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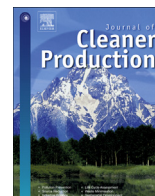
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**Sustainable Development Goal 12 and sustainable
practices: Food loss related to the use of standards**

Food loss study

The following informal document, submitted by the Netherlands, contains an article on standards, food loss and supply chains.



Cosmetic specifications in the food waste issue: Supply chain considerations and practices concerning suboptimal food products[☆]

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ABSTRACT

During the last decade, food waste has become an object of interest for both scholars and society. The existence of cosmetic specifications regarding the physical appearance of foods in the food supply chains is considered to be one of the important causes of food waste. The relevant aesthetic standards concern the product's weight, shape, and size and are thought to contribute considerably to food waste across multiple supply chain levels. It has been suggested that the abolition of these specifications could be a relatively easy way to prevent food wastage. However, there is a dearth of empirical research due to the lack of data on the extent to which foods are wasted as a result of cosmetic specifications only. Importantly, there is also a lack of insight into the decision-making process of supply chain actors regarding such suboptimal products. The present research aims to fill this gap by investigating the motivations and perceptions of supply chain actors in their strategies on how to handle suboptimal products in their business practices. From thirty-three interviews with primary producers, producer organizations, and retailers from Germany and the Netherlands, we derive initial insights into (1) the presence and nature of cosmetic specifications, (2) the impact of these specifications on food waste, (3) the motivations, abilities, and opportunities of supply chain actors to handle suboptimal products in their business practice and (4) their perspectives on the end consumers' willingness to buy and pay for suboptimal products. With the Motivation, Ability, and Opportunity (MOA) framework, we provide new understanding of supply chain actors' decisions concerning the production or wastage of suboptimal products, which can generate new and essential insights into the food waste problem.

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1. Introduction

Of the food produced for human consumption, a surprising one-third to one-half is not consumed by humans, but instead wasted (FAO, 2013; Parfitt et al., 2010). Food waste can be defined as “any food, and inedible parts of food, removed from the food supply chain to be recovered or disposed (including composted, crops ploughed in/not harvested, anaerobic digestion, bio-energy production, co-generation, incineration, disposal to sewer, landfill or

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¹ On the other hand, the edible and inedible parts of food used for animal feed, bio-material processing, or other industrial uses are considered by FUSIONS as ‘valorisation and conversion’ and not as food waste (FUSIONS, 2014; Parfitt et al., 2010).

discarded to sea)” (FUSIONS, 2014, p. 6).¹ Wasting food is inefficient in economic, environmental, social, and moral respects. For example, the food production is estimated to cause approximately a third of all greenhouse gas emissions (Garnett, 2011), requiring extensive use of water, energy, land, and other natural resources (FAO, 2013; Godfray et al., 2010). Wasting food is also problematic from a food security perspective, i.e., the challenge of feeding a growing population, and from a moral perspective, i.e., the value of food (Garnett, 2011). Food waste occurs along the entire food supply chain, including consumer households (Buzby et al., 2011; Garrone et al., 2014; Griffin et al., 2009; Parfitt et al., 2010). This suggests that successful strategies to reduce food waste should focus on multiple levels of, and actors within the food supply chain (Aschemann-Witzel et al., 2015).

According to several scholars (e.g., Beretta et al., 2013; Buzby et al., 2011; Gobel et al., 2015; Gustavsson and Stage, 2011; Lebersorger and Schneider, 2014), one important and easily preventable source of food waste at multiple levels in the supply chain

are the product standards or cosmetic specifications for food products, particularly for fruits and vegetables. Cosmetic specifications govern rules concerning the product's appearance, weight, shape, and size but not its intrinsic quality or safety (Gobel et al., 2015; Halloran et al., 2014). Products that do not meet such cosmetic specifications, which are also called oddly-shaped foods (Loebnitz et al., 2015), foods with aesthetical imperfections (Beretta et al., 2013), or a subcategory of suboptimal foods (Aschemann-Witzel et al., 2015; De Hooge et al., 2017), have difficulties moving through the food supply chain and reaching the end customer (or consumer) (Gobel et al., 2015).² Many suboptimal products are thought to be ploughed back into the ground, developed into cattle feed, fertilizer, or biogas, or simply wasted (Beretta et al., 2013). The existence of such suboptimal products is not only problematic from the perspective of preventing food waste; they may also have impact on the business practices of primary producers, producer organizations, and retailers.

Many researchers have quantified food waste at various stages of the food supply chain and have indicated that cosmetic specifications is a potential cause of food waste (e.g., Beretta et al., 2013; Buzby et al., 2011; Gobel et al., 2015; Gustavsson and Stage, 2011; Lebersorger and Schneider, 2014). However, thus far no research has specifically provided insights into the impact of cosmetic specifications on food waste. Knowledge about this phenomenon is inherently difficult to obtain because suboptimal products are hardly recorded in production statistics. Even more important for this phenomenon is the understanding of supply chain actors' motivations, abilities, and opportunities to prevent wasting of suboptimal products and to include them into their production systems. However, there are currently no studies on this subject.

The purpose of the present study is to fill this knowledge gap in the literature by identifying the impact of cosmetic standards on supply chain actors' business practices. In thirty-three in-depth semi-structured interviews with German ($N = 14$) and Dutch ($N = 19$) primary producers, producer organizations, and retailers³ we aim to identify (1) the presence and nature of cosmetic specifications and (2) their impact on food waste, (3) the motivations, abilities, and opportunities of supply chain actors in handling suboptimal products in their business practices, and (4) their perspectives on the willingness of consumers to buy suboptimal products. To develop our behavioural model concerning on how supply chain actors handle suboptimal products, we build on the Motivation, Ability, and Opportunity (MOA) framework (MacInnis et al., 1991; Ölander and Thøgersen, 1995).

1.1. Product specifications and food waste

Product specifications are an important tool in supply chains for managing the quality levels of products offered to (end)customers. Within Europe, product specifications for fruits and vegetables have been formalised in European and national legislations. These

specifications focus on the minimally required levels of quality, maturity (ripeness), safety, smell, taste, origin of produce, packaging, uniformity across products within one package, shape, skin, size, and weight. Quality-grade classifications are derived from these minimal levels (European Union, 2007, 2011). Such specifications are implemented as part of the marketing standards throughout all European food supply chains, and govern not only European produced foods but also fruits and vegetables imported from countries outside of the European Union. Products that do not fulfil the European product specifications are either not allowed into the European market or withdrawn (if they were already in the market when product aspects changed).

One part of the European product specifications concerns the cosmetic aspects or appearance of fruits and vegetables. These cosmetic specifications are the basis for the quality grading of fruits and vegetables into specified quality standards such as Extra, A-class, or B-class. Originally, the cosmetic specifications focused on the colour, shape, skin, size, and weight of all fruits and vegetables (European Union, 2007). In 2009, the cosmetic specifications were removed for 26 of the 36 product types (European Union, 2008). However, nowadays these specifications still exist for ten of the most popular fruits and vegetables in the European Union: apples, citrus fruit, kiwifruit, lettuces, peaches and nectarines, pears, strawberries, sweet peppers, table grapes and tomatoes (European Union, 2011). Several studies have indicated that these specifications contribute substantially to food waste (Aschemann-Witzel et al., 2015; Halloran et al., 2014). The main argument in this debate is that due to the cosmetic specifications, food products that meet all quality and safety specifications would be wasted just because their shape, size, weight, or colour "is different from usual aesthetic standards" (Aschemann-Witzel et al., 2015; De Hooge et al., 2017; Schneider and Lebersorger, 2011). Instead of wasting these products, their consumption could be a relatively easy way to provide safe and high quality foods for a large number of consumers.

It is not only the European Union that may set cosmetic specifications for fruits and vegetables; supply chain actors may also have a variety of reasons to set their own (Aschemann-Witzel et al., 2015; Gobel et al., 2015; Stuart, 2009). Together with setting supply chain standards for production, cosmetic specifications may also help avoid negative quality inferences that consumers could make about suboptimal products and consequently, about the actors that are selling these products (Stuart, 2009). If supply chain actors presume that customers and consumers will negatively evaluate suboptimal products, then actors may hold on to impression management concerns when deliberating whether to abolish cosmetic specifications. Also, cosmetic specifications regarding, for example, the shape and size of products may increase the efficiency of packaging and transport logistics (Raak et al., 2017). Hence, abolishing such specifications may lead to concerns related to logistics. Finally, cosmetic specifications may avoid competition among the actors' own products: i.e., those that fulfil the cosmetic specifications versus those that do not. Especially when suboptimal products are sold on the same retailer shelf as the "perfect" alternatives but with a price reduction (as is currently the case for some retailers, see Aschemann-Witzel et al., 2017), suboptimal products can form a direct competition for the actors' own perfect alternatives. Such strategy may ultimately undermine the price levels for perfect products. Offering perfect and suboptimal products at the same price, in direct competition with each other, may reduce choice likelihood for suboptimal products.

It has been suggested that the 2009 abolition of the European Union's cosmetic specifications for most of the fruits and vegetables did not lead to food waste reduction across supply chains (Loebnitz et al., 2015). This may be because of the existence of supply chain

² Whereas suboptimal products may also involve products that have passed the best-before date or products with damaged packaging (De Hooge et al., 2017), for the purpose of the present research, the term "suboptimal products" only refers to products that do not meet cosmetic specifications.

³ Throughout this paper, *supply chain actors* refer to producers, producer organizations, and retailers. We did not include processors in our study because they might not exert as much influence on production and marketing decisions concerning suboptimal fruits and vegetables as the producers, producer organizations, and retailers do. In support of this claim, our findings from the interviews indicate that only the latter three actors set cosmetic specifications on the food supply chain. We also did not include consumers because their decision-making context is substantially different from that of supply chain actors (e.g., consumers usually do not focus on the marketing of purchased products).

actors' own cosmetic specifications, but it is also possible that cosmetic specifications do not generate food waste. Although several research (e.g., Beretta et al., 2013; Buzby et al., 2011; Gobel et al., 2015; Gustavsson and Stage, 2011; Lebersorger and Schneider, 2014) have suggested that cosmetic specifications are a major source of food waste across supply chain actors, there is currently no empirical data that demonstrates that products that do not fulfil these cosmetic specifications are wasted. It is therefore possible that actors find alternative ways to manage and deal with suboptimal product streams. For example, they may donate suboptimal products to food banks, move them to private customer sales, or export them to non-European Union countries. Indeed, it could be argued that from an actor's point of view it would be economically irrational to waste products. In light of these discussions, we aimed for two things with our interviews: to provide insights into the existence and nature of cosmetic specifications, and to highlight the impact that these specifications have on the business practices of supply chain actors regarding products that do not conform to the specifications.

1.2. Business potential of suboptimal products

Supply chains are designed and optimised for the jointly effective and efficient delivery of value to consumers in the form of products and services (Kozlenkova et al., 2015). To achieve this, supply chains focus on consumer needs and on mutually profitable alignment among the involved actors (Feng et al., 2013). In other words, supply chains are focused on creating maximum value with minimum costs as an approach to utility maximisation. They do so with standardised production and marketing of products that conform to the (highest) quality specifications (Tan et al., 1998). Suboptimal products pose a complex problem for utility maximisation-focused supply chains: these products are deviations from mainstream operations and thus do not fit the standardisation process. When one takes into account that the production and marketing of suboptimal products are likely to be a source of impression management concerns, logistical complexities, pricing complexities, and competition complexities, then it seems very challenging to avoid costs of wasted resources without incurring too many additional costs and to manage the latter within the boundary conditions of the mainstream business model.

Consequently, the production and marketing of suboptimal products may not appear economically rational under current market conditions. However at the same time, wasting suboptimal products also seems to be an economically and morally irrational or inappropriate behaviour. Therefore, to analyse the decision process of supply chain actors concerning suboptimal products, we used the Motivation, Ability, and Opportunity (MOA) framework (MacInnis et al., 1991; Ölander and Thøgersen, 1995). The MOA framework states that the translation of weak(er) motivations into behavioural intentions and actual behaviour is dependent on relevant knowledge and skills and on the opportunities provided by the perceived facilitators and barriers present in the environment in which the behaviour is to occur.⁴ The MOA framework is well-established in marketing and management research areas as information processing (MacInnis et al., 1991), performance measurement (Clark et al., 2005), knowledge sharing (Siemsen et al., 2008), environmentally friendly behaviour (Ölander and

Thøgersen, 1995), and more general social marketing (Rothschild, 1999). The framework aims to predict individual behaviour in a social context on the basis of the individual's motivation and ability and the perceived opportunities in the social environment (MacInnis et al., 1991). Applied to the current context, 'motivation' stands for the supply chain actors' motivation to bring suboptimal products to the market, 'ability' captures the actors' knowledge ("know what"), skills, and competencies ("know how") related to the production and marketing of suboptimal products, and 'opportunity' represents the environmental or contextual facilitators and barriers that enable or hinder the production and marketing of suboptimal products. With the MOA framework, we identified the motivations, abilities and opportunities of supply chain actors in handling suboptimal products in their business practices. This is the third aim of our interviews.

Finally, because supply chains are ultimately focused on delivering value to consumers (Kozlenkova et al., 2015), the decisions of actors concerning cosmetic specifications and the marketing of suboptimal products will likely also depend on how much they think consumers are willing to purchase imperfect products. Thus, our fourth aim is to identify the actors' perspectives on consumers' willingness to buy suboptimal products.

2. Method

2.1. Research approach

Given the lack of prior research on cosmetic specifications, the current study adopted a qualitative approach. This approach is particularly appropriate for providing preliminary in-depth information (Gubrium and Holstein, 2002) in the (underlying) motivations and perceptions of supply chain actors concerning the production and marketing of suboptimal fruits and vegetables. We collected the data using semi-structured interviews with producers, producer organizations, and retailers.

2.2. Respondent selection

Semi-structured interviews were held with three groups of supply chain actors: managers of open-field farms or greenhouse production companies, managers of producer organizations, and purchasing managers of retail chains or local retail managers. Purposive sampling was used to select the potential respondents (Gubrium and Holstein, 2002). Respondents and organizations were identified and contacted via a web-based search and a snowballing method. The web-based search keywords included 'farm', 'producer', 'greenhouse', 'producer organization', 'retailer/supermarket', and 'fruits' or 'vegetables' (original in German and Dutch). Results (N = 7955) were then randomly selected and checked for a set of additional selection criteria. Specifically, respondents were required to be involved on a daily basis in the production and selling (for producers) or buying and selling (for producer organizations and retailers) of fruits and/or vegetables. Producers and producer organizations had to deliver at least part of their produce to German or Dutch consumers through regular supply chains (i.e., supply chains offering fruits and/or vegetables to consumers through one of the larger retailers in Germany or in the Netherlands). Retailers had to receive at least part of their produce from German or Dutch producers or producer organizations. Based on this screening, we contacted 156 potential interviewees that fulfilled the selection criteria. Thirty supply chain actors responded. During the interviews, two producer organizations provided the contact information of three additional retailers, whom we also interviewed (snowballing method). After these thirty-three interviews, we observed a level of information saturation occurring,

⁴ Technically, in terms of model specifications, the MOA model takes abilities and opportunities as *moderators* of the motivation-intention relationship, whereas traditional models like Theory of Planned Behaviour (TPB) (Ajzen, 1991) would consider them direct effects. However, the TPB and MOA can complement each other (e.g., Ölander and Thøgersen, 1995).

in that no new insights emerged, so we discontinued further contacting any potential interviewees. We conducted interviews both in Germany ($N = 19$) and the Netherlands ($N = 14$) to avoid drawing conclusions that would apply uniquely to a single country. The participants consisted of eighteen producers, seven producer organizations, and eight retailers. Three experienced interviewers conducted the interviews at the premises of the interviewees over the period of January 2016 to September 2016. The interviews took between 30 and 60 min and were recorded with the permission of the interviewees. Table 1 gives an overview of the respondents.

2.3. Procedure and measures

All interviews were conducted following the same semi-structured interview guide (see Appendix A). The guide started with a general introduction of the topic. Interviewees were informed that the topic concerned the evaluation of fruits and vegetables on the basis of cosmetic aspects, such as colour, shape, or size, and not on the basis of quality, safety, or taste aspects. The interview first focused on product specifications, i.e., the presence and nature of such cosmetic specifications and who imposes them (part A in the Appendix). Then the interviews moved to the impact of cosmetic specifications, focusing on the average number of products that did (not) fulfil the cosmetic specifications and on the

actions undertaken concerning those that did not fulfil the cosmetic specifications (Part B). Next, the MOA framework guided the extensive discussion on the business practice and on the potential of suboptimal products (Part C). These questions concentrated on the motivation to find markets for fruits and vegetables that do not fulfil the cosmetic specifications, on whether it would be possible to produce and market such products (the ability), and whether there would be facilitators or barriers in the business environment for the production and marketing of these suboptimal products (the opportunities). Finally, the interviews focused on the consumer perspective: whether the interviewees thought consumers would buy suboptimal products and why (Part D).

2.4. Data analysis approach

All interviews were fully transcribed and analysed within the qualitative software program, ATLAS.TI. Analysis was organized around the key interview concepts to find common phenomena by coding individual remarks or quotes. Similar individual remarks and quotes were organized together and colour coded. These codes were subsequently grouped into themes which are larger categories of quotes with similar meanings (see Table 2 for the codes and themes). Codes that were mentioned only once or twice and could not be placed in a theme were deemed as insignificant and

Table 1
Case descriptions.

Respondent code	Organization type	Types of fruits/vegetables sold	Customer
<i>Netherlands</i>			
NL 2	Producer (open field)	Onions, brussels sprouts	Producer organization, retailer, and export
NL 3	Producer (open field)	Celery and lettuce	Producer organization, retailer, and export
NL 4	Producer (open field)	Lettuce, Chinese cabbage	Food processor and retailer
NL 6	Producer (open field)	Onions, brussels sprouts	Producer organization, retailer, and export
NL 8	Producer (open field)	Zucchini and asparagus	Producer organization, auctions, and food processor
NL 26	Producer (greenhouse)	Bellpeppers	Retailer
NL 5	Producer organization	All fruits and vegetables	Retailer and export
NL 9	Producer organization	All fruits and vegetables	Retailer
NL 10	Producer organization	All fruits and vegetables	Retailer and export
NL 11	Producer organization	All fruits and asparagus	Retailer and export
NL 25	Producer organization (greenhouse)	Tomatoes	Retailer
NL 1	Retailer	All fruits and vegetables	End-consumers
NL 7	Retailer	All fruits and vegetables	End-consumers
NL 12	Retailer	All fruits and vegetables	End-consumers and companies
<i>Germany</i>			
GE 13	Producer (open field)	Apples	Retailer
GE 14	Producer (open field)	Apples	Retailer
GE 16	Producer (open field)	Apples	Retailer
GE 17	Producer (open field)	Spinach and Chinese cabbage	Retailer
GE 18	Producer (open field)	Strawberries, raspberries and asparagus	Retail, end-consumers (direct trade), and restaurants
GE 19	Producer (open field)	Strawberries and cherries	Producer organization and end-consumers (direct trade)
GE 21	Producer (open field)	Strawberries and asparagus	Producer organization, retail and end-consumers (direct trade)
GE 24	Producer (greenhouse)	Bellpeppers and tomatoes	Producer organization
GE 27	Producer (greenhouse)	Anonymous	Producer organization
GE 31	Producer (open field)	Potatoes, strawberries, asparagus and pumpkins	Retailer
GE 33	Producer (open field)	Carrots	Retailer
GE 22	Producer organization	All fruits and vegetables	Retailer
GE 30	Producer organization	All fruits	Retailer, food processor and end-consumers
GE 32	Producer organization	Several suboptimal fruits and vegetables (supply depends on what affiliated farmers had to reject)	Food processor and end-consumers
GE 15	Retailer	All fruits and vegetables	End-consumers
GE 20	Retailer	All fruits and vegetables	End-consumers
GE 23	Retailer	All fruits and vegetables	End-consumers
GE 28	Retailer	All fruits and vegetables	End-consumers
GE 29	Retailer	All fruits and vegetables	End-consumers

Table 2
Themes and code descriptions.

Part of Survey	Question	Theme	Code name		
Background	Country		◆ Germany		
			◆ The Netherlands		
	Product type		◆ Fruits		
			◆ Vegetables		
			◆ Fruits and vegetables		
			◆ Farmer		
	F&A supply chain actor		◆ Producer organization		
			◆ Retailer		
Part A	Who imposes? (questions 1 and 2)		◆ Cooperation/Wholesale requirements		
			◆ Cutter requirements		
			◆ EU/Local regulations		
			◆ Farmer regulation		
			◆ Internal requirements		
			◆ Regulations concerning class/form/size		
	Why cosmetic specifications? (questions 3 and 4)		◆ Retailer requirements		
			◆ Appearance		
			◆ Consumer/Customer expectation		
			◆ Logistic requirements		
			◆ Market share		
			◆ Pricing/Price formation		
			◆ Regulation		
	Part B		What percentage is rejected based on visual criteria? (question 1) What happens with products not fulfilling requirements? (question 2)	open	
				◆ Alternative Market: 'Local' market	
			◆ Alternative Market: Export		
			◆ Alternative Market: Other buyer/ customer		
			◆ Send to alternative market		
			Developed to other product/destiny	◆ Developed to biogas	
				◆ Developed to cattle feed	
				◆ Developed to manure	
				◆ Developed to new product	
				◆ Ploughed back into the ground	
◆ Donated to charity					
Donation					
Waste		◆ Destroyed at the farm			
		◆ Thrown away			
		◆ Thrown away bio waste			
		Part C	Would like to produce/sell? (questions 1 and 2)		◆ Societal/CSR/Sustainability
					◆ Yes: Positive image/brand
			Conditional motivation		◆ Yes: Sustainability
◆ Yes: If we produce/ sell en masse					
Image/Moral			◆ Yes; If retailer would sell products		
			◆ No: Against personal/organizational standard		
			◆ Yes; In favor of personal/organizational standards		
			◆ No: Low quality		
Market Mechanism	◆ No: Uniform product is economically attractive				
	◆ No: Imbalanced supply and demand				
	◆ No: Negative financial outcome				
	No market possibilities	◆ No: Difficult to sell			
◆ No: Does to sell					
◆ No: Consumer does not want it					
Would it be possible to produce/sell? (questions 3 and 4)		Logistical barrier/unsustainable logistics	◆ No: Not possible due to logistics		
	◆ No: Due to efficiency barriers in logistics				
	Cost of shelf space (retail)		◆ No: Costs of shelfe space		
			◆ No: (Increasing) visual requirements		
			No market prospects		

Table 2 (continued)

Part of Survey	Question	Theme	Code name
Part D	What are current barriers to produce/sell? (questions 5 and 6)	Market potential	<ul style="list-style-type: none"> ◆ No: Not enough power ◆ Yes: There is already a consumer market ◆ Yes; If there is demand from the market ◆ Yes: Depending on weather
		Equal handling process	<ul style="list-style-type: none"> ◆ Yes; Product tastes the same/equal harvest ◆ Yes: Possible to handle demand
		End-Consumer Expectation Barrier	<ul style="list-style-type: none"> ◆ Appearance important to end-consumer ◆ End-consumer determine what they buy ◆ Quality barriers
		Retailer barrier	<ul style="list-style-type: none"> ◆ If demand is high retailers refuse low quality ◆ Shelf Space availability/supply
		Costs, competition, pricing barrier	<ul style="list-style-type: none"> ◆ High organizational adaption and costs ◆ Pricing barriers ◆ Competition increase (if availability increases)
		Benefit Company Image	<ul style="list-style-type: none"> ◆ Yes; Benefit financially & morally company image ◆ Yes; In favor of societal/CSR standards
		Profit Incentives/Potential Benefit	<ul style="list-style-type: none"> ◆ Yes; If there is a financial improvements ◆ Yes; Market possibilities
		Appearance is main criteria	<ul style="list-style-type: none"> ◆ Appearance Critical Consumer ◆ Appearance Sensitive Consumer
		End-consumer does not care	<ul style="list-style-type: none"> ◆ Consumer is not interested ◆ The consumer does not care
		Special pricing	<ul style="list-style-type: none"> ◆ For each product there is a market ◆ Price Sensitive Consumer
	What are facilitators to produce/sell? (questions 7 and 8)	Sustainable relevance positioning	<ul style="list-style-type: none"> ◆ Market environment is changing ◆ Sustainable Conscious Consumer
	Why would consumers (not) buy? (questions 1 and 2)		

are not included in the coding schedule or result section. The codes were compared to each other both within and across the different organization types in the supply chain.

3. Results

3.1. Presence and nature of cosmetic specifications

The findings from the interviews supported our assumption that cosmetic specifications are not only set by the European Union but that they are also self-imposed by the food supply chain. At all three supply chain levels (producers, producer organizations, and retailers) both in Germany and the Netherlands, all interviewed parties indicated that cosmetic specifications were being used in their industry. They all admitted that next to the EU regulation, retailer requirements constituted a main source of cosmetic specifications. Most producers and producer organizations also set cosmetic specifications themselves to make sure that they would appear as a high-quality player in the market who delivers high quality products to their customers: *'According to us, the fruit needs to be immaculate. In fact, every deviation is not good'* (NL2, producer).

The majority of the interviewees indicated that consumers' appearance-related wishes or demands for perfect-looking fruits and vegetables was the major underlying reason for the existence of these cosmetic specifications: *'When not-perfect products are in a supermarket, consumers never take it. They select the perfect ones, and the bad ones remain. The next day new products are delivered yet again, and then the bad ones are thrown away anyway'* (NL8,

producer). The German-based interviewees strongly emphasized the trade regulations set by the EU as an additional underlying source of cosmetic specifications. It appeared that in both countries, the extent to which products conform to cosmetic specifications is checked to some degree by governmental and external agencies, but this is mainly done by chain actors themselves as a basis for transactions at the subsequent stages of the supply chain.

3.2. The impact of cosmetic specifications on food waste

Despite the consensus on the presence and nature of cosmetic specifications, there is considerable difference among the interviewees on their assessments of the impact of such specifications on business performance and product supply. In Germany, across the levels of farmers, producer organizations, and retailers, they assessed their wastage on the basis of cosmetic specifications (rejection rates) at around 20% on average but with considerable variation (ranging from 2% to 40%). However, in the Netherlands the retailers assessed their own wastage extremely low (1%). Among the producers, the self-provided estimates on the stream of products in their company that did not comply to the cosmetic specifications ranged from 2% (greenhouse production of tomatoes) to 25% (open-field production of lettuce and cabbage) in the Netherlands, and even up to 40% for open-field production in Germany. Producer organizations similarly indicated that between 1% and 30% (in Germany) and up to 40% (in the Netherlands) of their incoming products did not fulfil the cosmetic specifications. Among the German retailers, 2%–40% of their delivered fruits and

vegetables did not fulfil the cosmetic specifications.

The rejection of fruits and vegetables on the basis of cosmetic specifications did not automatically mean that these products were being wasted. Indeed, the interviewees from both countries pointed out that they undertake a range of activities for the suboptimal products. The percentage of suboptimal products being discarded as waste varied widely across actors. Particularly at the level of producers and producer organizations, part of the suboptimal foods were being sold either to alternative market channels abroad (as export) or to the food processing market: *'It is not the case that this lettuce is of lower quality. If it just has a small inside edge, then we can simply export it'* (NL4, producer). Open-field producers considered ploughing the products back into the ground as an alternative. When producer organizations could not accept the supply from producers, these suboptimal products ended up being destroyed or transferred into cattle feed, biogas, or manure. It is interesting to note that, although actors perceived ploughing back into the ground or transforming food into cattle feed, biogas, or manure as ways to avoid food waste, these actions are defined as food waste in the literature (FUSIONS, 2014; Parfitt et al., 2010). Producer organizations appeared to have some capacity to accumulate suboptimal products and to find new markets and new applications (e.g., processed foods): *'For example, all misshapen strawberries are moved to an industrial processor and they use the strawberries to make jams and flour and that kind of stuff. For a product like strawberries, about 5% goes to industrial processors'* (NL10, producer organization). Both producers and producer organizations reported discarding less than half of their suboptimal products as waste.

At the retail level, options were limited to donating suboptimal products to charity and discarding suboptimal products as waste. Many retailers, especially Dutch ones, have some standard donation outlets: *'Here in XX there are some food banks. They come by at noon, pick it up for the needy, and distribute it then. They pick up about two to three boxes every day'* (DE15, retailer). However, the majority of suboptimal products at the retailers were discarded as waste. Across all three supply chain levels, very few interviewees mentioned that suboptimal products were sold as second-class or lower-class products. Taken together, it appears that supply chain actors tried to find the best possible value propositions for their suboptimal products.

3.3. Motivation, ability, and opportunity to handle suboptimal products in business practices

As part of the exploration of the business potential of suboptimal products, we asked the interviewees whether, together with the production and marketing of perfect products, they would also be motivated to comprehensively produce and find markets for suboptimal products, and about their abilities and the potential facilitators and barriers (opportunities) that could influence their decision to do so.

3.3.1. Motivation

Regarding the *motivation* to bring to full production and market suboptimal products, in both Germany and the Netherlands the producers' and retailers' motivations were mixed, whereas producer organizations were more positive (see Fig. 1). Producer organizations were positive in their motivation to produce and market suboptimal products, but they acknowledged that market contextual factors had a negative influence on their decision to do so. Their motivations included societal motivations to reduce food waste (*'Just throwing it away is madness.'* DE17, producer organization) and reflections of personal and organizational standards (*'That is what we try to do; it is in our company's interests because of our own attitudes'*, DE22, producer organization).

For producers and retailers, market contextual factors were already taken into account when forming their motivations concerning the production and marketing of suboptimal products; this supports the social marketing MOA perspective. Comparable to the producer organizations, the producers and retailers also mentioned societal motivations or corporate social responsibility motivations. However, producers and retailers formulated conditional motivations (*'I do not have any problems with that if I can deliver my products directly to the retailer'* NL3, producer; *'If there is a lack of good products, we would certainly be motivated to do so'*, NL12, retailer), or mentioned that they had adjusted their motivation to the (negative) marketing conditions (*'I would want it, but it is also a trade-off that you have to make. I can put it in on the shelves, but when consumers do not buy it I still have to throw it away. Then it costs me even more money. Therefore, we now refrain from doing it'*, NL7, retailer).

Interestingly, all the interviewees gave personal moral and/or

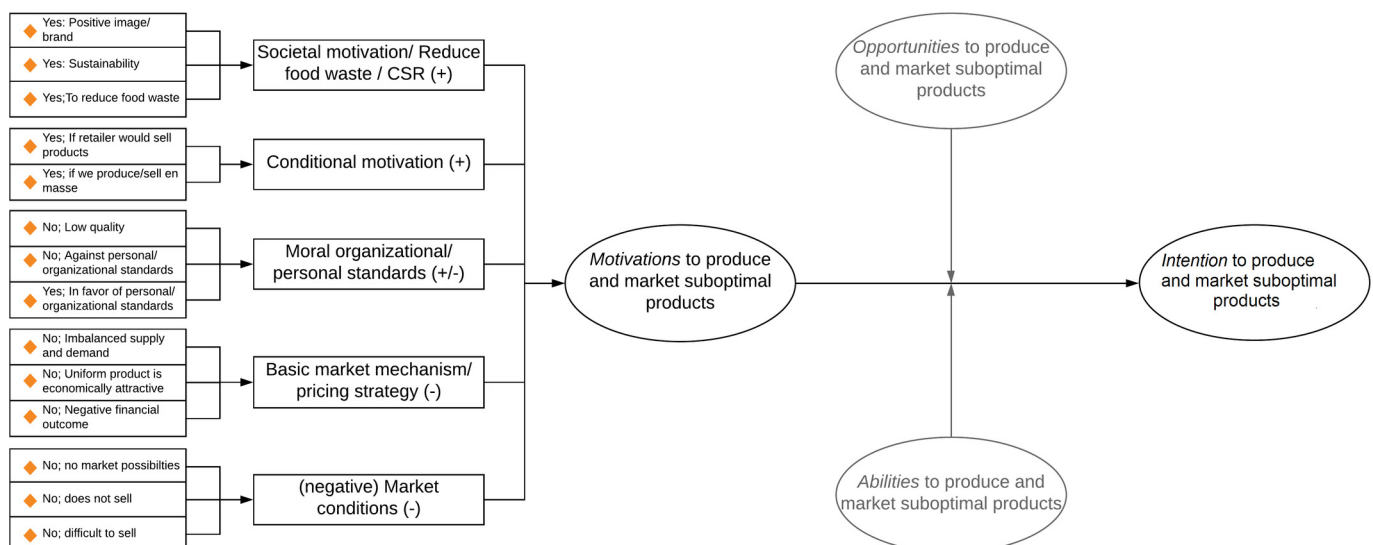


Fig. 1. Motivations (including themes and codes), abilities, and opportunities of supply chain actors to produce and market suboptimal products.

organizational standards as an explanation for *not* being motivated to produce and market suboptimal products. In this case, these standards were considered central to the desired positioning of the company or of the supply chain as a high quality producer who does not compromise on quality (including sub-optimality): 'We really only want to produce good and optically perfect products. The better it looks, the better price I can achieve' (DE15, retailer); 'We do not want it. We want to deliver high quality' (NL4, producer).

Most supply chain actors focused on the basic market mechanism and pricing strategies as the underlying reasons for not being motivated to produce and sell suboptimal products. Their reasoning followed two different lines. First, under the assumption that demand will not increase when suboptimal products also enter the market, the interviewees indicated that competition would increase if suboptimal products were produced and marketed. As more supply generally means lower prices for all products, the introduction of suboptimal products would thus harm the market for all products. Second, if suboptimal products were to be introduced as lower-quality class products, they would be sold at lower prices. This would be at the expense of the high-quality "perfect" products and would reduce both their demand and prices ('If you would sell second-class products, you would have to accept that you would get less for your first-class products, because you would then automatically have less demand for those', NL2, producer). None of the interviewees mentioned any positive price aspects or the possibility of introducing suboptimal products as a distinctive category that would generate higher prices due to their natural or authentic image (as sometimes applied to organic foods).

3.3.2. Ability

Concerning the *ability* to extensively produce and market products that do not fulfil cosmetic specifications next to perfect

products, half of the producers and retailers in both countries confirmed that they would be able to do so (see Fig. 2). These producers and retailers mentioned that potential consumer markets for such products already exist, such as the weekly local market, or that there would be a potential consumer for every potential product. Some producers stated that they have the ability to produce suboptimal products because the harvesting and production process for suboptimal products does not differ from the process for perfect products. In both countries, the producer organizations were most negative about their abilities to produce and market suboptimal products. One of the main arguments given was inadequate logistics to deal with deviantly shaped food products, or the negative effect on the overall sustainability of the logistics: 'Thus in another way, you will overburden your logistics, which means that we need more logistic handling for the same amount of cucumbers. This has an impact on the sustainability and on the environment as well, because we need "more logistic handling" and we transfer "more air" due to the suboptimal form' (NL10, producer organization).

For producers and producer organizations a main reason for not being able to extensively produce and market these products was the costs of shelf space. Retailers offer a limited amount of shelf space for fruits and vegetables, and producers and producer organizations were limited to delivering this exact amount of fruits and vegetables. As a consequence, retailers can only select products that would be sold easily because the shelf space would be too expensive for slow-moving products ('The products just have to be good, it will cost shelf space to put suboptimal products in there', NL6, producer; 'If you offer a product of which ten are already on the shelves, the retailer will not be prepared to add an eleventh with the likelihood that it won't sell', NL5, producer organization).

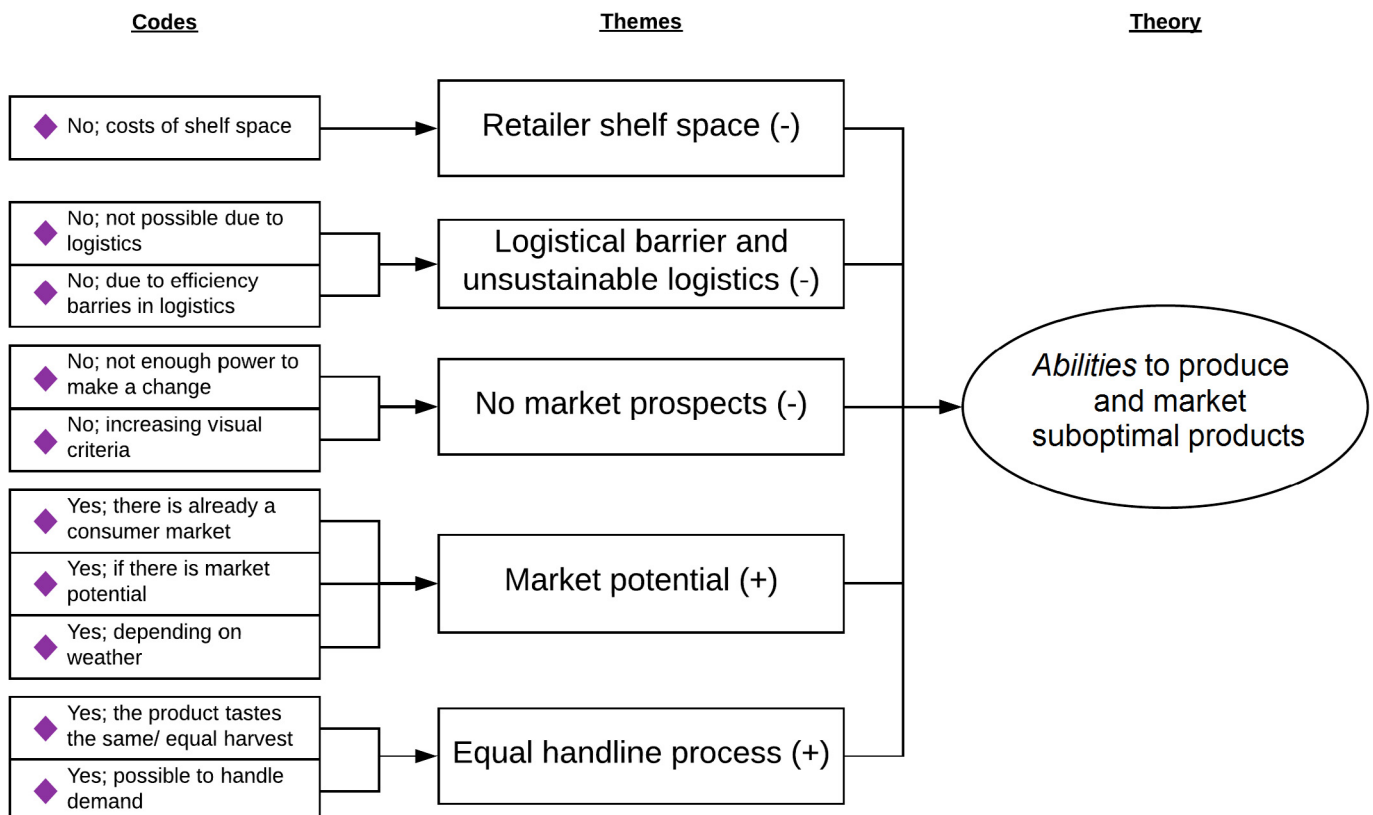


Fig. 2. Abilities (including themes and codes) of supply chain actors to produce and market suboptimal products.

3.3.3. Opportunity: facilitators and barriers

The majority of producers, producer organizations, and retailers we interviewed saw opportunities to produce and sell products that do not fulfil cosmetic specifications, but all of them also cited some possible barriers to realizing these opportunities (see Fig. 3). Across the three levels of supply chain actors in both Germany and the Netherlands, the most often mentioned opportunities were ones that were potentially beneficial for the company and company image. If supply chain actors could find channels that would financially reward them sufficiently for the production and marketing of suboptimal products, many would do it (*'The production costs must be under control, and afterwards you have to earn something'*, DE21, producer; *'It needs to generate a supplementary income for everybody'*, DE32, producer organization). Producing and marketing suboptimal products could also benefit a company's image: *'If it would come together with some marketing, for example "directly from the producer", it would be something new and different that would make you unique'* (DE20, retailer). In addition, it would be a sustainable solution that could contribute to a positive company image. Indeed, several producers and producer organizations mentioned sustainability positioning as another potential opportunity (*'Putting such products in the store can be done because it signals to the outside world that you are working in a socially responsible way. When you see what the revenues and results would be, I dare to say that companies would do it only to be socially responsible'*, NL11, producer organization).

All the interviewees mentioned at least one barrier. They all mentioned the consumers who *'are in the end the ones who determine what is sold'* (NL11, producer organization). Supply chain actors believed that the appearance of fruits and vegetables determined the consumers' first impressions of these products, which were believed to be *'for 90% leading consumers' purchase decisions'* (NL9, producer organization). Because the appearance of suboptimal products would deviate from consumers' expectations, consumers would then be unwilling to purchase suboptimal products (*'Consumers do not want this type of products'* DE22, producer organization; *'This is what you also see in stores. In stores consumers cherry-pick the perfect apples, and they become picky as*

soon as something deviates. Indeed, the remainders are the ones that deviate in one way or another', NL11, producer organization). As a consequence, producing and marketing suboptimal products could result in consumers moving to competitors for their grocery shopping (*'In the end, the retailer is dependent on the consumer. When consumers are of the opinion that the quality of retailer A's tomatoes are lower compared to retailer B's tomatoes due to the selling of such suboptimal products, consumers will move to retailer B'*, NL10, producer organization).

Producers and producer organizations also mentioned the retailer as a barrier. Retailers would have limited shelf space and would therefore only offer products that would certainly be sold. Producers and producer organizations believed that suboptimal products would not be sold easily due to the end-consumer barriers mentioned previously and that therefore retailers would be reluctant to include or would soon remove suboptimal products from the shelves (*'From a retailer perspective, the necessary shelf space is an important barrier'*, NL6, producer; *'For us there are no barriers, but the retailer is the barrier They have an economic concern. Suboptimal products are such slow movers that the retailer will just remove it from the shelves. Shelf space is too expensive for such products'*, NL11, producer organization). Finally, all interviewed mentioned market aspects such as costs, competition with "perfect" products, and pricing as barriers against the production and marketing of suboptimal products.

3.4. Perspectives on consumer willingness to buy suboptimal products

The needs and wants of the end-consumer were frequently mentioned both as central to an opportunity and as a barrier for the production and marketing of suboptimal products. When specifically asked about potential end-consumer demands and the marketing potential for suboptimal products, the majority of producers and a minority of producer organizations and retailers from both countries indicated that consumers would buy such suboptimal products. In almost all of these cases, the marketing potential would depend on the price setting for such products. This suggests

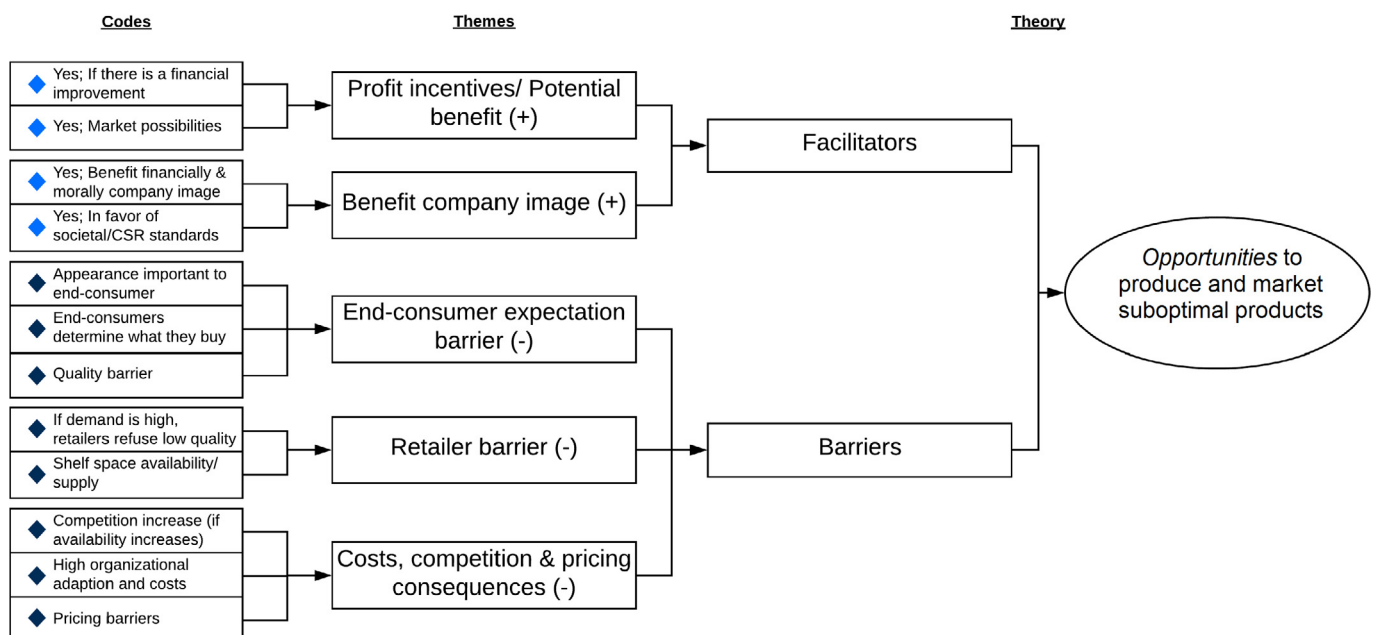


Fig. 3. Opportunities (including themes and codes) of supply chain actors to produce and market suboptimal products.

that consumer purchases would be conditional on *'only if you lower the price'* (DE20, retailer) relative to the prices of “perfect” products (*'If we lower the price, then consumers will buy the product. This is actually strange, because it is the same product, with the same contents, the same taste, and the same production. It only does not look 100% similar'*, DE15, retailer).

Those who did not believe in the market potential of suboptimal products indicated that consumers would neither care about nor be interested in products that do not meet cosmetic specifications (*'At the moment, the consumer's priorities are on visually perfect-appearing products. The priority of shopping consumers is primarily on the optical or visible texture and less on the actual taste'*, DE3, retailer; *'Most of the complaints we currently receive are about deviations of the product from the specifications. Ninety per cent of the consumers still want to have a perfect and complete product'*, NL7, retailer). Importantly, many of the interviewees from both countries indicated that they saw a small societal change occurring in which sustainability-relevant issues were becoming more important. For example, *'It seems as if [in] the last two years many things are changing in this respect'* (NL7, producer), and *'Youth is already different. I think that the future generation will think completely differently about this issue'* (NL11, producer organization). This suggests that there might be a market potential for suboptimal products in the future.

4. General discussion

4.1. Theoretical implications

Even though many researchers have pointed to the existence of cosmetic specifications as one potential cause of food wastage, to the best of our knowledge the current research is the first empirical study that focuses on the food waste implications of cosmetic specifications and on supply chain actors' decision-making process regarding the production, marketing, or wasting of products that do not meet such cosmetic specifications. Interviews with 33 producers, producer organizations, and retailers from two countries reveal that cosmetic specifications are set and maintained by multiple actors and that in each step of the supply chain between 1% and 40% of products are rejected on the basis of these specifications. As supply chain actors put effort into finding alternatives for such rejected products, it appears that varying amounts of suboptimal products are wasted. Moreover, the current findings reveal that the motivations and abilities of producers, producer organizations, and retailers to comprehensively produce and market suboptimal products are dependent on personal and organizational standards and market contextual factors such as competition, pricing, production costs, logistics, and consumers' wishes. Business potential for suboptimal products is found in corporate social responsibility approaches or in making the production and marketing of such products financially viable. However the success of such approaches rests on the perceived willingness of consumers to purchase such products. With these findings, the current research provides the first steps towards understanding the presence and impact of cosmetic specifications and the decision process of supply chain actors concerning suboptimal products.

The present research shows the complex trade-off between the economic, social, and environmental dimensions of sustainability and how the supply chain actors in the fruit and vegetable sector prioritise these dimensions. The actors' corporate social responsibility concerns, organizational image management, environmental concerns, and concerns about those worse off (as shown through donations to food banks) are motivations that play a role in the business practices concerning suboptimal products. Such motivations can be seen in small scale initiatives that have been

started worldwide as attempts to find (complementary) supply chains for suboptimal products (e.g., Albert Heijn's “Buitenbeentjes” and Intermarché's “Inglorious Fruits”) (Aschemann-Witzel et al., 2017). A number of such initiatives include actions that position suboptimal products as second-class products with reduced prices. However, moral or sustainability considerations are insufficient for the market positioning of suboptimal products to become a long-term success in mainstream marketing. Our findings reveal that suboptimal products must first fulfil actors' economic motivation to maximise value before such products will be successfully produced and marketed.

Our findings suggest that the essential factor for the potential long-term success of suboptimal products would be the consumer's preferences. Supply chains are ultimately focused on delivering products that are considered valuable by consumers (Kozlenkova et al., 2015). The current findings indicate that supply chain actors perceive consumers to be unwilling to purchase suboptimal products. These beliefs are partially supported by a recent research on consumer preferences for suboptimal products in stores, which shows that 25% of consumers were willing to buy a suboptimal product (De Hooge et al., 2017). However, the research also found a negative relationship with age: younger consumers were more willing to purchase suboptimal products. Similarly, the present research found some intimation of potential societal changes on this issue in the near future. Together, these findings suggest that supply chain actors may likely undertake more successful marketing of suboptimal products in the future.

4.2. Managerial implications

The findings demonstrate that the abolition of European cosmetic specifications would not stop the wastage of suboptimal food products. Cosmetic specifications were originally set as a basis for quality grading by European legislation (European Union, 2007). It now appears that multiple supply chain actors have adopted and maintained these high quality standards as the “minimum quality” standard for their products. For actors, there are limited incentives to produce or market foods that are less than perfect-quality level, other than for the processed food industry where imperfections become invisible. The European Union may have eased the cosmetic specifications with the goal of reducing food waste, but this action has limited effects because supply chains continue to maintain cosmetic specifications.

Interestingly, the recent findings suggest that the supply chain actors' definition of food waste is not consistent with that of scientists and policy makers. In the food waste literature, although there are divergent views on the definition, there is general agreement that food waste concerns all foods that are produced for human consumption but are ultimately not consumed by humans (e.g., Aschemann-Witzel et al., 2015; FAO, 2013). On the contrary, supply chain actors seem more focused on the economic and environmental aspects rather than on the social aspects of their business practice. Consequently, they do not consider as food waste alternative uses for suboptimal products, such as transforming these products into biogas, cattle feeds, or into fertilizer by ploughing them back into the ground. Greenhouse productions and open-field productions turn out to differ from each other on the amount of suboptimal products they generate (greenhouses have lower suboptimal product rates as a result of controlled conditions) and in their alternative uses of suboptimal products (ploughing back into the ground is an option that is exclusively available to open-field production). The differences in food waste terminology may complicate the collective efforts of scientists, policy makers, and supply chain actors to quantify food waste and to find potential

sustainable solutions for the problem.

There may be many actions that supply chain actors could undertake to successfully produce and market suboptimal products. The current research examined the mainstream production and marketing of suboptimal foods, in which case suboptimality is considered to be an abnormality. However, for specific product segments, suboptimal products may not be considered an abnormality. For example, organic products are often already marketed in such a way that the shape (and especially the non-“perfect” shape) reveals that the organic product is natural or authentic. Also, alternative marketing channels to mainstream supermarket-retailer distribution for suboptimal products, such as online ordered meal boxes, non-supermarket retail channels, or direct sales from producers to consumers, may provide situations where suboptimal products are not considered a deviation. Furthermore, the marketing of suboptimal products in a positive or corporate social responsibility way, with a focus on for example the exclusivity of suboptimal products or the possibility to contribute to a more sustainable future, could provide a potential solution. Future research is poised to examine the potential production and marketing of suboptimal products in such non-mainstream supply chains.

It is possible that the regular exposure of consumers to suboptimal products may already be sufficient to motivate consumers to purchase suboptimal products. One could argue that the current standardised, high-quality system has created an artificial situation in which consumers do not like suboptimal products because they hardly encounter suboptimal products during their daily shopping. If this is the case, then actors would do well to take up suboptimal products as regular products in their business practices. Research on whether such actions would result in long-term economic success despite potential losses in the short-term is necessary.

4.3. Limitations and future research

Four observations can be made concerning the present study. First, its qualitative research approach does not allow for the necessary quantification of the generation and waste of suboptimal products, nor for formal comparisons among the studied actors or between the two countries, or for the segmentation of suboptimal product waste across types of products. We believe that the previous lack of knowledge on the decision-making process of supply chain actors concerning the production, marketing, and waste of suboptimal products benefitted from a preliminary qualitative study on the presence and impact of cosmetic specifications, and the supply chain actors' decision-making process concerning suboptimal products. Our findings could inspire research on quantifying the consequences of cosmetic specifications, on comparisons between supply chain actors, and on further segmentation of suboptimal products.

Second, the current study focused on a relatively small sample from two neighbouring countries that have closely related markets. Despite this study providing new and valuable insights into a hotly discussed topic, it remains to be seen whether our findings would hold in differently shaped markets. Thus, one important line of future research would be to expand the geographical scope on this topic.

Third, our sample was too small to draw conclusions about different types of producers. However, we noticed that there may exist differences between greenhouse production and open-field production on some aspects of suboptimal products. For example, production conditions in greenhouses are mostly under control, whereas in open-field production, producers are dependent on weather issues. Consequently, suboptimal products seem to be found more often and in more varieties in open-field production

than in greenhouses. Hence, there is a need for future research on the relation between the cosmetic aspects of foods and the type of production and on the point at which cosmetically “perfect” products may become “artificial” products.

Finally, readers may wonder what the decision-making process of other supply chain actors, such as processors and consumers, would look like. Although there are some studies on consumer preferences for suboptimal products (De Hooge et al., 2017; Loebnitz et al., 2015), at present there is no research on processors' or consumers' decision-making process or motivations, abilities, and opportunities concerning suboptimal products. This is an interesting avenue for future research.

4.4. Conclusion

In the present research we learn that food supply chains are designed and successfully optimised to deliver standardised highest-possible quality levels, among others, by setting and using cosmetic specifications. However, we also learn that this success has a downside, namely that products that are suboptimal have a difficult future in competition with their optimal counterparts, and are regularly wasted. We now know that although farmers and producer organizations are in general motivated to keep suboptimal products in the chain, in their present situation they can only do so if they know what to do and how (ability) and with some support in the market (opportunity). Our research essentially reveals how the business practices of supply chain actors concerning suboptimal products can be modelled from a MOA perspective. Moreover, wastage of suboptimal food products is not a result of poor intentions: supply chain actors are in principle motivated to “make the best” out of this deviant stream of produce. However market contextual factors such as competition, pricing, production costs, logistics, and especially consumer demands need to change so we can avoid wasting, and provide ugly fruits and vegetables with a viable future.

Appendix A. Items semi-structured interviews

Introduction

Thank you for participating in this interview. In this interview we would like to talk about the product specifications for food products that are mainly delivered to supermarkets. Throughout the whole supply chain, products are evaluated on the basis of a number of rules and specifications related to safety, taste, quality, appearance, etc. In this research we are interested in the evaluation of fruits and vegetables on the basis of appearance (e.g., colour or shape) and not on the basis of safety, taste, or quality. We would like to find out who develops and maintains these appearance specifications, how many fruits and vegetables fulfil these specifications, and what happens with the fruits and vegetables that do not meet these specifications.

Product specifications and impact on food waste

A Presence and nature of cosmetic specifications

- 1 Are there any cosmetic specifications for fruits or vegetables in your sector?
- 2 Which parties impose these cosmetic specifications?
- 3 What are these cosmetic specifications based on?
- 4 Which parties check whether the fruits/vegetables fulfil these cosmetic specifications?

B Impact of cosmetic specifications

- 1 Can you provide a rough estimation of the percentage of your production that does or does not fulfil these cosmetic specifications?
- 2 What happens with the products that do not fulfil these cosmetic specifications?

Business potential of suboptimal products

- C Supply chain actors' motivation, abilities, and opportunities
 - 1 Would you (as a company) like to produce and market fruits/vegetables that do not fulfil the cosmetic specifications?
 - 2 Why or why not?
 - 3 Would it be possible to produce and market fruits/vegetables that do not fulfil the cosmetic specifications?
 - 4 Why or why not?
 - 5 Are there any barriers to produce and market fruits/vegetables that do not fulfil the cosmetic specifications?
 - 6 What are these barriers?
 - 7 Are there any facilitators to produce and market fruits/vegetables that do not fulfil the cosmetic specifications?
 - 8 What are these facilitators?
- D Supply chain actors' perspectives on consumers' willingness to buy
 - 1 Do you think that consumers would buy fruits/vegetables that do not fulfil the cosmetic specifications?
 - 2 Why or why not?

Thank you for your participation in this research.

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