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Part Two: Food Waste (and Loss) along the Food Supply Chain and its Institutions – Retail

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Abstract:

Food waste occurs along the entire food supply chain and gives rise to great financial losses and waste of natural resources. The retail stage contributes a proportionately smaller mass of waste than other stages in the food supply chain, but plays an important role as gatekeeper in the chain, significantly influencing upstream and downstream handling of food. In order to reduce food waste, it is important to understand the kinds of food wasted, but also the root causes of this waste. Since food waste is often generated for many reasons, multiple actions are needed to achieve a reduction. Food waste prevention can include technical solutions, like improved logistics, forecasting and packaging, but also incentive structures that motivate supermarkets to engage in social donations and improved routines. As in other levels of the food supply chain, there is no single waste prevention measure which could solve the problem within retail. There is a raft of measures which could be implemented within companies or together with partners along the supply chain. If these are not introduced voluntarily, compulsory actions could be considered to increase sustainability in the food supply chain.

1. Introduction

Within Sustainable Development Goal 12.3 of the United Nations (UN), the retail sector is named explicitly as a target level to fulfil the 50% food waste reduction goal by 2030 (UN, 2015). In recent years, more information has emerged about food losses and waste in retail, but in most cases the dataset is restricted to one company (e.g. Lebersorger and Schneider, 2014a), a few product groups (e.g. WRAP, 2011; Eriksson et al., 2012; 2016; Lebersorger and Schneider, 2014a; Buzby et al., 2015) or a restricted number of outlets (e.g. Eriksson et al., 2012; Buzby et al., 2015; Cicatiello et al., 2016;

Mattsson et al., 2018). In addition, the available literature world-wide is limited to mostly industrialised countries and to retail chains or supermarkets, while data from wholesalers, street markets and small grocery stores are lacking. While the scope of available data and the options for extrapolation are limited, the available data show that the proportion of waste in the retail sector is smaller than in many other stages of the food supply chain (FSC). The retail level is generally estimated to produce less than 10% waste in relation to delivered mass (Eriksson, 2015), whereas other stages in the FSC exceed this value. Nikkel et al. (2019) reported that retail food waste contributed 12% to entire food waste along the Canadian food supply chain and according to Stenmark et al. (2016) retail is believed to produce about 5% of the total food waste in EU.

Nevertheless, taking the retail sector into account is essential in prevention of food waste, for several reasons. For example, the retail stage is located near the end of the food supply chain and thus food offered on retail shelves comprises all resources used and environmental impacts generated upstream in food production, processing, packaging etc. Furthermore, supermarkets represent a relatively manageable number of sites where good-quality surplus food, mostly still fit for human consumption, could be collected and utilised for other nutrition purposes (Eriksson et al., 2015; Eriksson and Spångberg, 2017; Porat et al., 2018). According to Gruber et al. (2016), four additional factors explain the high relevance of the retail sector within the food waste issue.

First, retail plays an important gatekeeper function within the FSC (as do wholesalers). In countries with highly concentrated markets dominated by few companies, retail has high purchasing power and influence over the food items produced and offered, the amounts and the quality (Parfitt et al., 2010; Gruber et al., 2016; Feedback, 2017; Eriksson et al., 2017). Sweden is a good example of such a country, since the market share of the five largest food retail companies amounted to 94.7% in 2002, which was the highest in Europe (average 69.2%) (Vander Stichele et al., 2006). These five companies also own or control large parts of the distribution chain and, via private brands, some of the production. This reflects the typical situation in industrialised countries, where food retail involves national or international supermarket chains with many outlets. However, within emerging and developing countries the situation may be similar or completely different. Some, such as Indonesia, are facing an increasing growth of modern supermarkets in comparison to traditional wet markets such as 'pasar' (Soma, 2018). Other countries, such as South Africa, are in transition, depending both on small kiosks known as 'spazas stores' and informal street vendors, and on (inter)national supermarket chains, which are rapidly increasing in importance, especially in high-income urban areas (Battersby, 2017). In Brazil, public marketplaces such as the so-called CEASAs (Centrais de Abastecimento), which are mostly managed by public authorities, are important food supply sources for both retailers and consumers (Menezes et al., 2015). In all cases, as Gruber et al. (2016) point out, retail controls the point of sale and can stimulate specific purchasing habits by households. Second, the outlet is the real distribution point of food items and the corresponding food waste is generated there. Third, due to the high absolute concentration of surplus products which are not sold due to high turnover, retail outlets are easier to target in food waste prevention measures than e.g. households. Fourth, the cooperation paths of various stakeholders (e.g. suppliers, consumers, authorities) converge at the retail outlet (Gruber et al., 2016).

Most retail companies record non-sold products as a cost within their data warehousing. As non-sold products represent a loss of sales/turnover, information about food waste is hidden within cost accounting, but normally not determined in detail. Thus, the term used for non-sold products in cost accounting tools is "loss", expressed in terms of financial loss. This means that the available economic

data must be converted into mass if waste topics or environmental issues are to be addressed. Corresponding uncertainties result from that conversion. Moreover, many studies on retail food waste use terms such as “loss”, “shrinkage” or “shrink” (cf. Buzby et al., 2015) or similar terms, rather than “waste”. A precise definition of the food streams included or excluded is not always given in the literature.

Irrespective of the term or definition used for food waste in supermarkets, data from different supermarket departments provide different perspectives on the problem. Figure 1 exemplifies this by showing the share of waste generated in different product categories. As can be seen, fresh fruit and vegetables are the dominant category from a mass perspective, but are less dominant if the focus is shifted to economic value or environmental impact (here represented by the carbon footprint). The opposite trend can be seen for animal products, which have a higher value in terms of both economic and environmental impact and represent a more significant share of retail food waste when it is quantified in monetary units or environmental impact units.

Following increasing concerns among consumers about topics such as fair trade, healthy food, regional supply and responsible food production, in recent years retailers have started to broach the issue of food waste, reporting their responsibilities, strategies and measures within corporate social responsibility (CSR), sustainability reports and member mailshots (cf. Tesco, 2014; Spar AG, 2014; Spar Holding AG, 2017). Retailers are now also more interested in supporting food waste reduction initiatives and in cooperating with other stakeholders on this issue.

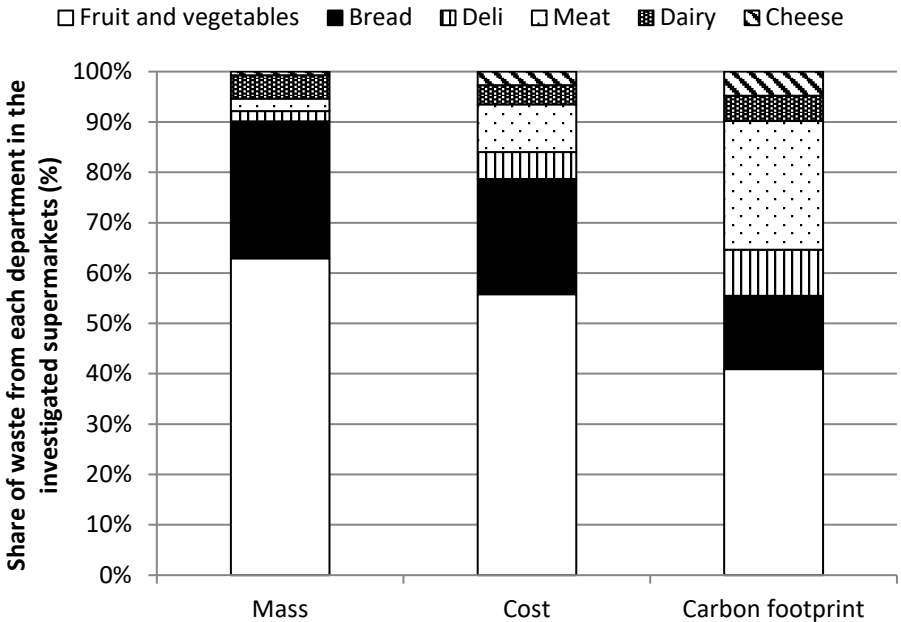


Figure 7.1. Depending on the units used, different supermarket products contribute different shares of food waste. Meat is a good example of products where a small mass of waste represents a much larger share of the environmental impact and cost. Source: Based on data presented in Scholz et al. (2015), Eriksson (2015) and Brancoli et al. (2017), with the dairy department used to normalise the data.

2. Generation and composition of food waste in retail

One of the first retail companies to publish internal data on food waste generated within operations was Tesco, in 2013. The data showed that less than 1% of the offered food was wasted, which corresponded to 46,000 t per year for Tesco's UK activities (Parfitt et al., 2010). This was an important signal to other international companies to begin playing a more active role in reducing food waste. Table 1 provides a brief overview of international results on food waste in the retail sector.

Table 7.2 Summary of published studies quantifying relative food waste in supermarkets. FFV = fresh fruit and vegetables, FSC = food supply chain. The relative waste refers to the percentage waste in relation to the specified reference base

Reference	Country	Data collection method	Reference base	Product group	Relative waste (%)
Fehr et al. (2002)	Brazil	Quantification at retailer	Delivered mass	FFV	8.8
Tofanelli et al. (2007)	Brazil	Interviews	Delivered mass	FFV:	3.2
Tofanelli et al. (2009)	Brazil	Interviews		in supermarkets	1.9
				in grocery stores	4.2
				in street markets	21.5
Buzby et al. (2009)	USA	Supplier records	Supplier shipment data	Fruit	8.4-10.7
				Vegetables	8.4-10.3
Göbel et al. (2012)	Germany	Analysis of national statistics	Delivered mass	Retail sector	1
Buzby & Hyman (2012)	USA	Analysis of national statistics	Food supply value	FFV	9
				Dairy products	9
Eriksson et al. (2012)	Sweden	Store records	Delivered mass	FFV	4.3
Beretta et al. (2013)	Switzerland	Estimate from store records	Volumes of sales	FFV	8 – 9
Katajajuuri et al. (2014)	Finland	Interviews	Not specified	Retail sector	1-2
Stensgård & Hanssen (2014)	Norway	Store records	Sales value	Fruit	4.5
				Vegetables	4.3
				Milk products	0.8
				Cheese	0.9
Lebersorger & Schneider (2014a)	Austria	Store records	Sales in cost price	FFV	4.3
				Bread & pastries wasted by retail	2.8
				Bread & pastries returned to bakery	9.7
				Dairy products	1.3
Lebersorger & Schneider (2014b)	Austria	Store records	Sales in cost price	Total	1.82
				FFV	5.05
				Dairy products	1.67
				Bread & pastries	2.91
Eriksson et al. (2014)	Sweden	Store records	Sold mass	Organic perishable animal products	0.70
				Conventional perishable animal products	0.56
Mattsson & Williams (2015)	Sweden	Store records	Sold mass	FFV (only in-store waste)	1.9
Eriksson (2015)	Sweden	Store records	Sold mass	FFV	4.7
				Dairy	0.34
				Cheese	0.55
				Deli	1.5
				Meat	1.3
Ju et al. (2017)	Japan	National statistics	Initial total net food supply to FSC	Retail sector	2.2
			Input into retail sector	Retail sector	2.3

Eriksson et al. (2017)	Sweden	Supplier records	Returned volume	Premium bread	32
Porat et al. (2018)	Israel	Interviews	FFV marketing volume	Bananas, tomatoes, cucumbers	15-17 7-11
				oranges, peppers, grapes potatoes, apples	4-5

As mentioned, total assessments of the national food retail sector or of individual retailers are still scarce, mostly due to data confidentiality. As food waste generated by retail is not restricted to the company itself, more information on the influence of retail on other levels of the FSC (pre-store, in-store and post-store) is provided in the following sub-sections.

2.1 Pre-store food waste induced by retail

Due to the strong influence of retail on quality issues, especially related to fresh produce, individual marketing standards have a strong influence on losses at global supplier level. Although 26 of the former specific marketing standards for fruit and vegetables in the European Union were replaced by general marketing standards in 2009, imperfect or ‘Wonky’ products are still generally not sold on retail level by international or national chains. Products not meeting specifications set by the purchasing department of retail chains are rejected on-site, as return transport is too costly. If they are returned to the supplier, they are mostly used for animal feed, biogas production or soil amendment. There are also take-back agreements and rejection policies that allow retailers to waste food at the expense of the supplier. These procedures make the waste problem less visible to retailers, as there is no internal recording, and suppliers are often not in a position to challenge the system (Parfitt et al., 2010; Eriksson et al., 2012; 2017; Feedback, 2017; Ghosh and Eriksson, 2019). In 2009, a case study in Austria showed that bread and pastries are generally governed by take-back agreements between supplier and retail (Schneider and Scherhauer, 2009). The supplier is only paid for the amounts sold, while non-sold products must be redistributed and handled at the supplier’s expense, a system which has considerably impaired the economic performance of bakeries. Discounters do not participate in such agreements and take responsibility for the whole order (Schneider and Scherhauer, 2009). In addition to marketing standards, contracts for agreed amounts of delivered produce lead to systematic overproduction in agriculture in order to overcome the risk of inability to deliver due to poor harvest, which would incur penalties (Feedback, 2017).

2.2 In-store food waste

As mentioned, non-sold food is usually recorded internally as a financial loss within the book-keeping tools of major food retailers. In order to determine the food waste prevention potential, these financial data must be converted into mass data and then divided into damage/breakages (e.g. products damaged/broken by staff or customers and no longer useable), stolen products, products used for own purposes (e.g. cleaning agents used for cleaning the outlet) and products removed from the shelf for other reasons. The latter are the primary target for food waste prevention measures, although such measures could also seek to reduce the share of damaged/broken products. However, part of this amount waste may already have been donated to social organisations or used for animal feed, which does not account for food waste but is an economic loss for the retailer. Thus, calculation and interpretation of data from cost accounting tools often needs some manual processing for the accurate assessment that is required to achieve reliable datasets and enable appropriate prevention measures to be formulated. Both Eriksson et al. (2012) and Cicatiello et al. (2017) quantified the share of food

that is wasted without being recorded, the unrecorded in-store waste. In contrast, Lebersorger and Schneider (2014a) did not find evidence for such variations in the book-keeping tool in comparison to test sorting in some outlets.

One of the first studies on food loss and waste along the entire food supply chain was published by the Economic Research Service of the US Department of Agriculture in 1995. The authors, Kantor et al. (1997), estimated that approximately 2 mass-% of available food in the USA was lost within the retail sector. Available data from the literature show that fruit and vegetables, dairy products, bread and fresh meat products are the most wasted products at retail level (e.g. Kantor et al., 1997; Schneider and Wassermann, 2004; Eriksson et al., 2012; 2014; 2017; Lebersorger and Schneider, 2014a, 2014b; Cicatiello et al., 2016; Brancoli et al., 2017).

Among the product groups with high levels of waste there are single products contributing with high shares of waste. For Swedish retail this is described in detail by Eriksson (2015) where tomatoes, bananas and lettuce was the most wasted products in the FFV section while pork chops, minced beef and pork legs was the most wasted in the meat section and semi skimmed milk, flavoured yoghurt and skimmed milk was the most wasted in the dairy section.

2.3 Post-store food waste induced by retail

As mentioned, retailers strongly influence the shopping and consumption habits of consumers. In particular, special offers on multi-packs and so-called BOGOF (buy one, get one free) offers are reported to lead to household-level surpluses of food, which is wasted once the 'sell by' or 'use by' date is reached. According to Parfitt et al. (2010), UK consumers attribute half their food impulse buying at retail outlets to in-store promotions. Mondejar-Jimenez et al. (2016) claim that the layout of goods in supermarkets also has a strong influence on the shopping behaviour of consumers and, as a consequence, on household food wasting behaviour. Moreover, a study in South Korea found evidence that travel time and buying frequency can influence food over-purchasing, with the individual effects differing depending on the format of the retail outlet visited (Lee, 2018). In surveys, consumers themselves blame retailers for not offering useful pack sizes or for selling poor-quality perishable food (e.g. for bread and FFV) (cf. Brook Lyndhurst Ltd., 2007; Schmidt et al., 2018).

3. Reasons and influencing factors for food waste in retail

There are multiple reasons for food losses at retail level, some of which are described in detail by Kantor et al. (1997), Schneider and Wassermann (2004), Mena et al. (2010), Lebersorger and Schneider (2014a), Canali et al. (2014), Buzby et al. (2015) and Lewis et al. (2017). Common reasons for food being discarded in supermarkets are: expired shelf-life (past the best-before or use-by date), visual defects/damage to the food item itself or the packaging, which make food unsellable (at least at full price), and overstocking due to difficulties in accurate sales prediction. Some of these issues are addressed below.

Because food can be wasted for a large variety of reasons, the food waste issue is difficult to solve with a single solution. As pointed out by Lindbom et al. (2014), it is important to identify not just the reason for food being discarded, but also the underlying root cause of the problem. However, such identification is problematic, since there are so many potential root causes of e.g. expired shelf-life, shortened shelf-life due to high piles at display, too large inflow of products, unexpected lack of demand, or a combination of all these. Since it is very difficult to identify a single root cause, it may be

more useful to assess risk factors, since these can potentially better capture the multiplier effect when several risk factors are present and include factors not necessarily leading to food waste, but increasing the risk of waste. Possible risk factors can be low demand, short shelf-life, unsuitable packaging or storage conditions and inappropriate handling by staff and customers.

Among others, Mercier et al. (2017) show that a poor cold chain due to long transport distances, improper or overloaded display cabinets in retail outlets and permanent rotation of stock between display and cooling facility within outlets leads to significant reductions in the shelf-life of perishables, even in developed countries such as Canada. This may have an impact at the retailer level or ultimately in the household, but is difficult to identify.

From an economic perspective, retailers try to order just the right amount of all products, meaning that there are no empty shelves (to avoid opportunity costs) and no unsellable surplus (to avoid loss of purchase costs). Unfortunately, there are several influencing factors that can introduce variation in demand and make prediction difficult. These include the weather, public holidays and school holidays, and also greater product variety (Lindbom et al., 2014), since having more different types of products decreases turnover for each and makes forecasting more difficult. On the other hand, providing a large variety of products also means freedom for customers, which supermarkets might use as a competitive advantage to differentiate them from their competitors. Since a larger variety might thus be expected to increase profits, retailers may be unwilling to reduce their product range, with waste simply being part of the price they have to pay for the larger range of products sold. In practice, Lebersorger and Schneider (2014b) show that food discounters with a smaller assortment of products generate less in-store food waste.

Promotions have a similar effect on food waste, since they temporarily shift the turnover of products and make forecasting more difficult. According to Eriksson (2015), some promotions prompt the customer to buy the promoted product, but to reject similar products (so-called substitute goods) as a consequence. Since forecasting of sales is more difficult when there are many aspects to consider, temporary shifts in sales can be difficult for retailers to predict accurately. This leads to a larger than necessary stock of non-promoted products and, since the store must not run out of the promoted product, a surplus of the promoted product. The result of the promotion is increased waste of the promoted product and also increased waste of similar products. Added to the cost of the waste is the lack of profit that arises when the store sells products at a lower margin than usual. Thus promotions can seem like a waste of effort, but they are unlikely to disappear since they are there to attract customers and thereby increase overall profits. Promotions can thus be viewed as a marketing cost and waste as simply part of that cost.

The literature is somewhat inconclusive regarding the effect of supermarket outlet size and the corresponding food waste generated within the outlet. Based on a review of a large range of results in the literature, Alexander and Smaje (2008) concluded that larger retailers have more losses as only perfect fruit and vegetables are offered to consumers. In contrast, Parfitt et al. (2010) concluded that future demand is more difficult to predict for small grocery outlets, as slight changes in consumer behaviour have more impact on stock and therefore generate a greater proportion of waste than in large supermarkets. Based on a detailed statistical analysis of 612 outlets of an Austrian supermarket chain, Lebersorger and Schneider (2014a) found that food loss rates decline with increasing sales area, increasing number of purchases per year and increasing sales of the retail outlet. They also found that these factors only explain 33% or less of the variation in food loss rates within the outlets of the same

retailing company, depending on food category. This indicates that food loss rates depend on other influencing factors such as individual work routines, planning approaches or staff experience (Eriksson et al., 2014; Lebersorger and Schneider, 2014a). A closer assessment of 83% of Austrian food retailers indicated that food retail discounters achieve a lower level of food waste than other supermarkets, which may be due to restricted assortment (Lebersorger and Schneider, 2014b).

Unexpected external events may cause irregular food waste at retail, e.g. if customers decide to stop buying a certain product. This decision might be caused by food scandals, such as presence of toxin-producing *Escherichia coli*, and it makes no difference whether the suspicion is proven or not. Several thousand cases of *E. coli* illness were reported in Germany in early summer 2011 and for some weeks it was not possible to identify the source. However, consumers were cautioned by the authorities about the safety of cucumbers and other vegetables and the market for these items collapsed after the first notice of suspicion, not only in Germany but also in surrounding countries. Beside the economic loss due to price deterioration, thousands of tons of good-quality fresh produce were wasted at production and retail level (Gaul, 2011). In less dramatic cases, such as discussions about unhealthy food, affected products are also likely to end up as food waste if the supplier cannot stop production fast enough or find an alternative market. According to Taylor (2006), there are a number of actions in the supermarket that can lead to a “bullwhip effect”, where the amplitude of the customer reaction increases from retail to wholesale, from wholesale to industry and from industry to primary production, and everyone along the chain increases/decreases production and increases/decreases stock in order to compensate for the customer reaction. Increased communication along the logistics chain, so that primary producers get their signals directly from the end customers, could be one way to deal with this problem. Another way to decrease the risk of a bullwhip effect could be by reducing the activities that increase variation. According to Taylor (2006), these activities include promotions, large numbers of products and/or actors in the logistics chain, and ordering and producing in large batches with large stocks. Therefore the same risk factors for food waste can be problematic both within supermarkets and in other parts of the food supply chain.

Literature from emerging and developing countries mentions other reasons for losses in the food retail sector. Improper storage (e.g. lack of cold chain during transport and retail, poor transport conditions (such as poor roads, lack of protecting packaging, huge distances), poor quality of produce coming from smallholders and challenging environment (such as temperature, humidity, rainfall) are some of the problems, in addition to those reported for industrialised countries (Tofanelli et al., 2007; Tofanelli et al., 2009). Lack of sufficient transport capacity and lack of regular access to new stock due to the rural location of retailers can also result in even non-perishable products having already reached their expiry date before the products reach the retailers. This situation has been reported e.g. in South Africa and leads to losses for the shop owners (Pereira et al., 2014).

4. Prevention measures

The varying food loss rates indicated by Table 1 and the weak influence of the outlet characteristics described above suggest that there is great potential for further food waste prevention in retail in practice. In recent years, many different prevention policies have been developed and implemented at retail level. These policies can be categorised as:

- targeting internal staff only, or including external stakeholders too
- brought into force by law (obligatory measures) or developed as voluntary agreements

- focusing on prevention of surpluses before generation, or finding alternative purposes for already generated surpluses.

Most types of waste and loss are unintentional, but since several risk factors are inevitably a natural part of any activity, waste must also be accepted as natural. A common reason for accepting the presence of risk factors is that they are too expensive or too difficult to prevent. There can also be a conflict of interest between waste reduction and increased profit, with waste reduction likely to be a lower priority. On the other hand, there are also many measures that could easily be economically justified and therefore should be implemented in order to reduce food waste (Eriksson & Strid, 2013). The problem is knowing which problems have low required management intensity (Garrone et al., 2014), meaning that they are cheap and/or easy to solve.

Possible measures include in-house measures, training of staff, restrictions on BOGOF offers and multipacks, reduced product range towards the end of opening hours, use of damaged/ripe products for in-house catering or ready-to-eat products, selling imperfect products, selling surplus products at a cheaper price, food donation and fair trading rules. A retail company in the UK tested a change in promotion strategy from BOGOF to “buy one, get one free later”, where consumers were able to convert a coupon within two weeks and did not have to purchase double amounts of perishable food at once (Gooch et al., 2010).

A well-known nationwide voluntary agreement on prevention of food waste is the Courtauld Commitment, which was introduced in the UK in 2005. The latest version, called Courtauld Commitment 2025, sets clear targets for the whole food supply chain, e.g. a 20% per person reduction in food and drink waste associated with food production and consumption (WRAP, 2018). The signatories from retail comprise 95% of the UK grocery retail sector by value of sales and have promised to report their food waste separately from other waste streams on an annual basis (WRAP, 2018). Another voluntary agreement, set up by The Consumer Goods Forum in 2015, aims to “first prevent food waste, then maximise its recovery towards the goal of halving food waste within our own retail and manufacturing operations by 2025, versus a 2016 baseline” (The Consumer Goods Forum, 2016). About 400 retailers and manufacturers around the globe are affected by this agreement. Implemented actions include advanced forecasting, pricing down food items near expiry date and partnerships with social organisations or restaurants using surpluses from retailers (The Consumer Goods Forum, 2016).

Reducing the price of products near their expiry date in the course of routine monitoring of shelves is a widespread prevention measure targeted at consumers who value reduced costs for slightly imperfect products. In order to increase demand for those price-reduced products and to automate recognition of expiry date, a mobile app called Chowberry has been developed in Nigeria. It informs supermarket owners about products expiring soon and informs deprived clients and social organisations about the price reduction. In 2018, the app already succeeded in tests covering 20 shops and 300 clients in Lagos and Abuja (<http://chowberry.com/>). Other research indicates that issues such as the introduction of dynamic shelf-life for perishable products, in combination with price reduction, could be a more effective strategy for retailers than single measures (Buisman et al., 2017).

Donation of edible surplus food from retail to social organisations is gaining increasing attention. This measure has been applied globally through voluntary agreements since the 1960s, and on an obligatory basis since 2014. A particular characteristic of surplus food donation is that it must make a

threefold contribution to sustainability, by resolving ecological, economic and social issues for all stakeholders. Long-time experience of voluntary agreements on donation of food surpluses shows that almost the total amount of food items offered by retail is suitable for redistribution to people in need (Alexander and Smaje, 2008; Schneider, 2013). Nevertheless, case studies show that the potential for food donation has not yet been exploited to the full, although some products are donated in amounts that exceed demand (Schneider, 2013; Capodistrias, 2017). Following years of voluntary activities, legislation governing surplus food donations from retail to social organisations was implemented in Wallonia in 2014 (Wallex, 2014) and in France in 2016 (Journal Officiel de la République Française, 2016). Similar legislation has been recommended in other countries, such as Norway, in order to exploit a greater share of the existing food waste reduction potential (Capodistrias, 2017).

Another statutory activity is mentioned by Lee (2018), who suggests introducing a regulatory framework for food retailers' marketing procedures, especially for developing countries, in order to avoid the development of disadvantageous lifestyles from the outset, including over-buying of food which leads to household food waste.

Food waste reduction measures that promote alternative uses for surpluses already generated are also addressed within the literature as valorisation measures. Those aim to create value from the surplus/waste occurring and thereby reduce the negative effect of the waste. Donation of surpluses to charity can be considered a valorisation measure, since it handles the surplus food rather than reducing the production of food. Using surplus bread from bakeries for the production of beer is another example.

The order of different waste prevention and valorisation options for supermarkets is shown in Figure 2. The concept of waste prevention differs depending on the perspective. From an environmental perspective, waste is prevented as long the food is never produced or used for its intended purpose, i.e. eaten by humans. From an economic perspective, it would be a waste to sell the food at a reduced price, since that is a loss of money. With this logic, the measure of cutting the price by 50% on the day before the best-before date may prevent food from being wasted, but still wastes some of the value of the product. However, since a price reduction also means that half the value is saved, this type of measure can be categorised as prevention through economic valorisation (Figure 2), as the food is sold through normal channels with a price reduction in order to save some of the economic value and possibly the whole environmental value.

In Figure 2, there are also a few important trends that follow the order of priority in the EU waste hierarchy. First, the less prioritised measures are all general and do not require food waste with high levels of product quality, biosecurity, separation or storage conditions. Therefore these options are cheap and general, but have an outcome with much lower economic value than the original food products. In order to prevent food from being wasted (i.e. using it for human consumption), there are high hygiene requirements that need to be met, which makes separation and proper storage important. These options therefore need more effort from the supermarket, but in return provide a more valuable outcome. The problem is that the outcome of most waste management options is profitable for society (SEPA, 2011; 2012), but not necessarily for the supermarket.

[Insert Figure 7.3 here]

Figure 7.3. Waste management framework showing the priority of different destinations for retail food waste. Source: Eriksson (2015).

Prevention measures suggested to have an impact on retail located in emerging and developing countries include optimisation of infrastructure (e.g. roads, cold chain), prioritising regional suppliers in order to cut long shipping distances and avoid damage during transport, and increased product quality from the start (Tofanelli et al., 2007; Tofanelli et al., 2009).

5. Conclusions

Although the proportion of food waste generated within the retail sector itself is relatively low (~10% of mass), retail has a significant influence on other stakeholders along the food supply chain. This available power and retail networks should be used to enhance cooperation among stakeholders and to provide/create a trading and purchasing environment that promotes prevention of food loss and waste. Retailers can actively influence the behaviour of stakeholders and also of their own management and staff members, which enables a broad range of potential measures to be implemented. In recent years, retailers have shown a remarkable change in acknowledging and shouldering their responsibility for food waste in the retail sector, which is promising, but their responses could sometimes be implemented in a more straight-forward approach. As at all other levels of the food supply chain, there is no single food waste prevention measure which could solve the problem within retail. However, there is a raft of measures which could be implemented within food retail companies or together with cooperation partners along the food supply chain. Some issues can be addressed on a voluntary basis, through agreements by individuals and market conditions. For other topics, obligatory measures may be needed, e.g. unfair trading practices which reflect the market power of retail and lead to food waste along the upstream food supply chain are currently under consideration within the European Union. There are several pros and cons which have to be balanced in formulating measures that consider the regional characteristics of member states, while also sharing the risk of natural uncertainties in product yield and quality, especially in agricultural produce and between suppliers and retailers.

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