The following subchapters will be dedicated to two main existing policy areas that play an important role in FLW reduction: firstly, waste policies that form a part of the newly adopted Waste Package and include FLW reduction, and secondly, policies connected to food regulation – food hygiene policies and marketing standards. Food hygiene policies and marketing standards

were chosen due to the fact that these are mentioned by Estonian food trading enterprises among the main policy reasons for FLW creation (Moora *et al.* 2015b, 15), additionally the two policy topics were discussed as important in the 2015 *Review of EU Legislation and Policies with Implications on Food Waste* by FUSIONS, and three ((EU) No 543/2011 of 7 June 2011; (EC) No 853/2004; (EC) No 852/2004) of the five legislative acts with the worst implications for FLW reduction were classified as belonging to either hygiene rules or marketing standards (Vittuari *et al.* 2015, 51). The latter part of the chapter will analyse areas of conflict or collision between the two sides based on these three acts.

2.1. The EU Waste Package

The EU Parliament adopted the renewed Waste Package on 18 April this year; the text is set to be formally approved by the Council in the coming months. Although the scope of the Package is much larger, introducing a general direction of the EU towards adopting the ideas of the Circular Economy, it is also the first act to regulate food waste reduction as such in the EU. In spite of the fact that there are no binding targets for food waste reduction in the Package, it is clear that the document will bring FLW to the political agenda in all Member States. The renewed Waste Package states that overall, "[w]aste management in the Union should be improved and transformed into sustainable material management, with a view to protecting, preserving and improving the quality of the environment, protecting human health, ensuring prudent, efficient and rational utilisation of natural resources, promoting the principles of the circular economy…" (European Parliament 2018, 4) and sets the following objectives on FLW specifically:

- To promote the prevention and reduction of food waste in line with the Sustainable Development Goals, in particular the halving per capita of global food waste by 2030 (*Ibid*., 9);
- Member States (MSs) should aim towards a target of 30% by 2025 and 50% by 2030 of FLW reduction in the EU (*Ibid*., 9).

To achieve these objectives:

- A common definition of FLW in the EU is set in place with the act: "'food waste' means all food as defined[7] in Article 2 of Regulation (EC) No 178/2002 of the European Parliament and of the Council that has become waste" (*Ibid*., 20, footnote added by the author);
- The Commission should establish a common FLW measuring methodology and reporting system in the EU by 31 March 2019 (*Ibid*., 32);
- Based on reports from the MSs, the Commission shall consider the feasibility of establishing binding targets for the MSs and, if seen as feasible, submit a legislative proposal to the Parliament and the Council (*Ibid*., 32).

The following tools and incentives are put in place or suggested to the MS:

- MSs should establish food waste prevention programmes within their general waste programmes (*Ibid*., 44), the programmes including awareness campaigns (*Ibid*., 9);
- MSs should increase awareness of the meanings of "use-by" and "best-before" among consumers (*Ibid*., 10);
- MSs should prioritise food donation or redistribution to processing leftover food into animal feed or other materials or products (*Ibid*., 31);
- MSs should incentivise the collection and safe redistribution of unsold food products to, for example, charitable organisations (*Ibid*., 10);
- MSs should measure and report FLW reduction annually (*Ibid*., 9);
- MSs can choose to incentivise food donations through fiscal incentives (*Ibid*., 52).

As it is still a very recent act yet to be formally approved by the Council, it is hard to foresee how its implementations will roll out in the MS. Although it states a common definition of "food waste", the exact details of what will and what will not be accounted for in the common measuring and reporting methodology are unclear. As noted in the first chapter of this thesis, many studies, including studies conducted in Estonia, note the confusion on these aspects. While it is unclear which methodologies shall be used in the first reports by the MS, a thoroughly analysed common reporting system, developed later on, will be useful to all parties involved. Although activists have welcomed the renewed Waste Package, many remain critical of the non-binding targets and the deadline for setting binding targets (Searle 2018).

[7] "Definition of 'food' – For the purposes of this Regulation, 'food' (or 'foodstuff') means any substance or product, whether processed, partially processed or unprocessed, intended to be, or reasonably expected to be ingested by humans" ((EC) No 178/2002, Article 2).

2.2. Food Hygiene Policies and Marketing Standards

The following subchapter will discuss the EU food hygiene policies and marketing standards that are most relevant in terms of FLW reduction. In the selection of these acts, analyses by the Court of Auditors (European Court of Auditors 2016) and FUSIONS (Vittuari *et al.* 2015) have been taken into account. FUSIONS has conducted an excellent review of EU legislative acts that influence FLW production and/or possible reduction. The researchers identified 53 legislative acts with implications on FLW and analysed the impact of each of these acts. The acts were sorted into a set of 9 different policy topics, of which two are most relevant to this thesis: "Hygiene rules" and "Marketing standards". The two, along with "Food information" are the policy topics that currently have the most negative impact on FLW, thus "the provisions regarding these topics represent policy measures in which strategic changes could result in a larger contribution to food waste reduction" (Vittuari *et al.* 2015, 7). The following acts that can be categorised into the two aforementioned categories are found to influence FLW production in the EU [the acts found among the five with the most negative impact on FLW are marked in bold (Vittuari *et al.* 2015, 51)]:

Hygiene:

- General Food Law Reg n° 178/2002;
- Dir 2002/99/EC;
- **Reg n° 852/2004** (Food and Hygiene Package);
- **Reg n° 853/2004** (Food and Hygiene Package);
- Reg n° 854/2004 (Food and Hygiene Package);
- Directive 2004/41/EC (Food and Hygiene Package);
- Reg n° 882/2004;
- Reg n° 1/2005;
- Reg n° 163/2009.

Marketing standards:

- Regulation (EC) No 1234/2007;
- Regulation (EC) No 1580/2007 (as amended, in particular by Regulation (EC) No 1221/2008);
- **Reg n° 543/2011**.

The food regulations of the EU are intended to provide "access to safe and wholesome food of the highest standard" to the citizens. The need for a set of regulations arose from a series of

incidences with food contamination during the 1990s, after which a White Paper on Food Safety was produced, followed in 2002 by the General Food Law Regulation (General Food Law 2018). The White Paper's objective was "[t]o outline a comprehensive range of actions needed to complement and modernise existing EU food legislation, to make it more **coherent**, **understandable** and **flexible**, to promote better enforcement of that legislation, and to provide greater transparency to consumers; in addition, to guarantee a high level of **food safety**" (White Paper on food safety; emphasis added by the author). The General Food Law Regulation lays down the "the general principles and requirements of food law, establishing the European Food Safety Authority and laying down procedures in matters of food safety" (Regulation (EC) No 178/2002) with the objective of ensuring a "high level of protection of human life and consumers' interests in relation to food, while ensuring the effective functioning of the internal market" (General Food Law 2018).

2.2.1. Hygiene Policies

The two food hygiene acts considered as having strong effects on FLW by FUSIONS both form a part of the "Food and Hygiene Package" set of policies adopted in 2004. The first one, regulation (EC) No 852/2004 lays down a rule that determines a very important dynamic for FLW and food law both: "primary responsibility for food safety rests with the food business operator" ((EC) No 852/2004, Chapter 1, Article 1.1.(a)). Although a seemingly sensible regulation, some questions still arise in the context of FLW prevention. Namely, food donors and Food Banks are seen as "food business operators" (FBOs) with full liability for the FLW they help prevent through donations to people in need (2017/C 361/01). It is possible then that FBOs may discard edible food products instead of donating them to avoid unwanted situations or even scandals related to food safety liabilities. Italy is an exception here – in 2003, one year before the adoption of the "Food and Hygiene Package", the Member State introduced a law to protect charitable organisations improving food security and preventing FLW: "[The] Good Samaritan legislation … protects food donors and the charitable organization collecting food surplus, by recognizing the latter as final consumers. Thus liability is transferred from industry to charity in the same way as at point of sale to consumers, preventing individuals receiving food from banks from being able to file a lawsuit against the food donor" (O'Connor *et al.* 2014, 51). As an example from outside of the EU, the Bill Emerson Good Samaritan Food Donation Act minimises the liability of an FBO in the context of food donations in the USA.

Regulation n° 853/2004 lays down the rules for food hygiene in relation to food products of animal origin, both processed and unprocessed. As discussed more thoroughly in chapter 1, this act has large implications on the FLW reduction in Estonian food trading enterprises, as meat products are at least number three in the quantity of FLW produced by such enterprises (Moora *et al.* 2015b). The only product groups that are disposed of more than meat are fruits and vegetables; in terms of both financial and environmental damage, meat products clearly surpass fruits and vegetables.

As noted in the introduction, during an open hearing in the Estonian Parliament in January, the Head of Food Department of the Food and Veterinary Board was reluctant to discuss the possibility of freezing meat products for donations. The official was adamant on the fact that there is no flexibility in the area of food safety and hygiene. Regulation n° 853/2004 indeed lays down the following rule: "Meat intended for freezing must be frozen without undue delay, taking into account where necessary a stabilisation period before freezing" (Regulation n° 853/2004, Chapter VII, 4). Thus, freezing meat products before the "use-by" date is reached would not be considered fitting. Yet, by working through the EU guidelines on food donation, we can see that indeed, there is flexibility:

> This requirement does not apply to retailers supplying other food business operators such as food banks provided that such retailers' activity stays marginal, localised and restricted in accordance with its Article 1(5)(b)(ii). Member States granting the possibility of freezing food of animal origin for redistribution purposes should adopt national measures accordingly and notify them to the Commission and the other Member States (EU guidelines on food donation 2017, 22).

Although EU food safety rules are strict, there is certain flexibility when it comes to food donations in order to reduce FLW and enhance food security. Evidently, a high level of protection of human life is not discarded here, and there is no conflict with the objectives of General Food Law – the MS are expected to adopt national measures to make sure food is still safe, yet making it possible to donate frozen animal products.

A good example here is Finland, which adopted guidelines for food donations in 2013. These guidelines were developed by Evira (Finnish Food Safety Authority) and give food donors and food banks a clear understanding of the allowed procedures while providing them with a legal

right to freeze food of animal origin (through adopting Member State national measures). The guideline states that products labelled with a "use-by" date (including meat and other products of animal origin) that have passed the expiry date are only acceptable as donations if they have been frozen before the date. The products must have a clear marking of the date of freezing and must be donated before passing two months of the freezing date. Not all products are suitable for freezing or must be processed with heat after thawing (Evira Guide 2017). Although there is flexibility in the aforementioned EU regulations, it is often the interpretation of the national authorities in Member States that make or break the ease of food donations. This is not solely an issue in Estonia – Gram-Hanssen *et al*. (2016) point out how EU food law interpretations vary in different Nordic countries and how it affects the ease of food donations. Similarly, O'Connor *et al*. (2014) conclude that countries such as France, Belgium, and Greece tend to interpret EU food regulations less stringently than for example Sweden or Denmark.

2.2.2. Food Marketing Standards

It is hard to find a clear analytical viewpoint on the overarching objectives considered while developing food marketing standards in the EU. Reg n° 543/2011 indicates that its objective is to lay down rules for the application of Reg n° 1234/2007 – which has since been repealed and replaced by (EU) No 1308/2013. According to the latter, the purpose of the standards is to "take into account the expectations of consumers and to contribute to the improvement of the economic conditions for the production and marketing of agricultural products and their quality" ((EU) No 1308/2013, rec 65) and to "enable the market to be easily supplied with products of a standardised and satisfactory quality" (*Ibid*., rec 71).

The policies seem to argue that agricultural products need to be standardised to meet the expectations of consumers. However, it is questionable whether the consumers of the EU indeed expect the "minimum refractometric index of the flesh [of a nectarine or peach to be] greater than or equal to 8° Brix" (Reg n° 543/2011, Part B, Part 5, IIB) or that the "minimum [grape] bunch weight shall be 75 g" (*Ibid*., Part B, Part 9, III). Yet, it can be assumed that these standards influence the generation of FLW throughout the food supply chain. The ratio of allowed brown spots in apples (*Ibid*., Part B, part 1C) or the obligation to sell only turgescent lettuce (*Ibid*., Part B, Part 4 IIA) can be seen as examples of standards that may cause food trade

enterprises to throw out edible produce, as indicated by Moora *et al.* (2015b). Indeed, food business operators are expected to dispose of any products not in accordance with the standards:

> The holder of products of the fruit and vegetables sector covered by marketing standards shall not display such products, offer them for sale or deliver or market them in any manner within the Union other than in conformity with those standards and shall be responsible for ensuring such conformity ((EU) No 1308/2013; Article 76, 3).

In 2008, a legislative reform (Regulation (EC) No 1221/2008) repealed the majority of marketing standards for fruit and vegetables – instead of 36 before the reform, only 11 standards (10 specific, 1 general) remain. An EC-financed evaluation claims that the repealing of standards for three examined types of products (carrots, melons, and mushrooms) did not lead to any negative impacts on the market situation (AND International 2009). Unfortunately, it was impossible to find public information on the reasoning why the standards for 10 types of fruits or vegetables were kept in place. Although there is no data on the influence of the repealing of some marketing standards on FLW in Estonia, studies from other MSs (see, e.g., Waarts *et al.* 2011, AND International 2009) note that in many cases, EU marketing standards were replaced with private marketing standards, thus not inducing an FLW reduction in food trade. Currently, a review of marketing standards and related regulation is in process and due to be completed by the 4th quarter of 2018 (European Commission 2018a). The review will also analyse the coherence of the policies under scrutiny with other EU policy sectors.

2.3. Are there Policy Conflicts?

The previous subchapters have taken a closer look at four legislative acts: Reg n° 852/2004 and Reg n° 853/2004 (Food and Hygiene Package), Reg n° 543/2011 (Fruit and Vegetables Marketing Standards), and the renewed EU Waste Package. Additional relevant legislative acts were taken into account where needed and possible. Although the renewal of the Waste Package (WP) has most certainly been a welcome move to achieve the reduction of FLW, it can be claimed that the effect of the act alone will be small if compared to a situation where the aforementioned policies (hygiene regulations and marketing standards) would be in coherence with the objectives set by the new WP.

Whilst comparing the **objectives** of the new WP with the objectives of hygiene regulations and marketing standards, there seems to be no conflict between the two sides. Yet, as the examples of the previous subchapters demonstrate, there are aspects of those legislations or the way these are implemented in MSs that clearly are in conflict with the objectives of the new WP. Furthermore, legislation may influence the private sector to enforce unnecessary private rules (as seems to be the case with marketing standards repealed in 2008) that, despite the annulment of legislation, continue to impact FLW. There is potential in the possible corrections to the two policy areas towards achieving the objectives of the new WP. Due to the fact that the **objectives** are not conflicting, there should be several amendments that could be classified as Pareto Improvements in this context. An overview of possible conflict mitigation efforts and amendments will be given in chapter 3.

CHAPTER 3. POSSIBLE COURSES OF ACTION

3.1. Best Practice Policies on FLW

This subchapter will introduce best practice policies of the EU and its MSs but also refer to some outstanding samples from beyond the EU. FAO (2013b, 12) recommends FLW reduction policies to follow the "food waste pyramid", symbolising the actions from most favourable (reduce) to least favourable (landfill): a) reduce; b) reuse; c) recycle/recover; d) landfill. Based on food-waste hierarchies from other studies, the European Court of Auditors (2016, 10) recommend a more specific "food waste pyramid" (from most favourable to least favourable): a) prevention; b) donation; c) animal feed; d) recycling; e) other recovery; f) disposal.

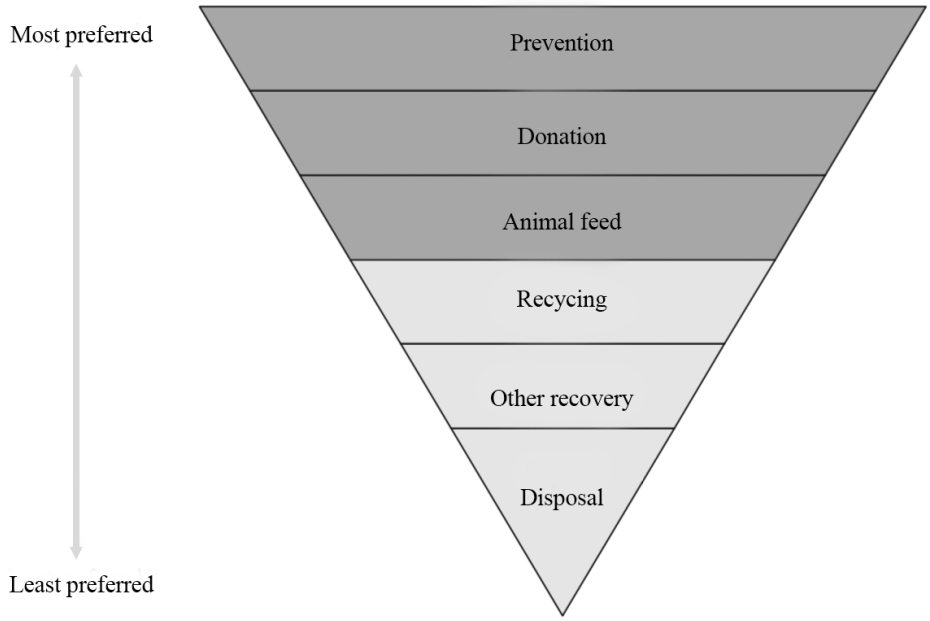

Figure 1. Food Waste Pyramid
Source: European Court of Auditors (2016, 10)

The reasoning for this hierarchy lies in the resource effectiveness in each of the steps – although the production of natural gas from FLW is still preferable to landfilling, it is claimed that not growing a tomato in the first place affects climate change 130 times less than producing gas with it (Stuart 2009, in FAO 2013a, 69). This chapter will look at examples of policy best practices, starting with the "bottom" – how to reduce landfilling and disposal – and continue "upwards" towards policies intended to prevent FLW. The examples have been chosen with regard to relevance and applicability in the Estonian context, and the list is not intended to be exhaustive.

3.1.1. Reducing Landfill Usage

The 1999 Landfill Directive indicated the way towards a general reduction of landfill usage in the EU (Piippo, Pongrácz 2014, 1). Whilst positively reducing landfill usage, it does have some questionable implications for FLW reduction. Most EU Member States have (in order to comply with the Landfill Directive) opted to incinerate the mixed material that otherwise would have been landfilled. Although a preferable solution to landfilling, incineration of general mixed municipal waste alongside wet biological waste such as FLW is less energy-efficient than incineration of waste without wet biological waste (see, e.g., Thyberg, Tonjes 2017 for a life cycle analysis on the topic). Thus, although incineration is an improvement from landfilling, several steps could be taken that would be more effective in the long run.

Still, landfilling bans can be very effective if constituting a part of more complex policy packages for FLW reduction. An outstanding sample of an FLW reduction package that includes a landfill ban is implemented in the Republic of South Korea. Korea introduced a law forbidding the landfilling of FLW in 2005, building upon previous volume-based wastage policies also known as "pay-as-you-throw" or PAYT that taxed general, unsorted waste from households based on the amount of waste disposed of. PAYT has been one of the most widely spread elements in waste (including FLW) reduction policy mixes, implemented also in countries such as Canada, Japan, Taiwan, Thailand, Vietnam, the Czech Republic, Sweden, and China (Herszenhorn *et al.* 2014, 41). In Korea, the PAYT policy was implemented in 1995, alongside the creation of the national Food Wastes Management Council. During the following years, a comprehensive National Food Reduction Plan was set and national awareness campaigns held. According to media, the awareness campaigns included various incentives, some intended to nudge citizens, others to punish more clearly: "When employees clean their plates in the

company cafeteria, they get a prize. Restaurants get tax breaks for serving a 'model menu' to cut waste. … A chemical company uses embarrassment: A scale is set up in the cafeteria and employees, in plain view of co-workers, must weigh what is left on their plates. … One manufacturer also gives a $6 gift certificate from a book store to each of 10 employees who do the best job of cleaning their plates each month" (Jelinek 1997). In order to further increase sorting and recycling, landfilling of food was banned and a new system of food recycling introduced, including an improved network for FLW collection and recycling. It must be noted that the landfill ban was also preceded by guidelines and financial support by the government to set up FLW recycling facilities. Currently, the rate of FLW recycling in Korea is above 90% (Ju *et al.* 2016).

3.1.2. Recycling and Recovering

In order to successfully and effectively recycle FLW or recover its energy in other ways, FLW needs to be separated from other waste streams. This is most challenging in the management of Municipal Solid Waste (MSW) streams – waste streams that in most cases include the majority of household waste produced. Thus, for successful recovery or recycling, citizens should separate their FLW from other household waste and the municipality should have the capacity to organise the collection and recycling of this material. In Estonia, Tallinn is one of the few municipalities with these capacities. Citizens are encouraged to compost their own bio-waste (including FLW) or, in cases of houses with more than 10 apartments, rent a bio-waste container from waste management enterprises (Tallinn 2018). Unfortunately, although officially obligatory, not many bio-waste containers can be found in town. How have other countries or municipalities enhanced FLW separation? As mentioned before, some countries (and municipalities) have introduced PAYT schemes to reduce landfilling of waste and thus improved on sorting and recycling rates. The different options in PAYT scheme fees make it flexible and easy to adapt to local needs – for example, in a society where sorting is not the norm, it is possible to allow citizens to dispose of properly sorted materials completely free, whilst the prices for unsorted waste disposal is augmented. In other situations, where citizens are used to sorting, PAYT schemes can provide an extra incentive to reduce a certain type of waste – for example, the media has reported the willingness of South Koreans to reduce food wastage after the financial "penalty" for the amount of FLW disposed of was augmented (Choon 2016).

In other sorting incentives, flexibility also tends to be the keyword for success. As an example, Finnish municipalities (starting with Helsinki) began experimenting with bio-waste collection already in 1980, and the system is still being developed to meet the needs of the population better. In the municipality of Oulu, for example, houses with more than 4 apartments have the obligation to sort waste into 5 categories: glass, metal, paper, liquid packages, and bio-waste. The municipality has collected bio-waste since 1995 and the success rate of sorting has been continuously growing, owing to a well-established recycling system, sufficient control, and awareness among citizens. An important success factor for bio-waste collection from food trade is also the fact that the bio-waste recycling plant is technologically capable of shredding packaging and separating it from wastes deemed suitable for anaerobic digestion (AD) to produce biogas (Piippo, Pongrácz 2014, 9). Biogas production is organised as a public-private partnership. A private company (Gasum) invested in an AD plant in Oulu in 2015 and started buying municipal bio-waste from Oulu Waste Management Company (Oulun Jätehuolto) – a municipal public-service company. After the AD process is finalised, Gasum is able to sell the biogas and put the by-product of gas production on the market as a natural fertiliser for private profit purposes. Today Gasum and Oulu Waste Management Company also cooperate in building and improving biogas solutions for (public) transport in Oulu (Piippo, Pongrácz 2014, 9; Gasum 2018). But as mentioned, flexibility is an important aspect of recycling efforts. Another interesting example from Finland is the municipality of Lapland – an area of very sparse population (less than 2 people per square kilometre) and extreme temperatures. Due to challenges in logistical distances and the fact that bio-waste may freeze rapidly in winter conditions, bio-waste is not being collected by the local waste company. Instead, the municipality offers a deduction in waste service prices, if the household is able to compost their own bio-waste (Piippo, Pongrácz 2014, 7).

3.1.3. Recovery as Animal Feed

Out of the approximately 88 million tonnes of FLW produced in the EU annually, only 3 million are directed to feeding animals (zu Ermgassen *et al*. 2016, 41), which is mostly due to Regulation (EC) No 1774/2002, which forbade all use of animal-origin by-products and FLW as animal feed after the foot-and-mouth disease epidemic a year earlier (Salemdeeb *et al.* 2017, 872). Although the regulation was intended to stop future epidemics, Salemdeeb *et al*. rightfully point out that the pig feed incident that started the epidemic in 2001 was in conflict with already

existing regulations at the time – the FLW-based feed had not been heated, although such practices were obligatory (*Ibid.*). Today, FLW is still being successfully and safely recycled as animal feed outside of the EU – in Japan, for example, 35.9% of FLW is directed to feeding the pigs (South Korea, too, recycles 42.5% of its collected FLW as feed) (*Ibid*., 872). During the same year that the EU was struggling with the foot-and-mouth disease, Japan adopted the Promotion of Utilization of Recyclable Food Waste Act, forcing food business operators to reduce FLW and recycle where possible. To amend compost overproduction due to FLW recycling, the act was revised in 2007 to promote the use of FLW as animal (pig) feed (Takata *et al.* 2012). Today, liquid pig feed known as "eco-feed" is being produced from FLW through a process of sorting, shredding, heating, and fermenting 33 tons of FLW a day. Feed safety is ensured by heating FLW at 80–90 degrees Celsius for 5–10 minutes and by constant microbiological testing. Pig farms using "eco-feed" are allowed to use marketing tactics to raise awareness among consumers and popularise "closing the loop" efforts (Japan Science & Technology Agency 2018). Currently, 75% of FLW produced by the manufacturing sector in Japan is recycled, and of the total FLW produced, more than 50% is processed into pig feed (Liu *et al.* 2016).

3.1.4. Donation

The French government adopted the National Pact Against Food Waste in 2013 and a law against food waste in 2016. Even before the adoption of the legislation, France had implemented a fiscal incentive to encourage food donations – French food business operators (FBOs) can claim 60% of the net book value of donated food as corporate tax credit (O'Connor *et al.* 2014, 22). Although separating bio-waste was already obligatory beforehand, the tax-credit measure provides extra leverage for FBOs to donate edible food that would have otherwise been recycled in AD plants – thus FLW is prevented on a higher step in the recommended hierarchy (*Ibid*., 58):

> For example, if a retailer has in its possession one tonne of surplus food estimated at 1000€ and landfill taxes are 100€, the retailer will lose 1100€ in order to discard the food. However, if the retailer donates the surplus food, not only will it save landfill costs, but it will also benefit from a tax credit of 600€. In this case, the retailer will only lose 400€ instead of 1100€ (*Ibid*., 59).

To facilitate food donations further, the French Federation of Food Banks has published a Best Practice Guide for donors, and regional toolkits have been published to producers, retailers, and catering businesses (*Ibid.*). With the 2016 legislation, France took a step further from "encouragement" and "facilitation" and set a considerable penalty for large FBOs that refrained from donating edible food. Unfortunately, there are very few academic analyses on the success rate on the legislation, but it is possible that considerable data is still lacking. According to media reports on the legislation, all food business operators of considerable size (more than 400 square meters) will be fined from 3,750 euros to 75,000 euros if edible food or food suitable for animal feed is disposed of instead of donating it; unfortunately redistribution networks are not yet ready to accept such large quantities of donations, making the law's objectives hard to accomplish (Gore-Langton 2017).

As mentioned in chapter 2 of this thesis, flexibilities with regard to liability and date-marking practices can be used as incentives to encourage more food donations. Best practices from the United States (Bill Emerson Good Samaritan Food Donation Act) and Italy (Good Samaritan legislation) were explained, as was the Finnish Elvira food donation guidelines and the practice of freezing "use-by" products before such a date to enable donating the product for 2 more months. Currently, the Commission has launched a pilot project (2018–2020) to map and assess food donation practices in MSs (European Commission 2018b).

3.1.5. Prevention

The most preferred step in the FLW reduction hierarchy is prevention. It is also one of the most complicated steps to achieve. As explained in chapter 1, FLW prevention practices can be categorised into "weak" and "strong" actions, with mostly "weak" actions dominating the discourse. "Strong" actions would entail addressing the core causes of FLW (Mourad 2016), thus possibly most effective for prevention. But could a variation of curated "weak" actions (such as awareness raising, waste regulations, etc.) contribute to one holistic "strong" prevention package? It is claimed that the main vehicle for FLW reduction is behavioural change – motivating, engaging, and encouraging citizens and enabling and exemplifying change simultaneously can cause behaviours to shift (BIOIS 2011). Well-planned awareness-raising campaigns can thus be a foundation for behavioural change. It is clear that awareness-raising and

educational programmes alone will not wish away FLW, but any prevention programme is incomplete without citizens interested in change.

"Stop Spild af Mad" ("Stop Wasting Food") is a Danish consumer-led initiative that has brought considerable attention to FLW in Denmark. According to the initiative's website, "Stop Spild af Mad" has so far generated more than 7000 media coverage pieces in Denmark and abroad, collaborated with 3 Danish governments, gotten the retail chain REMA 1000 to stop using bulk discounts in all of its Danish stores, contributed for reduced FLW to become a competitive parameter in the food-service industry, and contributed to the awareness of Danish consumers – in 2016, 83% of Danes admitted to becoming more interested in reducing FLW in their homes (Stop Wasting Food 2018). "Love Food Hate Waste" is an awareness initiative led by WRAP in the UK. According to WRAP, "Love Food Hate Waste" contributed to the reduction of avoidable FLW in West London by 14% in six months and "[f]or households who reported that they were aware of the campaign and other food-waste messaging and claimed to be doing something different as a result …, the reduction in avoidable food waste was 43%, a statistically significant change" (WRAP 2013, 6) There have also been some IT solutions for FLW prevention, e.g. apps such as OLIO, Too Good To Go, and ResQ. Although the premise of these solutions verges on the so-called solutionism, apps of this kind do contribute to prevention in terms of raising awareness among consumers.

3.2. Feasible Courses of Action Based on Pareto Optimality

In the context of the current thesis, a Pareto Optimal situation would be where EU policies with impact on FLW would be in such a balance that no policy instrument could be repealed – provided the repeal would facilitate the achievement of the objectives of other FLW-related policies – without impeding the feasibility of achieving the objectives of said policy. Thus, a Pareto Optimal situation would be one where any and all policy amendments are made to the previously existing food hygiene and marketing standard policies – towards achieving FLW-related objectives stated in the renewed Waste Package – without impeding the objectives of food safety and quality. A Pareto Improvement in this context would be the act of repealing or amending any policy instruments from the aforementioned policies that are not indispensable for

achieving the objectives but in fact possibly impede the FLW-related objectives of the renewed Waste Package.

In order to map possible Pareto Improvements, a mapping of objectives and instruments with implications on FLW was undertaken. Table 2 demonstrates the findings from the relevant acts from the domains of food hygiene and marketing standards; Table 3 demonstrates FLW-related objectives and instruments from the renewed Waste Package. Table 4 demonstrates suggested amendments or mitigation efforts of relevant acts to reduce implications on FLW. Amendments and mitigation efforts are chosen so as not to conflict with any of the objectives of the named legislation and thus fit under the category of Pareto Improvements.

The renewed WP states that all MSs should take measures to reduce and prevent FLW, aiming to reduce FLW in the EU by 30% by 2025 and by 50% by 2030. This and other FLW-relevant policy instruments listed in the table are intended to contribute to the prudent and rational utilisation of natural resources across the EU and contribute to achieving the Sustainable Development Goals of the UN, specifically target 12.3 – halving FLW amounts globally. The following instruments of food hygiene and marketing standards were found to be in conflict with achieving the objectives of the renewed WP:

- Primary responsibility for food safety rests with the food business operator;
- Meat intended for freezing must be frozen without undue delay;
- FBOs shall not display products that are not in line with marketing standards, offer them for sale or deliver or market them;
- Specific marketing standards that are set for apples; citrus fruit; kiwifruit; lettuces, curled-leaved and broad-leaved endives; peaches and nectarines; pears; strawberries; sweet peppers; table grapes; tomatoes.

In order to mitigate policy conflicts, the author suggests reviewing liability regulation in the EU with reference to adopting national guidelines and measures for incentivising food redistribution, whilst continuing to ensure a high level of food safety and public health.

Table 2. Instruments and objectives relevant to FLW reduction from hygiene policies and marketing standards

Objectives	Instruments with implications on FLW reduction	Reference
To ensure a high level of protection of human life and consumers' interests in relation to food, while ensuring the effective functioning of the internal market.	–	Regulation (EC) No 178/2002 of the European Parliament and of the Council of 28 January 2002 laying down the general principles and requirements of food law, establishing the European Food Safety Authority and laying down procedures in matters of food safety.
To ensure a high level of consumer protection with regard to food safety.	Laying down the rule: primary responsibility for food safety rests with the food business operator.	Regulation (EC) No 852/2004 of the European Parliament and of the Council of 29 April 2004 on the hygiene of foodstuffs.
To ensure a high level of food safety and public health, regulating unprocessed and processed products of animal origin.	Meat intended for freezing must be frozen without undue delay, taking into account where necessary a stabilisation period before freezing.	Regulation (EC) No 853/2004 of the European Parliament and of the Council of 29 April 2004 laying down specific hygiene rules for food of animal origin.
To take into account the expectations of consumers and to contribute to the improvement of the economic conditions for the production and marketing of agricultural products and their quality.	–	Regulation (EU) No 1308/2013 of the European Parliament and of the Council of 17 December 2013 establishing a common organisation of the markets in agricultural products and repealing Council Regulations (EEC) No 922/72, (EEC) No 234/79, (EC) No 1037/2001 and (EC) No 1234/2007.
To enable the market to be easily supplied with products of a standardised and satisfactory quality.	The holder of products of the fruit and vegetables sector covered by marketing standards shall not display such products, offer them for sale or deliver or market them in any manner within the Union other than in conformity with those standards and shall be responsible for ensuring such conformity.	
–	Specific marketing standards for apples; citrus fruit; kiwifruit; lettuces, curled-leaved and broad-leaved endives; peaches and nectarines; pears; strawberries; sweet peppers; table grapes; tomatoes.	Regulation (EU) No 543/2011 of 7 June 2011 laying down detailed rules for the application of Council Regulation (EC) No 1234/2007 in respect of the fruit and vegetables and processed fruit and vegetables sectors.

Table 3. EU Waste Package instruments and objectives relevant to FLW reduction

Objectives	Instruments with implications on FLW reduction	Reference
To improve waste management in the Union, and thereby to contribute to the protection, preservation and improvement of the quality of the environment, the health of the oceans …, and to the prudent and rational utilisation of natural resources across the Union.	Member States should make use of economic instruments and other measures to provide incentives for the application of the waste hierarchy such as landfill and incineration charges, pay-as-you-throw schemes, extended producer responsibility schemes, facilitation of food donation, and incentives for local authorities, or other appropriate instruments and measures.	European Parliament 2018.
To prevent the creation of structural overcapacities for the treatment of residual waste and lock-ins of recyclable materials at the lower levels of the waste hierarchy.	Member States should take measures to promote prevention and reduction of food waste in line with the 2030 Agenda for Sustainable Development.	
To contribute to the attainment of the UN Sustainable Development Goal target of halving per capita global food waste at the retail and consumer levels and reduce food losses along production and supply chains, including post-harvest losses, by 2030.	Member States should aim to achieve an indicative Union-wide food waste reduction target of 30% by 2025 and 50% by 2030.	
–	Member States should establish specific food waste prevention measures, including awareness campaigns to demonstrate how to prevent food waste, in their waste prevention programmes.	
–	Member States should measure progress made in the reduction of food waste on an annual basis. A common methodology for such measurement should be established.	
–	Member States should provide incentives for the collection of unsold food products at all stages of the food supply chain and for their safe redistribution, including to charitable organisations, prioritising human use over animal feed and the reprocessing into non-food products.	
–	Consumer awareness of the meaning of “use-by” and “best-before” dates should also be improved in order to reduce food waste.	
–	Member States shall adopt specific food waste prevention programmes within their waste prevention programmes.	

Table 4. Amendments or mitigation efforts of relevant acts to reduce implications on FLW

Objectives	Instruments in possible conflict with FLW reduction objectives	Amendment or Mitigation (Pareto Improvement)
To ensure a high level of protection of human life and consumers' interests in relation to food, while ensuring the effective functioning of the internal market.	–	None needed.
To ensure a high level of consumer protection with regard to food safety.	Laying down the rule: primary responsibility for food safety rests with the food business operator.	Excluding charities and food donors from "food business operator" category in terms of liability (such as in Italy). Adopt national measures for safety practices of charities and donors in MS that continue to ensure a high level of consumer protection.
To ensure a high level of food safety and public health, regulating unprocessed and processed products of animal origin.	Meat intended for freezing must be frozen without undue delay, taking into account where necessary a stabilisation period before freezing.	MS should be encouraged to adopt measures and clear guidelines for charities and food donors that include guidelines for safe freezing procedures (such as in Finland). Procedures should be regulated clearly to ensure a high level of food safety and public health.
To take into account the expectations of consumers and to contribute to the improvement of the economic conditions for the production and marketing of agricultural products and their quality.	–	Map expectations of consumers and raise awareness on FLW to make consumer expectations more sustainable. No negative effects on the improvement of the economic conditions for the production and marketing of agricultural products and their quality should be allowed.
To enable the market to be easily supplied with products of a standardised and satisfactory quality.	The holder of products of the fruit and vegetables sector covered by marketing standards shall not display such products, offer them for sale or deliver or market them in any manner within the Union…	In addition to current classification ("Extra", "Class I", "Class II"), a third class of "non-standard" products should be made available to consumers with relevant information on FLW; alternative markets (such as for processing purposes) for "non-standard" products should be encouraged.
–	Specific standards for apples; citrus fruit; kiwifruit; lettuces, curled-leaved and broad-leaved endives; peaches and nectarines; pears; strawberries; sweet peppers; table grapes; tomatoes.	Specific marketing standards should be revoked or made non-mandatory. Influence on current or previous standards on the private sector should be mapped and awareness on negative impacts from private-sector standards should be raised.

Whilst no negative effects on the improvement of the economic conditions for the production and marketing of agricultural products and their quality should be allowed, the following amendments should be made and/or activities incentivised:

- In addition to current classes of fruits and vegetables, a third class of "non-standard" products should be made available to consumers;
- Alternative markets for "non-standard" products should be encouraged;
- Specific marketing standards should be revoked or made non-mandatory;
- Influence on current or previous standards on the private sector should be mapped;
- Consumer expectations to market products should be mapped;
- Awareness on the effects of marketing standards on FLW should be raised.

The listed Pareto Improvements lay mainly within the domain of the relevant EU institutions, and whilst MSs can be expected to promote such improvements and advocate for more efficient policies, there are also ways to contribute to the FLW-related objectives of the renewed WP on the national level. These will be addressed in the next subchapter as policy proposals for the Estonian context.

3.3. Policy Proposals for the Estonian Context

The renewed EU Waste Package states: "Member States shall adopt specific food waste prevention programmes within their waste prevention programmes" (European Parliament 2018, 99). To contribute to the FLW-related objectives of the WP, a national FLW prevention programme should be the first step. The Estonian National Food Waste Prevention Programme should be a holistic mix of "weak" actions bringing about behavioural change in citizens needed for "strong" FLW prevention. Best Practices from South Korea should be taken into account while devising the national programme, along with experiences from Nordic countries, such as Finland, to complement them. The National Food Waste Prevention Programme should incentivise the prioritisation of the Waste Hierarchy through the following actions:

1) Minimise the landfilling and incineration of FLW through the following:
    a. Enhance waste sorting practices by households and the private sector through one of the following:
        i. Regulation;

ii. Awareness programmes;
iii. PAYT-schemes.

b. Provide feasible alternatives to incineration plants through:
i. R&D support;
ii. Public & Private partnership between municipalities and AD/compost plants;

2) Map the potential and feasibility of using FLW as animal feed in Estonia; participate in relevant discussions on legislation change on the EU level.
3) Based on stakeholder consultations and Best Practice from Finland, adopt clear and easy-to-follow National Food Donation Guidelines, keeping in mind both FLW reduction targets and food safety.
4) Enhance FLW prevention through efficient awareness-raising programmes that are designed to bring about behavioural change in the society.

In addition to the National Food Waste Prevention Programme, a specific category for FLW should be added to the National Waste Data System to measure and report progress on FLW reduction efforts. The category should be defined clearly and be in line with the FLW definition from the WP.

Although the aforementioned policy recommendations do not provide rapid alleviation to the global challenge of FLW and overall sustainability issues, they do offer steps for an EU MS to achieve a more resource-efficient food economy and set a positive example for other MSs. It is through the (pro-)activity of Member States that the EU can become more sustainable and set the example for the rest of the world that it has long aspired to. The author remains hopeful that the renewed Waste Package incentivises Estonian policy makers to address food loss and waste more efficiently and that in turn, efficiency in Member States incentivises the implementation of relevant Pareto Improvements on the Union level.

CONCLUSIONS

Food loss and waste (FLW) amount to considerable resource inefficiency. The problem is relevant globally, on the EU level, and on the national level in Estonia. Globally, approximately one-third of food is wasted (FAO 2011). In the EU, food worth 143,000,000,000 euros goes to waste annually – that is 88 million tons (FUSIONS 2016). In Estonia, households produce 96,000 tons of FLW per year, catering institutions (excluding event-catering and fast-food institutions) 22,000 tons of FLW per year (Moora *et al*. 2015a), and 12,000 tons of food are unsold yearly in food trade enterprises in Estonia (Moora *et al*. 2015b). FLW has strong implications on food security, the environment, and the economy. Not much research has been conducted on FLW reduction policies and the thesis at hand aims to contribute to that field.

The thesis aimed to analyse food hygiene policies and marketing standards in relation to the newly-adopted EU Waste Package in order to prove or refute the hypothesis that FLW reduction and food safety policies need not be in collision – or at least, less so than presently. To achieve this, the following legislative acts were analysed: Reg n° 852/2004 and Reg n° 853/2004 (Food and Hygiene Package); Reg n° 543/2011 (Fruit and Vegetables Marketing Standards); and the renewed EU Waste Package. Additional relevant legislative acts were taken into account where needed and possible. Three factors were of influence while selecting policies:

a) The conflict points between these policies and food donations emerged from exploratory interviews with stakeholders (Rimi Eesti, Toidupank) and at the FLW-themed open hearing in the Estonian Parliament on 23 January 2018;
b) According to Moora *et al*. (2015b), 61% of foodstuffs discarded by shops and supermarkets in Estonia were fruits, vegetables, and meat products. According to the researchers, the reasons of discarding largely entailed food hygiene policies and marketing standards;
c) Relevant policy analyses by the European Court of Auditors (2016) and FUSIONS (Vittuari *et al.* 2015) were taken into account in the selection of concrete legislative acts.

As a result of the analysis, the objectives of policies were not found to be in conflict, yet aspects of EU food hygiene regulations and marketing standards were found to impede the process towards the objectives of the renewed EU Waste Package. Possible amendments and mitigation points were mapped in accordance with Pareto Optimality and were presented as follows:

- In addition to current classes of fruits and vegetables, a third class of "non-standard" products should be made available to consumers;
- Alternative markets for "non-standard" products should be encouraged;
- Specific marketing standards should be revoked or made non-mandatory;
- Influence on current or previous standards on the private sector should be mapped;
- Consumer expectations about market products should be mapped;
- Awareness of the effects of marketing standards on FLW should be raised.

Additionally, the author suggests reviewing liability regulation in the EU with reference to adopting national guidelines and measures for incentivising food redistribution.

In addition to the listed Pareto Improvements, which lay mainly within the domain of the relevant EU institutions, Best Practices were mapped in accordance with the Food Waste Hierarchy recommended by the European Court of Auditors (2016, 10). Whilst MSs can be expected to promote the aforementioned Pareto Improvements and advocate for more efficient policies, the Best Practices present ways to contribute to the FLW-related objectives of the renewed WP on the national level. Based on the core of the thesis and on the Best Practices presented, the author has provided policy recommendations for Estonian policy-makers with regard to FLW reduction and the renewed EU Waste Package. Two main policy recommendations were given:

a) A national food-waste-prevention programme should be drafted and implemented, prioritising the Waste Hierarchy and consisting of a holistic mix of "weak" actions bringing about behavioural change in citizens needed for "strong" FLW prevention;
b) A specific category for FLW should be added to the National Waste Data System to measure and report progress on FLW reduction efforts.

This thesis has, in a timely manner, analysed the interplay between the recently adopted renewed EU Waste Package and EU food hygiene regulations and marketing standards. As FLW policy studies remain scant, further research on the topic would be highly valuable. Policy themes such

as how the EU Common Agricultural Policy and the Single Market Strategy influence FLW prevention could be addressed. Beyond policy interplay, the research theme of the influences of the financial economy on FLW remains to be elaborated on further. The work represents applied policy research, thus it can reasonably be expected that the policy recommendations are applicable to real-world policymaking. The author remains hopeful that the EU continues to aim towards sustainability and that policy optimisation can aid reaching this target. Our daily bread, alongside all the resources invested in it, deserves to be cherished. Through better policies, less waste can be made possible.

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