

ROSETTA

Reducing food waste due to marketing standards through alternative market access

D1.4 Estimation models of food waste generated by marketing standards

TEAGASC

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Executive Summary

The ROSETTA project aims to reduce and prevent food waste by improving access to foods that do not meet marketing standards but remain safe for human consumption. Additionally, the project has a specific objective to estimate the amount of food waste generated due to marketing standards across the entire value chain. This report, *Deliverable 1.4 Estimation Models of food waste generated by marketing models*, presents estimation models for food waste resulting from marketing standards, drawing from use cases in five European countries.

ROSETTA seeks to provide reliable evidence through transdisciplinary research, engaging multiple stakeholders in real-world case studies. In this context, the estimation models encompass the five project use case partners, namely Denmark, Greece, Ireland, Poland, and Spain. Each use case has contributed data on food waste specific to the selected food commodity in the respective country. This has resulted in 13 estimation models.

Accordingly, this report has developed estimation models to quantify the amount of food waste arising from the application of marketing standards, considering the interactions between various stages and actors within the value chain (primary production; processing and manufacturing; retail and other food distribution channels; restaurants and food services; and households). The estimates differentiate between the marketing standards responsible for generating food waste at different stages of the supply chain for the selected food types and commodities.

The methodology employed in this task adopts a qualitative approach, comprising interviews with supply chain actors, informed by a literature review. The data collected includes information on public and private marketing standards, as well as instances where food fails to meet these standards or consumer expectations and is consequently not sold, purchased, or utilised. The results are presented through flow charts.

Thirteen estimation models have been developed, covering four food commodity categories: fruit and vegetables, cereals, meat, and dairy. For fruit and vegetables, specific estimation models have been created for products such as spinach leaves, herbs, beetroot juice, apples, and broccoli. For meat, estimation models have been developed for chicken and pork. In the dairy category, the estimation models cover crème fraîche and yoghurt. For cereals, specific estimation models have been developed considering flour and flour for dumplings. Furthermore, different supply chain structures are presented for each food commodity, which include both short and long food supply chains.

The report provides valuable information regardless of the supply chain or commodity of interest, as the range of models presented can serve as a basis for developing other estimation models in different food supply chains.

1. Introduction

Food waste has significant economic, environmental, and social impacts (FAO, 2019), and the actions to reduce it is essential. The ROSETTA project addresses this issue by improving access to food that, while not meeting marketing standards, remains safe for consumption. A crucial first step in understanding food waste due to marketing standards is to assess the extent of food waste occurring at various stages of the supply chain and across different food commodities.

In this context, the project also aims to estimate the amount of food waste generated as a result of marketing standards. This report, *Deliverable 1.4 Estimation Models of food waste generated by marketing models*, specifically focuses on presenting the estimation models for food waste arising from the enforcement of marketing standards throughout the supply chain, across a variety of food commodities.

The estimation models for food waste were developed by considering both public and private marketing standards applied to various food categories. For this purpose, the use case partners contributed food waste data specific to their respective food commodities: Ireland and Spain focusing on fruits and vegetables; Poland on cereals; Denmark on dairy; and Greece on meat. The estimation models were developed with consideration of the interactions between various stages and actors within the value chain.

To better understand food waste across the supply chain, the use case partners engaged a wide range of stakeholders, including farmers, manufacturers, retailers, food service providers, restaurants, and consumers. This collaboration enabled the collection of both qualitative and quantitative data on food waste at each stage of the supply chain for key food commodities and specific products.

Through semi-structured interviews, the use case partners gathered information regarding situations where food fails to meet marketing standards or consumer expectations, leading to it being unsold, unused, or unpurchased. Additionally, they identified actions that were and/or could be deployed to reduce or prevent food waste.

The data collected was analysed and translated into flow charts, representing the estimation models of food waste resulting from marketing standards. The analysis uncovered various patterns and trends, which provided the basis for the development of thirteen estimation models, considering specific products, different supply chain contexts, and the most relevant marketing standards applied to each product. The following food commodities and supply chains were considered: Denmark (crème fraîche and yogurt, with two distinct supply chains); Greece (pork and chicken, with two supply chains); Ireland (beetroot juice, spinach leaves, and herbs, with four supply chains); Poland (flour and flour for dumplings, with three supply chains); and Spain (apples and broccoli, with two supply chains).

The method provided comparable estimations and better information for decision-making in each food commodity. The flow charts offer visual clarity, helping to identify the key factors that cause food waste and the main actions that can prevent or reduce waste at each stage of the supply chain for each specific product. Additionally, we identified that different products and varying supply chain configurations can influence the amount of food waste. Private marketing standards are the most significant cause of waste in the majority of the supply chains represented.

This report is structured into four sections: an introduction, methodology, estimation models for each food commodity, and a conclusion. Supporting materials are annexed.

2. Methodology

To achieve the objectives, the methodology was organised into three main components: (a) Literature review; (b) Semi-structured interviews; and (c) Data analysis.

2.1 Literature review

A literature review was conducted primarily using the project's library available on the shared drive, along with some sources from scientific databases. The literature review covered concepts related to food waste and the food supply chain. The review also addressed the factors that impact food waste (both positively and negatively) at different stages of the food supply chain, as well as existing estimation models for food waste. These concepts and factors supported the development of the interview guide. In the first phase of the literature review, the main actors involved in the food supply chain and their roles were identified, along with the food waste occurring at each stage. The second phase focused on identifying the causes of food waste and determining what could reduce or prevent food waste along the supply chain. The literature review, presentations and documents from the project regarding marketing standards and food waste were also considered.

García-Herrero et al. (2018) outlined the stages of the food supply chain as agricultural production, postharvest handling and storage, processing, distribution, and consumption. Agricultural production marks the initial stage of the supply chain (SC). In the case of crops, losses at this point arise from mechanical damage and/or spillage during harvesting. For animal products, this stage includes the death of animals during breeding, discards of fish during fishing, and milk losses caused by illness in dairy cows. Postharvest handling and storage involves the loss of commodities during handling, storage, and transportation from the farm to processing or distribution. For meat products, this includes deaths during transport to slaughter and the rejection of carcasses at the slaughterhouse. Processing and packaging account for losses due to spillage and degradation during both industrial and domestic processing. Distribution covers losses at both the wholesale and retail stages. Finally, consumption refers to losses that occur during consumption at both the household and service industry levels.

Sezer et al. (2024) emphasise that food supply chains are dynamic and complex networks, with many partners involved and interconnected. The authors affirm that collaboration is an important factor, as it provides information, resources, and knowledge sharing between them making the food supply chain more sustainable. Research has demonstrated that cooperation between farmers and various stakeholders improves vegetable quality (Yang et al., 2021), and in particular, collaboration between farmers and cooperatives can help reduce food loss (Despoudi et al., 2018).

Additionally, Duong, Kumar, and He (2024) presents the concept of Sustainable Food Supply Chain (SFSC) as the management of information, materials, activities, and capital flows along FSCs while considering three dimensions economic, environmental, and social goals. The authors explain that FSCs mainly consist of two key product categories: fresh foods (e.g., fresh fruits) and processed foods (e.g., ready-to-eat meals). Unlike other supply chains, FSCs have distinct features, such as the perishable nature of food products, supply uncertainties caused by climate change or inefficient food production practices, and fluctuations in consumer demand. As a result, recent research has concentrated on strategies to enhance the sustainability of FSCs through innovations and adjustments in farming practices.

Manzoor et al. (2024), affirms that food waste could be reduced through more effective redistribution of surplus food, waste management within the food supply chain, and sustainable food practices. The authors mentioned that the reduction of food waste is hindered by several factors, primarily stemming from

technological and infrastructure challenges. These require large-scale technological applications with minimal environmental impact, making it difficult to address food waste effectively across all stages of the food supply chain. While strategies for food redistribution, recovery, and reuse offer economic benefits through additional by-products and financial gains, changing consumption and production patterns at both the industry and market levels remains a challenge. This difficulty arises from the complex relationships between distributors and suppliers, contractual obligations, inaccurate food demand forecasts, and rigid food standards.

Analysis of the literature resulted in a excel file, organised according to different stages of the value chain, whereby factors contributing to/reducing food waste were translated into key questions to be addressed at each stage of the food supply chain. This is summarised in Table 1. These formed the basis of flow charts and related semi-structured interviews that are conducted in the next stage.

Table 1: Key questions for each stage of the food supply chain

Value chain actor	Key questions	Sub-Questions
Consumer	What factors result in waste due to marketing standards at this stage? What factors can reduce or prevent food waste at this stage?	What factors influence consumer willingness to purchase/use a product that does not meet the marketing standards? What actions have consumers taken to reduce or prevent food waste? Can technology help prevent or reduce food waste? How can “best before” and “sell-by dates” increase food waste?
Retailers	What factors result in waste due to marketing standards at this stage? What factors can reduce or prevent food waste at this stage?	What systems do retailers have in place to manage stock and avoid selling product that is at sell-by date? Can logistics increase food waste due to marketing standards? How does technology help prevent or reduce food waste? How does consumer demand impact food waste? Is there any collaboration to prevent or reduce food waste? How do they interact?
Food service	What factors result in waste due to marketing standards at this stage? What factors can reduce or prevent food waste at this stage?	What strategies do food service operators have in place to avoid wasting product at/close to sell by date? Can logistics increase food waste due to marketing standards? How does technology help prevent or reduce food waste? How does consumer demand impact food waste? Is there any collaboration to prevent or reduce food waste? How do they interact?

Value chain actor	Key questions	Sub-Questions
Processors	<p>What factors result in waste due to marketing standards at this stage?</p> <p>What factors can reduce or prevent food waste at this stage?</p>	<p>What strategies/systems do processors have in place to ensure no incorrect labelling and hence recall/disposal for incorrect labelling?</p> <p>How does consumer demand impact food waste?</p> <p>Can logistics increase food waste due to marketing standards?</p> <p>How does technology help prevent or reduce food waste?</p> <p>What systems, if any, do processors have in place to use ingredients that do not meet marketing standards?</p> <p>Is there any collaboration to prevent or reduce food waste? How do they interact?</p>
Producer	<p>What factors result in waste due to marketing standards at this stage?</p> <p>What factors can reduce or prevent food waste at this stage?</p>	<p>How do marketing standards affect the amount of food product grown/produced?</p> <p>How does consumer demand impact food waste?</p> <p>Can logistics increase food waste due to marketing standards?</p> <p>How does seasonality affect the amount of waste due to marketing standards?</p> <p>Is there any collaboration to prevent or reduce food waste? How do they interact?</p>

The literature review and overall approach was informed by discussions involving researchers specialising in food supply chain management and marketing, as well as with project members involved in related tasks, particularly the leader of Task 4.1 *Deploy, monitor and validate the solutions to be tested across each of the use case pilots*, Copenhagen Business School (CBS), who will be responsible for validating the estimation models. The proposed approach was subsequently presented to the other partners and approved during the project's semester meeting on December 4th, 2024.

2.2 Semi-structured interviews

To gather the empirical data, a semi-structured interview guide was developed considering all stages of the food supply chain (See Appendix 1 for more details). Teagasc as lead partner for *Task 1.4 Estimate food waste due to marketing standards and assess their impact*, developed an interview guide to accompany the semi-structured interview guideline and provided training to partners at the ROSETTA meeting in Copenhagen on December 4th 2024. This semi-structured interview guide helped identify the main causes of food waste at each stage of the supply chain and the practices that could reduce food waste. Additionally, the methodological approach was organised around a flow chart to assess marketing standards and food waste throughout the food supply chain. Figure 1 illustrates the connection between the flow chart and the questions in the semi-structured interview guide. The objective was to ensure that all critical questions were systematically integrated into the flow chart. Furthermore, the questions were formulated to guide the continued development of the flow chart, ensuring that all stages of the food supply chain were adequately represented and analysed.

The flow chart highlights the strategies currently in place, according to the interviewees, to prevent or reduce food waste. These data points are represented below the line. Additionally, the models represent actions or

strategies not yet implemented by them but which could contribute to reducing food waste if adopted. The main causes of food waste related to marketing standards were identified and are represented above the line. The information and percentages reflect the interviewees' perspectives.

Discussions at a ROSETTA project meeting resulted in a decision to focus the interviews on specific products within each food commodity rather than the broad commodity. This targeted approach enables a more precise evaluation of the factors contributing to food waste for each food commodity, and thus more precise estimation models.

Insights from previous discussions and stakeholder interviews highlighted that stakeholders often struggled to differentiate between private and public marketing standards, as they tended to adhere to the highest standard, typically the private one. Consequently, the estimation models were designed to focus on the marketing standards relevant to each case, regardless of whether they were public or private marketing standards.

The use case partners from Denmark (dairy), Greece (meat), Ireland (fruit and vegetables), Spain (fruit and vegetables), and Poland (cereals) conducted interviews in January and February 2025 with various food supply chain actors, including producers, processors, manufacturers, retailers, distributors, food service providers, wholesalers, and consumers. They submitted the reports in a text file format (.docx) to Teagasc. Teagasc subsequently analysed the data and updated the initial flow charts for each food item.

MARKETING STANDARDS IN FOOD WASTE

FOOD COMMODITY/PRODUCT ESTIMATION MODEL

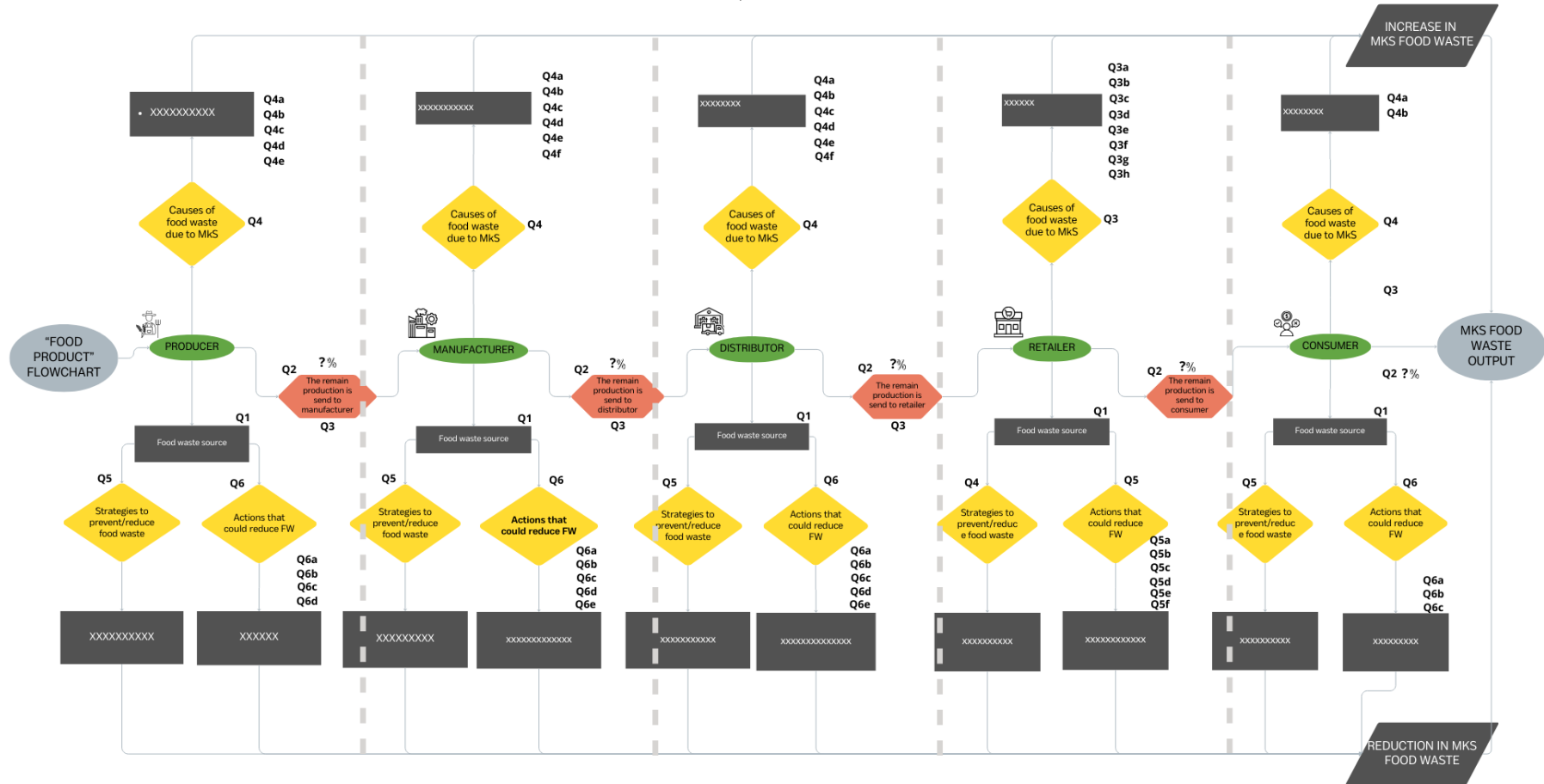


Figure 1: Proposed approach illustrated with a flow chart

2.3 Data analysis

The collected data was analysed and transformed into flow charts, illustrating estimation models for food waste driven by marketing standards. Thirteen estimation models were developed for specific products, various food supply chain contexts, and the most relevant marketing standards applicable to each product (Table 2). The study encompassed different food commodities and food supply chains across multiple countries:

Table 2: Food commodities, countries and products

Food commodity	Country	Product	Food supply chain
Cereals	Poland	Flour	Producer – Distributor – Retailer
Cereals	Poland	Flour	Producer – Distributor - Food Service
Cereals	Poland	Flour (dumplings)	Producer – Distributor - Food Service - Consumer
Dairy	Denmark	Crème fraîche and yogurt	Manufacturer – Retailer – Consumer 1 and 2
Dairy	Denmark	Crème fraîche and yogurt	Manufacturer – Wholesaler – Food Service
Fruits and Vegetables	Ireland	Beetroot juice	Producer – Manufacturer – Distributor – Retailer - Consumer
Fruits and Vegetables	Ireland	Spinach leaves	Producer – Retailer - Consumer
Fruits and Vegetables	Ireland	Spinach leaves	Producer – Food Service - Consumer
Fruits and Vegetables	Ireland	Herbs	Producer – Retailer - Consumer
Fruits and Vegetables	Ireland	Herbs	Producer – Food Service - Consumer
Fruits and Vegetables	Spain	Apples	Producer – Retailer - Consumer
Fruits and Vegetables	Spain	Broccoli	Producer – Distributor – Retailer - Consumer
Meat	Greece	Chicken	Producer – Manufacturer – Distributor – Retailer - Consumer
Meat	Greece	Pork	Producer – Manufacturer – Distributor – Retailer - Consumer
TOTAL			13

Additionally, in this deliverable, the focus for the Greek use case is placed exclusively on the meat food supply chain. While the ROSETTA Project Grant Agreement originally included both meat and fruit and vegetable supply chains for Greece, the latter has not been included in this report. This decision was made to avoid duplication, as the fruit and vegetable supply chain is already well represented in the Irish and Spanish use cases.

To ensure quality, a preliminary version of each estimation model was sent to the relevant ROSETTA partner to confirm the estimation models and the information provided. In the next section, the estimation models will be presented by food commodity, along with their respective flow charts and food supply chain actors.

The estimation models were developed prior to the final version of the use case operational plans. Therefore, the estimation models presented in this report should serve as a guide to be adapted and adjusted according to future definitions for each use case (Poland, Denmark, Ireland, Spain, and Greece), and aligned with their respective operational plans as outlined in the ROSETTA Project Grant Agreement. In Ireland, the use case will test a range of fruits and vegetables using food processing techniques. As illustrated by the processed beetroot juice example in this report, the use case partners can adapt the model to develop their own estimation approach in the future, considering the range of products they will test. In Spain, the use case partners will implement a short food supply chain solution with an online retail component, as demonstrated in the apple supply chain model (producer, retailer, and consumer). The model will be adapted considering the specific products and channels deployed in the use case. In Poland, the partners will follow the same food supply chain

structure presented in this report, which includes producer, distributor, food service, and consumer. The use case will adapt the model to the product and the digital approach. In Denmark, the focus is on the consumer level. The estimation models presented in this report can be adapted to estimate food waste across the food supply chain levels of manufacturer, retailer, and different consumers. Finally, in Greece, two different product categories will be applied: fruits and vegetables, and meat. For fruits and vegetables, the partners can adapt the previously developed estimation models from the Irish and Spanish use cases. For meat, the current estimation model can be applied, with adaptations to include food service, as the social kitchens.

3. Estimation models

This session presents the estimation models created using data collected from interviews conducted by each use case partner. The estimation models are illustrated through flowcharts, providing details about their structure. Each use case partner has selected specific products and food supply chains to represent in their respective flowcharts.

3.1 Cereals: Poland

For the cereal food commodity, the use case partner from Poland selected two different products: flour and dumplings made from flour.

3.1.1 Flour

Two distinct food supply chains (Figure 2 and Figure 3) have been considered for flour. The first one includes the producer, distributor and retailer, while the second consists of the producer, distributor and food service sector.

Producer

According to the interviewed producer, the main aesthetic reasons for food waste due to marketing standards are related to the colour of the flour, where slightly darker batches are often deemed unsuitable, and issues with incorrect flour granulation. Despite these constraints, the actual proportion of flour wasted at producer level due to marketing standards remains below 3%.

The principal causes of food waste in this sector are the strict requirements imposed by retailers, which impose specific flour granulation and colour parameters. Consumers also exhibit low acceptance of products with minor structural variations, enforcing strict adherence to visual and quality standards for flour. Additionally, standards define precise flour parameters, including gluten content, protein levels, moisture, water absorption, and dispensability, further narrowing the scope of acceptable production. While logistical issues contribute to waste, such as damage during transportation or contamination with dust. Also, climate changes can affect grain quality, but this only results in non-acceptance of the grain.

To mitigate food waste, the producer employs several strategies. Lower-quality flour is redirected to the animal feed industry, while bran is channeled into healthy food production or sold to the cosmetics sector. Within the production stage several actions are implemented to minimise waste: accepting only high-quality grain with appropriate parameters, ensuring proper grain cleaning, monitoring grain moisture, optimizing technological processes related to production, maintaining quality control in milling and packaging, and continuously monitoring the technological process. Adjustments to the milling process are also made flexibly in response to fluctuations in raw material quality and demand. Maintaining stable relationships with regular customers and planning production volumes in advance further helps to manage waste effectively. Figures 2 and 3 below illustrate the estimation models for flour.

MARKETING STANDARDS IN FOOD WASTE FLOUR - ESTIMATION MODEL I



Figure 2: Flour flow chart (retailer)

MARKETING STANDARDS IN FOOD WASTE FLOUR - ESTIMATION MODEL II



Figure 3: Flour flow chart (food service)

Technology is also applied to prevent waste through metal detection systems, systems for detecting damaged grains, stones, and straw, automatic granulation control systems, moisture sensors, and production monitoring.

While labelling and public marketing standards could be considered a potential source of waste, the producer ensures that rigorous quality control measures prevent inaccuracies in flour classification. Consequently, mislabelling does not contribute significantly to waste, as production batches are strictly monitored and labelled with precision.

To further address food waste, the producer indicated that financial support for modernising production lines would be beneficial. Moreover, educational campaigns could raise awareness about the diverse qualities of flour and their potential health benefits, encouraging greater consumer acceptance of non-standard products. The Future plans include the development of product lines from whole grain flours with non-standard structures, and the introduction of bran into the healthy food product range. According to the producers, other producers adopt various approaches to minimising waste. Some opt to sell "second-grade" flour at discounted prices, while others develop specialised products utilising waste fractions. Additionally, bran is increasingly being used in innovative applications, such as edible tableware and cosmetics production. These industry practices highlight alternative pathways for reducing waste and maximising resource utilisation.

Distributor

At the distribution stage, products are primarily supplied to supermarkets, bakeries, and food service establishments, with no food waste arising at the distribution stage according to the interviewee. Unsold products are usually used in other sectors or given as animal feed.

Retailer

According to the retailer, the main causes of waste for flour are packaging damage (e.g., torn bags), contamination, irregular label printing, and crushed packaging during transport or storage. Customers prefer flour with intact and visually appealing packaging, which results in rejection of even minimally damaged products. Delivery delays, improper storage, and packaging damage during transport contribute to product losses. Labelling errors, such as missing information on certifications or expiration dates, can result in the withdrawal of entire product batches. Approximately 2-3% of flour is wasted due to marketing standards at the retail stage.

To reduce food waste, the retailer suggests relaxing requirements for packaging appearance. This would allow the sale of slightly damaged products at discounted prices. Regular quality control, monitoring of temperature and humidity during transport, and investment in more durable packaging are also useful strategies to help reduce waste. The retailer promotes the sale of discounted products (e.g., with minor packaging damage) and collaborates with food banks to collect products that do not meet retail standards. This collaboration with food banks helps reduce waste by around 10%. Additionally, sales data is closely monitored to adjust baker production and order volumes, helping to reduce surpluses. Inventory management including expiration date monitoring systems are also in place; this help reduce losses by around 15%.

The shelf life of flour typically ranges from 6 to 12 months, which helps minimise retail-level waste. More flexible aesthetic standards, consumer education, improved storage technology, and subsidies or partnerships with logistics providers could significantly reduce losses. Future retailer plans to reduce food waste due to marketing standards include investing in more durable packaging and developing sales channels for discounted products.

Food service

In the food service sector, the primary cause of waste of flour products is often the mismatch between products and consumer expectations, as customers tend to prefer aesthetically perfect products. An ideal appearance is particularly important for cakes, buns, and biscuits—any imperfections, such as uneven shapes, damage, or changes in the crust, often lead to their rejection.

To minimise waste, the food service provider prioritise sourcing ingredients locally and regularly monitoring stock levels. Additionally, workshops are organised to educate young consumer on how to use ingredients efficiently and process them effectively. For example, bran can be utilised in the production of bars, waffles, or cakes, reducing waste while creating new products. Processed foods, such as cakes and pierogi, are also donated to local organisations to ensure they are not wasted.

According to the food service interviewee, raising awareness of the nutritional value of bran and its potential applications in various products, such as biscuits, waffles, cakes, and sandwiches, could further enhance its utilisation and contribute to waste reduction.

3.1.2 Dumplings

Another segment of the food supply chain examines the use of flour for dumpling production (Figure 4). A producer, distributor, food service provider, and consumer have been considered for this product. Information about the producer and distributor was provided in the previous flour section. Additionally, both a specific food service provider and a consumer have shared insights into food waste associated with this product.

Food service

The food service provider highlighted that consumer expectations significantly influence waste levels. Issues such as dumplings leaking filling, irregular shapes that do not meet visual expectations, and dumplings that crack or stick together during packaging or transportation can lead to product rejection and waste. Approximately 8-10% of dumplings are rejected for aesthetic reasons. However, the percentage of waste has been gradually decreasing each year due to improvements in production processes and the implementation of technologies that minimise damage, such as precise dough-shaping techniques.

Efforts are being made to ensure proper product labelling. However, occasional labelling errors can still result in waste. Additionally, labels indicating a very short shelf life may discourage customers from purchasing, even when the product remains fit for consumption. To address these challenges, precise dough-forming machines are used to minimise production rejects, and inventory management applications are in place to track stock levels and expiration dates efficiently.

Collaboration with local food banks and platforms such as *Too Good To Go* further helps in reducing food waste, although these initiatives can negatively impact financial performance.

Further strategies under consideration include the introduction of a "second-category" product line at a lower price and strengthening partnerships with retail chains to reduce the pressure of strict visual standards. Some dumpling producers have also implemented initiatives such as offering discounts on irregularly shaped products or selling them as semi-finished goods. To further prevent waste, financial support for investment in advanced packaging technologies and educational campaigns to raise consumer awareness would be beneficial according to the food service provider.

MARKETING STANDARDS IN FOOD WASTE DUMPLINGS - ESTIMATION MODEL

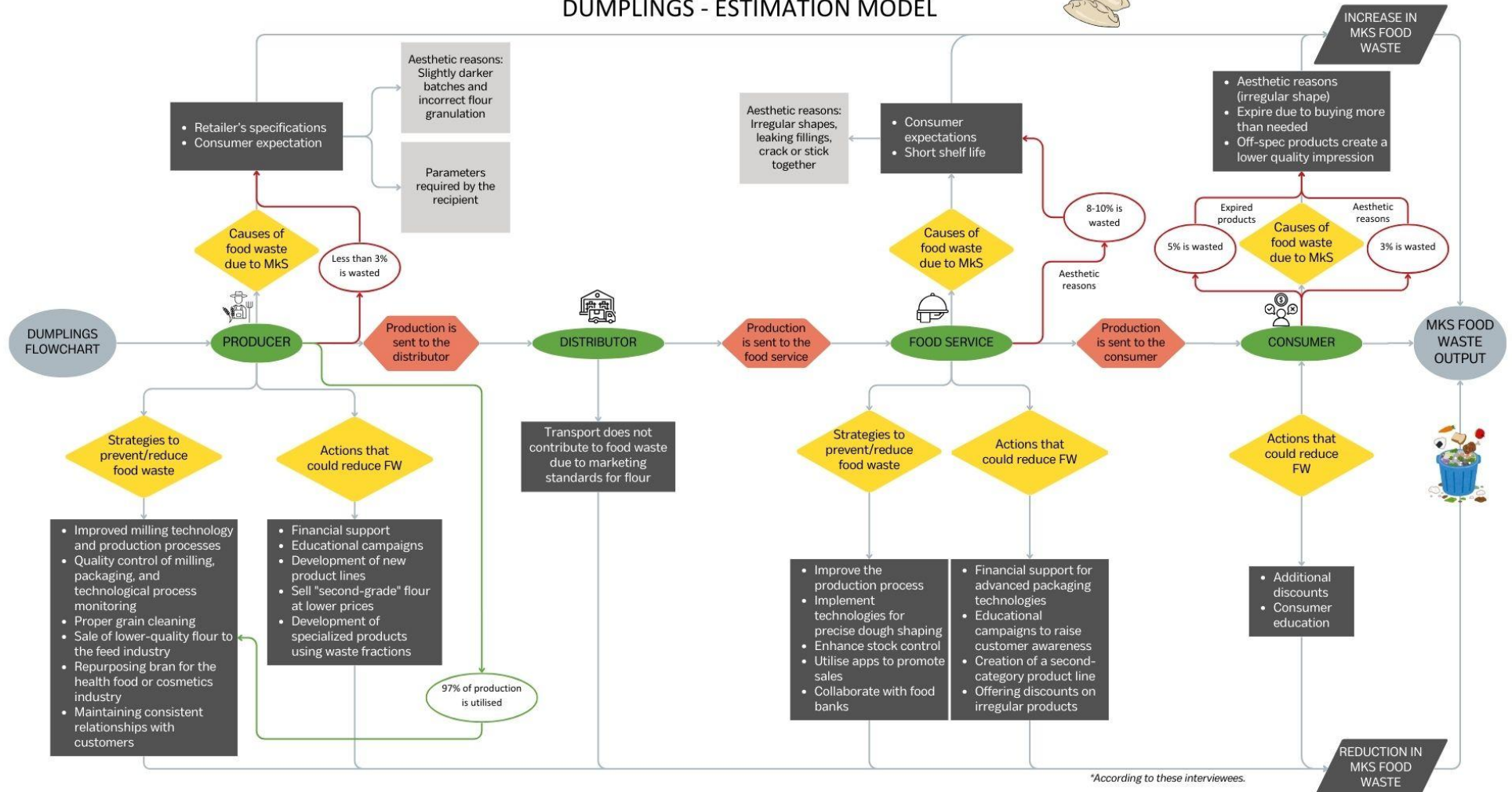


Figure 4: Dumplings flow chart

Consumer

For consumers, the primary reasons for food waste include irregularly shaped dumplings—such as those that are not properly sealed, causing the filling to leak during cooking—and damaged packaging, which leads to a loss of freshness. Approximately 3% of dumplings are wasted due to aesthetic reasons, with this percentage slightly increasing during the summer months when higher temperatures accelerate spoilage. Additionally, around 5% of dumplings are wasted due to expired shelf life, often resulting from over-purchasing.

Consumers of dumplings rarely purchase off-spec products unless they are significantly discounted and can be used quickly. Furthermore, consumers express concerns that such products may be of lower quality, even if they remain safe to eat. However, additional discounts or clear information on how to extend the product's shelf life—such as freezing instructions—could encourage more consumers to purchase these products.

According to the consumer, providing better consumer education on the continued edibility of off-spec products could help reduce waste and increase their acceptance.

3.2 Dairy: Denmark

For the dairy food commodity, the use case partner from Denmark selected two different products: crème fraîche and yogurt. However, the information provided covers both products in two separate food supply chains.

3.2.1 Crème fraîche and yogurt (Food Supply chain 1)

The food supply chain for these two products encompasses three actors: manufacturer, retailer and consumers. (Figure 5).

Manufacturer

Considering the manufacturer perspective, it was reported that the main cause of food waste due to marketing standards is the lack of customer forecasts, especially in the food service sector. Many customers place orders very late, on delivery day, making demand forecasting difficult. Shelf-life requirements are another key factor. Retailers often demand a minimum shelf life for dairy products, leading to waste if the product doesn't meet the required days before expiry. The total shelf life for products such as crème fraîche and yoghurt is 21 days. However, retail requirements demand that products have at least 16 days remaining on the shelf life, and food service requires 12 days. Additionally, logistics adds another day for delivery. This means that to meet retail requirements, products must have 16 days of shelf life remaining when they reach the store, leaving only a very short window (4 days in the case of retail ($21-(16+1)$), 8 days in the case of food service ($21-(12+1)$)) in the warehouse before the products become "too old" for sale to the retailer in particular. This tight time frame contributes to a significant amount of food waste at the warehouse.

Local and specialty stores typically order small quantities and carry a limited selection of products. While they contribute less to food waste than supermarket chains, they also require more flexible supply chain management. Additionally, production batch sizes, due to equipment constraints, can result in overproduction if demand is lower than expected.

The aesthetic reasons for food waste due to marketing standards include grainy or poor consistency. Approximately 1,000 litres of yogurt are wasted due to marketing standards. This includes small packaging sizes, which are difficult to predict precisely in terms of demand. Improvements in forecasting and planning can reduce waste slightly over time. For example, large customers provide forecasts, which help minimize waste. However, food service customers do not provide forecasts, making it difficult to predict demand and leading to more waste.

Another cause of waste occurs when large retailers place an order for a private label brand, as the product cannot be redirected to alternative markets. Additionally, contractual restrictions could lead waste, as own-brand products cannot be resold to other markets due to contractual and branding limitations.

According to the manufacturer, waste can also vary seasonally, particularly in the summer when demand for dairy products fluctuates. For food service customers, summer is especially challenging because schools and childcare institutions reduce their orders. Since these customers do not provide forecasts, they must estimate demand, increasing the risk of overproduction.

Consumer demand plays a significant role in food waste. Retailers and consumers expect dairy products to have long shelf lives, meaning products that do not meet these expectations are discarded, even if they are still safe for consumption. For instance, yogurt and crème fraîche is expected to have a minimum shelf life of

MARKETING STANDARDS IN FOOD WASTE CRÈME FRAICHE AND YOGURT (SUPPLY CHAIN 1) - ESTIMATION MODEL

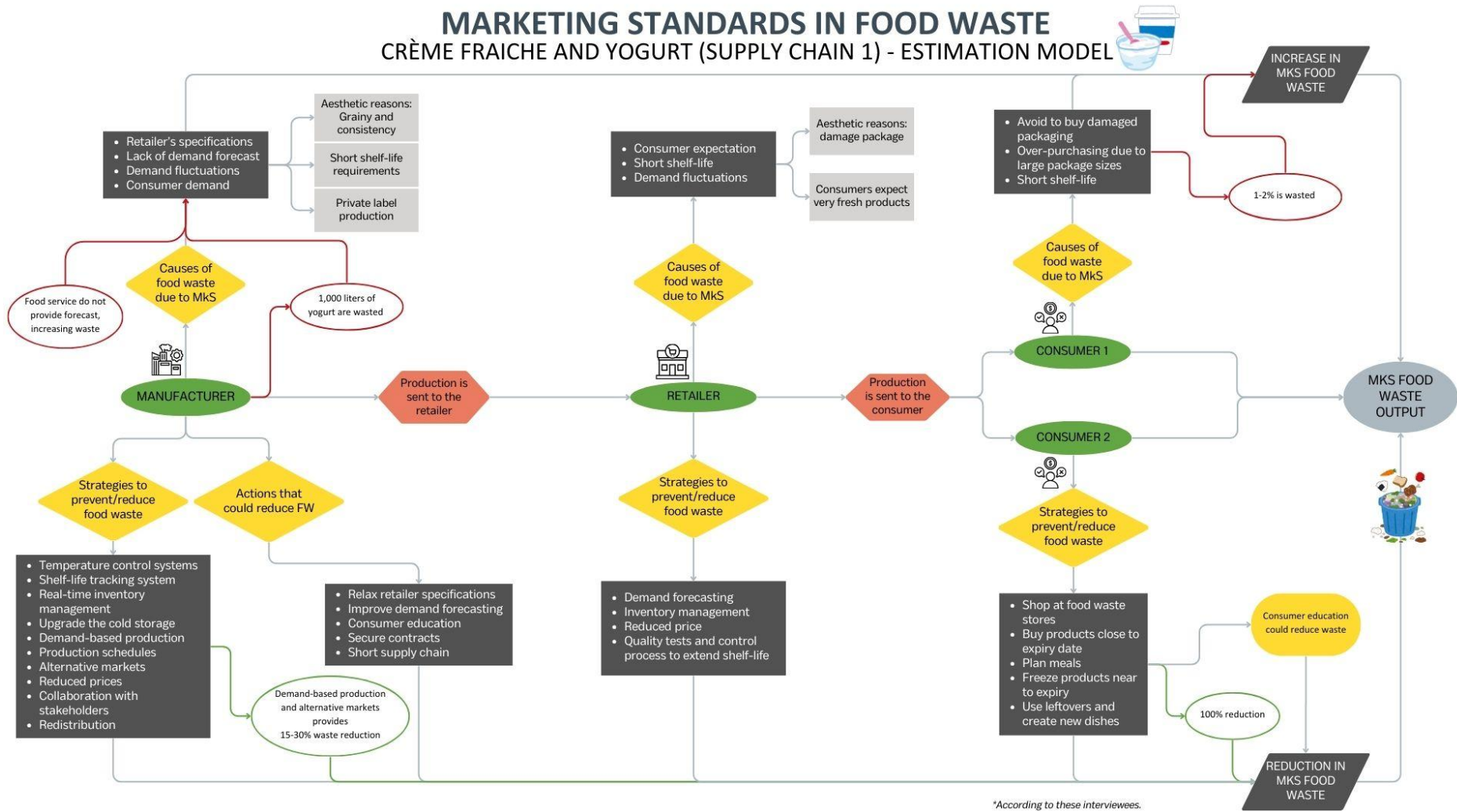


Figure 5: Crème fraiche and yogurt flow chart (Food supply chain 1)

17 days for retail customers, whereas they are produced with 23 days of shelf life. A reduction in this demand could contribute to a reduction in food waste for these products.

Logistics does not significantly contribute to food waste, although delays and damage during transport can occasionally lead to losses. If a truck makes a sudden stop or products are handled improperly, some items may become damaged. However, if only a few units in a package are damaged, the rest of the batch is usually still usable.

Labelling typically does not contribute to food waste, as manufacturers ensure compliance with regulations. However, if an incorrect label is printed (e.g., missing allergens or incorrect expiration dates), the affected batch must be discarded, leading to waste. To prevent errors, strict quality control procedures are in place before printing labels, including thorough product checks, automated labelling systems, and regular employee training.

To prevent food waste, strict temperature control systems are in place, and cold storage facilities have been upgraded to ensure that all products are stored under optimal conditions before delivery. Additionally, the manufacturer applies shelf life management, and try to balance production with demand. These include production planning based on forecasts where available, collaborating with large retail chains and meal kit providers to align production with expected demand. The manufacturer also explores alternative market strategies, particularly for private label products as they cannot be resold. They repurpose excess stock into secondary markets or integrate it into other product lines to avoid waste. Furthermore, flexible inventory management is in place to accommodate unpredictable orders from food service providers.

Designated production days for different dairy products improve efficiency and reduce excess inventory. Production schedules are also optimised to minimise waste, particularly when switching between yogurt and fermented product flavours. Switching requires batch cleaning resulting in small amounts of waste.

Discounted sales are implemented as a measure to prevent food waste. Advanced technology also plays a crucial role in minimising waste, with new cooling systems extending product freshness and shelf life. These improvements reduce spoilage and enhance supply chain flexibility. A shelf-life tracking system is utilised to optimise production planning, ensuring that products meet retailer requirements before reaching the shelves. Additionally, real-time inventory tracking helps prevent overstocking and allows for more precise stock control, reducing waste from expired products.

The manufacturer actively collaborates with various food supply chain partners to mitigate food waste caused by marketing standards. Key initiatives include:

- partnerships with Food Service Providers and Retail Chains – Aligning production with demand forecasts to minimise excess inventory. Food service partners receive products closer to their expiration date, extending the usability of dairy products while reducing waste.
- alternative Market Strategies – If surplus stock arises from private label production, which cannot be resold through traditional channels, the manufacturer explores secondary markets or repurposes products to prevent disposal.
- redistribution Initiatives – Excess stock is redistributed to food banks and other social initiatives, ensuring products are utilised rather than wasted. The estimated reduction in food waste through these collaborative efforts varies; however, by leveraging demand-based production and alternative markets, waste reduction is projected to be between 15–30%.

Marketing standards could help reduce food waste, but their impact depends on how they are designed and implemented. Actions like relaxing shelf-life requirements, and flexibility in batch quantities, as they are too large compared to actual demand could reduce waste. Also, consumer education is important. Consumers discard dairy products as soon as they reach the "best before" date, even when they are still perfectly safe to consume. If marketing standards included education efforts about food durability or adjusted labeling practices, this could reduce unnecessary disposal.

Additionally, alternative market for products that do not meet strict marketing requirements (e.g., shorter shelf life, minor packaging defects), such as discounted sales, smaller retailers secondary processing or food donation programs, could prevent waste.

To reduce or prevent food waste caused by marketing standards, manufacturers can, improve demand forecasting, invest in cold storage, collaborate with customers, adjust production schedules to match demand, minimize waste during product changeovers, secure contracts where buyers commit to full production batches.

The manufacturer also highlighted issues with campaign forecasts, noting that they are often far from reality. As a result, they tend to overproduce and struggle to sell crème fraîche or yogurt in time.

Retailer

According to the retailer, damage package can increase food waste due to marketing standards. Consumer expectations play a role in food waste. In the dairy sector, consumers have come to expect very fresh products. Any product perceived as not sufficiently fresh may be discarded, even if it is still safe for consumption.

To prevent and reduce food waste, several strategies have been implemented by the retailer. One of the main approaches is based on demand forecasting and inventory management. By having a good understanding of the typical sales patterns in the farm-shop, they ensure that only bring in the necessary quantity of products, avoiding overstocking. Additionally, waste is minimised by selling products at reduced prices when nearing their expiration date. A pricing system is used that progressively reduces prices based on the remaining shelf life.

Quality tests and control processes are in place to extend the shelf life wherever possible. In addition to these measures, products that are still safe for consumption but cannot be sold are donated to a local food waste organisation. Any remaining waste is directed to biogas production.

Consumers

Two quite different consumers of yoghurt and crème fraîche were interviewed. The first one adopts several strategies to prevent food waste, aiming to minimise environmental impact and save money. One of the primary strategies is shopping at a stop-food-waste store, where most dairy products are close to their expiry dates. Despite this, the consumer expresses confidence in the quality of the products, as they rely on their senses (such as smell and appearance) rather than strictly following date labels. At home, the consumer carefully plans meals based on available ingredients in the refrigerator, ensuring that nothing goes to waste. If products are nearing their expiry date, they are either used immediately or stored in the freezer to extend their shelf life. When shopping at supermarkets, the consumer actively seeks out discounted items from the food waste cooler, particularly those with damaged packaging or approaching their expiry date, which would otherwise be discarded. The consumer suggests that campaigns should encourage people to rely on their senses—such as sight, smell, and touch—rather than strictly following date labels. They also note the

confusion surrounding the difference between "best before" and "use by" dates, and propose that further clarification could help reduce unnecessary food disposal.

The second consumer reported that the main causes of food waste for them are linked to product quality concerns (damaged packaging or spoilage), over-purchasing due to large package sizes, and the short shelf life of certain products.

The consumer tends to avoid purchasing products with dented or pressed cartons due to the fear that they may leak or spoil. At home, if dairy products such as crème fraiche tastes strange, the consumer discards them. Despite this, the consumer estimates that only 1-2 percent of dairy products go to waste.

Regarding the use of expiration dates, the consumer admits that they do not rely heavily on them but rather on their senses. If a product still tastes good and does not show signs of spoilage such as lumps or an unpleasant smell, it is consumed.

However, the consumer also notes that the price difference between different package sizes can sometimes result in purchasing larger quantities than needed, which ultimately leads to more waste.

3.2.2 Crème fraiche and yogurt (Food supply chain 2)

The second food supply chain encompass three actors: manufacturer, wholesaler and food service (Figure 6). The manufacturer is the same as for the previous model.

Wholesaler

According to the wholesaler in this chain, the primary reason for food waste in dairy products is their short shelf life, especially for milk (4-6 days), with less waste with yogurt, as it has a longer shelf life. Lack of demand forecasts from customers is another factor. No specific aesthetic reasons such as irregular shapes or damaged packaging were mentioned, but date labelling plays a crucial role.

Also, the wholesaler affirmed that food waste increases during holidays and vacation periods, when, for example, canteens have fewer employees to serve, leading to uncertainty in ordering. Consumer expectations and contractual requirements, including purchase agreements, often impose strict shelf life demands, which can lead to food waste.

The wholesaler said that customers, in this case, professional kitchens, order precisely but have limited flexibility in accepting products close to their expiration date. However, some customers have started accepting products closer to expiration to reduce waste—especially if it comes with a discount. Large customers, especially canteens and hospitals, have strict contractual date requirements, which limit the use of products close to their expiration date.

The wholesaler has implemented several strategies to minimise food waste resulting from marketing standards. To reduce waste, the logistics system has been optimised, enabling dairy products to be delivered to the warehouse twice daily. This frequent replenishment helps maintain product freshness and minimise spoilage. Additionally, a live inventory management system ensures precise ordering, reducing excess stock and preventing unnecessary waste.

An electronic tracking system monitors expiration dates, allowing for the prioritisation of products with the shortest shelf life, following the First-In, First-Out (FIFO) principle. Furthermore, a "Food Waste Section" has been introduced in the web shop, where products with a short shelf life are sold at a discounted price. The closer a product is to its expiration date, the larger the discount, encouraging timely sales.

For larger batches of products, agreements with specific customers allow surplus items to be offered for purchase. Optimised delivery frequencies, including the ability to order multiple times per day, reduce the need for excessive safety stock. While donations are rare, most surplus goods are sold through discount schemes, and employees are occasionally allowed to take home remaining items. Minimal waste ends up in landfill, as unsold products are primarily utilised for biogas production.

There is ongoing dialogue with customers regarding delivery frequency adjustments (e.g., reducing from five to three times per week) to decrease waste and lower CO₂ emissions. Additionally, close collaboration with dairy suppliers ensures efficient handling of unsold products.

According to the wholesaler, an effective approach to reducing food waste is modifying expiration labelling terminology. Changing "Best before" to "Best used by" could help minimise food waste by encouraging consumers to rely on their judgement rather than strictly adhering to dates. Increased understanding and acceptance are essential, particularly for dairy products, where many items remain safe for consumption beyond their labelled expiration date.

According to wholesaler, strict contract requirements for expiration dates present challenges in delivering products close to their expiry. Optimising logistics, demand forecasts, and delivery frequency could help mitigate this issue and reduce food waste. Additionally, extending product shelf life, where food safety permits, would allow for longer usability and decrease unnecessary disposal. Encouraging more flexible shelf life requirements from customers could ensure that products nearing expiration remain available for sale.

What the wholesaler intends to do is to increase focus on transport optimization, negotiate with customers about reducing the frequency of deliveries during the week; further develop f the food waste section of the online shop, allowing more customers to access surplus products; and strengthen partnerships with food waste organisations to distribute surplus goods more effectively.

MARKETING STANDARDS IN FOOD WASTE CRÈME FRAICHE AND YOGURT (SUPPLY CHAIN 2) - ESTIMATION MODEL



Figure 6: Crème fraiche and yogurt flow chart (Food supply chain 2)

Food Service

Several factors contribute to food waste due to marketing standards within food service operations, primarily involving issues related to short shelf life, damaged packaging, and labelling errors. Short shelf life is a significant factor in food waste. When products approach or pass their best before, they are generally removed from the stock, as customers expect to receive fresh products. Additionally, damaged packaging, though rare, can contribute to waste as the product is deemed unsellable. However, the waste is less than 2% of the total volume.

They have strict purchasing agreements stipulating that two-thirds of the total shelf life must remain when they receive products. If this requirement is not met, they assess the product and return it to the wholesaler.

Errors in labelling, particularly concerning allergens, can also result in product discard. If a product lacks a necessary allergen declaration, it is immediately discarded to ensure patient safety. This is due to the potential risk that a patient may unknowingly consume a product that contains allergens. The same applies to missing or incorrect expiration dates on products, although if they can see that the product is still usable (e.g., for use in a buffet dressing), they will assess and consider its re-use.

The practice of labelling products with a "may contain traces of" statement can sometimes lead to unnecessary waste. This label often implies a risk of cross-contamination due to production in the same facility, but the actual risk may be minimal if the products were not produced on the same production line. However, the labelling system must be followed strictly to avoid potential hazards.

While they explored the option of donating surplus food, the documentation requirements proved to be too rigid, requiring additional staff to manage the process. They believe that food donations should be based on trust, and the administrative burden made this unfeasible for them.

Several strategies have been implemented to reduce and prevent food waste, with a focus on efficient inventory management, improved food handling, and adapting to demand fluctuations. The terminology for date marking was changed from "Minimum durability" to "Best before," and the practice of portion-packing was introduced. This ensures that smaller portions are used, reducing the risk of waste when products are not consumed in time. This shift, particularly with items like 0.25L milk cartons and small yogurt cups, prevents waste by better aligning product size with actual consumption.

Temperature control plays a crucial role in reducing spoilage, particularly during transportation and storage. By implementing a demand-driven inventory management system, stock levels are closely aligned with actual needs, reducing excess supply and preventing over-purchasing. The use of a real-time electronic inventory system tracks stock levels and trends, enabling proactive adjustments in stock levels, such as reducing milk supplies when consistently surplus.

Daily deliveries and constant stock monitoring allow for minimal stock levels, ensuring that fresh products are always available. The workflow ensures that departments only receive what is necessary, avoiding waste due to overstocking. Additionally, the flexibility of the ordering system enables departments to adapt quickly to changing needs.

The introduction of a new meal service concept, where patients only receive meals they have ordered, resulted in a significant reduction in food waste. By eliminating pre-plated meals and switching to à la carte orders, food waste decreased by almost 40%, with a reduction of over 30 tons of food waste annually. Smaller portions are also available.

Surplus food is managed through initiatives like lucky bags, which are packed with food that is close to its expiration date and sold at a discounted price. This has proven successful, with nearly all bags selling out.

Limited use of surplus food, such as using expired crème fraiche to create a pasta salad for staff consumption within the same day, is a strategy to prevent waste. This approach is carefully monitored to ensure the food is still safe for consumption, with a focus on avoiding waste without extending shelf life unnecessarily.

According to the food service, to effectively reduce and prevent food waste, several key actions should be considered. These measures focus on adjusting operational requirements, increasing regulatory flexibility, and establishing clearer assessment guidelines. Small adjustments to their operations should be done by reviewing and relaxing internal requirements.

Current regulations require food to be discarded if labelling errors occur, even when all necessary information is still included on the packaging. Introducing more flexibility in labelling standards—such as allowing products to be used when key details are available but not perfectly formatted—would help reduce unnecessary recalls and waste, according to the food service interviewee.

Finally, the food service interviewee affirmed that a major challenge in food waste reduction is the inconsistency in how regulations are interpreted and enforced. Currently, food safety decisions are often left to the judgment of individual inspectors, leading to variations in enforcement. Establishing a clear, standardised framework for food safety assessments would provide businesses with more certainty and consistency, reducing unnecessary food disposal due to overly cautious interpretations of regulations.

3.3 Fruit & Vegetables: Ireland

For the fruit and vegetable food commodity, the use case partner from Ireland selected three different products: beetroot juice, spinach leaves and herbs.

3.3.1 Beetroot juice

The food supply chain for beetroot juice includes primary producers, manufacturers, distributors, retailers, and consumers (Figure 7).

Producer

According to the producer, by producing juice rather than selling whole vegetables, the impact of marketing standards is minimised. Beets used for juicing can vary in size, shape, and appearance, significantly reducing waste. From the producer's perspective, processing methods have been adopted to minimise waste and optimise product sales without relying on retailers' standards. Instead of discarding surplus beets, all available production is now directed towards juice manufacturing, leading, sometimes, to a beetroot shortage rather than waste. Weather conditions can also contribute to shortages; for instance, an early and severe winter may force producers to harvest earlier to prevent crop loss. For distributors, logistical challenges such as glass bottle breakage can result in product loss; however, this issue also falls outside the scope of marketing standards.

Retailer

From a retailer's perspective, the long shelf life and ambient storage of beetroot juice contribute to waste reduction. Additionally, demand-driven deliveries ensure that stores receive only the required volume of products, preventing overstocking.

Regarding marketing standards, public regulations on labelling can contribute to food waste if not properly followed. Juice bottles must comply with these standards before being released to the market. However, public marketing standards can also help increase beetroot juice sales and reduce food waste that could arise for the fresh produce, by promoting consumer demand through labelling, certifications, and awards.

Consumer

The interviewed consumers is not willing to buy beetroot juice close to its expiry date. Additionally, after opening the product, they follow the 5-day consumption recommendation and typically discard around 30% of the juice.

Although collaborations exist within the food supply chain, they are not specifically aimed at reducing food waste. Potential solutions to food waste caused by marketing standards include providing grants, tax breaks, and funding to support value-added processing and sustainable packaging. Training programmes can educate growers on product diversification opportunities, while consumer campaigns can promote the acceptance of imperfect beets. Additionally, collaboration through farmer cooperatives, retailer agreements, and partnerships with food businesses can help efficiently utilise off-grade beets.

MARKETING STANDARDS IN FOOD WASTE BEETROOT JUICE ESTIMATION MODEL

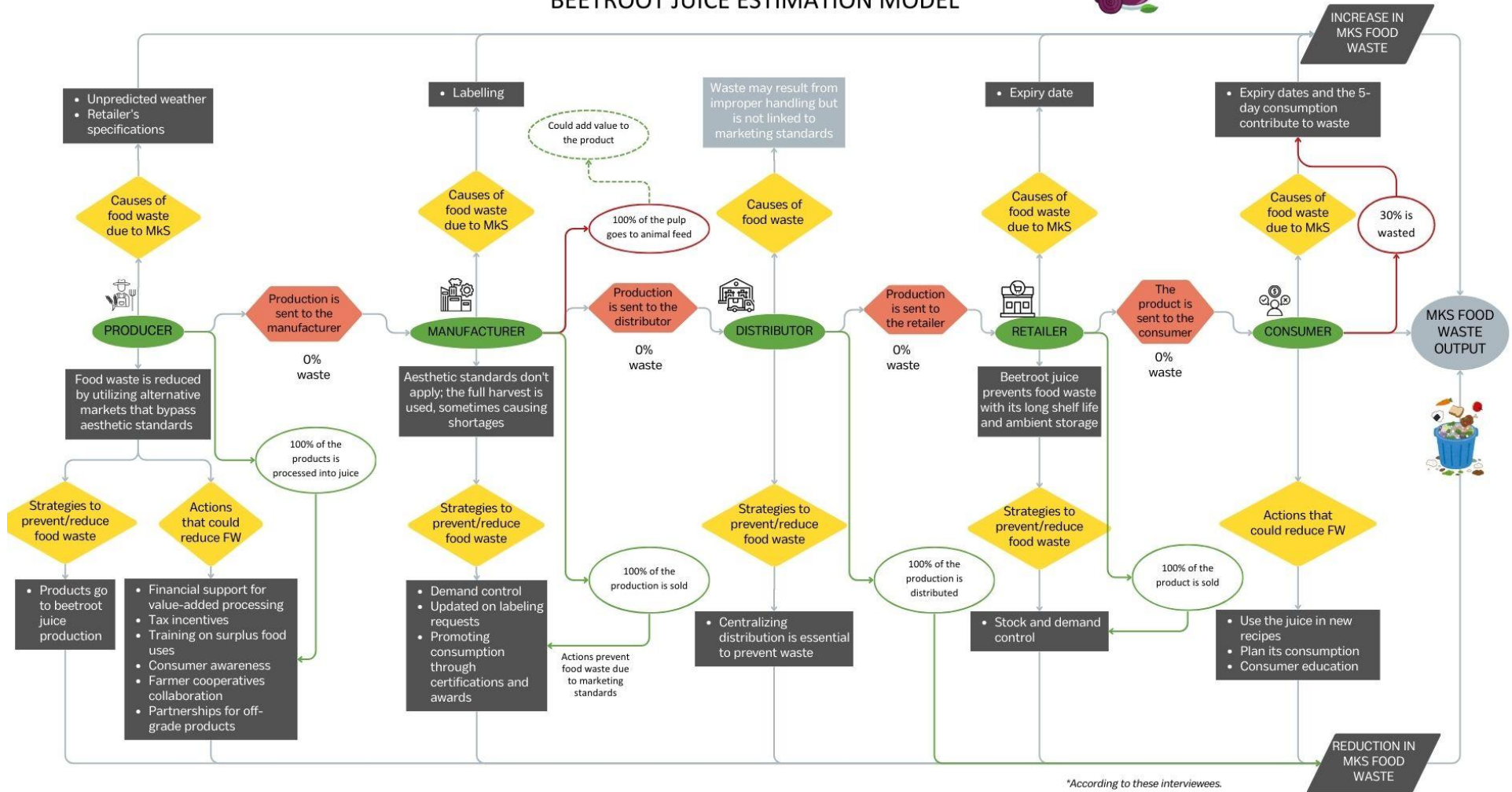


Figure 7: Beetroot juice flow chart

3.3.2 Spinach leaves

For this product, we have considered two sets of food supply chains: one focusing on the role of retailers (Figure 8) and the other on food service providers (Figure 9).

Producer

According to the producer, while some food service operators are flexible and willing to accept products that may not be aesthetically perfect, retailers tend to be much stricter. The producer interviewee did not provide a specific percentage for the difference but stated that there is a clear contrast. Retailers contribute significantly to food waste due to their strict private standards, while food service partners play a less demanding role in this regard.

According to the producer, certain retailers impose stricter shelf-life requirements on spinach leaves than their actual longevity allows. While spinach may have a shelf life of up to 10 days, some retailers require no more than four to five days. As a result, a significant portion of the product's potential shelf life remains unused within the food supply chain. The waste for spinach leaves at producer level is 6%.

The producer affirms that the main aesthetic reasons for food waste in spinach leaves are wilting, yellowing, and hail damage. Short harvest seasons and extreme cold weather also contribute to food waste due to marketing standards. During the local growing season, wastage may increase due to an abundance of home-grown produce being available at the same time. However, outside the local season, when produce needs to be imported from Europe, wastage can occur due to factors such as transportation delays. While the causes of waste vary, seasonal changes play a significant role in its occurrence.

Public marketing standards, such as labelling, comply 100% with requirements. A technical team handles any concerns related to labelling. Additionally, they are audited by an external company and their customers, who ensure compliance with up-to-date labelling legislation, even in cases where public standards may be unclear.

Several factors contribute to the reduction of food waste due to marketing standards in the production level. The simple production process, which involves few stages, helps minimise waste. The producers do not wash the leaves or use chlorination. Other factors also contribute to reducing food waste due to marketing standards, as the extended harvest period maximizes crop use and provides higher-quality vegetables. The producer asserts that the Lean program prevents waste, as it is a systematic approach designed to minimize waste, enhance efficiency, and maximize value in processes. Production based on demand and comply with labelling requirements, also are strategies cited by the producer to prevent and reduce waste.

To reduce food waste, actions such as relaxing retailer specifications and providing financial support to farmers for investing in new products could be effective according to the producer.

Retailer

From a retailer's perspective, the ordering and delivery of fresh products every day, based on forecast consumer demand, helps prevent waste, as it meets consumer expectations. Additionally, the retailer mentioned that they only accept Class 1 products, ensuring that their products meet very high standards, with no products rejected at retail level due to not meeting marketing standards.

MARKETING STANDARDS IN FOOD WASTE SPINACH ESTIMATION MODEL

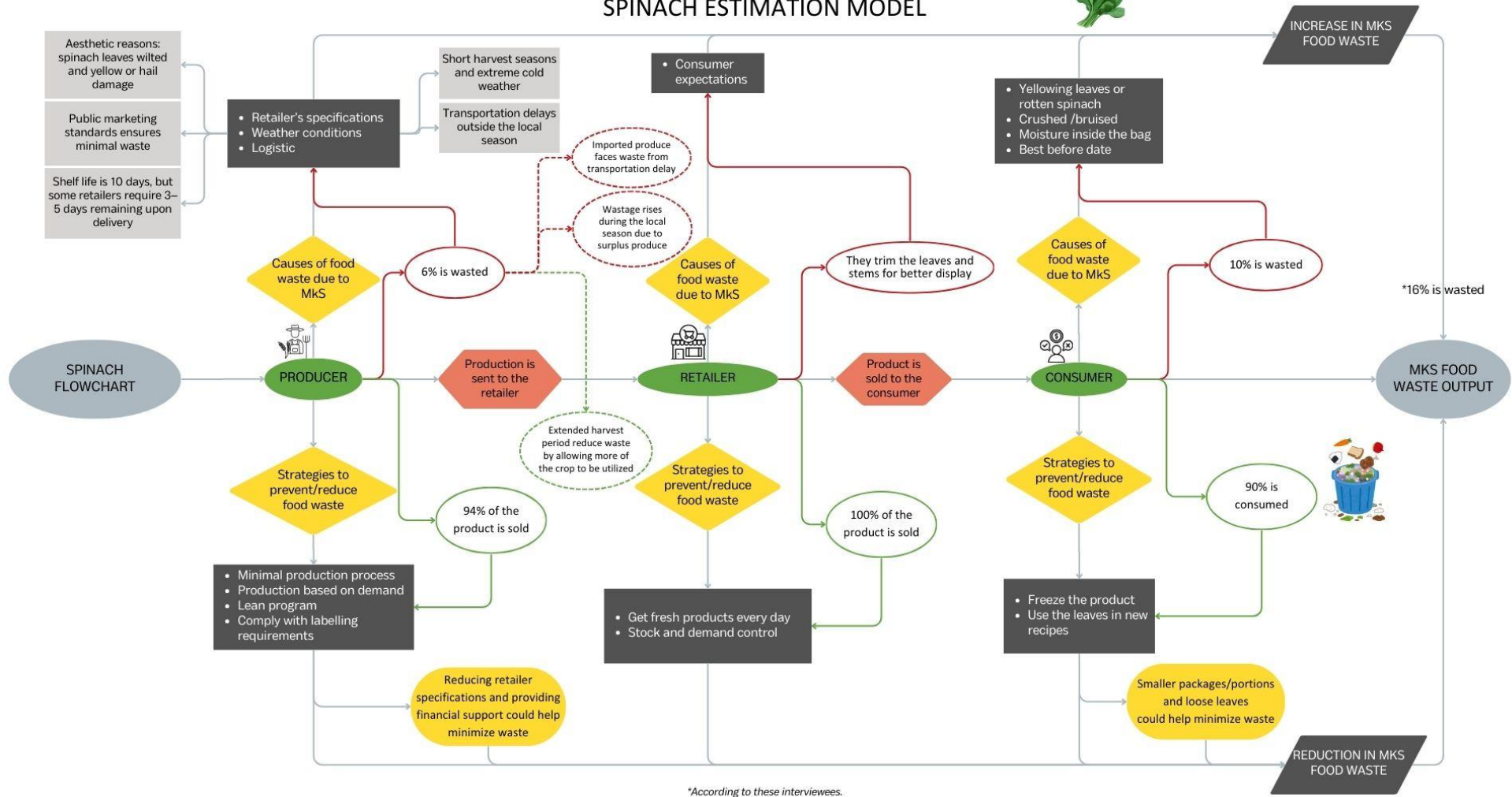
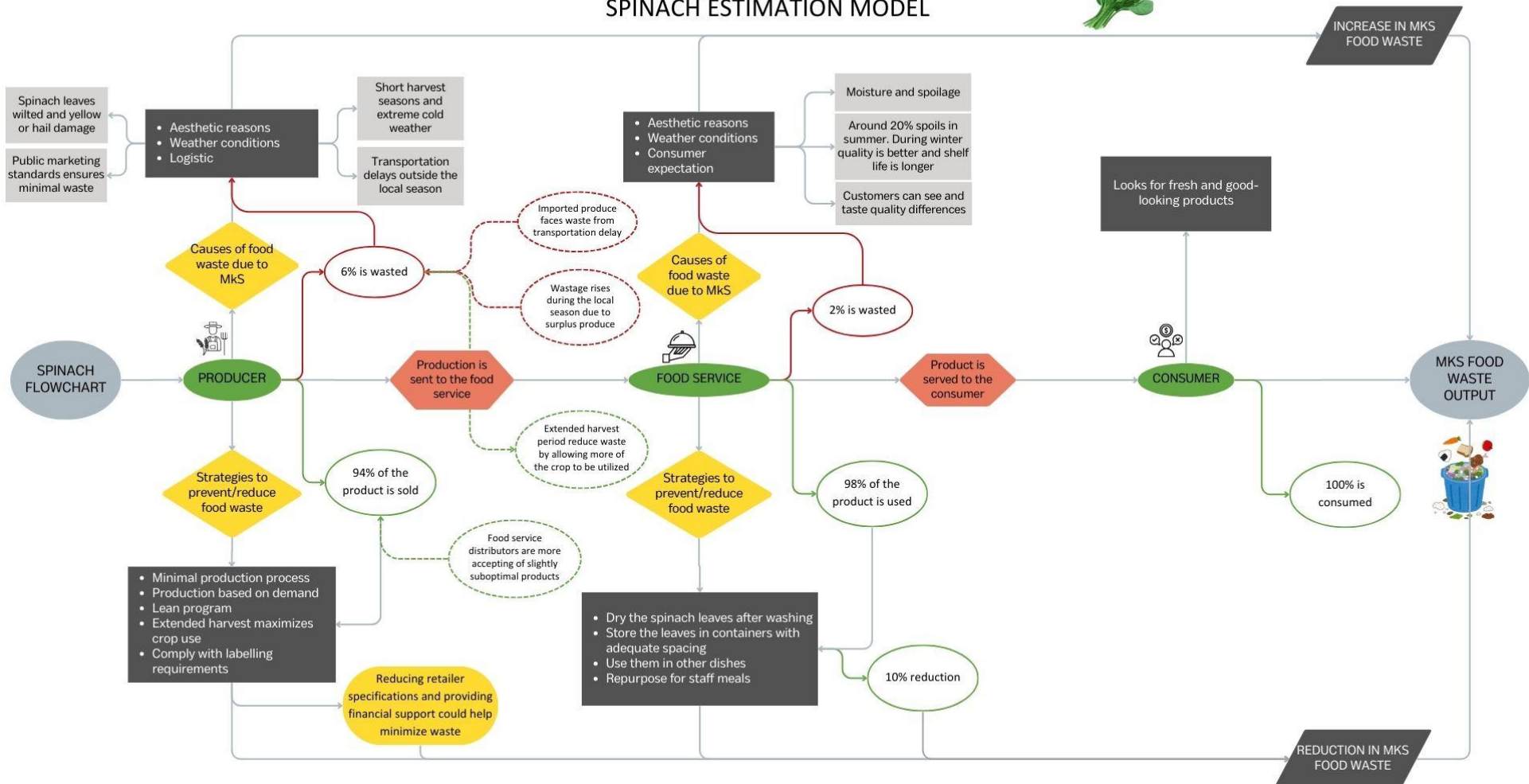


Figure 8: Spinach flow chart (Retailer)

MARKETING STANDARDS IN FOOD WASTE

SPINACH ESTIMATION MODEL



*According to these interviewees.

Figure 9: Spinach flow chart (Food service)

Consumer

From the consumer's point of view, expectations are high. Common causes of waste at household level include yellowing leaves, rotten spinach, crushed or bruised produce, moisture inside the bag, and expired best-before dates. According to the consumer, 10% is wasted. The consumer affirmed that offering smaller packages, portion sizes, or loose leaves in food stores could help minimise waste.

Food service

According to the food service provider, the handling of produce is influenced by seasonal variations, with a higher spoilage rate (around 20%) in summer compared to winter, allowing for longer shelf life. Efforts to minimise waste include washing, drying, and removing damaged parts before storage. Proper drying is particularly important, as insufficient drying accelerates spoilage. By implementing these measures at food service level, waste is reduced by approximately 10%.

To prevent damage, produce is stored with adequate spacing in containers. If items become unsuitable for sale but remain edible, they are repurposed for staff meals or incorporated into other dishes, such as gyoza mix. Only around 2% of the produce is discarded when it reaches an unusable condition.

Consumer

From the consumer's perspective, expectations are high when dining at a food service establishment. However, food service providers generally succeed in meeting these expectations.

3.3.3 Herbs

The estimation model for herbs is presented below, including producer, retailer and consumer (Figure 10). For herbs, the scenario is quite similar to that presented in the spinach leaves, although some differences should be highlighted.

Producer

The information provided in the producer session of spinach leaves, can also be applicable for herbs. However, the main difference is the notably waste during at the production stage increased to 30%, primarily due to retailer specifications, such as stem length (15 to 20cm).

Retailer

The retailer order fresh herbs every day, based on forecast consumer demand. This strategy helps prevent waste, as it meets consumer expectations.

Consumer

From the consumer perspective, there is a significant difference in waste at the household level, with 75% of the herbs being discarded. This could be attributed to packaging containing more product than needed, as well as a lack of actions to reduce waste, such as freezing the herbs or preparing new dishes.

MARKETING STANDARDS IN FOOD WASTE HERBS ESTIMATION MODEL

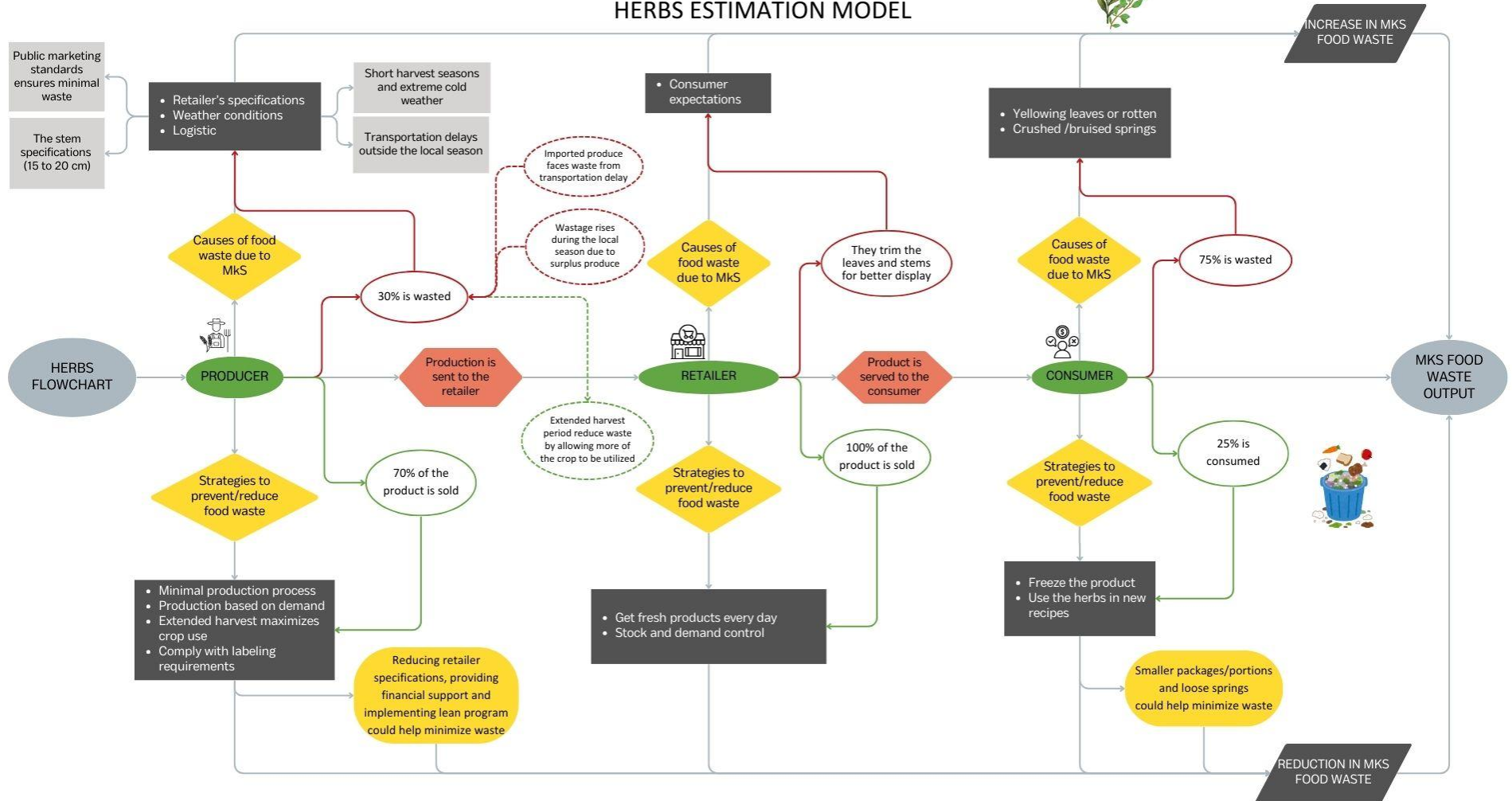


Figure 10: Herbs flow chart

3.4 Fruits and Vegetables: Spain

For the fruit and vegetable food commodity, the use case partner from Spain selected two different products: apples and broccoli.

3.4.1 Apples

The estimation represented in this report for apples includes a producer, a retailer, and a consumer (Figure 11).

Producer

The apple producer affirms that the main aesthetic reasons for food waste in apple production stem from strict cosmetic requirements imposed by both public and private marketing standards. These factors include:

- Size and shape uniformity, with apples being too small, too large, or irregularly shaped often rejected, despite being perfectly edible.
- Colour expectations, as certain retailers require that a minimum percentage of the fruit's surface display a specific shade of red or yellow.
- Minor imperfections such as scratches or russeting (a natural occurrence on apples) can disqualify fruit from retail shelves. Fruits that sustain minor bruising during handling or transportation may not be accepted by supermarkets. Also, weather conditions, such as temperature fluctuations and wind exposure in high-altitude orchards, can result in tougher skin or superficial marks.

Approximately 20-22% of production does not meet private marketing standards, with 80% of those rejections attributed to aesthetic reasons, such as size, shape, colour, or minor blemishes. The percentage varies seasonally. This variation is influenced by seasonal weather conditions: During the early season, like spring and early summer, fruits tend to develop under cooler temperatures, leading to better colour formation and more uniform shapes. During this period, rejection rates due to cosmetic imperfections are generally lower. During the mid to late season, summer and early autumn, as temperatures rise, fruits may grow faster, sometimes leading to larger-than-standard sizes, sunburn spots, or uneven ripening, increasing rejection rates. Late season, like autumn and early winter, cooler temperatures at night can improve colour intensity, but early frosts or strong winds can cause surface blemishes or minor bruising, which may increase waste levels.

Seasonal weather conditions, some factors increase or reduce waste. Pest and disease cycles can increase food waste throughout the year. For example, summer months often bring higher insect pressure, which can lead to minor external damage that disqualifies fruit from supermarket shelves, even though it remains edible. Fruits harvested at peak ripeness in cooler months tend to meet marketing standards more easily. However, if a heatwave accelerates ripening, fruits may develop softer textures, inconsistent coloration, or slight over-ripeness, leading to a higher rejection rate. Fruits harvested in late autumn and stored for long periods might suffer from slight dehydration or skin blemishes, making them less visually appealing by the time they reach retailers. If humidity levels fluctuate during storage, apples and pears may develop minor surface defects, increasing waste percentages in the off-season.

MARKETING STANDARDS IN FOOD WASTE

APPLE ESTIMATION MODEL

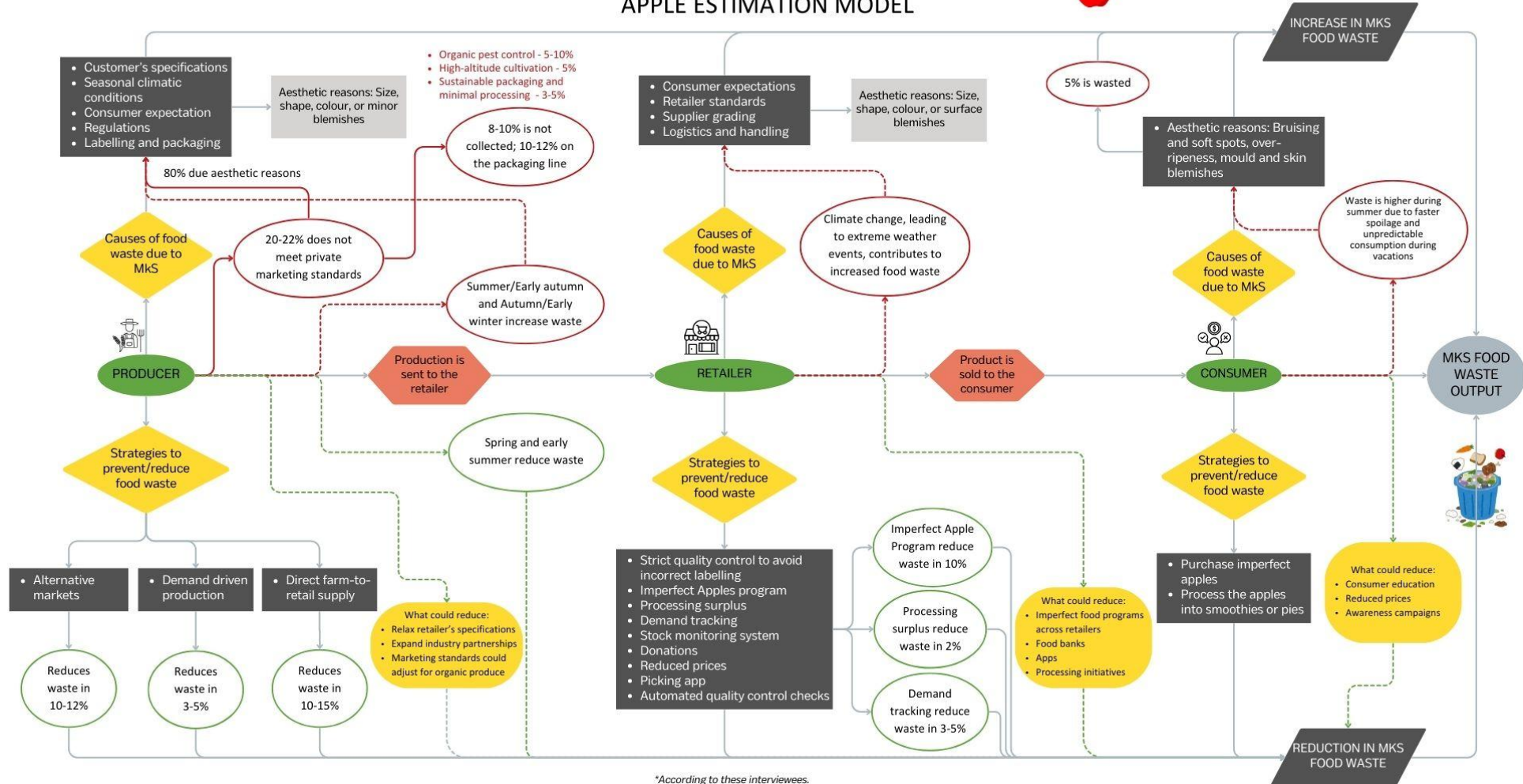


Figure 11: Apple flow chart

According to the producer, retailer specifications leads to 50% of food waste across the whole chain due to strict size, shape, and colour requirements imposed by supermarkets. Consumer expectations is responsible for 20% of food waste, because of their demand for visually perfect fruit. Distributor and manufacturer requirements leads to 15%. Their quality requirements are generally more flexible than supermarkets. Regulations, like EU marketing standards for fresh produce dictate minimum quality and classification requirements, contributing to 10% of waste. Errors in labelling or minor damage during transport can lead to 5% of rejections.

The producer break down the 20-22% food waste as follows: 8-10% happens directly on the tree, i.e. 8-10% is not collected because they are partly rotten or with high superficial imperfections; 10-12% happens on the packaging line. The reason here being mainly aesthetic imperfections.

Organic pest control eliminates the need for chemical pesticides but can lead to minor blemishes or insect marks, increasing rejections. Impact on food waste is 5-10% (due to stricter cosmetic rejections). High-altitude cultivation enhances flavour and crispness but exposes fruit to strong winds and cold temperatures, sometimes causing surface imperfections. Impact on food waste is 5% (due to cosmetic damage). Careful harvest timing and handling ensures optimal ripeness and quality but does not prevent rejections based on strict size and shape grading. However, no significant impact on food waste. Sustainable packaging and minimal processing reduces environmental impact but increases the risk of transport-related blemishes, increasing on food waste in 3-5% (due to packaging and handling issues). Direct farm-to-retail supply bypasses intermediaries, extending shelf life and reducing unnecessary handling, reduce food waste in 10-15% (by delivering fresher produce with fewer rejections).

The producer has alternative markets and product diversification strategies to reduce food waste. The result of these strategies leads to 10-12% less food waste. There are three types of industry partnerships: Baby Food (Highest-paying, strictest standards); Creams (Moderate quality standards, more flexibility); Juices (Lowest-paying, accepts most defects, including partially rotten fruit).

The demand driven production adjustments reduces waste by ~3-5%. Which includes close communication with customers to adjust harvest volumes based on demand. Dynamic pricing & flexible contracts with alternative buyers to absorb excess production.

Direct farm-to-retail supply chain reduces waste by ~5-8%, selling through next-gen retailers allows the producer to bypass strict supermarket cosmetic standards, reducing waste from unnecessary rejections.

The producer affirms that they could be leveraged as a tool to reduce waste if they were adapted to be more inclusive of natural variation in organic fruit production. For that, there are several things that can be done. The EU has already taken steps to allow the sale of “imperfect” produce, but, in their opinion, supermarkets still impose stricter private standards. If retailers adopted more flexible cosmetic grading, more apples and pears with minor blemishes, irregular shapes, or slight discoloration could reach consumers instead of being discarded or downgraded.

Another solution, according to the producer, would be to create a secondary market channel. Expanding industry partnerships (e.g., juice production, dried fruit, or baby food manufacturers) could provide structured alternatives for fruit that does not meet fresh market standards. Retailers could create imperfect produce sections (like online players do), encouraging consumers to purchase nutritious fruit at lower prices rather than rejecting it at the supplier level.

Organic farming avoids synthetic chemicals, meaning pest control and natural growing conditions. As a result, these practices lead to more cosmetic defects. Marketing standards could adjust for organic produce,

recognizing its differences from conventionally grown fruit and ensuring it is not unfairly disadvantaged. The reality, is that organic growers are extremely limited when it comes to farming practices. Everytime they try to innovate to improve the final product, they are shut down by the organization that certifies their product as Organic.

To reduce food waste due to marketing standards, relaxing regulations on permitted inputs for organic farming would be essential. Current EU rules restrict certain pest control and fertilization methods, making it harder to meet strict cosmetic standards. This is especially unfair since imported products from Morocco or South America, for example, do not face the same requirements, creating an uneven playing field. Aligning regulations for both EU and non-EU producers would help reduce unnecessary waste while maintaining fair competition.

The producer also plans to decrease the share of apples currently left in the trees to channel them to certain industry players.

Retailer

The retailer plays an important role, mainly considering the aesthetic reasons for food waste due to marketing standards, which include: size deviations, like apples that are too small or too large; shape irregularities, apples with unusual shapes; surface blemishes, like minor marks, russeting, or superficial scarring; and color requirements, some apple varieties need a minimum percentage of red or yellow on their surface.

A specific program called "Imperfect Apples" was launched by the retailer to help educate consumers about accepting out-of-spec products. After its implementation, food waste dropped from 12% to below 1%.

Yearly variations in apple waste are influenced by harvest conditions, consumer preferences, and supplier variability. Certain growing seasons, like summer, produce more apples with surface imperfections due to heat stress, as higher temperatures accelerate spoilage and bruising during transport. Additionally, climate change resulting in extreme weather events can increase blemished apples.

According to the retailer, the main causes of food waste due to marketing standards are consumer expectations, which account for 50% of waste; retailer standards, responsible for 30% (even though the retailer accepts a wider range than most competitors); supplier grading, which represents 15%, as suppliers pre-sort based on expected retail acceptance; and logistics and handling, responsible for less than 5%, particularly in direct food supply chains.

The retailer also highlighted what actions they are implementing to reduce and prevent food waste due to marketing standards:

- Strict quality control to prevent labelling errors.
- *Imperfect Apples* programme allows the sale of visually imperfect apples, reducing waste by approximately 10%.
- Surplus apples are processed into pre-defined fruit baskets for office clients; this occurs only when supply exceeds demand and can reduce apple waste by around 2%.
- Data-driven inventory management tracks sales trends to optimise stock levels.
- Apple orders are adjusted based on sales trends to avoid overstocking, potentially reducing waste by 3–5%.

- Donations include gifts for customers with large orders, employee consumption, discounted sales to local stores, and charitable donations when possible.
- A stock monitoring system tracks volumes of traditional, imperfect, and wasted apples.
- A picking app matches customer preferences to reduce rejections.
- Automated quality control checks minimise errors and waste.

Marketing standards can also contribute to reducing food waste by relaxing aesthetic requirements, encouraging secondary markets, and educating consumers about the quality and taste of non-uniform apples. Additionally, some retailers collaborate with food banks or use third-party apps (e.g., *Too Good To Go*) to minimise waste. Further processing initiatives, such as producing dried apples, could also be explored in the future.

Consumer

Consumer expectations for apples are high, particularly concerning aesthetic factors. Apples are primarily discarded for reasons such as bruising, soft spots, over-ripeness, mould, or skin blemishes. It is estimated that approximately 5% of apples are wasted due to over-ripeness or aesthetic issues, especially after being stored for long periods in the fridge. This percentage fluctuates seasonally, with higher waste rates observed during the summer months. The warmer temperatures accelerate spoilage, while less predictable consumption habits during vacation periods also contribute to increased waste.

The consumer has occasionally purchased imperfect apples and is open to buying them, particularly when offered at a discounted price. However, the consumer generally prefers apples that will last longer to maintain their freshness.

When faced with a surplus of apples at home, two main actions are taken. The apples are either included in fruit smoothies or occasionally used to make apple pie. The consumer does not use any applications or tools to reduce food waste.

The consumer suggests several strategies for reducing apple waste and increasing the purchase of imperfect apples: Consumer education, teaching consumers how to store apples properly to extend their freshness; Promotions on imperfect apples; and awareness campaigns, which supermarkets and brands could help shift consumer perceptions by highlighting the quality and nutritional value of imperfect fruit.

3.4.2 Broccoli

The food supply chain represented in this report for broccoli includes a producer, a distributor, a retailer, and a consumer (Figure 12).

Producer

The producer affirms that broccoli waste due to marketing standards is minimal, less than 4% of total production, however, the primary reason for rejection occurs when extremely low temperatures cause the surface of the broccoli to develop a purple hue. While this does not affect the quality or nutritional value, it does not meet the aesthetic standards required for fresh market sale. When discoloration happens, the produce needs to be handled and separated into main channel vs. industry.

MARKETING STANDARDS IN FOOD WASTE BROCCOLI ESTIMATION MODEL

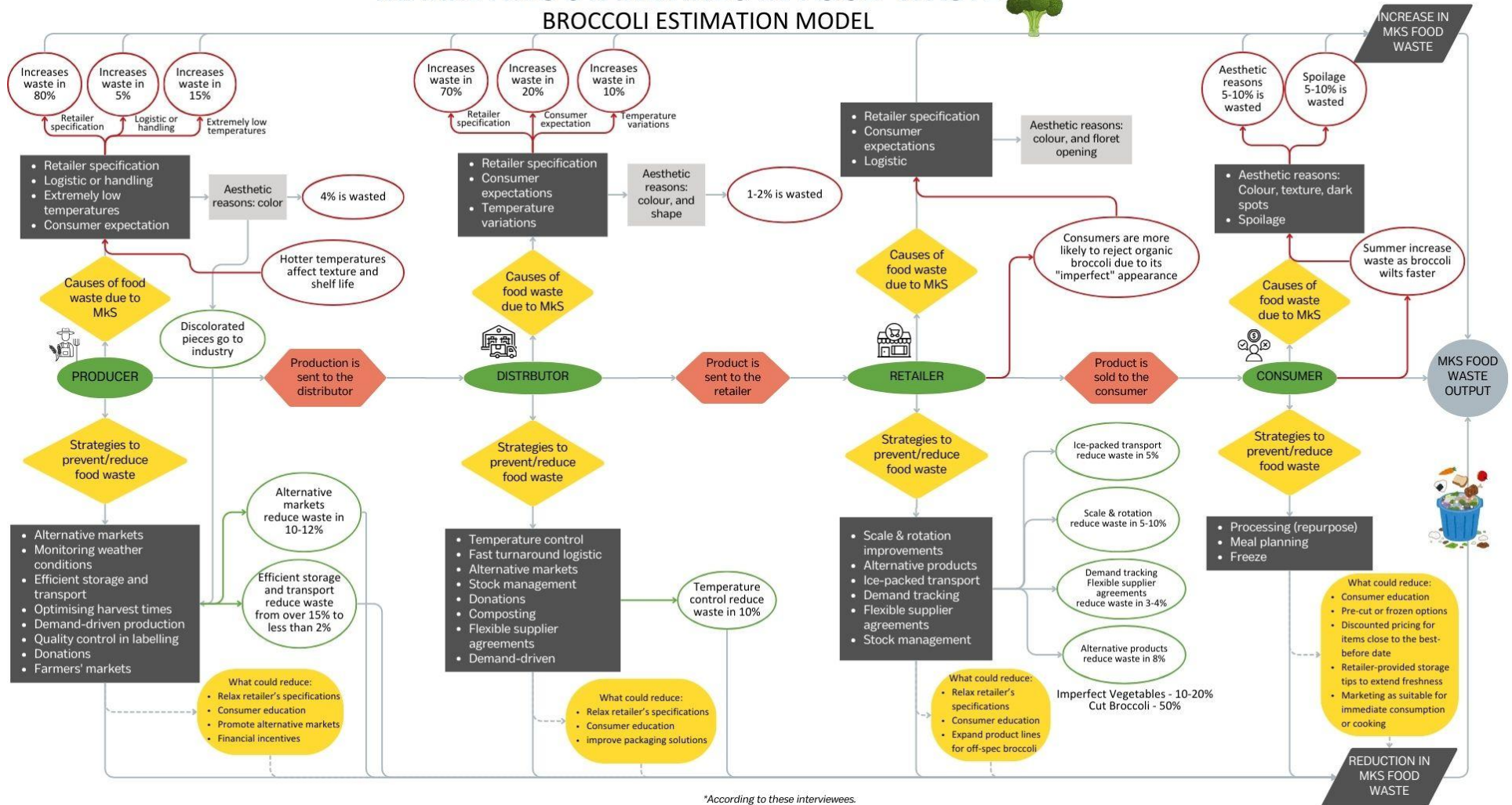


Figure 12: Broccoli flow chart

Unaffected pieces continue to go to the main retail channels while discoloured pieces go directly to the industry for products such as prepared foods, creams or juices.

Retailer specifications account for 80% of broccoli waste due to strict standards for colour and uniformity, followed by cold temperature effects (15%) that cause purple discolouration during extreme cold, and logistics or handling issues (5%) leading to minor damages during transport.

Consumers expect vibrant green broccoli, leading retailers to reject broccoli with minor discoloration, even when perfectly edible.

Broccoli is a highly perishable product. If transportation is delayed or improper cooling occurs, its freshness can deteriorate, leading to rejections. Their broccoli production is transported in white boxes with ice. In their experience, they have been able to reduce waste generated through transportation from over 15% to less than 2% with this method.

Climate change can increase food waste, as said, during colder winters lead to increased broccoli discoloration. In the hotter temperatures can affect texture and shelf life. The producer adapts by adjusting harvest times and implementing controlled cooling techniques.

The strategies to prevent and reduce waste of broccoli is optimise harvest times, reducing exposure to extreme temperatures. Cold storage management also ensures product freshness and minimizes deterioration. Alternative markets are applied for any broccoli with slight discoloration, sold them to the processed food industry (soups, creams, frozen vegetables). Additionally, adjusting harvest schedules when extreme cold is expected helps prevent discoloration. Efficient storage and transport logistics reduces deterioration and ensures maximum freshness upon arrival.

According to the producer, some production practices help reduce waste. The producer adjusts production volumes based on retailer demand forecasts to avoid overproduction. Additionally, broccoli that does not meet strict fresh market standards can still be sold to industry buyers.

Marketing standards can also contribute to waste reduction by educating consumers about natural variations in appearance, such as slight discolouration, and encouraging retailers to adopt more flexible aesthetic standards. Additionally, promoting alternative markets could ensure that all edible broccoli is utilised.

Several actions can be taken to reduce waste. Retailers can adopt greater flexibility regarding minor aesthetic imperfections. Increasing consumer awareness of natural variations in broccoli colour and providing financial incentives for food waste reduction initiatives would also help minimise unnecessary waste.

The producer is exploring further partnerships with food manufacturers to increase the volume of broccoli used in processed products. However, prices in this sector are significantly lower than in mainstream retail and are therefore only pursued when necessary. Some producers sell imperfect broccoli at farmers' markets or donate surplus to food banks.

Distributor

According to the distributor, food waste in broccoli due to marketing standards is minimal. The primary reason for rejection is surface discolouration, particularly when cold temperatures cause a purplish tint. Another issue is floret opening, which occurs when temperature variations cause the broccoli heads to loosen, making them less visually appealing to wholesalers and retailers. Although these issues do not affect quality, they lead to rejections in the fresh market.

Less than 1–2% of broccoli is wasted due to marketing standards. Most broccoli that does not meet strict retail requirements is redirected to low-cost retailers at discounted prices or to industry buyers. However, a challenge with industry sales is the required packaging format, as industry buyers do not accept broccoli packed in white iced boxes.

Retailer specifications account for 70% of waste due to strict appearance and size requirements. Consumer expectations contribute to 20% of waste, as buyers prefer uniform, vibrant green broccoli. Finally, temperature variations cause 10% of waste.

Additionally, some production practices can help reduce food waste. Strict temperature control during transport minimises spoilage, and the use of ice within the boxes can reduce waste by 10%. Another effective practice is fast turnaround logistics, ensuring that broccoli reaches buyers quickly, thereby reducing waste. Expanding sales to smaller retailers and food service providers that accept greater variability in broccoli appearance, along with efficient stock management, helps to minimise excess inventory.

Additionally, technologies such as temperature monitoring systems and inventory management systems can help prevent waste. Without cooling chambers, waste has been observed to increase by more than 10%.

To adjust production to demand fluctuations, various strategies are implemented. These include daily sales tracking to adjust purchase volumes based on real-time demand and maintaining flexible supplier agreements, which allow for quick adaptations to prevent surplus and ensure efficient inventory management.

Although rare, the distributor also donates to food charities when alternative sales are not possible. Another option for non-edible surplus is to send it for composting to reduce environmental impact.

Another important point is that marketing standards can help reduce food waste by encouraging retailers to accept natural discolouration in broccoli, educating consumers about minor imperfections that do not affect quality, and supporting alternative sales channels for cosmetically imperfect broccoli to ensure that more of the product reaches the market rather than being discarded.

Finally, for the distributor, three main actions could help reduce waste: retailer flexibility on minor imperfections, consumer education on natural variations in fresh produce, and improved packaging solutions to better meet industry buyer requirements.

Retailer

The retailer experienced broccoli waste due to discolouration (purpling), floret opening, and lack of proper cooling during transport. These issues made it difficult to meet consumer expectations. However, with improvements in handling, storage, and alternative product lines, these causes of waste have significantly decreased. At the beginning, the retailer had a 15-20% waste rate for broccoli. After implementing key changes, including better packaging, ice-packed shipments, and product diversification (Imperfect Vegetables and Cut Broccoli), waste has dropped to around 2%.

Considering consumer expectations, they are responsible for two thirds (67%) of waste, while transports and logistics accounts for one third (33%) of causes.

To reduce and prevent broccoli waste, the retailer has adopted multiple initiatives:

- Scale & rotation improvements: Faster turnover keeps products fresher and improves waste for around 5-10%

- Alternative products: Imperfect Vegetables and Cut Broccoli allow the retailer to utilise broccoli that does not meet fresh retail standards. This saves around 8% of potential broccoli waste.
- Ice-packed transport – Reduces spoilage and extends shelf life. At retail level, it can reduce waste for around 5%
- Imperfect Vegetables: This product line allows the retailer to include slightly imperfect broccoli, such as those with minor discolouration or floret opening, along with other vegetables. This strategy helps maximize the use of edible produce and ensures that visual imperfections do not lead to unnecessary waste. Imperfect Vegetables accounts for around 10-20% of the Broccoli waste reduction at the company.
- Cut Broccoli: The retailer also offers pre-cut broccoli florets, making it easier for consumers to use in ready-to-cook meals. This format enables to utilise broccoli heads that are not entirely perfect but still have the majority of the product in good condition, thus reducing rejections due to minor imperfections. Cut Broccoli accounts for 50% of the broccoli waste reduction.

To adapt to demand fluctuations, the retailer minimizes food waste by implementing real-time sales tracking, which allows for continuous adjustments to purchase volumes based on demand, ensuring that supply matches consumer needs. Additionally, flexible supplier agreements enable quick modifications in order quantities, preventing overstocking and reducing the risk of waste while maintaining product freshness. Both initiatives allowed to reduce broccoli waste of around 3-4% percentage points.

Advanced technology to minimize food waste by utilizing a predictive demand model that accurately forecasts future sales, ensuring that inventory levels are aligned with consumer needs and reducing the risk of overstocking. Additionally, the company employs a custom picking app that tailors selections based on the specific preferences and purchasing habits of each customer. This personalized approach not only enhances customer satisfaction but also optimizes stock management, ensuring that products are distributed efficiently and waste is kept to a minimum. However, the retailer mentioned it is difficult to estimate the percentage of waste reduction due to the implementation of these two initiatives.

The retailer believes that marketing standards can reduce broccoli waste, by encouraging retailers to accept minor imperfections, educating consumers about natural variations in broccoli, and promoting alternative product lines like imperfect vegetables and pre-cut broccoli.

Consumer

The consumer occasionally discards broccoli due to yellowing florets, a soft or limp texture, or dark spots that develop over time. The estimated waste due to aesthetic reasons is 5-10%. This percentage tends to increase in warmer months, as broccoli wilts faster, and slightly decreases in colder months, when vegetables generally last longer in her home. Additionally, around 5% of her broccoli purchases are wasted due to spoilage.

The consumer would be more inclined to buy near-expiry broccoli if: there were discounted pricing for these products; retailers provided storage tips to extend freshness; it was marketed as suitable for immediate consumption or cooking (e.g., in pre-cut or frozen formats).

The consumer also affirms being willing to buy broccoli that is slightly imperfect, as long as it is still fresh and safe to eat, and is labelled as such and priced lower.

Strategies to prevent waste include repurposing broccoli that is not visually perfect by using it in soups or stir-fries, blending it into smoothies if it is still fresh but slightly soft, freezing it if she knows she won't use it before

it spoils, or cutting away bad parts and consuming the rest. The consumer does not use any specific food waste prevention app but typically plans meals to avoid overbuying and wasting food.

What would help the consumer reduce broccoli waste are pre-cut or frozen options, learning how to store broccoli properly, and discovering creative ways to use it before it spoils.

3.5 Meat: Greece

For the meat food commodity, the use case partner from Greece selected two different products: chicken and pork.

3.5.1 Chicken

The food supply chain for chicken is producer, manufacturer, distributor, retailer and consumer (Figure 13).

Producer

According to the producer, the carcasses are categorised into Category A and Category B based on quality grading. Category A birds meet the highest standards, are free from bruises or defects, and are used as a whole. Category B birds may have minor defects, such as a bruised leg, but are still safe for consumption. These birds are processed to separate the affected parts while ensuring that the usable portions are not wasted.

Food waste is mainly caused by aesthetic issues, such as minor defects during processing or manual handling errors, which point to opportunities for process improvement. Additionally, climate change poses a challenge, as poultry is highly sensitive to temperature changes. The use of advanced technologies in poultry farms helps mitigate this risk, ensuring optimal conditions even during extreme temperatures.

Some strategies are applied to reduce and prevent food waste through marketing standards, ensuring high quality: The production process is supported by a vertically integrated system, ensuring the efficient use of every part of the bird, with no waste generated; Farmers adhere to strict protocols, supported by technical assistance and regular training from veterinarians; The production plan is carefully structured to align with market needs, avoiding both shortages and overproduction; The entire operation is overseen by a veterinary agency, ensuring compliance with regulations; Internally, a dedicated safety team ensures that the production process follows quality standards designed to reduce waste; Marketing standards also play a role in this, as compliance with legislation and labelling requirements helps reduce food waste; The company also maintains high animal welfare standards and applies strict quality controls throughout the process to prevent potential issues leading to waste.

However, there are opportunities for improvement, including the introduction of innovative solutions, process enhancements, and improvements in poultry collection mechanisms.

Manufacturer

According to the manufacturer, second-grade quality products (Category B) are caused by manual handling errors during processing, such as bruises on the legs, wings, and back. Improving processing could help reduce waste and cosmetic damage. Increased product returns, mainly due to temperature fluctuations, are especially common in summer. Climate change also affects live poultry and cold chain management, creating additional challenges.

MARKETING STANDARDS IN FOOD WASTE CHICKEN - ESTIMATION MODEL

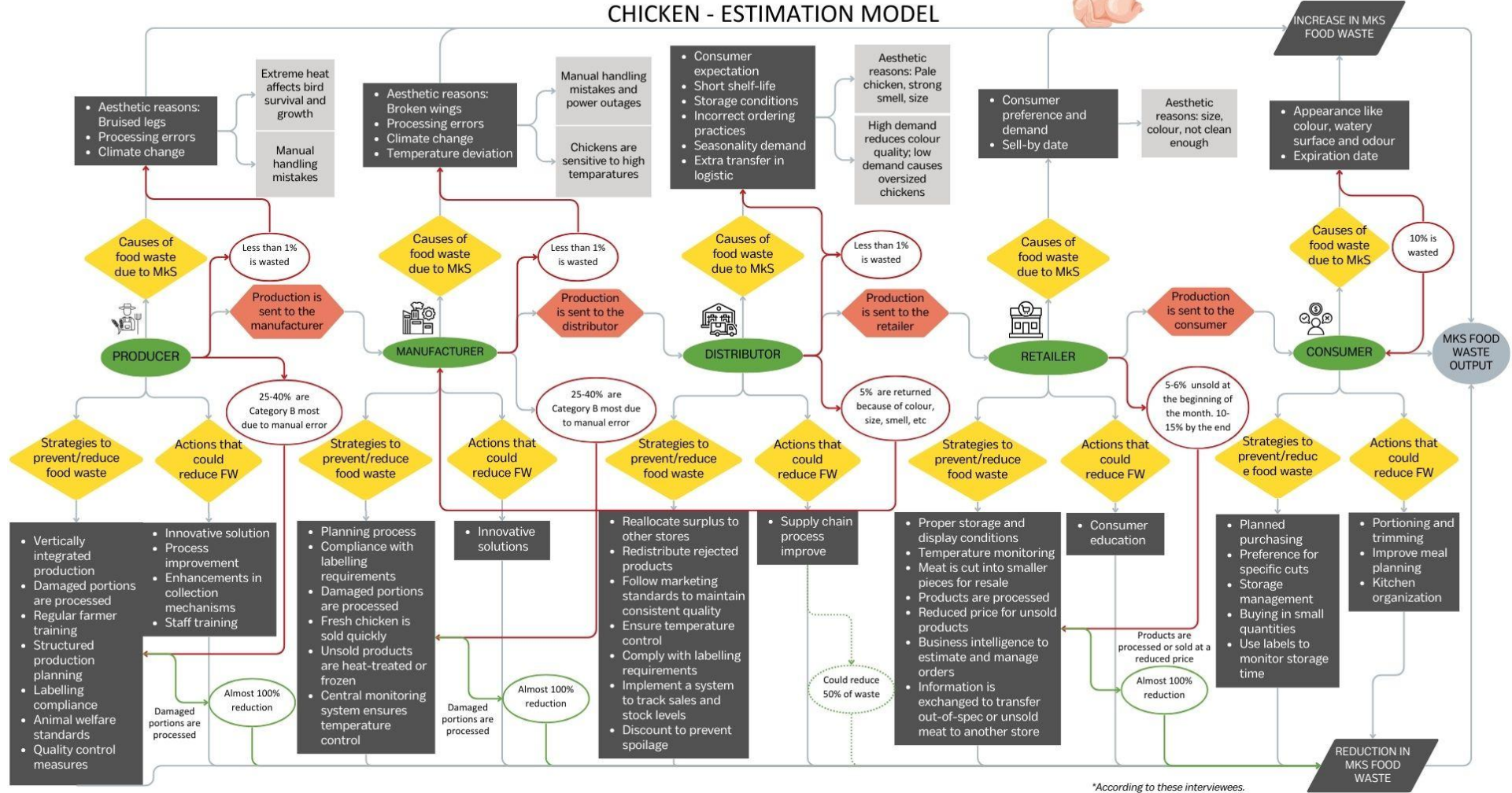


Figure 13: Chicken flow chart

However, actions can be taken to reduce waste at this stage of the food supply chain. These include ensuring legal labelling compliance and repurposing damaged portions as ground meat or pre-cooked products. To manage the short shelf life of fresh chicken, products are sold as fresh as possible. Any unsold items older than two days are either heat-treated or frozen to extend shelf life. Unsold fresh chicken nearing expiry is immediately frozen, giving it a shelf life of up to 16 months. A central monitoring system helps maintain proper temperature control to prevent waste. Introducing innovative solutions and continuous improvements could further reduce waste.

Distributor

Food waste in distribution is influenced by several factors. Temperature deviations are the primary cause of food waste throughout the supply chain. Consumer expectations play a key role, particularly regarding colour preference. Yellow chickens are favoured over pale or white ones, and during winter, high demand leads to shorter growth periods, preventing chickens from developing the desired colour. This contributes to a return rate of approximately 5% for local chickens. Additionally, oversized chickens are sometimes rejected. The short shelf life of fresh chicken further exacerbates waste, as even four days before expiry, the meat can develop a strong odour. Storage conditions, incorrect ordering practices, and the additional transfer process further increases waste. However, improving food supply chain efficiency could reduce food waste by up to 50%. Currently, food waste for chicken is estimated at around 1%.

Distributors implement several strategies to prevent and reduce chicken waste. Surplus products are reallocated within their network to other stores, ensuring minimal losses. Rejected products may also be redistributed to alternative buyers, reducing overall waste. Marketing standards are followed to maintain consistent quality (stable feeding practices minimise variability in the final product). Proper temperature control is maintained throughout logistics and they ensure compliance with labelling requirements. A tracking system monitors sales and stock levels at each supermarket, helping to prevent incorrect orders. When stock levels are high, distributors may offer discounts, reducing the risk of spoilage.

Retailer

The retailer ensures product quality through their distribution centre. Chicken meat is delivered from local producers to the store via the supermarket distribution centre, where quality control is implemented. The distribution centre ensures that non-conforming products are not delivered to stores, maintaining strict logistical standards to prevent product issues.

The retailer's specification includes aesthetic reasons for food waste in chicken, such as non-conforming size (either too small or too large), colour issues, or remaining feathers. If such issues are detected upon delivery, the affected products are returned to the supplier. Additionally, consumer preferences and strict adherence to sell-by dates contribute to waste, as consumers are particularly sensitive about freshness. Marketing standards account for 10-15% of unsold chicken, with variations in non-conforming products throughout the month. At the start of the month, non-conforming products typically make up 5-6%, but this increases towards the end of the month (up to 10-15%) due to lower demand and longer shelf life, as the company aims to maintain full product displays.

From retailer's perspectives, to reduce food waste for chicken, several strategies are employed. Proper storage and display conditions are maintained, and temperature is monitored three times a day to ensure the quality of the meat. Processing is carried out, such as removing bones and cutting products into smaller pieces for resale under different product codes, with bones sent for bio-recycling. Products are marinated and sold up to three days after marination, while roasted products are sold as cooked meals on the same day of

preparation. Any unsold roasted products, especially towards the end of the day, may be sold at a 50% discount. Additionally, unsold roasted meat is often donated to families in need through a dedicated programme, further reducing food waste. Orders are based on historical demand estimates, using Business Intelligence (BI), which improves the accuracy of demand forecasting and order management. Furthermore, stores within the same supermarket chain exchange information, allowing unsold or out-of-spec meat to be transferred between locations, further minimising waste.

Actions that could be done is regarding consumer education. Consumers should receive clear guidance on how to store meat products properly to prevent spoilage and waste, especially for highly perishable items like chicken.

Consumer

According to the consumer, they usually remove parts of the chicken, like the skin from the neck or breast. Chicken is discarded if it doesn't meet aesthetic preferences or due to unpleasant odours, or colour changes from exposure to low temperatures. Chicken is considered more perishable, leading to careful handling. Consumers associate a watery surface with spoiled white chicken, unlike "yellow" chicken. They are reluctant to buy meat near its expiration date and prefer not to purchase out-of-spec chicken products.

Various strategies are employed to minimise food waste when purchasing and storing chicken. They plan their purchases carefully, buying only what is necessary and opting for specific cuts from the butcher counter rather than pre-packaged options. Meat is portioned for immediate use or short-term storage, with refrigeration for next-day consumption and freezing for longer periods. They prefer to buy in small quantities, occasionally taking advantage of discounts on short-dated products. Trust in the supplier plays a key role, with a preference for locally sourced and unpackaged meat, which is perceived as fresher. Additionally, they track purchase dates when freezing meat to ensure proper storage management.

Regarding strategies that could prevent and reduce food waste due to marketing standards, consumers affirmed that they could select cleaner meat cuts at the point of purchase, as well as ensuring portioning and trimming are done at the butcher's shop instead of at home. Improved meal planning and kitchen organisation are also important factors. Many consumers prefer buying meat from a butcher shop where they can observe the cutting and packaging process, offering reassurance about the meat's quality, especially for ground meat. Transparency is key, as consumers can recognise local suppliers and feel more confident about the origin of the meat. The preference for locally sourced meat also reduces transportation distances. Cultural and psychological factors play a role, as consumers are often taught to visually inspect meat before purchasing.

3.5.2 Pork

The food supply chain for pork is producer, manufacturer, distributor, retailer and consumer (Figure 14).

Producer

The causes of food waste due to marketing standards in pig farming is primarily driven by wholesalers and manufacturers, who impose strict specifications on the size and weight of pork carcasses to align with consumer expectation. Approximately 2% of pigs each year fail to reach the required weight within six months, though their meat is typically redirected to alternative market channels, such as processed meat production, rather than being discarded. Seasonal fluctuations also impact compliance with weight standards; during hot summers, reduced feed intake can slow growth, while lower consumer demand may result in pigs exceeding the ideal weight, leading to increased fat content.

MARKETING STANDARDS IN FOOD WASTE PORK - ESTIMATION MODEL

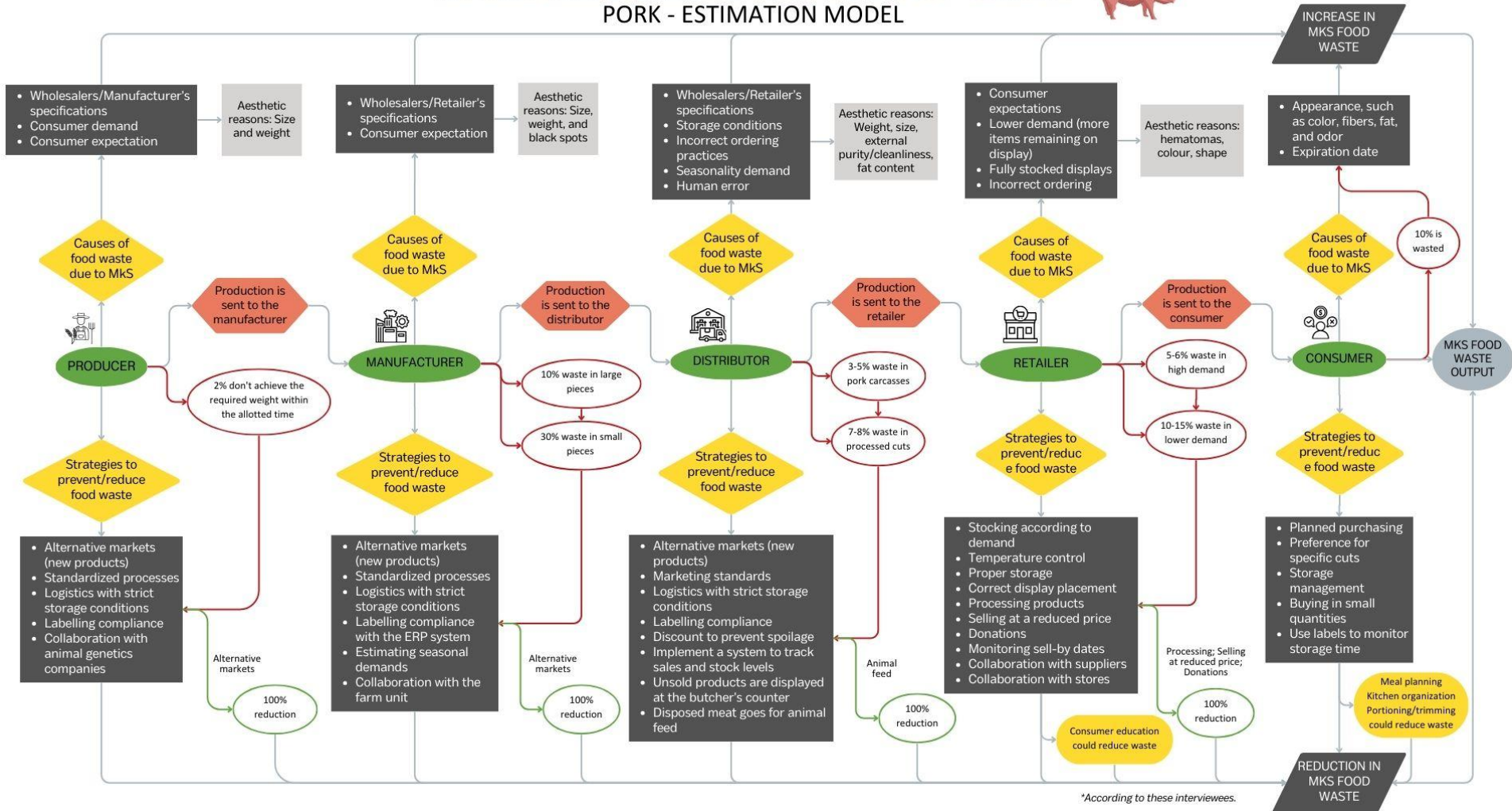
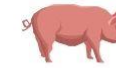


Figure 14: Pork flow chart

Standardised processes ensure that breeding conditions, including feed type and energy use, are carefully controlled, reducing non-conforming products by 98% and maintaining consistent carcass weight and size. Another strategy adopted to prevent food waste is to access alternative markets for pigs that do not meet size and weight specifications, redirecting them into processed meat products such as minced meat and sausages. Also, logistics management with strict storage and transportation conditions ensure product quality. Compliance with labelling regulations is strictly followed, with state veterinary oversight during slaughter, preventing any waste at this stage. Finally, collaboration with animal genetics companies helps optimise breeding conditions, further reducing non-conformity and food waste in pig farming.

Manufacturer

Food waste in the meat processing industry often results from strict marketing standards imposed by clients, including wholesalers and retailers. The primary specifications typically focus on the type, size, and weight of pork meat cuts. Also, minor inconsistencies, such as black spots resulting from improper handling at the slaughtering stage, may cause non-conformance. Additionally, when carcasses are cut into large pieces, around 10% of the meat cuts may not meet client specifications, while cutting into smaller portions, such as steaks of a specific weight, can increase non-conforming cuts to as much as 30%. Consumer preferences heavily influence these client requirements, making it challenging to ensure that all processed meat meets the desired specifications.

To mitigate food waste caused by marketing standards, the manufacturer has implemented various strategies. Non-conforming products are redirected to alternative market channels where strict requirements on size and weight are not enforced. For example, these products may be processed into trimmings for other meat products or sold as frozen meat for catering services, such as on ships. Additionally, meat cuts affected by black spots are trimmed, and the unaffected portions are repurposed for minced meat or other processed products. A key approach to reducing waste is standardisation at the pig farming stage, where close collaboration ensures that carcasses meet manufacturing specifications before they reach processing. Furthermore, an ERP system is in place to minimise labelling errors, preventing incorrectly labelled products from being shipped. Lastly, seasonal demand is estimated based on historical data, allowing the manufacturer to adjust production accordingly without generating surplus waste.

Distributor

Regarding the distribution stage, weight, size, external cleanliness, and fat content, are aesthetics characteristics observed by them. Products that do not meet these specifications are rejected following a visual and empirical evaluation. A second quality check during the cutting process is conducted and if defects such as hematomas are identified, the product is returned to the supplier. Additionally, the distributor affirms that poor ordering practices or improper storage can lead to returns. The waste rate for whole pork carcasses remains relatively low at 3–5%, whereas processed cuts have a slightly higher waste percentage of 7–8%, influenced by seasonal variations and changes in supplier feed.

To minimise food waste, the distributor has some strategies: To manage excess stock, the distributor reallocates surplus products between stores within their network, redirecting unsold items to locations with higher demand; Marketing standards help reduce waste by ensuring consistent quality across products; Thermometers are randomly placed in trucks to monitor temperature during transport, guaranteeing that the cold chain is maintained and products are stored under the required conditions, preventing spoilage; Compliance with labelling standards helps avoid returns; Only qualified personnel are responsible for careful cutting and deboning of meat; If certain cuts, such as chops, are in excess, they are offered at a discount before being delivered to supermarket stores; A system is used to monitor stock levels at each store, adjusting orders

to prevent overstocking; The distributor has invested in modified atmosphere packaging for pork meat, which extends the shelf life to 13 days, compared to the typical 3-5 days for fresh meat; Products that remain unsold within 2-3 days of their expiry date are retrieved from stores, repackaged, and displayed at the butcher's counter to offer them for sale before they spoil; Disposed meat is repurposed as a by-product for animal feed, ensuring that nothing goes to waste.

Retailer

The primary causes of food waste related to marketing standards for pork at the retail stage include incorrect ordering and consumer bias. If the meat does not meet the expected standards, customers will refuse to buy it. Over time, consumer expectations have increased, making them more demanding. Additionally, competition with local butcher shops is tense.

For the retailers, the presence of hematomas, which can be identified during slicing, is an aesthetic issue. These hematomas may result from either physical impacts, or from injections before slaughter. Since hematomas affect the quality and safety of the meat, any affected portions are discarded. Additionally, meat colour plays a significant role in consumer purchasing decisions. Poor transport or refrigeration conditions can cause the meat to darken, making it less visually appealing to customers. Although the quality and safety of such darker-coloured meat may not be compromised. On a local level, improper cutting can sometimes result in uneven portions. However, instead of discarding these pieces, these are repurposed into smaller meat bites, or ground meat for products such as burgers. If the appearance of the meat does not meet quality expectations, it is not accepted upon delivery.

At the beginning of the month, when employees receive their salaries, demand increases leading to fewer non-conforming products (5 - 6%). Toward the end of the month, demand tends to decrease, which can result in more products remaining in the display, and subsequently to more non-conforming products (10 - 15%). Despite lower demand, the display must always be fully stocked to be visually appealing, as this is the company's policy, leading to a higher percentage of non-conforming products.

The following practices and methods at the retail stage impact food waste related to marketing standards for pork, leading to minimisation of it (nearly 100% reduction of food waste). Sales are managed based on demand fluctuations by reviewing sales data from the same period last year, with orders placed accordingly (+/- 5%). A centralized BI software tracks and verifies orders, considering factors like weather and holidays. They monitor the temperature control three times daily with recorded measurements. Also, meat is kept in well-ventilated chambers and correct display placement ensures optimal presentation and maintains the product's visual appeal. The retailer processes meat that is unfit for display, mainly due to aesthetics or approaching sell-by dates. A software program tracks sell-by dates, ensuring products near expiration follow the waste minimization strategy. The strategy includes processing meat into products like bite-sized pieces or burgers, pre-marinated and ready-to-cook meat, pre-cooked meals. Unsold roasted products are sold at a 50% discount at the end of the day or the next day. If cooked meat isn't sold, it is donated to families after communication via a platform. Additionally, suppliers accept returns of non-conforming products upon delivery and redistribute them through other market channels and stores within the same chain share information, allowing for the transfer of out-of-spec or unsold meat to locations with higher demand or processing facilities.

The retailer believes consumers should be informed about proper meat storage and safety to prevent spoilage. They also feel that some consumer concerns about meat are excessive and unrelated to actual safety risks.

Consumer

When interviewing consumers, they affirm that they are aware of how to store meat and prevent spoilage. However, they are more concerned about the aesthetics of pork, discarding unwanted parts like fat and fibres, and are not willing to buy out-of-spec products. Meat with unpleasant odours or colour changes, especially when exposed to low temperatures, is also discarded. Some consumers track purchase dates, label meat when freezing, and avoid buying meat close to expiration, while others are more willing to buy products near the expiration date. They prioritise locally sourced meat for its quality, transparency, and reduced distance from production to consumption. Preferring to buy from a local butcher, they value personal relationships that provide a sense of trust, which cannot be replaced by mobile apps. Consumers avoid pre-packaged meat, instead requesting specific cuts from the butcher, and believe portioning and trimming should be done at the butcher's shop to minimize waste. Cultural practices, such as inspecting meat and specifying desired cuts, influence their purchasing decisions. Improved meal planning and kitchen organization could also help reduce waste.

4. Conclusion

This report presents the development of 13 estimation models created considering four different food commodities: cereals, dairy, fruits and vegetables, and meat. To achieve this, interviews were conducted with actors across the food supply chain of each food commodity to identify the causes of food waste due to marketing standards and the strategies for their reduction. Specific products were considered within each commodity to allow for a more detailed analysis of each scenario. Additionally, different groups of actors were investigated to develop estimation models for different types of food supply chains.

Various actions and causes related to food waste due to marketing standards have been identified. However, it is important to emphasise that these findings reflect the reality of the respondents in this specific study. Therefore, other actions and causes may be identified and incorporated into the flow charts.

In summary, different estimation models are needed for various products and types of food supply chains. However, the same process can be used to develop these models, i.e., mapping out the chain and identifying the key questions to be addressed. In other words, the development of these models can serve as a tool applicable to different food commodities and specific products.

The models presented in this report will be adapted and validated in the future during the development of Task 4.1, which aims to deploy, monitor, and validate the solutions to be tested across each of the use case pilots.

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Annexes

INTERVIEW GUIDE

INTRODUCTION

In this task, our goal is gather data to validate the preliminary model that was developed to estimate food waste that arises due to food marketing standards. To do this we need to identify the drivers of food waste due to marketing standards at each stage of the supply chain and to explore potential practices to reduce it within a specific food chain, i.e. not observed practices and systemic insights. To do this, we've created a semi-structured interview guide. The information gathers both the causes of food waste due to marketing standards and how it is reduced for that specific chain, with slight variations in the questions posed to actors at different stages in the chain (i.e. primary producers, manufacturers, distributors, wholesalers, retailers, food service operators and consumers). It is also concerned with how food marketing standards are seen to reduce food waste within the chain. The information you provide will be turned into a flow chart for each food commodity that is considered in ROSETTA (Fruit & Vegetables, Dairy, Cereals and Meat). A generic form of this flow chart was presented at the ROSETTA M12 Semester 3 meeting on 4th December and is presented in Appendix 1. This will provide the basis for an estimation model.

When conducting interviews with supply chain actors, please provide information for all the questions below. Keep the answers simple and concise, as the data will be translated into a flow chart representing different estimation models for each food commodity.

As identified in previous tasks, private marketing standards play a primary role, setting the highest standards that influence food production and consumption. Therefore, this task will focus on private marketing standards. However, if you can identify specific public marketing standards that impact the food supply chain, you may also conduct the interviews with those in mind. In any case, the focus should be on the marketing standards that are the most challenging for the supply chain interviewee to reach, and result in the most food waste.

The duration of each interview is likely to vary however, an estimated time for each interview is provided below.

Approach

The aim is to interview all the actors in a single specific supply chain, rather than for example a producer from one supply chain and a manufacturer for another. It is important to consider the characteristics of each food commodity and the relationships between the actors involved. You may encounter different settings, such as a short food supply chain where there is only 2-3 interviewees per chain or a long chain potentially involving 6-7 interviewees. A short supply chain typically involves fewer intermediaries between the producer and the consumer. This often means foods move directly from farms or manufacturers to local markets, retailers, or even consumers themselves (Paciarotti, & Torregiani, 2021). Thus you can interview a producer who sells directly to a farmers market and provide information for this short supply chain. Additionally, you can also have a long supply chain with more stages and intermediaries. Both cases are valid for our approach. Ensure that when reporting the information, you provide separate files for each supply chain example.

Remember, you need to conduct min. 10 interviews for this task. You can define your own supply chain settings to meet this KPI, meaning you can provide one or more examples of supply chains for your food commodity. The monitoring tool for the interviews is available in the ROSETTA repository – Task 1.4 folder.

As the aim is to interview stakeholders who have relationships throughout the supply chain, consider applying the snowball technique to select the interviewees. For example: a producer provides beetroot to a manufacturer; the manufacturer prepares beetroot juice and sends it to the distributor; the distributor delivers the beetroot juice to retailers, who then sell it to consumers. All of these should be interviewed if possible. Identifying the right interviewee is crucial. It is recommended to start with the primary producer and work forward along the chain. The job title of the appropriate interviewee within each stage may be different, reflecting the different size of organisations. The owner/CEO is likely to be the interviewee at the primary production stage, while the production, quality assurance or sustainability manager may be the appropriate interviewee in larger organisations. When considering a specific product, please, adapt each question to focus on that particular product.

Concepts

It is important to ensure that the interview focuses on food waste due to marketing standards as opposed to food waste generally. The concepts about marketing standards are as assumed previously in Task 1.2 and Task 2.1 developed by UNIVIE and AUA. By 'marketing standards' we refer to a set of rules aimed to ensure that the market is supplied with food products of standardised quality that meet consumer expectations. These include regulations about appearance/condition, classification, content, and packaging/labelling.

There are two types of marketing standards, public marketing standards, and private marketing standards. 'Public marketing standards' are set by governmental institutions (regulatory agencies), and generally companies' compliance with them is obligatory.

On the other hand, 'private marketing standards' are set by private companies (i.e., retailers and producers) with or without the participation of public bodies. They often focus on the same domains that the public body imposes public marketing standards, and they are not mandatory. However, they are important for businesses to follow if they want to sell their products to certain markets or customers.

By 'food waste' we mean all kinds of food intended for human consumption that are eventually not used for their purpose but are wasted and lost. It refers not only to food that consumers don't finish at restaurants or is thrown away at home, but also to raw materials and produce that are lost in the farming stage, harvesting processes, transportation, and storage. In addition to explaining the concepts to the interviewee at the start of the interview, it is useful to provide an example. So, for example, we are talking about¹.....

*1 Please, choose an example related to the product category the interviewee has experience with.

Fruits and vegetables [Ireland, Spain, and Greece]: So, for example, we are talking about carrots that are not straight, too short or too long, or potatoes with surface scars.

Cereal grains [Poland]: So, for example, we are talking about breakfast cereals with damaged packaging or close to their expiration date, or wheat grains that are too small or too light. Remind them that the focus is on grains for food rather than feed purposes.

Dairy products [Denmark]: So, for example, we are talking about milk with damaged packaging or close to its expiration date

Meat [Greece]: So, for example, chickens with torn skin or beef cuts that do not have the specified level of intramuscular fat.

Check list for the interview

Introduction: Start the interview introducing yourself and the aim of ROSETTA, which is reducing food waste due to marketing standards through alternative market access, and explaining these concepts to them.

Highlight the Purpose of the Interview: Clearly explain that the goal of the interview is to gather key information on the causes of food waste due to marketing standards and strategies to reduce it, in order to support the project in creating an estimation model. Explain that the estimation model will be tested later in the project and that the value of this is an ability to quantify the amount of food waste that arises due to food marketing standards, and to identify approaches to minimise this. The focus is on a specific supply chain rather than observed practices and systemic insights. The supply chain that is being discussed should be clarified at the start of the interview.

Duration of the Interview: Share with the interviewee an estimated timeframe for the interview, based on the information you need. Interviews will not exceed 60 minutes (check the allocated time for each stakeholder).

Interviewee Data Management: Assure the participant that all responses will be kept confidential. Any information included in our report will not identify the respondent. Remember, the respondents are not obligated to discuss anything that they are uncomfortable with and are free to end the interview at any time. There are no right or wrong answers.

Structure of the Interview: Outline the flow of the session: General information; Questions about factors contributing to food waste in the specific supply chain; Questions about factors reducing or preventing food waste in the specific supply chain.

Clarify Questions: Ask if the interviewee has any questions before starting. Sign the informed consent form if they have not already indicated their consent as member of the MIPs.

Permission to Record: Request permission to record the session, emphasising that the recording will only be used to take accurate notes later and will be deleted after the analysis is completed (by March 2025).

Be ready to provide examples as prompts to stimulate responses to questions. Prompts should only be used to stimulate response after the interviewee has had an opportunity to think about the question.

Where respondents are not able to quantify waste or impacts of solutions in the specific supply chain, please ask them for their best estimates.

Reporting:

Please provide one report for each specific supply chain rather than individual reports for each actor in the specific supply chain. For instance if you interview 5 actors in a specific supply chain (e.g. pork meat) you should send one report with the response of all actors in that chain. Similarly, if we interview 5 actors in another specific supply chain (e.g. peaches) you should send a second report for that specific supply chain, etc. In other words, if we interview 10 people in 2 or 3 different supply chains we send you only 2 or 3 reports, one for each supply chain. Please provide the following information at the start of each report.

Describe the supply chain that is being discussed (e.g. producer, manufacturer, distributor, wholesaler, retailer, food service, and consumer):

Describe the specific product:

Please indicate the name and nature of the highest marketing standard that this actor operates to

Marketing standard: _____

Public () Private ()

INTERVIEW GUIDE: PRODUCER

(Approximate duration: 30 minutes)

“Thank you for joining us today. To start, we’d like to clarify what we mean by ‘waste due to marketing standards.’ In this context, we’re referring to products that do not meet specific market specifications, such as size, shape, or appearance, despite being perfectly edible. For example, in the case of producers, this includes crops left unharvested because they do not align with these marketing requirements. Our goal is to understand how this type of waste impacts your operations and explore potential solutions together.”

General information

What are the main aesthetic reasons for food waste due to marketing standards for your business in relation to this [food commodity/specific product]? *[e.g., Broken pieces, non-uniform shapes, and seasonal factors like tougher skins]*

In general, what percentage of production for this [food commodity/specific product] is wasted due to marketing standards?

Does this vary from year to year? If so, please describe this variation and explain the cause of the variation.

Does this vary throughout the year or seasonally? If so, please describe this variation and explain the cause of the variation.

Where do your products [food commodity/specific product] typically end up? *[e.g., supermarket, foodservice or manufacturing or direct to consumer]? [If the producer does not know please indicate this].*

Considering [food commodity/specific product] and the supply chain we are focused on, do you think marketing standards can help reduce food waste in this sector? If yes, how? *[This question aims to determine whether marketing standards can also help reduce food waste. For example, the EU marketing standards for fruits and vegetables have relaxed cosmetic standards for produce, while certain certifications, such as the Bureau Veritas Food Waste Management System, promote a management system-based approach for preventing and managing food loss and waste at each stage of the supply chain. Furthermore, producing products in line with quality standards might impact production practices, resulting in the production of higher quality products from an aesthetic perspective and thus reduced waste. For example a grower might put in place extra measures (e.g. use certain varieties or use fungicides) to ensure potatoes do not have surface scars]*

Factors contributing to food waste

[Please note that Question 5 aims to identify the main causes of food waste resulting from marketing standards at this stage of this specific supply chain. Sub-questions a, b, c, and d are provided to help identify some potential causes. You may also consider adding other questions that might be relevant to your specific food commodity or product].

Considering your business, what are the main causes of food waste due to marketing standards for [food commodity/specific product]? *[e.g., retailer specifications, distributor or manufacturer requests, consumer expectations, regulations, labelling, etc.]* Can you estimate the breakdown of this?

In your business, does, and if so how does, consumer demand lead to food waste due to marketing standards in [food commodity/specific product]? *[e.g., Fruits and vegetables that don't meet size, shape, or color standards are discarded in the field]*

In your business, does, and if so how does, logistics contribute to food waste caused by marketing standards in [food commodity/specific product]? *[e.g., Delays and damage during transportation can affect product quality and aesthetic].*

In your business, does labeling, as required by marketing standards, contribute to food waste in [food commodity/specific product]? And if so how? *[e.g., If there are errors in the label, such as incorrect information or the absence of required certifications, the products may be discarded before being sent to market and/or recalled]*

Does climate change contribute to food waste that arises due to marketing standards in relation to [food commodity/specific product] in your business? If yes, how? If no, do you expect this to change in the future? Do you have an example? *[e.g. Unpredictable weather patterns can cause shortage of products or delay. For example, hailstorms and unseasonal frosts, increasingly common due to climate change, can cause superficial blemishes or scarring on apple skins].*

What kind of food production practices (methods, techniques, and processes) in your business impact food waste due to marketing standards in [food commodity/specific product]? *[e.g. Introducing or improving temperature monitoring during transportation and storage could help extend the shelf life of milk and reduce spoilage, preventing unnecessary waste].* What impact do these have on the amount of food waste in [food commodity/specific product]? *[e.g. It reduces food waste by X%]*

Factors reducing/preventing food waste

What strategies do **you** have to prevent/reduce food waste due to marketing standards for [food commodity/specific product]? *[e.g., demand control, alternative markets, food banks, etc.]?* Can you describe these please? What impact do these have on the amount of food waste in [food commodity/specific product]? *[e.g. It reduces food waste by X%]*

What strategies are adopted to adjust production according to demand fluctuations and prevent surpluses [food commodity/specific product]? What impact do these have on the amount of food waste in [food commodity/specific product]? *[e.g. It reduces food waste by X%]*

Do you use any technology to prevent or reduce food waste in [food commodity/specific product]? *[e.g., demand, stock levels, expiry dates control].* If so, which one? What is the impact on food waste? *[e.g. It reduces food waste by X%]*

What actions are taking to prevent food waste due to incorrect labelling in [food commodity/specific product]? What is the impact on food waste? *[e.g. It reduces food waste by X%]*

Do you collaborate with any other organisations, either within your sector and supply chain or outside of it, to reduce food waste caused by marketing standards for [food commodity/specific product]? Could you describe this collaboration and indicate the percentage by which it reduces food waste?

What would help you to reduce/prevent food waste due to marketing standards in [food commodity/specific product]? *[e.g., financial support, training, courses, collaboration, alternative marketing models]*

What, if any, additional approaches are you planning to undertake to reduce food waste due to marketing standards in [food commodity/specific product]?

Are you aware of any actions that other producers take to address food rejected due to marketing standards in [food commodity/specific product] *[e.g., food banks, farmers market, etc.]*? Do you plan on adopting any of them in the future? What prevents you from taking on these solutions at the moment? What, if anything, might help you to take them on?

INTERVIEW GUIDE: MANUFACTURER

(Approximate duration: 30 minutes)

“Thank you for joining us today. To start, we’d like to clarify what we mean by ‘waste due to marketing standards.’ In this context, we’re referring to products that do not meet specific market specifications, such as size, shape, or appearance, despite being perfectly edible. Our goal is to understand how this type of waste impacts your operations and explore potential solutions together.”

General information

What are the main aesthetic reasons for food waste due to marketing standards for your business in relation to this [food commodity/specific product]? *[e.g., broken pieces, non-uniform shapes, seasonal factors like tougher skins]*

In general, what percentage of production for this [food commodity/specific product] is wasted due to marketing standards?

Does this vary from year to year? If so, please describe this variation and explain the cause of the variation.

Does this vary throughout the year or seasonally? If so, please describe this variation and explain the cause of the variation.

Where do your products [food commodity/specific product] typically end up? *[e.g., supermarket, food service, etc.]*.

Considering [food commodity/specific product] and the supply chain we are focused on, do you think marketing standards can help reduce food waste in this sector? If yes, how? *[This question aims to determine whether marketing standards can also help reduce food waste. For example, the EU marketing standards for fruits and vegetables have relaxed cosmetic standards for produce, while certain certifications, such as the Bureau Veritas Food Waste Management System, promote a management system-based approach for preventing and managing food loss and waste at each stage of the supply chain. Furthermore, producing products in line with quality standards might impact production practices, resulting in the production of higher*

quality products from an aesthetic perspective and thus reduced waste. For example a grower might put in place extra measures (e.g. use certain varieties or use fungicides) to ensure potatoes do not have surface scars]

Factors contributing to food waste

[Please note that Question 5 aims to identify the main causes of food waste resulting from marketing standards at this stage of this specific supply chain. Sub-questions a, b, c, and d are provided to help identify some potential causes. You may also consider adding other questions that might be relevant to your specific food commodity or product].

Considering your business, what are the main causes of food waste due to marketing standards for [food commodity/specific product]? *[e.g., retailer specifications, consumer expectations, regulations, labelling, etc.]* Can you estimate the breakdown of this?

In your business, does, and if so how does, consumer demand lead to food waste due to marketing standards in [food commodity/specific product]? *[e.g., Fruits and vegetables that don't meet size, shape, or color standards are discarded in the field]*

In your business, does, and if so how does, logistics contribute to food waste caused by marketing standards in [food commodity/specific product]? *[e.g., Delays and damage during transportation can affect product quality and aesthetic].*

In your business, does labeling, as required by marketing standards, contribute to food waste in [food commodity/specific product]? And if so how? *[e.g., If there are errors in the label, such as incorrect information or the absence of required certifications, the products may be discarded before being sent to market and/or recalled]*

Does climate change contribute to food waste that arises due to marketing standards in relation to [food commodity/specific product] in your business? If yes, how? If no, do you expect this to change in the future? Do you have an example? *[e.g. Unpredictable weather patterns can cause shortage of products or delay. For example, hailstorms and unseasonal frosts, increasingly common due to climate change, can cause superficial blemishes or scarring on apple skins].*

What kind of food production practices (methods, techniques, and processes) in your business impact food waste due to marketing standards in [food commodity/specific product]? *[e.g. Introducing or improving temperature monitoring during transportation and storage could help extend the shelf life of milk and reduce spoilage, preventing unnecessary waste].* What impact do these have on the amount of food waste in [food commodity/specific product]? *[e.g. It reduces food waste by X%]*

Factors reducing/preventing food waste

What strategies do **you** have to prevent/reduce food waste due to marketing standards for [food commodity/specific product]? *[e.g., demand control, alternative markets, etc.]?* Can you described these please? What impact do these have on the amount of food waste in [food commodity/specific product]? *[e.g. It reduces food waste by X%]*

Do you have any programme for donating, recycling, or transforming unsold products to prevent waste? If yes, please describe the key elements of the programme and the impact it has on food waste. *[e.g. It reduces food waste by X%]*

What strategies are adopted to adjust products according to demand fluctuations and prevent surpluses [food commodity/specific product]? What impact do these have on the amount of food waste in [food commodity/specific product]? *[e.g. reduces waste by X%]*

Do you use any technology to prevent or reduce food waste in [food commodity/specific product]? *[e.g., Demand, stock levels, expiry dates control]*. If so, which one and what is the impact on food waste? *[e.g., It reduces food waste by X%]*

What actions are taking to prevent food waste due to incorrect labelling in [food commodity/specific product]? What impact do these have on the amount of food waste in [food commodity/specific product]? *[e.g. It reduces food waste by X%]*

Do you collaborate with any other organisations, either within your sector and supply chain or outside of it, to reduce food waste caused by marketing standards? Could you describe this collaboration and indicate the percentage by which it reduces food waste?

What would help you to reduce/prevent food waste due to marketing standards in [food commodity/specific product]?

What, if any, additional approaches are you planning to undertake to reduce food waste due to marketing standards in [food commodity/specific product]?

What actions do other manufacturers take to address food rejected due to marketing standards in [food commodity/specific product] *[e.g., Food banks, alternative markets, etc.]*? Do you plan on adopting any of them in the future? What prevents you from taking on these solutions at the moment? What, if anything, might help you to take them on?

INTERVIEW GUIDE: DISTRIBUTOR

(Approximate duration: 30 minutes)

“Thank you for joining us today. To start, we’d like to clarify what we mean by ‘waste due to marketing standards.’ In this context, we’re referring to products that do not meet specific market specifications, such as size, shape, or appearance, despite being perfectly edible. Our goal is to understand how this type of waste impacts your operations and explore potential solutions together.”

General information

What are the main aesthetic reasons for food waste due to marketing standards for your business in relation to this [food commodity/specific product]? *[e.g., Broken pieces, non-uniform shapes, seasonal factors like tougher skins]*?

In general, what percentage of production for this [food commodity/specific product] is wasted due to marketing standards?

Does this vary from year to year? If so, please describe this variation and explain the cause of the variation.

Does this vary throughout the year or seasonally? If so, please describe this variation and explain the cause of the variation.

Where do your products [food commodity/specific product] typically end up? *[e.g. supermarket, foodservice, manufacturing, direct to consumer]*

Considering [food commodity/specific product] and the supply chain we re focused on, do you think marketing standards can help reduce food waste in this sector? If yes, how? *[This question aims to determine whether marketing standards can also help reduce food waste. For example, the EU marketing standards for fruits and vegetables have relaxed cosmetic standards for produce, while certain certifications, such as the Bureau Veritas Food Waste Management System, promote a management system-based approach for preventing and managing food loss and waste at each stage of the supply chain. Furthermore, producing products in line with quality standards might impact production practices, resulting in the production of higher quality products from an aesthetic perspective and thus reduced waste. For example a grower might put in place extra measures (e.g. use certain varieties or use fungicides) to ensure potatoes do not have surface scars]*

Factors contributing to food waste

[Please note that Question 5 aims to identify the main causes of food waste resulting from marketing standards at this stage of this specific supply chain. Sub-questions a, b, c, and d are provided to help identify some potential causes. You may also consider adding other questions that might be relevant to your specific food commodity or product].

Considering your business, what are the main causes of food waste due to marketing standards for [food commodity/specific product]? *[e.g., retailer specifications, consumer expectations, regulations, labelling, etc.]*
Can you estimate the breakdown of this?

In your business, does, and if so how does, consumer demand lead to food waste due to marketing standards in [food commodity/specific product]? *[e.g., Fruits and vegetables that don't meet size, shape, or color standards are discarded in the field]*

In your business, does, and if so how does, logistics contribute to food waste caused by marketing standards in [food commodity/specific product]? *[e.g., Delays and damage during transportation can affect product quality and aesthetic].*

In your business, does labeling, as required by marketing standards, contribute to food waste in [food commodity/specific product]? And if so how? *[e.g., If there are errors in the label, such as incorrect information or the absence of required certifications, the products may be discarded before being sent to market and/or recalled]*

Does climate change contribute to food waste that arises due to marketing standards in relation to [food commodity/specific product] in your business? If yes, how? If no, do you expect this to change in the future? Do you have an example? *[e.g. Unpredictable weather patterns can cause shortage of products or delay. For example, hailstorms and unseasonal frosts, increasingly common due to climate change, can cause superficial blemishes or scarring on apple skins].*

What kind of transportation practices in your business impact food waste due to marketing standards for [food commodity/specific product]? *[e.g. Introducing or improving temperature monitoring during transportation and storage could help extend the shelf life of milk and reduce spoilage, preventing unnecessary waste].* What

impact do these have on the amount of food waste in [food commodity/specific product]? *[e.g., It reduces food waste by X%].*

Factors reducing/preventing food waste

What strategies do **you** have to prevent/reduce food waste due to marketing standards for [food commodity/specific product] *[e.g., demand control, alternative markets, etc.]*? Can you describe these, please? What impact do these have on the amount of food waste in [food commodity/specific product]? *[e.g., It reduces food waste by X%]*

Do you use any technology to prevent or reduce food waste in [food commodity/specific product]? *[e.g., demand, stock levels, expiry dates control]*. If so, which one and what is the impact on food waste? *[e.g., It reduces food waste by X%]*?

Do you have any programme for donating, recycling, or transforming unsold products to prevent waste in [food commodity/specific product]? If yes, please describe the key elements of the programme and the impact it has on food waste. *[e.g. It reduces food waste by X%]*

What strategies are adopted to adjust products according to demand fluctuations and prevent surpluses for [food commodity/specific product] in your business? What impact do these have on the amount of food waste in [food commodity/specific product]? *[e.g. It reduces food waste by X%]*

Do you collaborate with any other organisations, either within your sector and supply chain or outside of it, to reduce food waste caused by marketing standards? Could you describe this collaboration and indicate the percentage by which it reduces food waste?

What would help you to reduce/prevent food waste due to marketing standards in [food commodity/specific product]?

What, if any, additional approaches are you planning to undertake to reduce food waste due to marketing standards in [food commodity/specific product]?

What actions do other distributors take to address food rejected due to marketing standards in [food commodity/specific product] (e.g., food banks, farmers market, etc.)? Do you plan on adopting any of these in the future? What prevents you from taking on these solutions at the moment? What, if anything, might help you to take them on?

INTERVIEW GUIDE: WHOLESALER

(Approximate duration: 30 minutes)

“Thank you for joining us today. To start, we’d like to clarify what we mean by ‘waste due to marketing standards.’ In this context, we’re referring to products that do not meet specific market specifications, such as size, shape, or appearance, despite being perfectly edible. Our goal is to understand how this type of waste impacts your operations and explore potential solutions together.”

General information

What are the main aesthetic reasons for food waste due to marketing standards for your business in relation to this [food commodity/specific product]? *[e.g., Broken pieces, non-uniform shapes, seasonal factors like tougher skins]*?

In general, what percentage of production for this [food commodity/specific product] is wasted due to marketing standards?

Does this vary from year to year? If so, please describe this variation and explain the cause of the variation.

Does this vary throughout the year or seasonally? If so, please describe this variation and explain the cause of the variation.

Where do your products [food commodity/specific product] typically end up? *[e.g., Supermarket, foodservice, manufacturing, direct to consumer]*?

Considering [food commodity/specific product] and the supply chain we are focused on, do you think marketing standards can help reduce food waste in this sector? If yes, how? *[This question aims to determine whether marketing standards can also help reduce food waste. For example, the EU marketing standards for fruits and vegetables have relaxed cosmetic standards for produce, while certain certifications, such as the Bureau Veritas Food Waste Management System, promote a management system-based approach for preventing and managing food loss and waste at each stage of the supply chain. Furthermore, producing products in line with quality standards might impact production practices, resulting in the production of higher quality products from an aesthetic perspective and thus reduced waste. For example a grower might put in place extra measures (e.g. use certain varieties or use fungicides) to ensure potatoes do not have surface scars]*

Factors contributing to food waste

[Please note that Question 5 aims to identify the main causes of food waste resulting from marketing standards at this stage of this specific supply chain. Sub-questions a, b, c, and d are provided to help identify some potential causes. You may also consider adding other questions that might be relevant to your specific food commodity or product].

Considering your business, what are the main causes of food waste due to marketing standards for [food commodity/specific product]? *[e.g., Consumer expectations, regulations, labelling, etc.] Can you estimate the breakdown of this?*

In your business, does, and if so how does, consumer demand lead to food waste due to marketing standards in [food commodity/specific product]? *[e.g., Fruits and vegetables that don't meet size, shape, or color standards are discarded in the field]*

In your business, does, and if so how does, logistics contribute to food waste caused by marketing standards in [food commodity/specific product]? *[e.g., Delays and damage during transportation can affect product quality and aesthetic].*

In your business, does labeling, as required by marketing standards, contribute to food waste in [food commodity/specific product]? And if so how? *[e.g., If there are errors in the label, such as incorrect information or the absence of required certifications, the products may be discarded before being sent to market and/or recalled]*

Does climate change contribute to food waste that arises due to marketing standards in relation to [food commodity/specific product] in your business? If yes, how? If no, do you expect this to change in the future? Do you have an example? *[e.g. Unpredictable weather patterns can cause shortage of products or delay. For example, hailstorms and unseasonal frosts, increasingly common due to climate change, can cause superficial blemishes or scarring on apple skins].*

What kind of practices (methods, techniques, and processes) in your business impact food waste due to marketing standards in [food commodity/specific product]? *[e.g. Introducing or improving temperature monitoring during transportation and storage could help extend the shelf life of milk and reduce spoilage, preventing unnecessary waste].* What impact do these have on the amount of food waste in [food commodity/specific product]? *[e.g., It reduces food waste by X%]*

Factors reducing/preventing food waste

What strategies do **you** have to prevent/reduce food waste due to marketing standards for food commodity/specific product *[e.g., Demand control, special promotions, etc.]*? Can you describe these please? What impact do these have on the amount of food waste in [food commodity/specific product]? *[e.g., It reduces food waste by X%]*

Do you have any programme for donating, recycling, or transforming unsold products to prevent waste for food commodity/specific product? If yes, please describe the key elements of the programme and the impact it has on food waste. *[e.g. reduces waste by X%]*

What strategies are adopted by you in [business name] to adjust products according to demand fluctuations and prevent surpluses for [food commodity/specific product]? What impact do these have on the amount of food waste in [food commodity/specific product]? *[e.g., It reduces food waste by X%]*

Do you use any technology to prevent or reduce food waste in [food commodity/specific product]? *[e.g., demand, stock levels, expiry dates control]*. If so, which one? What is the impact on food waste? *[e.g., It reduces food waste by X%]*

What policies do you have for handling unsold products or those approaching their expiration date in [food commodity/specific product]? What impact do these have on the amount of food waste in [food commodity/specific product]? *[e.g., reduces waste by X%]*

Do you collaborate with any other organisations, either within your sector and supply chain or outside of it, to reduce food waste caused by marketing standards for [food commodity/specific product]? If yes, could you describe this collaboration and indicate the percentage by which it reduces food waste?

What would help you in [business name] to reduce/prevent food waste due to marketing standards in [food commodity/specific product]?

What actions do other wholesalers take to address food rejected due to marketing standards in [food commodity/specific product] (e.g., food banks, processing, etc.)? Do you plan on adopting any of these in the future? What prevents you from taking on these solutions at the moment? What, if anything, might help you to take them on?

INTERVIEW GUIDE: RETAILER

(Approximate duration: 40 minutes)

“Thank you for joining us today. To start, we’d like to clarify what we mean by ‘waste due to marketing standards.’ In this context, we’re referring to products that do not meet specific market specifications, such as size, shape, or appearance, despite being perfectly edible. Our goal is to understand how this type of waste impacts your operations and explore potential solutions together.”

General information

What are the main aesthetic reasons for food waste due to marketing standards for your business in relation to this [food commodity/specific product]? *[e.g., Broken pieces, non-uniform shapes, seasonal factors like tougher skins]*?

In general, what percentage of production for this [food commodity/specific product] is wasted due to marketing standards?

Does this vary from year to year? If so, please describe this variation and explain the cause of the variation.

Does this vary throughout the year or seasonally? If so, please describe this variation and explain the cause of the variation.

Considering [food commodity/specific product] and the supply chain we are focused on, do you think marketing standards can help reduce food waste in this sector? If yes, how? *[This question aims to determine whether marketing standards can also help reduce food waste. For example, the EU marketing standards for fruits and vegetables have relaxed cosmetic standards for produce, while certain certifications, such as the Bureau Veritas Food Waste Management System, promote a management system-based approach for preventing and managing food loss and waste at each stage of the supply chain. Furthermore, producing products in line with quality standards might impact production practices, resulting in the production of higher quality products from an aesthetic perspective and thus reduced waste. For example a grower might put in place extra measures (e.g. use certain varieties or use fungicides) to ensure potatoes do not have surface scars]*

Factors contributing to food waste

[Please note that Question 4 aims to identify the main causes of food waste resulting from marketing standards at this stage of this specific supply chain. Sub-questions a, b, c, and d are provided to help identify some potential causes. You may also consider adding other questions that might be relevant to your specific food commodity or product].

Considering your business, what are the main causes of food waste due to marketing standards for [food commodity/specific product]? *[e.g., Consumer expectations, regulations, labelling, etc.] Can you estimate the breakdown of this?*

In your business, does, and if so how does, consumer demand lead to food waste due to marketing standards in [food commodity/specific product]? *[e.g., Fruits and vegetables that don't meet size, shape, or color standards are discarded in the field]*

In your business, does, and if so how does, logistics contribute to food waste caused by marketing standards in [food commodity/specific product]? *[e.g., Delays and damage during transportation can affect product quality and aesthetic].*

In your business, does labeling, as required by marketing standards, contribute to food waste in []? And if so how? *[e.g., If there are errors in the label, such as incorrect information or the absence of required certifications, the products may be discarded before being sent to market and/or recalled]*

Does climate change contribute to food waste that arises due to marketing standards in relation to [food commodity/specific product] in your business? If yes, how? If no, do you expect this to change in the future? Do you have an example? *[e.g. Unpredictable weather patterns can cause shortage of products or delay. For example, hailstorms and unseasonal frosts, increasingly common due to climate change, can cause superficial blemishes or scarring on apple skins].*

What is the shelf life of the [food commodity/specific product], and how does it impact waste at retail level? *[The shelf life of food commodities can be considered in different ways, depending on the reference point. In the case of fruit and vegetables, it starts from harvesting by the farmer/producer, and includes the time the product can be consumed after purchase by the final consumer]*

What kind of practices (methods, techniques, and/or processes) in your business impact food waste due to marketing standards in [food commodity/specific product]? *[e.g. Introducing or improving temperature monitoring during transportation and storage could help extend the shelf life of milk and reduce spoilage, preventing unnecessary waste].* What impact do these have on the amount of food waste in [food commodity/specific product]? *[e.g., It reduces food waste by X%].*

Factors reducing/preventing food waste

What strategies do **you** have to prevent/reduce food waste due to marketing standards for [food commodity/specific product] *[e.g., Demand control, special promotions, etc.]*? Can you describe these please? What impact do these have on the amount of food waste in [food commodity/specific product]? *[e.g., It reduces food waste by X%]*

Do you have any programme for donating, recycling, or transforming unsold products to prevent waste? If yes, please describe the key elements of the programme and the impact it has on food waste. *[e.g., It reduces food waste by X%]*

What strategies are adopted to adjust products according to demand fluctuations and prevent surpluses [food commodity/specific product]? What impact do these have on the amount of food waste in [food commodity/specific product]? *[e.g., It reduces food waste by X%]*

Do you use any technology to prevent or reduce food waste in [food commodity/specific product]? *[e.g., Demand, stock levels, expiry dates control].* If so, which one and what is the impact on food waste? *[e.g., It reduces food waste by X%]*

What are your policies for handling unsold products or those approaching their expiration date in [food commodity/specific product]? What impact do these have on the amount of food waste in [food commodity/specific product]? *[e.g., It reduces food waste by X%]*

Do you collaborate with any other organisations, either within your sector and supply chain or outside of it, to reduce food waste caused by marketing standards for [food commodity/specific product]? Could you describe this collaboration and indicate the percentage by which it reduces food waste?

What would help you to reduce/prevent food waste due to marketing standards in [food commodity/specific product]?

What actions do other retailers take to address food rejected due to marketing standards in [food commodity/specific product] *[e.g., Food banks, processing, etc.]*? Do you plan on adopting any of them in the future? What prevents you from taking on these solutions at the moment? What, if anything, might help you to take them on?

INTERVIEW GUIDE: FOOD SERVICE

(Approximate duration: 30 minutes)

“Thank you for joining us today. To start, we’d like to clarify what we mean by ‘waste due to marketing standards.’ In this context, we’re referring to products that do not meet specific market specifications, such as size, shape, or appearance, despite being perfectly edible. Our goal is to understand how this type of waste impacts your operations and explore potential solutions together.”

General information

What are the main aesthetic reasons for food waste due to marketing standards for your business in relation to this [food commodity/specific product]? *[e.g., Broken pieces, non-uniform shapes, seasonal factors like tougher skins].*

In general, what percentage of [food commodity/specific product] is wasted due to marketing standards in your business?

Does this vary from year to year? If so, please describe this variation and explain the cause of the variation.

Does this vary throughout the year or seasonally? If so, please describe this variation and explain the cause of the variation.

Where do your products [food commodity/specific product] typically end up? *[e.g., Consumers, supermarket, hospital, schools].*

Factors contributing to food waste

[Please note that Question 5 aims to identify the main causes of food waste resulting from marketing standards at this stage of this specific supply chain. Sub-questions a, b, c, and d are provided to help identify some potential causes. You may also consider adding other questions that might be relevant to your specific food commodity or product].

Considering your business, what are the main causes of food waste due to marketing standards for [food commodity/specific product]? *[e.g., Consumer expectations, regulations, labelling, etc.] Can you estimate the breakdown of this?*

In your business, does, and if so how does, consumer demand lead to food waste due to marketing standards in [food commodity/specific product]? *[e.g., Fruits and vegetables that don't meet size, shape, or color standards are discarded in the field]*

In your business, does, and if so how does, logistics contribute to food waste caused by marketing standards in [food commodity/specific product]? *[e.g., Delays and damage during transportation can affect product quality and aesthetic].*

In your business, does labeling, as required by marketing standards, contribute to food waste in [food commodity/specific product]? And if so how? *[e.g., If there are errors in the label, such as incorrect information or the absence of required certifications, the products may be discarded before being sent to market and/or recalled]*

Does climate change contribute to food waste that arises due to marketing standards for [food commodity/specific product] in your business? If yes, how? If no, do you expect this to change in the future? Do you have an example? *[e.g. Unpredictable weather patterns can cause shortage of products or delay. For example, hailstorms and unseasonal frosts, increasingly common due to climate change, can cause superficial blemishes or scarring on apple skins].*

What kind of food production practices (methods, techniques, and processes) in your business impact food waste due to marketing standards in [food commodity/specific product]? *[e.g. Introducing or improving temperature monitoring during transportation and storage could help extend the shelf life of milk and reduce spoilage, preventing unnecessary waste].* What impact do these have on the amount of food waste in [food commodity/specific product]? *[e.g., It reduces food waste by X%]*

Factors reducing/preventing food waste

What strategies do **you** have to prevent/reduce food waste due to marketing standards *[e.g., Demand control, alternative markets, etc.]* for food commodity/specific product? Can you describe these please? What impact do these have on the amount of food waste in [food commodity/specific product]? *[e.g., It reduces food waste by X%]*?

What strategies are adopted to adjust products according to demand fluctuations and prevent surpluses in [food commodity/specific product]? What impact do these have on the amount of food waste in [food commodity/specific product]? *[e.g., It reduces food waste by X%]*

Do you use any technology to prevent or reduce food waste in [food commodity/specific product]? *[e.g., Demand, stock levels, expiry dates control]*. If so, which one? What is the impact on food waste? *[e.g., It reduces food waste by X%]*

Do you have any programme for donating, recycling, or transforming unsold products to prevent waste in [food commodity/specific product]? If yes, please describe the key elements of the programme and the impact it has on food waste. *[e.g., It reduces food waste by X%]*

Do you collaborate with any other organisations, either within your sector and supply chain or outside of it, to reduce food waste caused by marketing standards in [food commodity/specific product]? Could you describe this collaboration and indicate the percentage by which it reduces food waste?

What would help you to reduce/prevent food waste due to marketing standards in [food commodity/specific product]?

What actions do other food services take to address food rejected due to marketing standards in [food commodity/specific product] (e.g., food banks, alternative markets, etc.)? Do you plan on adopting any of them in the future? What prevents you from taking on these solutions at the moment? What, if anything, might help you to take them on?

INTERVIEW GUIDE: CONSUMER

(Approximate duration: 10 minutes)

“Thank you for joining us today. To start, we’d like to clarify what we mean by ‘waste due to marketing standards.’ In this context, we’re referring to products that do not meet specific market specifications, such as size, shape, or appearance, despite being perfectly edible. Our goal is to understand how this type of waste impacts your consumer behavior and explore potential solutions together.”

General information

What are the main aesthetic reasons for food waste in your home for food commodity/specific product from this supply chain [*e.g., Broken pieces, non-uniform shapes...*]?

What percentage of the [food commodity/specific product] from this supply chain that you regularly buy goes to waste due to aesthetic reasons (yearly)? Does this vary throughout the year? If so, can you explain why this is the case?

What percentage of the [food commodity/specific product] from this supply chain that you regularly purchase goes to waste due to expiration dates?

Do you purchase [food commodity/specific product] from this supply chain that is close to its best before date? Why/why not? If not, what would encourage you to buy such foods?

How willing are you to purchase out-of-spec products for [food commodity/specific product] in this supply chain? Do you usually do that? Why or why not?

Factors reducing/preventing food waste

What actions do you take with [food commodity/specific product] rejected due to aesthetic reasons?

Do you use any app to prevent or reduce food waste? If so, which one?

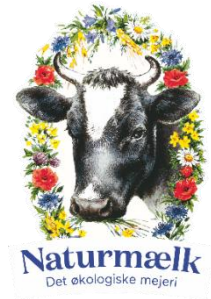
What would help you to reduce/prevent food waste due to marketing standards regarding [food commodity/specific product] in this supply chain?

ROSETTA

Reducing food waste due to marketing standards through alternative market access

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