

BSc Thesis

Student: Nicolien Teunissen

Student number: 960727827020

BSc program: management and consumer studies

Supervisor: prof. dr. J.H. Trienekens

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REDUCING FOOD WASTE OF SUBOPTIMAL FRUITS AND VEGETABLES

Abstract

Suboptimal fruits and vegetables are deviating on aesthetic standards from the optimal ones in terms of shape, size or colour, but are safe and perfectly fit for human consumption.

Nowadays, a big part of these suboptimal fruits and vegetables are wasted instead of processed or sold. This study shed a light on the causes of suboptimal food waste and discusses fields for improvement according the framework of Göbel et al., (2015) to reduce the amount of wasted suboptimal fruits and vegetables.

The fields: structure and rules, recovery and re-use, consumer appreciation and process enhancement are studied. The analysis demonstrate that the fields are in strong relationship with each other and can be combined to form strategies to reduce the amount of food waste of suboptimal fruits and vegetables.

A combination of new structures and rules, gaining consumer appreciation and recovery and re-use will fit to reduce food waste of suboptimal fruits and vegetables. Process enhancement and interface management is needed to facilitate a combination of these fields. Suboptimal fruits and vegetables can be used in the processing industry for human consumption or alternatively for animal feed. In addition, suboptimal fruits and vegetables can be sold to consumers in several ways. To achieve this, clear communication between the farmer and the retailer is necessary and the farmers and the retailers to efficiently make use of suboptimal fruits and vegetables. To support the sales of suboptimal fruits and vegetables, farmers and retailers can be supported by the government via taxes or subsidies. Furthermore, consumers need to be informed about suboptimal fruits and vegetables and food waste. This can be done by retailers, the government, a brand which uses suboptimal fruits and vegetables, environmental organizations or farmers themselves. Crucial is to make people aware of the problem of food waste and the opportunity to reduce food waste by consuming suboptimal fruits and vegetables.

To make sales of suboptimal fruits and vegetables possible, several options have potential, but crucial is that the entire supply chain needs to be taken into account to achieve the goal of reducing food waste.

Content

Chapter 1 Introduction.....	4
1.1 Background	4
1.2 Problem description	6
1.3 Objective	6
1.4 Main question	6
1.5 Sub questions.....	6
Chapter 2 The key actors in the fruit and vegetables supply chain and why do they generate suboptimal products.....	8
2.1 Introduction.....	8
2.2 Actor 1: Farmer; raw materials.....	8
2.3 Actor 2: Manufacturing; processing and packaging industry	10
2.4 Actor 3: Retailer; finished products	10
2.5 Actor 4: Consumer; finished products.....	12
Chapter 3 What is the actual amount of food waste of suboptimal products of each actor ..	14
3.1 Introduction.....	14
3.2 Amount of suboptimal food waste	14
Chapter 4 Structure and rules	16
4.1 Introduction.....	16
4.2 The EU Marketing standards	16
4.3 Alternative uses	17
4.4 Governmental support	18
4.5 Conclusion.....	19
Chapter 5 Re-use and recovery instead of devaluation	20
5.1 Introduction.....	20
5.2 Prevention	21
5.3 Re-use.....	21
5.4 Recycling.....	22
5.5 Recovery	22
5.6 Conclusion.....	22
Chapter 6 Consumer appreciation.....	24
6.1 Introduction.....	24
6.2 Education and information	24
6.3 Price setting and marketing	25
6.4 Conclusion.....	27

Chapter 7 Process enhancement and Interface management.....	28
7.1 Introduction.....	28
7.2 Reducing overproduction.....	28
7.3 A lack of information sharing and poor forecasting:	29
7.3 Collaboration	29
7.4 Awareness campaigns.....	30
7.5 Opening Alternative markets.....	30
7.6 How to apply process enhancement and interface management in the supply chain .	31
7.7 Conclusion.....	32
Chapter 8 Conclusion.....	34
Chapter 9 Discussion	37
Chapter 10 References	39
10.1 Literature	39
10.2 Websites.....	42

Chapter 1 Introduction

1.1 Background

Nowadays, a third of all produced fruits and vegetables is thrown away even before it reaches the consumer (Parfitt et al., 2010). This amount of food waste seems contradictory with the world population growing towards nine billion people by 2050, people who all need food to survive (Gustavsson, 2011).

Food waste can be defined as: “any food, and inedible parts of food, removed from the food supply chain to be recovered or disposed” (Aschemann-Witzel et al., 2015)

The amount of wasted food can be divided in two categories: edible and non-edible waste (Halloran et al., 2014). The difference between edible and non-edible waste is that edible food waste is intended for human consumption since these have the potential to be eaten but are discarded from the supply chain for economic or aesthetic reasons (Halloran et al., 2014).

Non-edible food waste refers to inedible bi-products like a banana peel or bones in meat. Especially the waste of edible products is inefficient as these products are not harmful for health or food safety and they could safely be consumed (De Hooge et al., 2017). Now a part of these edible products is disposed and not used for human consumption or purposes other than the trash can.

These edible products are called suboptimal or imperfect foods. Suboptimal products are products that deviate from normal or optimal products without deviation on the intrinsic quality or safety (Halloran et al., 2014). There are three categories to distinguish for suboptimal products (De Hooge et al., 2017):

- 1) They differ on the basis of appearance standards in terms of weight, shape, colour or size.
- 2) They differ on the basis of their date labelling. In this case they are close or beyond the best-before date.
- 3) They differ on the basis of their packaging such as a torn wrapper or a dented can.

For this research, the focus is on fresh fruits and vegetables which belong to the suboptimal category and are therefore wasted. Fresh fruits and vegetables are not always packed and thus they do not contain an expiry date. The first category is therefore the most influential for these products (Helmert et al., 2017).

Several studies have been conducted on the causes of food waste in general and in the last years, waste of suboptimal products is also receiving more attention. The combination of product quality standards and consumer appreciation is crucial because consumers do not wish to buy and consume suboptimal products (Gustavsson and Stage, 2011). Therefore, the purchase behaviour of consumers influences the stakeholder decisions along the entire supply chain. Since the retailers do not want to buy suboptimal products due to the risk that consumers do not want to buy them, the wholesaler will also not purchase them from the farmer. This results in the fact that a lot of the suboptimal products are thrown away.

Recent research showed that consumers will buy these suboptimal products under certain conditions (Ashemann-Witzel et al., 2015, de Hooge et al., 2017). For example, consumers are in general willing to pay less for foods with visual imperfections than optimal foods. Additionally, the type of sub optimality influences the willingness of the consumers to buy a suboptimal fruit or vegetable. By making a distinction between the optimal and the suboptimal products with classification and prices, consumers realise that there is a difference and consumers will be positive to buy also suboptimal fruits and vegetables. This indicates that there are opportunities that can reduce the waste of suboptimal products.

To reduce the waste of suboptimal fruit and vegetables, two dimensions are distinguished by Buzby et al., (2014), namely prevention and diversification. With prevention, the amount of uneaten food is reduced in the first place. For diversification it is important what is done with uneaten food once it is generated.

Several approaches are discussed in literature to reduce or diversify the amount of food waste within the supply chain to make the supply chain more sustainable and reduce the amount of edible food waste (Kaipia et al., 2013, Göbel et al., 2015). Some are more focused on the sharing of information and cooperation within the supply chain, some more on the consumers and others more on the wasted products itself.

Göbel et al., (2015) state four central fields of action (Fig 1). For every category, the main causes of food waste are mentioned as well as recommendations for research to possible solutions for the causes. The upper fields are more focused on prevention and the lower fields on diversification.

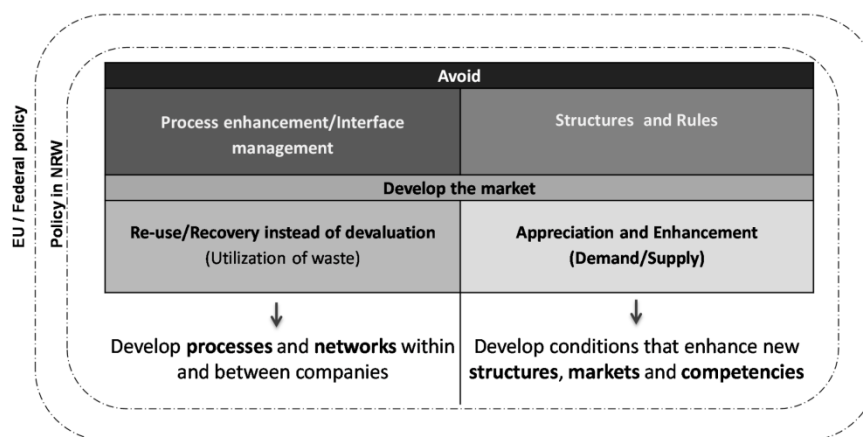


Figure 1. *New appreciation for food- four central fields of action (Göbel et al., 2015)*

For the category “Process enhancement and Interface management”, the problem of insufficient cooperation across actors leads to a lot of food waste. Each actor in the food supply chain tries to optimize their own process but at the same time, their actions may lead to an accumulation of food waste at earlier stages in the chain. For example stock keeping, by demanding a permanent stock availability of suppliers, the risk of spoilage transfers to the earlier stages of production. In this field, the focus is on prevention of the waste by reducing the surplus and on diversification.

The category “Structure and Rules” points out the problem of rules and structures which regulate food production but also induce food waste. The wasted products are in this case

not meeting rules about product quality categories or standards and would be usually classified as avoidable waste. Hence, this field of action focusses on waste prevention. Göbel et al., (2015) recommends a multi-stakeholder dialogue which critically deals with the use of and need for norms, rules, specifications, quality expectations and habits with particular regard to the reduction of food waste. It is important to take consumer protection and food safety into account while studying this field of action.

The third category, “Re-use/Recovery instead of devaluation” focusses more on diversification. Causes of food waste are often linked to a lack of concepts for subsequent use and or insufficiently utilized ways of disposal. These causes and possible options are mentioned in the category “Re-use/Recovery instead of devaluation”.

The last category is “Appreciation and Enhancement”. This field is mainly focussed on causes of food waste linked to the way consumers appreciate food, in the knowledge of food and the ability of preparing or storing food. Recommendations to minimize food waste are to educate and inform actors of the supply chain as well as consumers on the topic of food waste.

1.2 Problem description

Recent studies showed that consumers are willing to buy these suboptimal products (de Hooge et al., 2017, Helmert et al., 2017). The difficulty is the unwillingness of actors in the supply chain to purchase and sell suboptimal products due to different factors. Now these so called suboptimal foods are wasted while there are still customers for them, or other ways to implement them in the chain and find consumers for it. To achieve this, there is a need for the implementation of sustainable solutions across the entire food supply chain to realize the potential of food waste reduction (Parfitt et al., 2010)

There are several lists of factors of influence and possible approaches to adjust the supply chain strategy to implement these sustainable solutions, but they are not integrated with each other to achieve a more closed loop supply chain. By analysing the four central fields of Göbel, an overview of the main constraints and possibilities for action will be generated.

1.3 Objective

Reduce food waste caused by suboptimal fruits and vegetables by investigating alternative use for suboptimal fruits and vegetables

1.4 Main question

How to apply and combine the four central fields of action from Göbel (2015) on the fruit and vegetables supply chain to reduce the waste of suboptimal products?

1.5 Sub questions

- What are the key actors in the fruit and vegetables supply chain and why do they generate suboptimal products
- What is the actual amount of food waste of suboptimal products of each actor

- How can process enhancement and interface management contribute to reducing the waste of suboptimal products
- Which structures and rules are needed to reduce the waste of suboptimal products
- Which forms of re-use or recovery can be implemented in the supply chain to reduce the waste of suboptimal products
- How to achieve consumer appreciation to make selling suboptimal products possible

Chapter 2 The key actors in the fruit and vegetables supply chain and why do they generate suboptimal products

2.1 Introduction

First, the supply chain for fruits and vegetables has to be defined (Fig 2). It all starts with a farmer who grows the product. After harvesting, several actions might be required like sorting, packaging and sometimes processing. The focus of this report is not on processed but fresh fruits and vegetables. However processing can play a role in the implementation of suboptimal fruits and vegetables in the supply chain. For example the processing of suboptimal strawberries to make jam of them. It depends on several factors, as for example the size of the farm, if sorting and packaging happen at the farm or somewhere else. After this step, the products go via retail towards the consumer. Also storage, transportation and logistics play a role for all actors and can have a big influence on the quality.

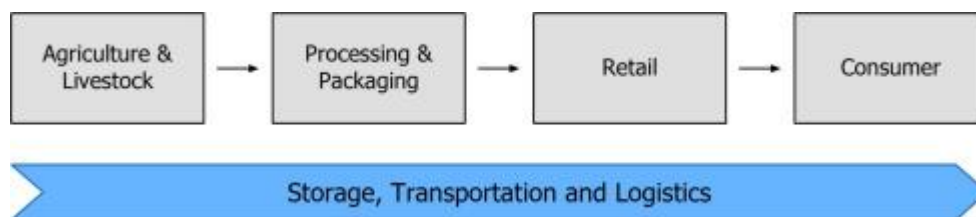


Figure 2. *The food supply chain (Raak, et al 2016)*

Losses of suboptimal products occur among the entire chain. In figure 3, a graphic overview of processing- and product-related food waste and losses is given. In the following part, the main causes for generating edible food waste are examined for each actor.

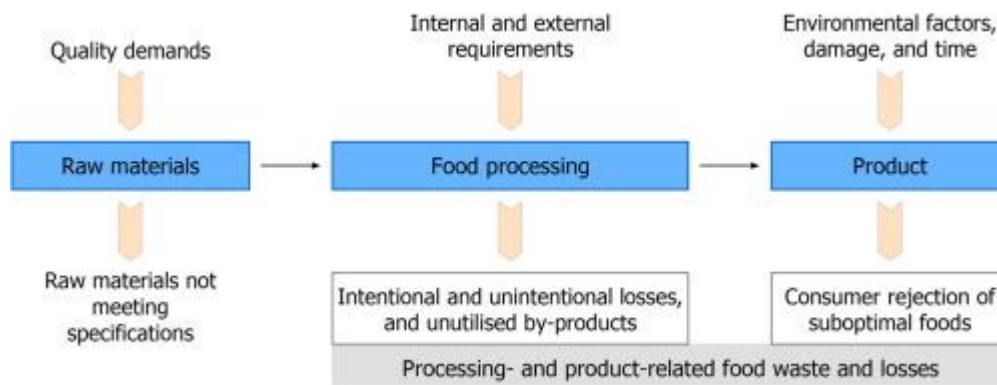


Figure 3. *Processing- and product-related food waste and losses (Raak et al., 2016)*

2.2 Actor 1: Farmer; raw materials

It all starts with the raw materials (Fig 3). For this research, the raw materials are solely the fruits or vegetables at the farm. The size of the production ranges from large-scale commercial farming to small family farms (Halloran et al., 2014).

There are multiple factors influencing the quality of the crops at the farm. Some of them cause food losses, these are products that are no longer suitable for human consumption. Other factors can cause edible food waste where the food is not used for human consumption, but would still be usable (Cicatielle et al., 2016).

Some examples of causes of food loss are weather damage, pest infestation, germ outbreak and processing waste.

The following section focuses on the factors that influence edible food waste. For the farmer these are overproduction, incorrect storage, non-harvest due to low market price and unsuitable quality standards. These causes will be explained in the following part.

For the raw materials, quality demands are mentioned by Raak et al., (2016) as a big influence. In industrialized countries, fruit and vegetable waste is mainly generated before reaching consumers, due to programmed overproduction and unfulfillment of retailer quality standards (Plazzotta et al., 2017). Due to selection depending on visual appearance by the final consumer, the retailer forms standards for the processing/packaging industry and the farmer and therefore quality demands have a big influence on the amount of waste generated at the begin of the supply chain. Due to the standards the main edible waste generated by farmers are crops that do not fulfil the quality standards.

Due to fluctuating demand, weather uncertainty and quality demands, overproduction is required (Plazzotta et al., 2017). This overproduction results in unnecessary inventory which is kept to act as a buffer against poor quality products (De Steur et al., 2016). The inventory at the farm level contains raw crops which are perishable, so when the quality after harvesting seems good, there will remain products in stock and after some time they will have to be disposed. However, these products were edible products without limitations on the intrinsic quality and are now wasted.

Incorrect storage includes storing at an incorrect temperature and food damages due to bad storing facilities (Corrado et al., 2017). Food losses due to storage failures mainly occur in developing countries and not very often in Europe (Parfitt et al., 2010). Besides the country, it depends on the type of crop whether there is a high loss due to storage conditions (Corrado et al., 2017). During the storage period damage can occur to the crop which will cause the crop to spoil faster. In case of temperature failure the fruits and vegetables are mostly not edible because deterioration processes take place when the temperature is too high or too low.

Another crucial aspect that can be influenced during storage of the fruits and vegetables is the colour. The colour of the product can be affected when the storage conditions are not optimal (Gnanasekharan et al., 1992). Due to a deviation in the optimal temperature or the amount of light, fruits and vegetables can discolour and will become classed as suboptimal.

Technical conditions are also a factor of influence for the farmer. To deliver high quality raw materials in sufficient amounts, the quality of the used materials needs to be sufficient. Machine related failures involve losses in the quality of the raw materials and can cause suboptimal products (Bliska et al., 2016). Also, primary and auxiliary materials are involved in this category. For example the use of fertilizers and the quality of the soil influence the quality of the final crop.

In summary, there are several factors which contribute to the origin of suboptimal fruits and vegetables. The weather, the soil quality, storage conditions and more are mentioned. The main reason why the farmer cannot sell the suboptimal fruits and vegetables are the quality standards he gets from the retailer.

2.3 Actor 2: Manufacturing; processing and packaging industry

The second actor in the supply chain of fruits and vegetables is the industry where sorting, packaging and sometimes processing happens. Food processors contribute rather minimally to food waste (Halloran et al., 2014). The main quality shifting happens at the farmer and the retailer. However, some waste is still created at this stage of the process.

For the manufacturer, internal and external requirements are the main factor for the creation of waste and suboptimal products (Raak et al., 2016). These internal and external requirements are associated with food safety and the demand qualities (Göbel et al., 2015). On the one hand products are discarded to prevent health risks, on the other hand products with too low quality are discarded.

The latter category are the products, which do not fulfil the quality standards of the retailer (Plazotta et al., 2017). In this way, there are suboptimal products created at the manufacturer. Contributing to the quality standards, are the standardized packages used for fruits and vegetables. Retailers offer products in a way they believe consumers want them to be presented (Göbel et al., 2015). As a result of that, consumers receive food in the right appearance, weight, size and shape and are standardized packages possible. The standard packages are used to save costs and to provide an optimal quality (Göbel et al., 2015). Due to this the manufacturer can only make use of the fruits and vegetables with the right shape and size, otherwise they will not fit in the package.

Another waste causing event is storage. The products need to be stored when they arrive at the manufacturer and after they are sorted and packed. If the storage conditions are not right, the products spoil and cannot be sold for human consumption anymore. For this reason the generated waste is not edible and also not suboptimal.

2.4 Actor 3: Retailer; finished products

For fruits and vegetables, the retailers are mostly supermarkets and some specialized grocery shops. There are several causes that can be mentioned for food waste at the retailer point in the supply chain (Fig 4).

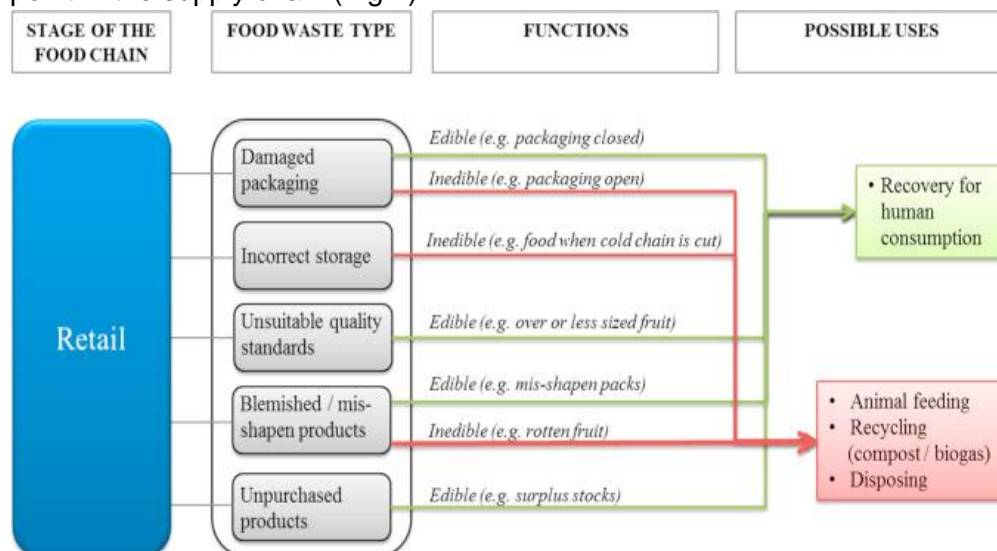


Figure 4. retail food waste and possible uses (cicatielle et al., 2016)

The first one, damaged packaging, plays not that big role for fresh fruit and vegetables since only a small part of the fresh fruits and vegetables is packed. But the ones who are packed and wasted due to damaging, belong to the group of suboptimal food waste. This because they are still perfectly edible, but a broken package makes them suboptimal.

Incorrect storage in terms of temperature is an important factor for a lot of fruits and vegetables. The wasted products as a result of incorrect storage, are classified as inedible and therefore not belonging to the suboptimal category and are not considered in this research.

Again, unsuitable quality standards are mentioned as a cause of edible food waste.

A bit similar with the unsuitable quality standards category, are the products that are blemished or misshapen. The biggest difference is that there are also inedible products in this category. A blemished apple for example, can be the result of a decolourization without affecting the intrinsic quality and is still edible, or it is a sign of rotting which makes it unfit for consumption.

The last category is unpurchased food, also called surplus food. These fruits and vegetables are produced, processed and delivered to retail but not sold or not consumed for various reasons (Bliska et al., 2016) Food surpluses are a form of waste that is mostly observed in developed countries (Asheman-Witzel et al., 2015). The explanation for these surpluses is programmed overproduction (Papargyropoulou et al., 2014). It is estimated that there is a surplus needed of 30% to compensate for unexpected losses and to maintain food security. But the actual surplus is currently exceeding 50% (Raak et al., 2016). There are two main reasons why this is so high. Both of the reasons are a consequence of trade demands. The first is the risk of not complying with quality requirements. This risk is not only present at the retailer stage, but starts at the beginning of the supply chain for the farmer.

The second one is the risk of being burdened by contractual penalties or product take back when not fulfilling trade demands (Raak et al., 2016). Because of these reasons, a higher production value than needed is forced to fulfil the demands and to avoid penalties. Penalties are expensive both penalties and not fulfilling demand trades can give the company a bad name. Companies avoid this risk by planning overproduction and store a lot of products which at the end are spoiled because of perishability.

The food waste at the retailer state was neglected by studies for a long time but it is an issue that is gaining more attention in the public opinion. This is because much of the food wasted at the retailer stage, unlike most of the other stages, is still fully fit for human consumption (Cicatielle et al., 2016). Another important aspect is that the retail can contribute in limiting the implication of food waste in a consistent way. At the same time, sustainability is becoming an important business issue for retailers, as their practices may influence the whole supply chain (Claro et al., 2013). This makes retail an interesting stage in the supply chain for reducing food waste.

To summarize, the main motives to waste suboptimal fruits and vegetables are unsuitable quality standards, blemished or misshapen products and surpluses.

An underlying reason for these motives is that for a retailer, an attractive produce department is regarded as the best way to give a positive quality image of their store (Nunes et al., 2009). To achieve this, the retailers offer products in a way they believe the

consumers want them to be presented (Göbel et al., 2015). Therefore the sensory attributes of fruits and vegetables have to fulfil the requirements the retailer sets.

2.5 Actor 4: Consumer; finished products

The last actor in the chain is the consumer. Consumers are a big player in food waste for developed countries (Asheman-Witzel et al., 2015). Therefore their role is crucial for reducing food waste.

Among the consumers are differences in the attitude towards waste. Overall, research found that women, younger consumers, consumers with children, lower educated consumers and consumers with a higher household income tend to waste more food (De Hooge et al., 2017) Also personal interest in for example the environment influence consumer behaviour towards food waste.

There are a couple of drivers for consumers to waste products themselves, so at home. Another way of waste caused by consumers, is when they just do not buy particular products at the retailers.

For the decision of buying a product at a retailer, there are two main influencers: aesthetic aspects of the product and date labelling (Asheman-Witzel et al., 2015). However, date labelling is not relevant for fresh fruits and vegetables.

The aesthetic standards are definitely applicable on fresh fruits and vegetables. The appearance of fresh fruits and vegetables is a primary criterion in making purchasing decisions. Product appearance is characterized by colour, size, shape, condition and absence of defects (Kays., 1999). It seems that households are unwilling to purchase suboptimal or imperfect food based on the appearance (De Hooge et al., 2017)

Colour indicates the degree of ripeness and is associated with taste and especially quality (Kays., 1999). The products which look unripe or too ripe, like brown banana's, will not be purchased. De Hooge et al., (2017) found that products with a colour deviation were perceived as unattractive, unsafe to eat, and a bad taste. But consumers appeared to be willing to purchase and consume a product that deviated on the basis of shape. Furthermore, consumers indicated lower necessities for discounts and lower tendencies of wastage for a shape deviating product than for other suboptimal products. However, a deviation in terms of colour was only very limitedly accepted.

The desired size can differ among consumers and depends also on the price setting. If fruits or vegetables are sold by weight, the somewhat smaller fruits and vegetables are desired (Kays., 1999). When they are sold at a fixed price, a larger size seems to be preferred (Kays., 1999).

The last two attributes are linked with natural deterioration processes of fruits and vegetables. Fruits and vegetables are very sensitive for temperature changes, too hard handling and by the time they spoil. The condition of the product in terms of freshness will decrease and the change of defects will increase (Kays., 1999). In theory the products are suboptimal, but they started as optimal products. So they are a bit in between because after some time these products will not be edible anymore.

Consumer preferences for suboptimal food products are suggested to play a large role in the retailer and consumer food-waste issue (Aschemann-Witzel et al., 2015). Almost every type of suboptimal product can be sold when consumers receive a discount or are better informed about the suboptimality (De Hooge et al., 2017). When they would purchase it, it is not wasted anymore and retailers will see opportunities in selling suboptimal products. In this way consumers can contribute to reducing the amount of food waste.

Chapter 3 What is the actual amount of food waste of suboptimal products of each actor

3.1 Introduction

The aim of this chapter is to describe the amount of suboptimal fruits and vegetables that are wasted on a yearly basis.

It is difficult to quantify the amount of food waste for a specific country, product, branch or company. First, there are a lot of definitions for food waste or food loss (Parfitt et al., 2015). Second, the amount of waste differs a lot per type of product. However this is only on food waste in general. The data available on food waste of suboptimal products is still scarce.

3.2 Amount of suboptimal food waste

The FAO, food and agriculture organization of the United Nations, published a report in 2011 about global food losses and food waste. In Europe, there is a production volume of 200 million tonnes of fruits and vegetables per year.

According the FAO, the total food losses and waste for fresh fruits and vegetables is 56% a year for Europe. The waste is mainly generated at the farmer and the consumer stages (Fig 5). These two actors count together for more than half of the total waste. The total amount of food waste of fresh fruits and vegetables in Europe is 68,57 million tonnes a year. Of this amount a significant part is still edible: 53,25 million tonnes. This edible part of the total waste accounts for 77.66% of the total.

Stage	loss in %	Total food waste of fruits and vegetables in 1000 tonnes that was allocated for human consumption	Food waste of edible fruits and vegetables in 1000 tonnes
Agricultural production	20%	41502	31957
Post-harvest handling & storage	5%	8146	6273
Processing & packaging	2%	2378	1784
Distribution	10%	6105	4884
Consumption	19%	10439	8352
Sum	56%	68570	53250

Figure 5. *Calculations of losses and waste for fruits and vegetables in Europe, (FAO 2011)*

As mentioned before, there are multiple reasons for edible products to be discarded from the supply chain. A part of the edible fresh fruits and vegetables is discarded due to low market prices, damages, incorrect storage and poor planning or cooking skills of consumers

(Ashemann-Witzel et al., 2017). For this section, the focus is on the suboptimal fruits and vegetables that are discarded due to aesthetic reasons.

In the Netherlands, there is an initiative called Kromkommer. They make soup of rejected vegetables because of their looks and provide a lot of information via social media to consumers about suboptimal vegetables. They state that 10% of all produced vegetables and fruits is wasted on basis of appearance (<http://www.kromkommer.com>). In 2007, there was a production of 166 million tonnes of fruits and vegetables in Europe (FAO, 2011). When using the number of 10% for suboptimal foods, the amount of wasted suboptimal foods due to aesthetic standards was 166 million tonnes.

For 2007, as seen in figure 5, the total amount of edible waste was 53,25 million tonnes. One part of this edible waste is the 166 million tonnes of waste of fruits and vegetables because of their looks. The waste of food due to aesthetic standards is then 31.17%.

To conclude, it can be said that food waste of fresh fruits and vegetables mainly occurs at the farmer and consumer stages. However, in the report of the FAO the retailer is not mentioned as a separate actor. Literature states that retailers also have an substantial role in causing food waste.

Chapter 4 Structure and rules

4.1 Introduction

This chapter describes the field “structure and rules” of the framework of Göbel et al., (2015). Some current structures and rules for the fresh food supply chain will be mentioned and their impact on the generation of suboptimal fruits and vegetable waste is explained. In the literature some possible changes for rules or structures are already mentioned and an overview of them is given. The aim of this chapter is to explore which structures and rules are needed to reduce the waste of suboptimal products.

4.2 The EU Marketing standards

Till July 2009, the United Nations Economic Commission for Europe (UNECE) stated 36 specific EU product marketing standards for fresh fruits and vegetables. But in July, the UNECE reduced this amount of marketing standards to ten (Milzow., 2009). This decision was made to limit waste and to increase product choice for the consumer.

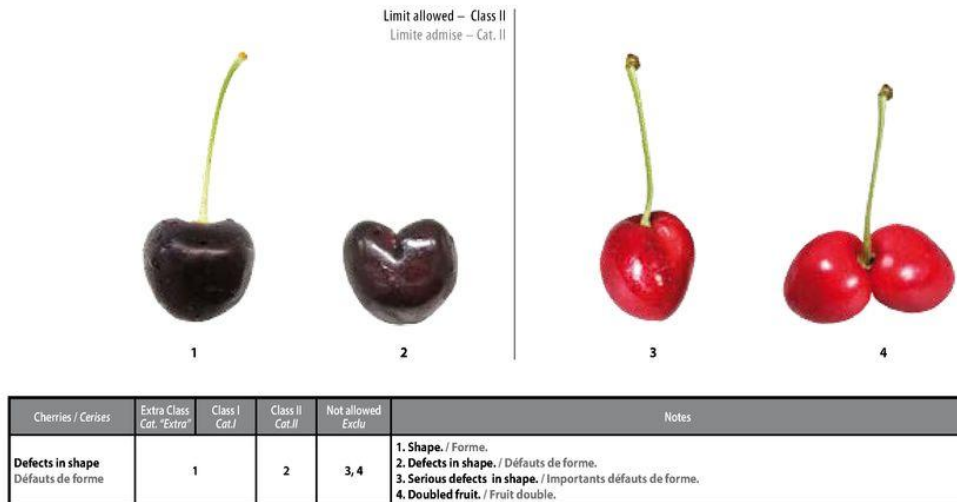
These standards include some minimum requirements regarding food safety and some quality standards referring to shape, size and colour (www.unece.org). All previously described actors in the fruits and vegetables supply chain have to deal with these standards.

In practice, the impacts of repealing the specific EU marketing standards to ten remained quite small (Priefer et al., 2016) and some conclude that it was only a large symbolic initiative (Milzow., 2009). The sales of fruits and vegetables with deviant shape, size or colour were not increased. This has to do with the fact that categorization of products into different quality levels or classes of trade is still allowed (Göbel et al., 2015). This is done to provide homogeneity whereby products fit in a standard package and are optically the same (Blasco et al., 2013). Besides that, the old marketing standards were still being used as private standards (Waarts et al., 2011). So, companies still work with the old standards and they are widely available.

For fifty different fruits or vegetables a separate handbook on UNECE website is available (<https://www.unece.org/trade/agr/standard/fresh/ffv-standardse.html>). In these handbooks, first the minimum requirements for food safety are described. Then a chapter about classification follows and the requirements for all the classes, like extra class, class 1 and class 2 are described. The conditions in which a certain product has to be in terms of shape, colour defects and size are mentioned with exact numbers.

Besides these standards, there is also a link mentioned by the reports to the website of OECD, the Organisation for economic co-operation and development, which provides fruit and vegetables schemes to facilitate international trade. The schemes they have, are used by 25 European countries and facilitate the consistent interpretation of the international standards for fruit and vegetables by means of photos and explanatory notes (<http://www.oecd.org/agriculture/fruit-vegetables/publications/brochures/>). In figure 6, an example of such a criterion for cherries is visible. Three types of defects in shape are shown and in the table the defect of shape is linked to a quality class. This is an example of quality standards which are still used, however it is not mandatory. Often it happens that the class 2 products are not sold in supermarkets and therefore also not bought by the retailers. Numbers 3 and 4 are not allowed in the lowest class, despite the fact that they are perfectly edible.

Defects in shape
 Défauts de forme

 Classification - Defects in shape
 Classification - Défauts de forme


14

© OECD 2015



Figure 6, classification on deviation in shape for cherries (http://www.keepeek.com/Digital-AssetManagement/oecd/agriculture-and-food/cherries_9789264248625-en-fr#.WVotSYR9670)

This categorization causes food waste of edible suboptimal products which do not fulfil the standards, as for example the class 2 cherries. So, the European marketing standards are in combination with the categorization the most influencing policies which encourage food waste of suboptimal fruits and vegetables (Waarts et al., 2011). In the following part, several options to alter these rules or ways to deal with these rules will be discussed.

Priefer et al., (2016) discusses amendment of the existing European marketing standards as an option to possible reduce the waste of suboptimal fruits and vegetables. Criticism on the previous change of the regulations came from farmers and processors of producing countries (Priefer et al., 2016). The larger farmers have adjusted their production to the standards and use as much high class products as possible to avoid losses in the operations because, from the farmers point of view, making use of suboptimal products is not efficient because machines, material and logistics are not set up for them (Waarts et al., 2011). So the curly cucumber can be sold according the existing rules, but it does not happen that often because of stricter private standards to foster efficiency.

4.3 Alternative uses

According to Priefer et al., (2016) and Waarts et al (2011) it is most promising to further develop solutions for alternative sales and processing of products which are now used for animal feed or thrown away instead of changing the EU regulations. By finding alternative ways, the private standards can be tackled. To achieve this, companies are needed that are able and willing to sell, process and transport suboptimal fruits and vegetables. Hence the

current machines and logistics do not support fruits and vegetables deviating in size and shape, other equipment or way of working is necessary to achieve this.

This new equipment and alternative selling practices can be efficient solutions, but require some investments. These investments are a bit risky because the market of suboptimal fruits and vegetables is quite new and not much is known about it. Besides that, the selling prices for suboptimal fruits and vegetables should be lower, otherwise consumers do not buy them (De Hooge et al., 2017). In summary, a new market, little information about the market and low selling prices does not sound as the most attracting financial investment. But there is some potential for change. Making use of suboptimal fruits and vegetables is important to lower greenhouse gas emission, to reduce waste and is a step to provide enough food for nine billion people in 2050 (Gustavsson et al., 2011). Therefore the EU and local governments recognise the need to reduce food waste of suboptimal products and want to stimulate companies and people in reducing this waste (Thyberg et al., 2016).

4.4 Governmental support

The government can support producer cooperatives or other collaborations in starting up an initiative to reduce the waste of suboptimal fruits and vegetables. Firms are often willing to achieve environmental or social goals, as for example reducing food waste, because this enhances their competitive advantage (Niesten et al., 2017). Niesten et al., (2017) found out by analysing different case studies that collaborative governance forms are often necessary to achieve sustainable benefits such as reducing food waste. An example is the government of Brazil. They facilitated companies' collaboration in donations to food banks with tax deductions and then food which otherwise would be wasted was used (Aschemann-Witzel et al., 2016). Also Hanss et al., (2013) states that structural strategies as subsidies or green taxes are an efficient way of promoting sustainable behaviours. A first step could be to review the current EU tax regulation in order to remove all incentives that may encourage the generation of food waste. This can be legal requirements for the prevention of risks to consumers' life and health, which are anchored in various EU regulations (Priefer et al., 2016). These may conflict with the ambition to avoid food waste (Priefer et al., 2016). A prerequisite for any weakening of the strict standards is that further research will be carried out to exclude microbiological and chemical risks for consumers (Priefer et al., 2016). A limitation against changing the health and safety standards is according to Priefer et al., (2016), that fruit producers, wholesalers and supermarkets would not adopt toned down norms in practice. Because these actors often adhere to even stricter safety limits than required by law as a result of the 'naming and shaming' of retailers when they get in the media because of a food scandal (Priefer et al., 2016)

Second, taxes and fees can be introduced to make use of suboptimal fruits and vegetables (Priefer et al., 2016). One example is the introduction of taxes and fees on waste treatment which can be seen as economic incentives as they escalate the total costs of waste handling, increasing the financial benefits of waste reduction (Priefer et al., 2016). When using taxes on waste treatment as a tool to prevent food waste, certain requirements have to be met: the tax rate must be high enough to create a sufficiently strong incentive for waste minimisations as well as for the donation of waste or surplus to food charities. However, high taxes can provoke illegal dumping, so regulatory measures need to be developed as well (Priefer et al., 2016).

4.5 Conclusion

In the end, it can be said that private regulations among the actors in the fresh fruit and vegetable supply chain are key in withholding of selling suboptimal fruits and vegetables.

To change this, alternative sales and markets need to be developed. When a place is created for these products and it becomes a business opportunity, the private rules will not stop the sales of these fruits and vegetables anymore. To set this up some things are important. The timing to create these markets has to be good (Aschemann-Witzel et al., 2016), marketing is important (De Hooge et al., 2017) and collaboration among the actors and involving the government can contribute to a success and a reduce of waste. After some time, the private standard become less important or will be adjusted which makes selling the suboptimal products easier. The consumers are willing to buy these products, now the companies need some support to actually bring the suboptimal fruits and vegetables on the markets.

Another crucial subject when talking about regulation are the taxes. Some countries are already experimenting with taxes as an instrument for food waste reduction and these pilots suggest that there is a clear relationship between the total costs of landfilling and the percentage of municipal waste recycled and composted (Priefer et al., 2016).

Chapter 5 Re-use and recovery instead of devaluation

5.1 Introduction

This part aims at another side of reducing suboptimal food waste, namely by finding customers for suboptimal fruits and vegetables and make use of them for other purposes than selling at a supermarket. These can be end-consumers, but also companies like manufacturers or animal feed companies who can make use of suboptimal fruits and vegetables to recover or reuse the products instead of throwing them away. So, this chapter focuses on forms of re-use or recovery which can be used or implemented in the supply chain.

In the current situation only 2% of the edible food loss is recovered for human consumption (Dou et al., 2016). This show that there is a large amount of edible food which can possibly be recovered. Suboptimal fruits and vegetables have a high degree of recoverability, which means they are easy to recover and can be potentially consumed by people without prior transformation (Garrone et al., 2014)

To get suboptimal fruits and vegetables to potential consumers, is finding an appropriate way to recover or reuse the fruits and vegetables. The European Parliament Council constructed a food recovery hierarchy in 2008. This hierarchy is not specific for suboptimal products or fruits and vegetables, but for food waste in general.

Nevertheless, it can be applied to recover suboptimal fruits or vegetables. Figure 7 shows the order of most to least preferred way of food recovering.

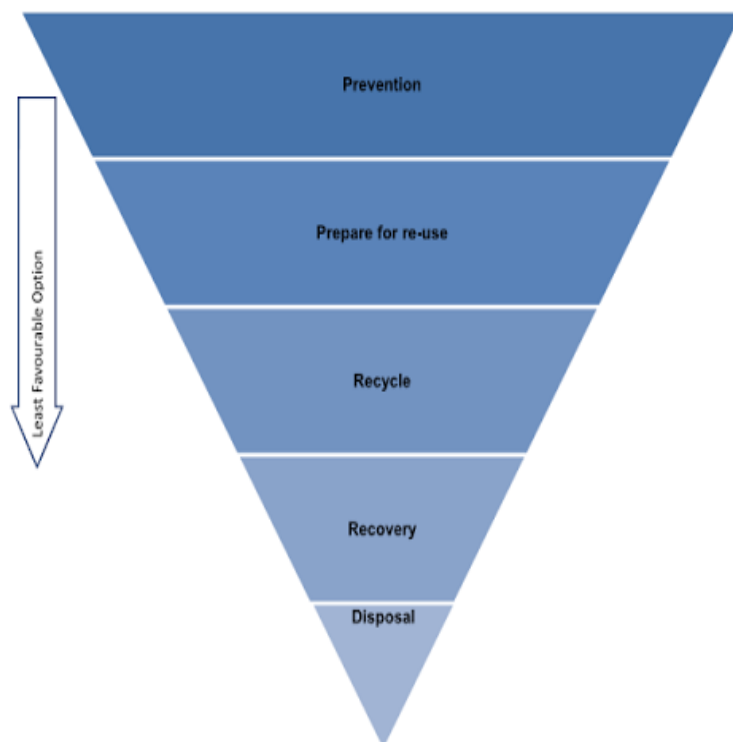


Figure 7. *The waste hierarchy (Papargyropoulou et al., 2014)*

In 2016, 1.6% of 'wasted food' in the manufacturing sector and 18% of the 'waste' in the retail- wholesale sector was recovered for human consumption through donation (Dou et al.,

2016)., In the current situation, the majority of wasted food at the manufacturer stage is used for animal feed and at the retailer stage it is disposed (Dou et al., 2016).

5.2 Prevention

Most preferred is prevention. Prevention consist of reducing at the source, optimizing processes and adapting processes to needs (Mourad., 2016) In general, prevention mainly focuses on decreasing the food surplus (Dou et al., 2016). This leads directly to less food waste. Source reduction of suboptimal fruits and vegetables itself is not that realistic, since fruits and vegetables are agricultural products and not much can be changed yet on how they grow in terms of shape, size and colour. The other way of source reduction is changing classification rules, see chapter 4, whereby suboptimal products are not suboptimal anymore and are used as a lower class product. These classification roles are being used by the retailers and have crucial impact upstream the supply chain. This is in line with the assumption that food waste prevention in developed countries should focus more on the retail and consumption stages (Papargyropoloul et al., 2014). The retail stage is definitely important when talking about prevention of food waste caused by suboptimal fruits and vegetables. If they would make use of these fruits and vegetables, the products do not need to be wasted in all stages of the supply chain till the retailer.

Also technological improvements are a method of prevention of suboptimal fruits and vegetables. Technological improvements in packaging, sorting machines or logistics could making use of unstandardized shaped fruits and vegetables much easier and so prevent the waste (Papargyropolou et al., 2014).

5.3 Re-use

The second option in the waste hierarchy is re-use. Re-use means in this context: redistributing food to people who need and/or want it (Mourad., 2016). The category re-use is very suitable for suboptimal fruits and vegetables because they still fit for human consumption. In this case, the fruits and vegetables which are rejected by retailers because of deviating colour, shape or size but are still safe and perfectly edible, can be easily used by the end consumer. Re-use can take place at production, retailer and consumer level (Mourad., 2016).

Re-using suboptimal fruits and vegetables can involve gleaning unharvested or unused produce on farms and retailers (Mourad., 2016). Some examples are making jam, drinks or soup of deviating fruits and vegetables. Then the suboptimal products are distributed to processors after the farmer or processor stage in the supply chain.

Another way of re-use is matching the supply of suboptimal fruits and vegetables to the demands of food banks and charities to feed people who do not have access to enough food.

Since the increasing attention for edible food waste at the retailer stage, companies get interested to do something to prevent edible food waste (Cicatiello et al., 2016). Various charity organizations work in partnership with food establishments to re-purpose unsaleable but safe-to-eat food for food-insecure families. Also start-ups now see food recovery as a potential profit-making opportunity (Mourad., 2016). Aschemann-Witzel et al., (2016)

mention that companies see initiatives against edible food waste as a business opportunity. For this reason, it becomes more popular and an interesting way of doing something good and earning money.

Since there is more awareness making use of suboptimal products, actors also ask what would happen if more food would be redistributed. One of the main challenges is that the donated foods not necessarily match with the needs of the hunger-relief organizations and their clients. Sometimes they count in kilograms per person, so companies are encouraged to donate heavy food that is not always nutritious (Mourad et al., 2016). Fruits and vegetables are very nutritious, but not heavy. Besides that, food recovery is increasingly institutionalized through national partnerships between food bank networks and stores headquarters. Many smaller retailers or for example farmers do not have recourses to fill out all the required paperwork (Mourad et al., 2016).

In the UK, a case-study was executed in cooperation with the charity FareShare to donate surplus foods to a Day Centre for homeless people and a residential homeless hostel (Alexander et al., 2008). They also faced the problem of heavy and luxury foods donated. For them this is difficult, because they make meals with the donated food. But a crate of apples isn't a good combination with some pudding and salmon sandwiches for a diner. But in general, donating or selling at a lower price to charitable organizations is a good way of reusing the suboptimal fruits and vegetables.

5.4 Recycling

The next option is recycling. There are two ways recycling finds mostly place. The first is recycling of food waste into animal feed and the second is recycling of food waste via composting. This is mostly done with food that is no longer suitable for human consumption and therefore not the most ideal option for suboptimal fruits and vegetables, but it is still higher in the hierarchy than disposal. The fruits and vegetables can send to an animal feed company when collected at the farm or at the processor, but another option is after the supermarket (Brancoli et al., 2017). Brancoli et al., (2017) did an experiment with bread waste at a supermarket and it appeared that the use of bread waste as animal feed had an advantage, since it decreases the environmental impact at the same time as being a revenue stream for the supermarket. This could possibly be done with suboptimal fruits. If a lot of suboptimal fruits and vegetables will be leftover at the supermarket, they can be sold for animal feed. However, fruit and vegetables are not ideal for animal feed because of the moisture content.

5.5 Recovery

The last category before disposal is recovery for energy via anaerobic digestion. Recovery for energy is mostly done with unavoidable food waste as by products. So, this is also not the most applicable solution for suboptimal fruits and vegetables. But, maybe it can be combined with re-use. If fruits and vegetables are used for soups, salads, jams etcetera, there exist by-products and these can be used for energy.

5.6 Conclusion

When following the hierarchy of recovery, prevention and reuse are the most favourable options (papargyropoloulou et al., 2014). Prevention of the waste of suboptimal fruits and vegetables can be stimulated on multiple ways and is also discussed in the other chapters. For this part, reuse is very important. Reuse is very applicable For example by donating (Mourad et al., 2016) or processing the fruits and vegetables into other food products (Dou et al., 2016).

Recycling can also be applied to the wasted suboptimal fruits and vegetables but is less preferred (Brancoli et al., 2017).

Chapter 6 Consumer appreciation

6.1 Introduction

This chapter studies the field of consumer appreciation, described by Göbel et al., (2015). This field is aimed at developing a new appreciation for food to minimize food waste linked to consumer perception. To minimize food waste caused by suboptimal fruits and vegetables, consumers are a very crucial actor. This is because all the other actors in the chain prefer not to make use of suboptimal fruits and vegetables as a result of the unwillingness of consumers to buy them (De Hooge et al., 2017). Therefore strict marketing standards exist which cause the waste of suboptimal fruits and vegetables (Aschemann-Witzel et al., 2016). If the attitude of consumers towards these products can be changed, it can lead to less strict marketing standards or adjusted structures or rules (De Hooge et al., 2017). Also process enhancement or interface management is partly based on the attitude of the consumer towards suboptimal fruits and vegetables.

To influence the consumer perception of suboptimal fruits and vegetables, some instruments are mentioned. The most promising will be explained further. These are: education and informing of the consumer and price setting and marketing.

6.2 Education and information

Consumer perception and habits are crucially shaped by their upbringing, the social and cultural background and what they have been taught to expect in the food market environment that they face (Aschemann-Witzel et al., 2015). They rationally pick the good looking fruits and vegetables and are not familiar with the suboptimal ones. Experts mention that providing information and educating consumers is needed to change their habits. Consumers use the available cues about a product to assign a specific quality category in which the negative cues have more impact than positive ones (Purohit et al., 2001). If the right information is provided, this cues can influence the quality people assign to a suboptimal fruit or vegetable.

A crucial factor for consumers when taking decisions about their fresh groceries in the supermarket is food safety (De Hooge et al., 2017). As mentioned before, suboptimal fruits and vegetables only differ in appearance but are as safe as the optimal ones, but this is not known by consumers. When it is known, consumers will be more positive towards suboptimal fruits and vegetables.

Creating awareness is a part of educating the consumers about suboptimal fruits and vegetables. People are not aware of the mismatch or problems created by their behaviour, such as the waste created by abnormally shaped foods (Loebnitz et al., 2015). They do not link suboptimal fruits and vegetables to food waste. But, recognizing the problem is a prerequisite to fixing it (Dou et al., 2016). If people are more aware of the food waste issue behind the suboptimal fruits and vegetables, it is more likely that they are going to show pro-environmental behaviour by buying these fruits and vegetables (Loebnitz et al., 2015). In figure 8, the relation between problem awareness of food waste and the purchase intention of suboptimal fruits and vegetables (carrot, lemon, eggplant and apple) is shown.. Therefore, the effect of self-identity on food purchasing behaviour likely interacts with people's

awareness of food waste issues (Loebnitz et al., 2015). Values and moral considerations, as doing the right thing, are the main determinants of pro-environmental behaviour.

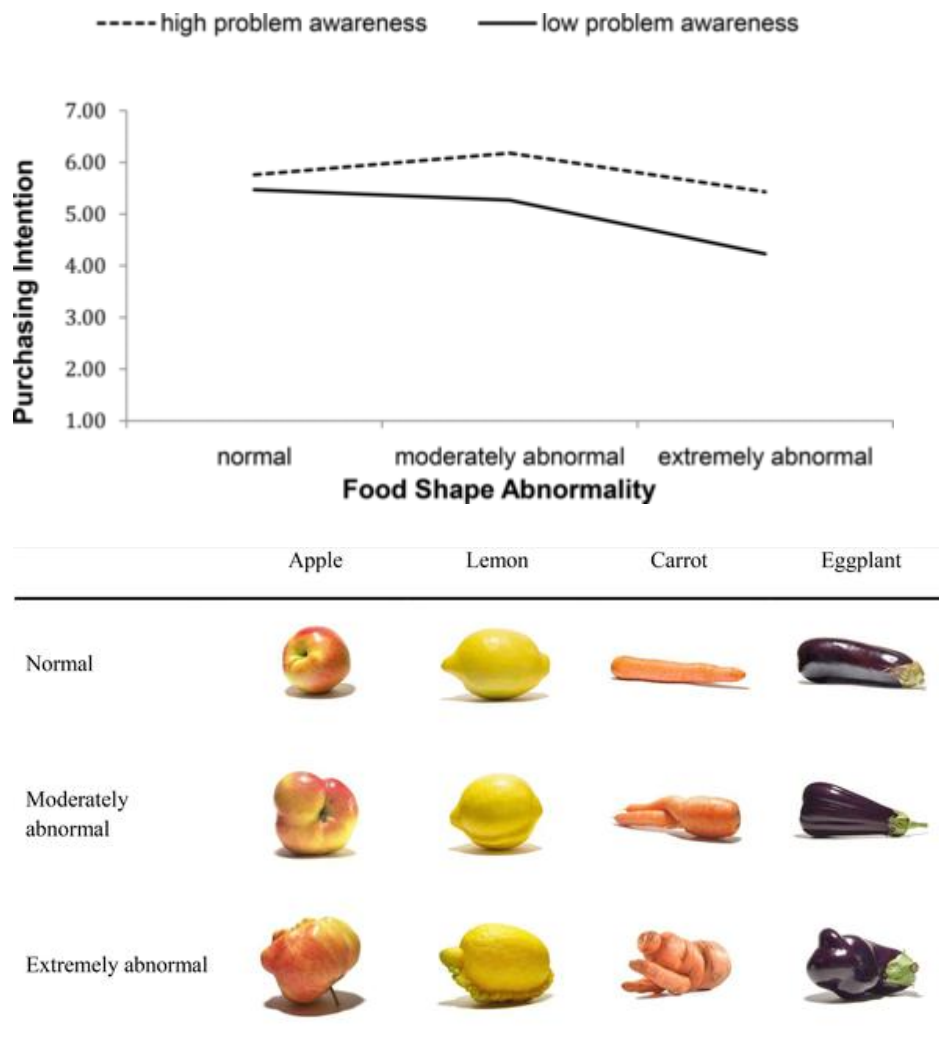


Figure 8. Interaction effect of food shape abnormality and problem awareness on purchasing intentions (Loebnitz et al., 2015).

So, it is crucial to share information with consumers about suboptimal fruits and vegetables to create some awareness and educate the consumer about the products. To inform and educate successfully, it is important to repeatedly provide information, since consumers tend to forget. Furthermore delivering information via various sources is essential, as consumers differ as to which information source they rely on most (Aschemann-Witzel et al., 2015). Information and capacity building initiatives ought to focus on the positive aspect of valuing and using the food, in a tasty and fun way. This can possibly be done by using a sense of humor and ascribing suboptimal foods as a personality (Aschemann-Witzel et al., 2016). Dou et al., (2016) even suggest to involve this subject in the education of children to get them used to these kind of products and the story behind it. Their food habits, knowledge and attitudes will determine not only their own behaviour over their life-spans but also affect future generations (Dou et al., 2016).

6.3 Price setting and marketing

Consumers' willingness to pay for a product decreases with the extent of the remaining shelf-life (Tsiros et al., 2005). This in combination with the fact that consumers base their judgement about quality, freshness and remaining shelf-life on how a product looks, makes that consumers do not want to pay the same price for a suboptimal product as for an optimal product (Aschemann-Witzel et al., 2015).

For fruits and vegetables, the type of sub-optimality has an influence on the motivation and willingness of consumers to buy them and therefore also on the price. De Hooge et al., (2017) found that consumers are more willing to buy a product deviating in shape than a product deviating in colour. A suggestion for retailers is to make a distinction between appearance deviations in terms of shape, colour and size since this makes a difference for the consumer and the value of the product (de Hooge et al., 2017 and Calvo-Porrall et al., 2017).

Another factor that has to be taken into account when attracting consumers for suboptimal fruits and vegetables, are personal factors such as age, environmental concern and knowledge (Melbye et al., 2017). This results in different prices, but also in different marketing strategies for each target group (Melbye et al., 2017). Some people will be interested in suboptimal fruits and vegetables because they are cheaper, then the benefits of costs saving need to be emphasized. Others will buy them out of environmental concern, then the fact that it otherwise would end up as waste and lead to more production and gas emission has to be highlighted (Aschemann-Witzel et al., 2015). De Hooge et al., (2017) conclude after research, that their data suggests that there is a marketing potential for suboptimal foods, especially towards people interested in cooking. Because they are most familiar with the products and know how to deal with them.

The retail sector plays a crucial role as the link between the stakeholders in the supply chain system and their logic on one side, and consumers, authorities and waste-handlers with a different logic on the other side (Halloran et al., 2014).

When retailers include suboptimal products in their standard assortment, people get used to it. According to the mere exposure effect, consumer will be more open to suboptimal products after some time (De Hooge et al., 2017). This increases the likelihood of purchasing and at the end generates a stable group of consumers for suboptimal fruits and vegetables.

To develop the process of selling suboptimal fruits and vegetables, retailers can further test and evaluate different pricing strategies for suboptimal products to strike a balance between consumers' desire of an optimal price-quality relation and reducing food waste (Aschemann-Witzel et al., 2015). Retailers can try out different prices for different quality classes.

A final step for the retailer, is to work towards the reduction of food waste upstream the food supply chain by making use of their negotiation power and downstream by finding alternative ways to dispose when foods cannot be sold. For example by passing it on to food banks or by letting them convert it into other products. (Ashemann-Witzel et al., 2015).

Some examples show that marketing campaigns of supermarkets that provided or still provide suboptimal fruits and vegetables are successful (De Hooge et al., 2017).

In the Netherlands, the retailer Albert Heijn started with selling suboptimal fruits and vegetables under the name “Buitenbeentjes”. It appeared to be successful and the assortment of the suboptimal fruits and vegetables is still expanding. The price for the “Buitenbeentjes” is slightly lower than the price for the optimal variants (<https://www.ah.nl/buitenbeentjes> and de Hooge et al., 2017).

In France, the large retailer Intermarché launched a campaign to promote malformed fruit and vegetables (<http://itm.marcelww.com/inglorious/> and Aschemann-Witzel et al., 2016). The fruits and vegetables were sold at a 30% reduced price and were presented in separate aisles and had their own in-store communication via posters. The campaign got impressive media attention, boosted store traffic in the fruit and vegetable section with 21%, increased sales and maybe one of the most important things, it triggered competitors to act similarly. Besides that, the campaign motivated consumers to reduce food waste, offering the benefit of reduced price in return. After one month, 21 million people were reached with this campaign. Half a year later, it was announced that French retailers should be prescribed by law to deal with oversupply.

Both examples show that retailers are able to create a business case revolving around food waste resulting in direct benefits (Aschemann-Witzel et al., 2016). The suboptimal fruits and vegetables were ascribed as a personality and this campaign attracted people (Aschemann-Witzel et al., 2016).

6.4 Conclusion

To conclude, it can be said that information and education as well as price setting and marketing are important drivers to achieve consumer appreciation. Information and education helps the consumer to understand what suboptimal products are and why they should be eaten. Price setting and marketing is supportive in showing the consumer what the benefits are of these suboptimal products in term of price but marketing can also give people the feeling they are doing something good if they purchase suboptimal fruits or vegetables instead of optimal ones.

Chapter 7 Process enhancement and Interface management

7.1 Introduction

The fourth central field of action is process enhancement and interface management. This part studies how the waste of suboptimal fruits and vegetables can be reduced by process enhancement and interface management and is key in integrating the other three fields in the supply chain.

The main critical point at the moment for this category is insufficient cooperation (Göbel et al., 2015). Every actor in the chain wants to optimize their own processes and products, but at the end this is not the best for the entire supply chain. This has become visible in the previous section in terms of surplus formation and quality demands. In the current situation, quality demands induce programmed overproduction at all stages to ensure the demand requirements and to avoid penalties (Raak et al., 2016). This stems from the variation of the fruits and vegetables. Despite it is natural that not all pears have the same length or that cucumbers are not always straight, consumers are used to a standardized appearance of fruits and vegetables (Aschemann-Witzel et al., 2017). To provide these standardized appearance, a higher amount than needed is produced to on one hand fulfil the quality requirements and on the other hand fulfil the fluctuating demand of fruits and vegetables.

The surplus food in generally has to be reduced and thus aims on waste prevention. Even after prevention of overproduction, there will be edible food waste left. For this part a diversification strategy is applicable and this will be explained in the last part of this section and in chapter 5.

7.2 Reducing overproduction

First the focus is on reducing the overproduction by process enhancement and interface management. The variation in quality of the raw materials is seen as a fact and the aim of process enhancement and interface management is not to provide a better quality of all the raw materials at the farmer to reduce waste. However, the characteristics of fresh food need to be taken into account because they affect the management and performance of supply chains.

The three key characteristics of the fresh food market are demand uncertainty, customer order lead time and supply chain lead time (Kittipanya-ngam et al., 2010).

Demand uncertainty does not only depend on seasonality and unusual weather patterns, but also on promotion activities (Taylor et al., 2009). Striking is that retailers do not have a mechanism to measure the overall impact of promotions on supply chain cost which include inventory level, production and distribution costs and waste rates. At last, a small case study with potatoes showed that the impact of interdependent demand for complementary products also affects the demand of fresh food products (Taylor et al., 2009).

The supply chain lead time is short for fruits and vegetables because they are perishable products. The retail customers in this market also require a short customer order lead time. These two characteristics need a high responsiveness of the actors in the supply chain and contribute to the generation of overproduction in the fresh food supply chain (Kaipia et al., 2013).

Kaipia et al., (2013) have stated that a lack of information sharing and forecasting difficulties are key factors in the food supply chain and lead to unnecessary overproduction and at the end food waste of suboptimal products. This two subjects will be outlined below.

7.3 A lack of information sharing and poor forecasting:

Each actor in the chain uses their own data about demand, inventory levels and more to make decisions about inventory levels, but do not communicate with the other actors about their inventory levels or forecasts. Information sharing across the supply chain can bring a great advantage in inventory management and quick response for the whole chain (Yu et al., 2011). Moreover, it has been stated that demand information sharing becomes more beneficial when variation in demand is high. Fruits and vegetables are products with a high demand variation, so information sharing can lower the overall inventory level and therefore the amount of wasted fruits and vegetables (Kaipia et al., 2013).

A way of creating better forecasts is by decision making due to retail demand information sharing. By joint decision making with respect to demand forecasts, production scheduling, distribution and contingency planning the supply chain can improve their ordering and thus reduce the waste. Information sharing will lower the surpluses for the processing, manufacturer and retailer stages, but the entire chain is still dependent on the harvest. This is because farm production is essentially a 'push' system from the farmer to the other actors (Taylor et al., 2009). So, the exact timing and amount of crops cannot be controlled. The benefit of information sharing can possibly be that the farmer will know how much he will have left and can find other buyers for it before the quality decreases and only the option of disposal is left (Taylor et al., 2009).

Another topic is the disconnection between agricultural production and consumer demand. When a farmer decides how much to grow of a certain crop, he bases this on his own judgements. Retailers do not provide a long term forecast. The production of a joint long term forecast by farmers, processors and retailers for a time period determined by the growth cycle of the particular product would be an important step in helping to link farm production to consumer demand and can at the end contribute in the reduction of fruits and vegetable waste.

To summarize, the current surplus can be reduced when actors in the chain share more information about the demand and inventory levels. Then orders will be more in line with the real demand and less waste is created, but the fact that farming is a push-system needs to be considered.

7.3 Collaboration

A totally other way of process enhancement and interface management is collaboration with actors or other organizations to set up retail and supply chain alteration initiatives (Aschemann-Witzel et al., 2016). These initiatives are focused on prevention or avoidance of food waste by actions within the supply chain to use the suboptimal fruits and vegetables. These initiatives are examples of informing and educating the consumer with campaigns as mentioned in chapter 6.

Five success factors are established for retail and supply chain alteration initiatives: timing, collaboration, business opportunity, competencies and right place (Ashemann-Witzel et al., 2016).

Timing is all about doing things at the right moment. So, when there is growing attention for suboptimal products, it is the right moment to come in action. This comes in combination with place. If you undertake action at the right moment, but at the wrong place, then it still will not work.

Strong collaboration between different supply chain actor is needed to create a holistic approach and tackle all actions, down- and upstream, and make use of the wasted products. It is important that people with the right competencies are involved with making success.

To maintain the initiative, it is important that there is attention for the initiative by (social) media and reaches a large scale in terms of volume.

If all these factors are present, initiatives can be successful and contribute to reduce the waste of suboptimal products. The actors can set up initiatives to sell suboptimal products to the consumers or to other markets and find consumers for them.

7.4 Awareness campaigns

Another practice of process enhancement and interface management are awareness campaigns (Secondi et al., 2015). When consumers have more information or are attracted to something, their purchasing behaviour can be influenced (Aschemann-Witzel et al., 2015, Priefer et al., 2016). Hanss et al., (2013) found after an intervention study that awareness campaigns promote sustainable behaviour and supplement structural strategies like subsidies or taxes. There are already a lot awareness campaigns in European countries, but they should be aimed more to different target groups in close cooperation with retailers and the hospitality sector (Priefer et al., 2016). With collaboration an awareness campaign can be set up better and has more chance to succeed. (Aschemann-Witzel et al., 2016). So an awareness campaign has to be supported by more than one actor and collaboration is needed between the actors to work on the common goal to reduce the waste of suboptimal fruits and vegetables. The government can support the retailers and the farmers for an initiative, but the farmer and the retailer need to collaborate to let it work.

If a campaign receives attention, and the management of the attention is done right, there is a good chance that a large scale audience is reached. When this happens, making use of suboptimal products and thus investing in it, is much more an business opportunity (Aschemann-Witzel et al., 2016).

7.5 Opening Alternative markets

Another structure to reduce the waste of suboptimal fruits and vegetables is by opening alternative markets, such as farmers markets (Trobe., 2001). Farmer markets are a form of direct marketing since the food goes directly from producers to consumers. This idea was originally not aimed at reducing waste, but at supporting local economies by stimulating people to buy local food (Priefer et al., 2016). Since the middleman in the supply chain is skipped, it appeared that this contributes to prevention of food waste. Farmers markets are often local and people experience grocery shopping differently at a farmers market than in a supermarket. Trobe (2001) investigated what the most important factors are for people to come to the farmers markets and buy products. They first come out of curiosity, but later on

the main goal of consumers is to buy fresh and healthy products. Quality is with 57% by far the most important factor in the decision of buying products at a farmers market. Appearance is not that influential with only 6%. Farmers markets make natural diversity more visible and therefore people are more informed and familiar with it. This makes consumers keen on buying suboptimal fruits and vegetables at farmers markets and later on also in supermarkets. Therefore, farmers markets can be a form of education and information as discussed in paragraph 6.2. .

Other examples of direct marketing with suboptimal fruits and vegetables are delivery of fruit or vegetable boxes with suboptimal products or producer cooperatives which together start with using suboptimal fruits and vegetables. To set something up like the boxes, the process needs to be changed. The farmer has to pick up the suboptimal products instead of leaving them on the land and the retailer has to buy them and needs to find customers for the boxes. A new channel will be added to the supply chain which only will maintain if the actors which are involved, work together.

7.6 How to apply process enhancement and interface management in the supply chain

Taylor et al., (2009) constructed a framework to develop a more systematic and integrated approach to demand management across food supply chains. This approach would improve customer service by contributing to higher levels of product availability and it would lower costs through the reduction of product waste. This framework is shown in figure 9. It consist of two dimensions and four stages.

The two dimensions are technology and organisation. Technology has to do with the availability and accuracy of data and the technological possibilities to share the data upstream the supply chain. Organisation is about the existing organisational structures, policies and procedures that hinder the adoption of good demand management practices. The four stages represent the different stages at which intervention is required if demand management is to be structured, planned, resourced and executed to maximum effect at minimum cost within fresh food supply chains.

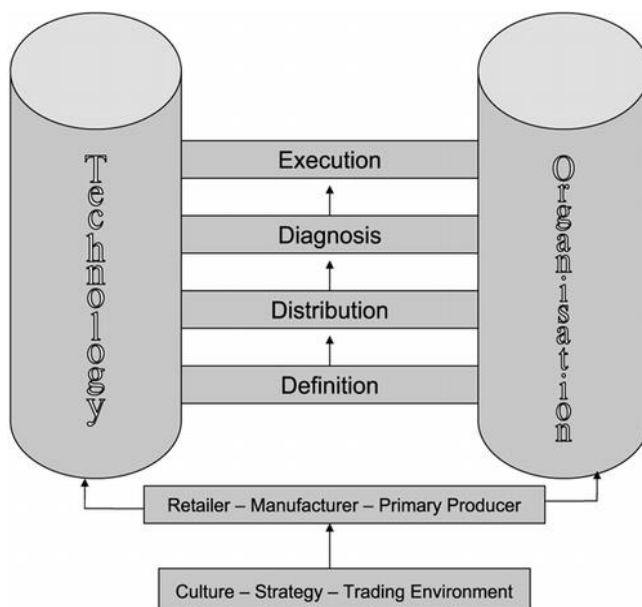


Figure 9. *Demand management improvement framework (Taylor et al., 2009)*

Stage 1 - Definition: Define the relevant data and record them on an on-going basis. In this case, data as inventory levels, demand and ordering patterns can be recorded to provide better information sharing.

To open new markets or set up effective awareness campaigns, a clear definition about food waste and suboptimal products needs to be developed (Parfitt et al., 2010)

Stage 2 - Distribution: This stage involves the distribution of final demand information upstream the chain. Important are the information flows within and between companies. Nowadays, even the small scale companies like farmers make use of systems and this gives the opportunity to provide all the actors with more information and results in lower administrative costs and less order errors

Also information about the amount of suboptimal product, the type of suboptimality and information about the product itself are important to share downstream the chain, therefore retailers can make campaigns to provide the right information or marketing strategies (de Hooge et al., 2017 and Aschemann-Witzel et al., 2016).

Stage 3- Diagnosis: This stage involves operational and strategic changes for a longer term. This stage focuses on understanding the nature of demand and how to synchronize the demand more effectively with the supply.

In terms of surplus minimizing, this can be done by long term forecasting and jointly forecasting. Especially aimed at the retailer forecasts. Then with step one and two this information can be shared with the other actors and the surplus can be reduced. To achieve this, more collaboration is needed in the chain between the retailers. This seems not that complicated, but the retailers are competitors of each other and information sharing with your competitors is risky.

The aforementioned amplification effect which happens within the chain is also a topic that needs a diagnosis intervention to reduce it. If, for example an overall management, would measure the effects of promotional activities within the chain, orders can be much more precise when there is a promotion. Again, this requires information and collaboration within the chain to eventually reduce the surplus.

Other operational and strategic changes are changes that make distributing and selling suboptimal products easier. Nowadays a lot of equipment is not suitable for shape or size deviation of fruits and vegetables (Waarts et al., 2011). Examples of solutions are machines which can handle deviating shapes or sizes, crates that are larger and not only fit for perfect standardized products, or packages which are not standardized.

Stage 4 - Delivery: The final stage is on tactical level. It involves tactical planning and execution of the demand management strategy. By focusing more on daily order patterns within the weekly trading cycle and the timing of order transmission between retailers and processors overproduction can be reduced (Taylor et al., 2009).

7.7 Conclusion

To conclude, it can be said that the main ingredients to reduce overproduction and food waste are information sharing and collaboration. As well information sharing as collaboration

is crucial among the chain but also within one company or between several companies at the same stage in the supply chain. When information is shared or collaboration is successful, the surplus can be minimized or initiatives can deliver good results. The crucial topics where more information or collaboration is needed are ordering patterns, inventory levels and promotional activities. The biggest gap is at the moment the information sharing between the farmer and the retailer.

Collaboration and information sharing are also needed for other forms of process enhancement like setting up awareness campaigns or opening alternative markets. These two things are already happening and appear to be successful, but collaboration is key to make it a success (Aschemann-Witzel et al., 2016).

Chapter 8 Conclusion

This research gives a literature overview about food waste of suboptimal fruits and vegetables to first understand why suboptimal fruits and vegetables are often wasted instead of used and second to analyse areas for improvement to come up with an overview of the problem and possible solutions to decrease the amount of suboptimal fruits and vegetables which are waste. This analysis is done according the four central fields of action which Göbel et al., (2015) have constructed.

First the supply chain of fresh fruits and vegetables is analysed and the amount of suboptimal fruits and vegetables each actor wastes is defined. Chapter 2 and 3 showed that the supply chain consist of a farmer, a processor or manufacturer, a retailer and et the end the consumer. The farmer and the consumer generate the most suboptimal fruit and vegetable waste (FAO., 2011). Namely 20% and 19% of a total of 53 million tonnes of fruits and vegetables.

The retailer is not the actor with the most waste, but it was mentioned multiple times in research that retailers are key players in generating but also in reducing the amount of suboptimal fruits and vegetables wasted. This is related to a multiple time mentioned reason why suboptimal fruits and vegetables are wasted. In all chapters quality standards on the appearance of a fruit or vegetable are returning as an important reason for not making use of suboptimal fruits and vegetables. In chapter 2, calculations show that almost a third of all key edible fruit and vegetable waste is caused due to aesthetic standards. The retailer is key because of the position in the supply chain. The retailers set the standards which the farmers and the processors follow and at the same time this are the standards the consumers are used to. Therefore it can be concluded that the retailers are essential in reducing suboptimal fruit and vegetables waste.

Amendment of the EU marketing standards will not have a big impact because of the existing private standards. Taxes and subsidies are mentioned as means to create new rules or structures which can have substantially impact in reducing the amount of suboptimal fruits and vegetables food waste.

Reuse and recovery offer multiple ways to make use of the suboptimal fruits and vegetables by for example processing in other food products for human consumption as soup, juice, jam or more. Converting in animal feed or recovery for energy are also possible, but less preferred.

In the category consumer appreciation, literature points out that consumers are willing to buy suboptimal fruits and vegetables when they get information about them, they are sold for a lower price than the optimal ones and to achieve high sales, marketing campaigns are very important.

The last sub question studies the role of process enhancement and interface management to reduce the waste of suboptimal fruits and vegetables. The most important topics are collaboration and information sharing to work as a chain together, organise awareness campaigns or open alternative markets to make use of suboptimal products.

After studying the four central fields of Göbel et al., (2015), the main question is how to combine these fields to waste less suboptimal fruits and vegetables.

It became clear that to actually make use of the suboptimal products, there are two main options: processing or directly selling.

When processing is chosen, the EU marketing standards do not have any impact. Suboptimal products are safe and sometimes already used for processing. For example too small fruits are processed into jam. Processing is a nice alternative for disposal, but not much information is known about the impact on the reducing of suboptimal food waste. Neither about processing directly on farm or processing the suboptimal fruits and vegetables to a meal that is ready to eat. This are new topics and therefore literature is limited.

The other option is selling the suboptimal fruits and vegetables as they are. The current tendency is that people concern more about the environment and food waste is a hot topic. When the link is made between pro-environmental behaviour and buying of suboptimal fruits and vegetables, people will be willing to purchase deviating fruits or vegetables according consumer research. This can be achieved by informing and educating consumers about suboptimal fruits and vegetables and food waste.

This type of education can be linked to awareness campaigns and subsidies or taxes which discourage food waste. In some countries it is proven that governmental support contributes to food waste reduction, so the combination between governmental support and information and education would fit really nice.

The retailer needs to decide how he wants to present the suboptimal products and which for price he will sell them. To conform this for the whole chain, process enhancement and interface management is needed. The consumer wants to pay a lower price than normal for the deviating fruits and vegetables. Therefore the retailer probably also wants to buy them from the processors or farmers for a lower price. For the farmer, a deviating fruit or vegetable has the same cost price as an optimal one or even higher because they normally do not put effort in a deviating piece. When using it, it has to be harvested, sorted, stored and transported which costs money that is not spent when the crops were left on the fields. Then the situation occurs that the farmer has to pay for the lower price of these fruits and vegetables and then it will not work. So, there need to be offers made by the actors or the government to make a lower price for suboptimal products possible

A lot of examples showed that the most initiatives started small. Supermarkets started with only a few suboptimal fruits or vegetables in their shelves. Sometimes it even where only temporary campaigns. But also for processing, donating initiative, farmer markets or in the hospitality sector. After some time, these initiatives expanded. Therefore the suggestion is to start relative small with a few products. Since the retailer has such an important position, any project to sell suboptimal fruits and vegetables on regular basis has to involve the retailer to be successful and to reach an effective amount of consumers.

Education and information are crucial so the customers of the retailer need to be informed about the products and food waste. This can maybe be on local scale, maybe even with local products from farmers in the region, or more global information.

After some time, such an initiative can be scaled up on more places or a typical project at a certain place can be expanded.

The recommendation is to start downstream the supply chain with the consumer and retailer and then work upstream the farmer. But, the communication between the retailer and the farmer is essential. The current big gap between them must be reduced to set up efficient collaboration and selling of suboptimal fruits and vegetables.

To place a solution in the theoretical framework, it will mostly lay in the part of consumer appreciation and structure and rules because this are the most developed subjects in research and experiments are already done (Fig 10).

Recovery can contribute a bit for maybe the most abnormal shaped fruits and vegetables which not suite direct selling.

When consumer appreciation expands, the other fields will probably also develop, because they are all related. To stimulate the process, structure and rules can be important to discourage the actors to waste the suboptimal fruits and vegetables. Maybe, after some time, structure and rules become less important when suboptimal fruits and vegetables are in a routine.

Process enhancement and interface management is crucial, but more a consequence when suboptimal fruits and vegetables are actually going through the supply chain instead of ending up in the field at the farmer and will be a very dynamic topic. The supply chain will need to adjust to make selling of suboptimal fruits and vegetables possible and efficient.

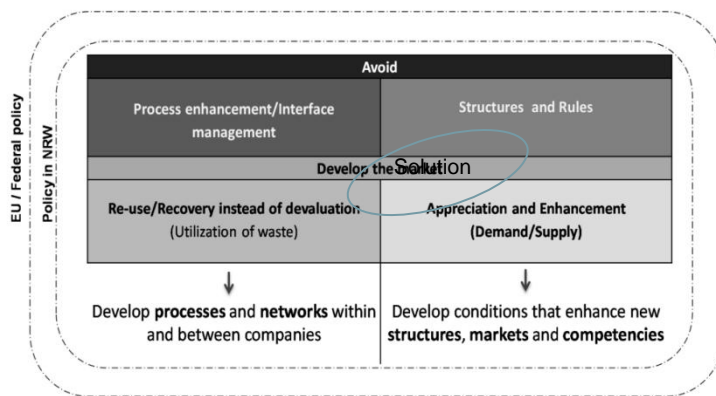


Figure 10. View of placing of the possible solution to reduce the amount of suboptimal fruit and vegetable food waste.

Chapter 9 Discussion

This overview is mainly based on literature studies, reviews of case studies and a few reports of institutions. Therefore the reliability of this research depends largely on the use of the literature.

Suboptimal fruits and vegetables is a very specific and quite new topic. To gain information about suboptimal fruits and vegetables in the supply chain, mainly literature is studied from Aschemann-Witzel, Göbel, De Hooge, Oostindjer and Loebnitz. These authors wrote articles specifically about deviating fruits and vegetables. The content was specifically on consumer appreciation and initiatives to make use of these fruits and vegetables. In other literature, suboptimal fruits and vegetables were a small part of the content, but important information was mentioned.

In general, the foundation of this overview is therefore based on the articles of these authors and it has been supplemented with information about edible food waste or food waste in general which is corresponding with suboptimal fruits and vegetables food waste. Additionally, maybe not all information about suboptimal fruits and vegetables waste is found, because there is not an unambiguous term for deviating fruits and vegetables. For this overview, the term suboptimal is used because this corresponds with the literature of Göbel et al., (2015) where this whole research started with. However, words like misshapen, deviating, ugly, nonstandard, rejected and more are also used in literature about suboptimal fruits and vegetables. Therefore it would be very helpful for further research if a list of terms is being drawn up for this fruits and vegetables.

The same problem counts for the term food waste. There are multiple definitions for the terms food loss and food waste, whereby it is not always sure if one article can be compared with another article.

The analysis started with the model of Göbel' et al., (2015). No other models according food waste of suboptimal products are used. Despite this, at least one of the four fields of action from Göbel et al., (2015) returns in almost every article about suboptimal fruits and vegetables.

Information about consumer appreciation was in comparison with the other topics widely available. About recovery is a part of the information about suboptimal fruits and vegetables and another part is derived from recovery of regular food waste.

The topic structure and rules is focused on the EU marketing standards. Information about these standards is gained from governmental resources and also from scientific articles. All used information about these standards is comparable with each other, which make the resources valid.

About the process enhancement and interface management part, literature is the most scarce. This is related with the gap in literature about the farmer and the processor actors. For the retailer it is more known how he had to adjust his process and activities when selling suboptimal fruits and vegetables, but for the more upstream actors not. Therefore limitations for starting with selling suboptimal fruits and vegetables are used as topics which need to be considered when looking for solutions according process enhancement and interface management.

Besides that, overproduction is considered as one of the consequences of suboptimal fruits and vegetable waste and possible process enhancements and interface management solutions are mentioned to solve this.

Overproduction is not always related to suboptimal fruits and vegetables, also to uncertainty and therefore literature about reducing overproduction is widely available and used to answer the question about process enhancement and interface management.

Suggestions for further research are to gather more data about the perception of the farmer towards suboptimal fruits and vegetables. Research about suboptimal fruits and vegetables is still very new and limited, but most of the existing research focuses on the consumer and the retailer. However the farmer is also crucial in the process of selling suboptimal fruits and vegetables.

Second, it would contribute in the mission to reduce food waste of suboptimal fruits and vegetables if more information about the influence of selling suboptimal fruits and vegetables on the current prices is known. It is suggested to sell suboptimal fruits and vegetables towards a lower price, but there is not yet research about the consequences. Who is going to pay for the lower prices, is a lower price valid for the farmer and what is going to happen with the sales of the optimal fruits and vegetables if suboptimal ones are also sold.

Furthermore, there are economic reasons as standardized logistics with high volumes and low unit prices, why food wastage takes place in the supply chains of fruits and vegetables in developed countries. Stakeholders might think that making use of suboptimal fruits and vegetables lowers their efficiency and profit.

In the literature, the following questions emerged for further research on suboptimal fruits and vegetables:

- What is the actual amount of suboptimal fruits or vegetables which is thrown away
- Where lies the economic argument in work against food waste?
- What is the impact on both profitability and effectiveness in terms of food waste reduction?
-

Information about the farmer is scarce and recommendations for further research concerning suboptimal fruits and vegetables are not mentioned. An interesting research question would be:

- What is the cost-benefit analysis for the farmer for making use of suboptimal fruits and vegetables or not

Chapter 10 References

10.1 Literature

- Aggarwal, S., & Srivastava, M. K. (2016). Towards a grounded view of collaboration in Indian agri-food supply chains: A qualitative investigation. *British Food Journal*, 118(5), 1085-1106.
- Alexander, C., & Smaje, C. (2008). Surplus retail food redistribution: An analysis of a third sector model. *Resources, conservation and recycling*, 52(11), 1290-1298.
- Aschemann-Witzel, J., de Hooge, I., Amani, P., Bech-Larsen, T., & Oostindjer, M. (2015). Consumer-related food waste: causes and potential for action. *Sustainability*, 7(6), 6457-6477.
- Aschemann-Witzel, J., de Hooge, I. E., Rohm, H., Normann, A., Bossle, M. B., Grønhøj, A., & Oostindjer, M. (2016). Key characteristics and success factors of supply chain initiatives tackling consumer-related food waste—A multiple case study. *Journal of Cleaner Production*.
- Aschemann-Witzel, J., Jensen, J. H., Jensen, M. H., & Kulikovskaja, V. (2017). Consumer behaviour towards price-reduced suboptimal foods in the supermarket and the relation to food waste in households. *Appetite*, 116, 246-258.
- Aviv, Y. (2001). The effect of collaborative forecasting on supply chain performance. *Management science*, 47(10), 1326-1343.
- Bilska, B., Wrzosek, M., Kolożyn-Krajewska, D., & Krajewski, K. (2016). Risk of food losses and potential of food recovery for social purposes. *Waste Management*, 52, 269-277.
- Blasco, J., Aleixos, N., & Moltó, E. (2003). Machine vision system for automatic quality grading of fruit. *Biosystems engineering*, 85(4), 415-423.
- Brancoli, P., Roustas, K., & Bolton, K. (2017). Life cycle assessment of supermarket food waste. *Resources, Conservation and Recycling*, 118, 39-46.
- Buzby, J. C., Farah-Wells, H., & Hyman, J. (2014). The estimated amount, value, and calories of postharvest food losses at the retail and consumer levels in the United States.
- Calvo-Porrá, C., Medín, A. F., & Losada-López, C. (2017). Can Marketing Help in Tackling Food Waste?: Proposals in Developed Countries. *Journal of Food Products Marketing*, 23(1), 42-60.
- Cicatiello, C., Franco, S., Pancino, B., & Blasi, E. (2016). The value of food waste: An exploratory study on retailing. *Journal of Retailing and Consumer Services*, 30, 96-104.

- Claro, D. P., Neto, S. A. L., & de Oliveira Claro, P. B. (2013). Sustainability drivers in food retail. *Journal of retailing and consumer services*, 20(3), 365-371.
- Corrado, S., Ardente, F., Sala, S., & Saouter, E. (2017). Modelling of food loss within life cycle assessment: from current practice towards a systematisation. *Journal of Cleaner Production*, 140, 847-859.
- Dou, Z., Ferguson, J. D., Galligan, D. T., Kelly, A. M., Finn, S. M., & Giegengack, R. (2016). Assessing US food wastage and opportunities for reduction. *Global Food Security*, 8, 19-26.
- Garrone, P.; Melacini, M.; Perego, A. Opening the black box of food waste reduction. *Food Policy* 2014, 46, 129–139
- Göbel, C., Langen, N., Blumenthal, A., Teitscheid, P., & Ritter, G. (2015). Cutting food waste through cooperation along the food supply chain. *Sustainability*, 7(2), 1429-1445.
- Gnanasekharan, V., Shewfelt, R. L., & Chinnan, M. S. (1992). Detection of colour changes in green vegetables. *Journal of Food Science*, 57(1), 149-154.
- Gustavsson, J.; Cederberg, C.; Sonesson, U.; van Otterdijk, R.; Meybeck, A. Global Food Losses and Food Waste. Extent, Causes and Prevention. *Study Conducted for the International Save Food Congress at Interpack 2011, Düsseldorf, Germany*; Food and Agricultural Organization of the United Nations: Rome, Italy, 2011.
- Gustavsson, J., & Stage, J. (2011). Retail waste of horticultural products in Sweden. *Resources, Conservation and Recycling*, 55(5), 554-556.
- Halloran, A., Clement, J., Kornum, N., Bucatariu, C., & Magid, J. (2014). Addressing food waste reduction in Denmark. *Food Policy*, 49, 294-301.
- Hanss, D., & Böhm, G. (2013). Promoting purchases of sustainable groceries: An intervention study. *Journal of Environmental Psychology*, 33, 53-67.
- Helmert, J. R., Symmank, C., Pannasch, S., & Rohm, H. (2017). Have an eye on the buckled cucumber: An eye tracking study on visually suboptimal foods. *Food Quality and Preference*, 60, 40-47.
- de Hooge, I. E., Oostindjer, M., Aschemann-Witzel, J., Normann, A., Loose, S. M., & Almlí, V. L. (2017). This apple is too ugly for me!: Consumer preferences for suboptimal food products in the supermarket and at home. *Food Quality and Preference*, 56, 80-92.
- Kaipia, R., Dukovska-Popovska, I., & Loikkanen, L. (2013). Creating sustainable fresh food supply chains through waste reduction. *International journal of physical distribution & logistics management*, 43(3), 262-276.

- Kays, S. J. (1999). Preharvest factors affecting appearance. *Postharvest Biology and Technology*, 15(3), 233-247.
- Kittipanya-ngam, P., Shi, Y. and Gregory, M.J. (2010), "Food supply chain (FSC) in manufacturing companies – an exploratory study on product and configuration", *Proceedings of 17th EurOMA Conference, Porto, Portugal*.
- Loebnitz, N., Schuitema, G., & Grunert, K. G. (2015). Who buys oddly shaped food and why? Impacts of food shape abnormality and organic labelling on purchase intentions . *Psychology & Marketing*, 32(4), 408-421.
- Melbye, E. L., Onozaka, Y., & Hansen, H. (2017). Throwing It All Away: Exploring Affluent Consumers' Attitudes Toward Wasting Edible Food. *Journal of Food Products Marketing*, 23(4), 416-429.
- Mena, C., Adenso-Diaz, B., & Yurt, O. (2011). The causes of food waste in the supplier–retailer interface: Evidences from the UK and Spain. *Resources, Conservation and Recycling*, 55(6), 648-658.
- Milzow, K. (2009). The EU's Marketing Standards for Fruit and Vegetables: The End of a Myth. *Papiers d'actualit e/Current Affairs in Perspective, Fondation Pierre du Bois* (9).
- Mourad, M. (2016). Recycling, recovering and preventing "food waste": competing solutions for food systems sustainability in the United States and France. *Journal of Cleaner Production*, 126, 461-477.
- Nielsen, E., Jolink, A., de Sousa Jabbour, A. B. L., Chappin, M., & Lozano, R. (2017). Sustainable collaboration: The impact of governance and institutions on sustainable performance. *Journal of Cleaner Production*, 155, 1-6.
- Nunes, M. C. N., Emond, J. P., Rauth, M., Dea, S., & Chau, K. V. (2009). Environmental conditions encountered during typical consumer retail display affect fruit and vegetable quality and waste. *Postharvest Biology and Technology*, 51(2), 232-241.
- Papargyropoulou, E., Lozano, R., Steinberger, J. K., Wright, N., & bin Ujang, Z. (2014). The food waste hierarchy as a framework for the management of food surplus and food waste. *Journal of Cleaner Production*, 76, 106-115.
- Parfitt, J., Barthel, M., & Macnaughton, S. (2010). Food waste within food supply chains: quantification and potential for change to 2050. *Philosophical Transactions of the Royal Society B: Biological Sciences*, 365(1554), 3065-3081.
- Plazzotta, S., Manzocco, L., & Nicoli, M. C. (2017). Fruit and vegetable waste management and the challenge of fresh-cut salad. *Trends in Food Science & Technology*.

- Priefer, C., Jörissen, J., & Bräutigam, K. R. (2016). Food waste prevention in Europe—A cause-driven approach to identify the most relevant leverage points for action. *Resources, Conservation and Recycling*, 109, 155-165.
- Purohit, D., & Srivastava, J. (2001). Effect of manufacturer reputation, retailer reputation, and product warranty on consumer judgments of product quality: A cue diagnosticity framework. *Journal of Consumer Psychology*, 10(3), 123-134.
- Quested, T. E., Marsh, E., Stunell, D., & Parry, A. D. (2013). Spaghetti soup: The complex world of food waste behaviours. *Resources, Conservation and Recycling*, 79, 43-51.
- Raak, N., Symmank, C., Zahn, S., Aschemann-Witzel, J., & Rohm, H. (2016). Processing- and product-related causes for food waste and implications for the food supply chain
- Secondi, L., Principato, L., & Laureti, T. (2015). Household food waste behaviour in EU-27 countries: A multilevel analysis. *Food Policy*, 56, 25-40.
- De Steur, H., Wesana, J., Dora, M. K., Pearce, D., & Gellynck, X. (2016). Applying Value Stream Mapping to reduce food losses and wastes in supply chains: A systematic review. *Waste management*, 58, 359-368.
- Taylor, D. H., & Fearn, A. (2009). Demand management in fresh food value chains: a framework for analysis and improvement. *Supply Chain Management: An International Journal*, 14(5), 379-392.
- Thyberg, K. L., & Tonjes, D. J. (2016). Drivers of food waste and their implications for sustainable policy development. *Resources, Conservation and Recycling*, 106, 110-123.
- Trobe, H. L. (2001). Farmers' markets: consuming local rural produce. *International Journal of Consumer Studies*, 25(3), 181-192.
- Tsiros, M., & Heilman, C. M. (2005). The effect of expiration dates and perceived risk on purchasing behaviour in grocery store perishable categories. *Journal of marketing*, 69(2), 114-129.
- Waarts, Y. R., Eppink, M., Oosterkamp, E. B., Hiller, S. R. C. H., Van Der Sluis, A. A., & Timmermans, T. (2011). *Reducing food waste; Obstacles experienced in legislation and regulations* (No. 2011-059). LEI, part of Wageningen UR.
- Yu, Z., Yan, H., & Edwin Cheng, T. C. (2001). Benefits of information sharing with supply chain partnerships. *Industrial management & Data systems*, 101(3), 114-121.

10.2 Websites

<https://www.ah.nl/buitenbeentjes> visited on 27-06-2017

<http://itm.marcelww.com/inglorious> visited on 27-06-2017

<http://www.kromkommer.com/> visited on 07-06-2017

<https://www.unece.org/trade/agr/standard/fresh/ffv-standardse.html> visited on 20-06-2017

<http://www2.epa.gov/sustainable-management-food/food-recovery-hierarchy>. Visited on 22-06-2017
<http://www.oecd.org/agriculture/fruit-vegetables/publications/brochures/> visited on 29-06-2017