LOWINFOOD

Multi-actor design of low-waste food value chains through the demonstration of innovative solutions to reduce food loss and waste

GA No. 101000439

D3.2 ROADMAP FOR TRACKING AND REDUCING BREAD WASTE IN BAKERY-RETAILER INTERFACE

WP3 – Type of deliverable: Report – Dissemination level: Public – Due date: 31st October 2022 (M24)

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TAU, SLU, UNITUS, CNA

LOWINFOOD Consortium

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2	Alma Mater Studiorum Università di Bologna	UNIBO	Italy
3	Sveriges lantbruksuniversitet	SLU	Sweden
4	FH Munster University of Applied Sciences	ISUN	Germany
5	The James Hutton Institute	JHI	United Kingdom
6	Universitaet Fuer Bodenkultur Wien	BOKU	Austria
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LOWINFOOD has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101000439.

Table of contents

Summary

This is the second deliverable (D3.2) of WP3 in the LOWINFOOD project. The deliverable presents three country-specific roadmaps for the bread value chain stakeholders created as a result of stakeholder dialogues held in Italy, Finland, and Sweden from November 2021 until September 2022. The objective of the dialogues was to identify, together with the bakeries and other stakeholders of the bread value chain, new social and organisational solutions to reduce and prevent the loss and waste of bread products along the whole value chain. The dialogues included discussions about the current problems and how they could be solved. Each of the three roadmaps includes a description of the country's bakery sector, identification of key stakeholders for bread loss and waste reduction, as well as suggested actions for bakeries, retailers, and other stakeholders. Joint conclusions and lessons learnt from the three stakeholder dialogues are presented at the end of the document.

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Introduction to the deliverable

LOWINFOOD is a project committed to co-design, together with actors of the food chain, low-waste value chains by supporting the demonstration of a portfolio of innovations in a set of value chains particularly concerned by food loss and waste (fruits & vegetables, bakery products and fish), as well as in at-home and out-of-home consumption. Each of these value chains corresponds to a single Work Package (WP) of the project.

The innovations are selected among promising solutions that have already been developed and tested by some partners of the consortium, with the aim to provide the necessary demonstration and upscale to allow market replication.

The LOWINFOOD consortium comprises 27 entities, located in 12 different countries, and ranging from universities and research institutes to start-ups, foundations, associations, and companies working in the food sector. During the 52 months of the project, the partners are committed to complete 30 tasks and to deliver 60 outputs (deliverables).

This deliverable (D3.2) is part of WP3, which is dedicated to reducing loss and waste in the bakery value chain. D3.2 is a result of task 3.2 (T3.2) where the objective is to promote coordination between stakeholders in the bread value chain through stakeholder dialogue (the protocol for conducting the stakeholder dialogues has been described earlier in deliverable D3.1). D3.2 presents the results of the stakeholder dialogues organised in three EU countries (Italy, Finland, and Sweden) from November 2021 until September 2022. In the stakeholder dialogues, stakeholders of the bread value chain discussed the prevailing problem areas from the bread loss and waste point-of-view and the possible solutions to address them. The deliverable consists of three roadmaps which outline the solutions addressed in the stakeholder dialogues. Due to substantial differences in how the bread market functions and in the role of different stakeholders, country-specific roadmaps have been created. The impact of the proposed roadmap actions will be assessed – with a special focus on the Italian craft bakeries – considering the amount of bread loss and waste avoided, the socio-economic and environmental effects. The results of such assessment will be reported in the deliverable D3.6 (due in M40, February 2024).

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1. Introduction to the roadmap

This chapter describes the content of the second deliverable in WP3 (D3.2) which focuses on presenting roadmaps for bread loss and waste prevention and reduction actions for the bread value chain stakeholders in Italy, Finland, and Sweden. In addition, it introduces the joint focus areas used for developing the roadmaps.

Content of this deliverable

This deliverable, D3.2, is the second deliverable of WP3 of LOWINFOOD and is dedicated to reporting the results from stakeholder dialogues organised for the bread value chain stakeholders in Italy, Finland, and Sweden. The protocol used for the stakeholder dialogues has been discussed in an earlier deliverable (D3.1).

Due to differences in the bread value chain and respective markets in the three countries (Finland, Italy, Sweden), country-specific roadmaps have been developed. The Italian roadmap actions are presented first, followed by Finland and Sweden. Each chapter with a country-specific roadmap follows a similar structure. First, some characteristics of the country's bakery sector are identified and discussed, followed by identifying the key stakeholders in each market. The roadmap actions for bakeries are presented first, followed by actions suggested for retailers, and finally for other stakeholders. Each roadmap chapter also includes a brief description of how the stakeholder dialogues were organised. Finally, joint learnings from the three roadmaps – i.e., conclusions – will be discussed in the last chapter.

In this deliverable, we use the terms 'bread loss', 'bread waste', and 'bread surplus'. *Bread loss* refers to any materials wasted before the bread enters the retail and consumption phase. This includes for example, dough or flour lost during production of the bread in the bakeries. *Bread surplus*, on the other hand, refers to bread that is baked and retailed, but for various reasons is not sold to the intended customer. In the end, bread surplus becomes *bread waste* if it is not redistributed to human consumption and is recycled or disposed.

Focus areas of roadmap development

In the roadmaps, the objective has been to identify actions where bread waste is reduced at the level of the whole value chain – throughout the 'bread's journey'. As food waste is a wicked, unstructured, and cross-cutting problem of the food system (Närvänen et al., 2020), the causes and effects of waste might be difficult to identify as one actor's action might have effects elsewhere along the value chain. As identified in previous research, supplier-retailer interface is critical for the emergence of bread waste (Brancoli et al., 2019), therefore, the actions in the roadmaps focus on bakeries and retailers. However, we also discuss the role of other stakeholders as they might have an important role in enabling bread waste reduction in the value

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chain.

Furthermore, while the actions in the roadmaps have been developed together with the stakeholders, the LOWINFOOD researchers have structured them according to the waste hierarchy for food outlined in the revised Waste Framework Directive of the European Commission[1]. The primary focus has been on actions that prevent the loss and waste from occurring in the first place. Some of the actions in the roadmaps relate also to the second, third, and fourth levels, i.e., the actions that enable reuse primarily for humans, secondarily to animal feed, and finally the actions that enable revalorisation through reusing by-products and recycling food waste into new products.

Bread and bakery products as a product group can include various types of bread that differ how well they preserve and thus how susceptible they are to becoming wasted. Also, consumer preferences for different types of bread are different in Northern and Southern Europe. For example, in Finland and Sweden, crisp breads (i.e., dried bread products) are important part of bread culture. In this roadmap, the focus is on fresh bread rather than on more easily preserved types of bread such as bread sold as frozen or dried.

Finally, there are some focus areas related to the retailing and consumption phases. When referring to retailers in this deliverable, the focus is on traditional, brick-and-mortar food retailing. However, many of the actions presented in the roadmaps are applicable also to the online context. Secondly, regarding the consumption phase, the focus in the roadmaps has been on consumers and households, i.e., on the consumer market rather than on bread sold to the HoReCa sector. In all three countries, a majority of bread is sold to consumers either through retailers or directly from bakeries.

[1] https://food.ec.europa.eu/safety/food-waste/eu-actions-against-food-waste/food-waste-measurement_en

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2. Roadmap for tracking and reducing bread waste in Italy

Description of the bakery sector in Italy

In Italy, the bakery sector is driven by nearly 25,000 small-scale bakeries that produce fresh bread to consumers. These craft bakeries produce 84.1% of the bread sold in Italy every year (Associazione Italiana Bakery Ingredients, 2022); they are typically family businesses, with a maximum of 10 employees. In most cases, these bakeries sell their products at their own stores besides supplying supermarkets and large retail stores. In 2021, 43.1% of the fresh bread consumed in Italy was sold at own stores of the producing bakeries; 43.5% at supermarkets, while the remaining share was distributed to restaurants (Associazione Italiana Bakery Ingredients, 2022).

The main ingredients of the baking process are flour (different quality or mix may be used to make different types of bread), water, salt, and yeast. For special breads and bread rolls, bakers may add more ingredients (for example oil or milk). The bread dough is typically made by each bakery at their own bakehouse during the night and after the rise it is baked in an oven on site. The fresh bread is therefore ready early in the morning, every day; it is delivered directly to their own stores, supermarkets and grocery stores and it must be sold on the same day. According to Italian legislation (Benozzo et al., 2011), 'fresh bread' can only be sold within 24 hours from the end of the production phase, otherwise it can no longer be marked as 'fresh'.

The bakery sector in Italy is facing various problems arising from the effects related to the global crisis linked to the Ukrainian conflict. This has highly affected the bakery businesses, due to the high increase in energy costs (in a sector with very high electricity needs) and the simultaneous increase in the cost of flour. This is putting a strain on bakeries, in particular on the small ones for which higher costs have a direct impact on the revenue of the family. This 'perfect storm' hinders the occupational stability of more than 120,000 workers (I.Stat, 2017), and the survival of thousands of small businesses. In this context, it is clear that wasting part of the product is a cost that bakeries can no longer bear.

In Italy, the quantity of bread wasted at the bakery level has never been measured. Task 3.2 activities of LOWINFOOD will provide the first assessment of bread waste. Data from other countries and direct observation suggest that the quantity of bread produced largely exceeds the quantity that can actually be sold on the market, causing a significant surplus which should be prevented and/or managed in an efficient way. Actions to support the recovery of the sector must therefore include a reduction of bread surplus and, for the quantity of surplus that cannot be prevented, its better management, in order to avoid waste as far as possible and to achieve more revenue from the entire production.

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The roadmap for tracking and reducing bread waste in Italy was developed in the northern part of the Lazio Region, in the centre of the country. This area is characterised by two medium-sized cities (Viterbo and Civitavecchia, the first of which is the capital of the province of Viterbo) and a number of small towns and villages, nestled into a rural landscape. The total population living in the area is about 400,000.

For years, the price of bread and bakery products in the case study area has ranged between 2.00-2.40 euros per kilogram, while it increased up to 3 euros per kilogram in mid-2022 (on average +20%) as a consequence of the Ukrainian war. However, this is still a low price compared to the rest of Italy, where the price of a kilogram of bread can reach 6 or 7 euros (Milano and Bologna, respectively, according to the National Observatory of Prices established by the Italian Ministry of Economic Development, https://osservaprezzi.mise.gov.it/).

Many craft bakeries of the case study area are associated with the local branch of CNA (Italian Confederation of Craft Trades and Small- and Medium-Sized Enterprises), which is a partner of the LOWINFOOD project. In the development of the roadmap for tracking and reducing bread waste in Italy, CNA bridged with the bakeries and promoted their involvement in the stakeholder dialogues, as described in deliverable D3.1. Twelve small-scale bakeries joined the activities by participating in three stakeholder dialogues and by committing to measure on a regular basis the quantity of bread lost and wasted. The next sections report the results of this activity, which led to the identification of a set of actions to prevent bread loss and waste, developed through the discussion conducted at the stakeholder meetings.

Relevant stakeholders for the roadmap in Italy

Since the Italian case study is strongly focused on small-scale bakeries, these are considered the main stakeholders to introduce and enhance innovations to reduce bread loss and waste. The bakeries are directly involved in these actions. They can introduce internal strategies to better foresee the sales, thus avoiding producing bread in surplus, for example by monitoring production and sales to adjust the quantity produced. For the quantity of surplus that cannot be prevented, bakeries can identify new destinations to avoid waste, for example through donations, last-minute sales and other actions.

The bakeries are usually familiar with their customers since most of them buy bread every day. This reflects also on the everyday activities of the businesses, which are highly customised and try to match the requests of customers, for example, with the habitude to keep the shelves well-filled until the end of the day. The latter is one of the observed causes of the bread and bakery products' surplus production since it is usual that part of the bread produced remains unsold at the end of the day.

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In addition to the bakeries, other relevant stakeholders involved in the roadmap are consumers, charity organizations, and local institutions (e.g., CNA and the municipalities). To avoid the surplus to become waste and to improve actions to help charities, institutional stakeholders, like the Municipality of Viterbo, will be invited to consider a proposal to tackle food waste. At the same time, citizens are needed to be involved in activities to tackle and prevent food waste.

The expected benefits for the participating bakeries are related to the collaboration they establish together towards a common objective, and the promotion of actions to give more value to the bread that they produce and sell. One key aspect is to improve the ability of the bakeries to tailor their production to the actual customer demand, thus reducing bread surplus as far as possible. Indeed, as fresh bread can only be sold on the day of production, the ability to predict the actual demand is crucial to avoid excess production and thus to save costs. It should be noted that for small craft businesses, changes in the costs have an immediate effect on the revenues available for the family. Another expected benefit comes from the sharing of tools and best practices to manage surplus bread and waste in an efficient way; this means, in line with the priorities set by the EU WFD hierarchy to facilitate the use of surplus bread for human consumption as a first choice, and to promote recycling and recovery as alternative options.

The roadmap is also meant for replication in similar contexts, as well as to provide a benchmark for contexts where measures against loss and waste of bread have never been applied.

Roadmap actions suggested for bakeries in Italy

In order to develop the '*Roadmap – Una mano contro lo spreco*'[2], three meetings were organized with the 12 involved bakeries, CNA and UNITUS researchers. This allowed to set up the activities to develop the final roadmap. The meetings took place in November 2021, March 2022, and May 2022. These meetings were organized as structured discussions, with a moderator who guided the participants into pre-defined discussion topics. Topics of discussion reflected those agreed with the actors implementing the same actions in Sweden and Finland (see deliverable D3.1). They covered the causes of bread loss and waste in the bread value chain (from production to sale), how to quantify such losses, and the solutions that are available to bakeries and other stakeholders to reduce this issue.

Moreover, from February to June 2022 (5 months), each bakery reported in a diary, on a daily basis, the quantity of bread produced and the quantity remaining at the end of the day, thus allowing for a first assessment of the surplus of bread, which is likely to become waste in absence of proper actions. The three most relevant products which were included the direct measurement are: common bread, focaccia bread and typical Italian bread (*rosette/sfilatini/panini all'olio*, meaning different types of bread rolls).

[2] In Italian, 'una mano contro lo spreco' means 'a hand against waste'.

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To monitor the quantity of bread surplus, at the beginning of every month CNA provided each bakery with a diary. The staff of each bakery store had to note the following data every day, at the beginning and at the end of the working day:

- Daily production of bakery products (kg) at the beginning of the working day;
- Selling price (€/kg);
- Surplus of bakery products (kg) at the end of the working day;
- Number of daily receipts;
- Destination of product surplus (with the possibility to check different destinations).

Bakeries with several stores were provided with one diary for each store. In total, 17 bakery stores participated in the assessment. The diaries were collected on a monthly basis and the data were manually entered in Microsoft Excel. The elaborations were performed in Excel as well. Therefore, every day, for every bakery branch, three rows are reported in the dataset: one for common bread, one for focaccia bread, and the last one for a typical Italian bread. These results allowed us to have a baseline measurement of the bread surplus at the craft bakeries involved in the Italian case study.

Following the information noted in the diaries regarding how to use the surplus and the roundtable discussion with the bakeries, several important outcomes have emerged (see Figure 1). In 38% of cases, the surplus of bread and bakery products was reused, mostly as breadcrumbs. This is the most preferred action by bakeries, and it is used in particular for reusing the surplus of bread; breadcrumbs can be resold at a competitive price.

Another result that emerged both from the diaries and from the discussion concerns the use of the app 'Too Good To Go' to sell the unsold bread and bakery products at the end of the day. This applies to 13% of recorded cases. With Too Good To Go, products are sold at 1/3 of the original price. A similar frequency is recorded for donation of products, free of charge, to local charities. The discussion highlighted that the bakeries would like to improve this method, even if they explained that the legal burdens of this option are significant. In fact, the EU regulations about food safety are quite strict and their application to bread donations could imply extra costs for bakeries (for example, for the packaging). Moreover, there are several logistical issues related to the pick-up of the goods, because donation occurs at the end of the day, and consumption of these products by final users at the charities has to be very fast. The donation is completely free of charge, which means that, despite its social and environmental benefits, economic drivers might be needed for the bakeries to overcome these practical barriers. The Italian law against food waste (law n.166/2016) foresees that the municipalities can give economic incentives (in form of a discount on the local waste tax) to food companies which regularly donate surplus products to charities, but its implementation remains scattered and very limited in the country.

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Sometimes, especially at the end of the day, bakeries are used to giving the unsold products to customers to reward their loyalty. This applies to 11% of cases. Instead, in 12% of cases the surplus bread was sold or given for free to be used as animal feed.

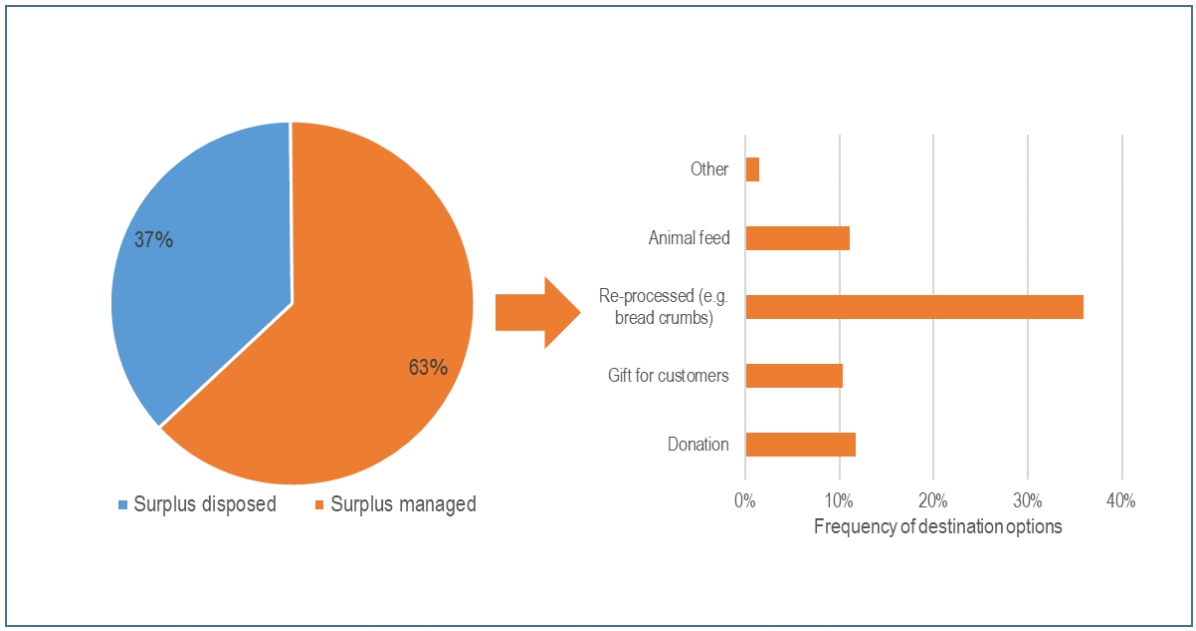

Figure 1 – Frequency of bread surplus management options, selected by the bakers involved on a daily basis[3]

After two rounds of discussion and the first results of the baseline assessment, a '*Roadmap – Una mano contro lo spreco - roadmap, a hand against the waste*' was elaborated. It included the actions against bread surplus and waste generation that were mentioned and tackled during the discussion. It includes the actions raised by the bakers participating in the activity, grouped and listed to reflect the prioritization emerged during the discussion.

As shown in Figure 2, the roadmap is composed of the following five bullet points (corresponding to five fingers of the hand):

1. Measure the daily surplus;
2. Encourage daily orders to plan sales;
3. Increase consumer awareness of the problem of waste by making 'anti-waste' activities recognizable;
4. Encourage donations of the surplus for human consumption (through a collective organization) by reuse, use of apps, and / or donation to charities;
5. Suggest collective actions against food waste at a municipal level (together with CNA).

[3] Percentages do not refer to the quantity of surplus destined to the different options, but rather to the frequency with which the different options were activated.

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Figure 2 – Roadmap 'Una mano contro lo spreco'

Each action is aimed to tackle a specific problem related to bread surplus and to promote actions against food waste. The first three actions are focused on bakeries, while the last two actions are mainly addressed for the other stakeholders.

1- *Measure daily surplus*

The first action consists of measuring the daily surplus. In the first meeting, all bakeries were confident that there was no waste in their bakery or that the surplus was not so relevant. One baker was so sure about this that he told us that 'he could write a name on every loaf that he produced with the name of the customer'. Anyway, as they started the quantification with the daily diary, they understood that the waste was even higher than what they could think of. For this reason, the first action is addressed to promote and encourage the use of diaries to take note of and to quantify the surplus of bakery products. Also, the diaries function as a historical data set, in order to better forecast sales, to check and think about the reasons behind the production of everyday surplus and the factors that can influence it.

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2- *Encourage daily orders to plan sales*

This action was seen necessary by bakers in order to better forecast the quantity of products that has to be produced for the following day. In fact, these products are prepared during the night: forecasting the production that will be sold on the following day can be difficult and uncertain, and the surplus fluctuates a lot during the week and months. By reducing the possibility of fulfilling orders of unexpected quantities, encouraging customers to place daily orders, will help in planning sales, consequently, boosting the reduction of surplus through better sales forecasting.

3- *Increase consumer awareness of the problem of waste by making 'anti-waste' activities recognizable*

The third activity concerns increasing the consumer awareness of the problem of food waste. In the roundtable discussions, it was clear that one of the major problems related to the bread and bakery product waste was linked to their customers' habits. In fact, bakers affirmed that customers have a better image of the bakery when they see the shelves full, even though at the end of the day, not all products would be sold. On the other hand, customers perceive empty shelves as negative. Such customer expectations push the bakeries to regularly produce more bread than they think they can actually sell, just to make sure that the shelves of the bakery will remain well-filled until the end of the day. For this reason, in this activity bakeries explain that it would be critical to educate customers on practices and behaviours that can help preventing and reducing bread waste in bakeries, for example by making them aware that full shelves are not desirable to define the quality of the bakery. To highlight the effort of the bakers that are implementing the roadmap, together with CNA and the participants, a brand or a symbol will be created that will give greater visibility to the bakeries involved.

Roadmap actions suggested for retailers in Italy

In the Italian case, retailers were not included in the stakeholder dialogues. The focus of the Italian case study is on small scale bakeries - the part of the bread value chain that both produces and sells fresh bread. As mentioned above, this part of the value chain accounts for 43.1% of the fresh bread sold in Italy (Associazione Italiana Bakery Ingredients, 2022).

Retailers' market share is 43.5% of the fresh bread sold to consumers; they are either supplied by small craft bakeries (which represent 84.1% of the total production, as mentioned in the introduction) or by industrial bakeries, or they use frozen products that are baked directly at the store.

Retailers' commercial relations with big industrial bakeries may include different forms of take-back agreements which are very likely to increase the quantity of bread surplus and waste.

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However, the adoption of the EU directive 633/2019, against Unfair Trading Practices (UTP), which was transposed in the Italian legislation in November 2021 (Leg. Decree n. 198/2021), limited these practices to a certain extent. Before the adoption of the directive, take-back agreements were very common in the commercial relations between retailers and small craft bakeries. During the roundtable discussions conducted with small bakeries, they reported that such agreements were very unfair for the bakers, which were forced to accept them due to their limited bargaining power against bigger players.

Roadmap actions suggested for other stakeholders in Italy

In the roadmap developed, the activities 4 and 5 are focused on local stakeholders that may engage in actions towards the reduction of bread loss and waste. In particular, the involvement of consumers and institutional stakeholders is considered crucial to obtain the expected results of the activities of the roadmap. A closer collaboration between relevant stakeholders and other (local) stakeholders, for example collaboration between bakeries and charities to redistribute the surplus, is needed to reach systemic and lasting results. It would therefore be a valuable action to improve the role of CNA, as a representative of bakeries to represent their needs and ideas. Another opportunity is to bring forward proposals with the municipalities. Article 17 of the Gadda Law No. 166 of 19 August 2016, which is applicable in the whole country, foresees that municipalities can apply a discount rate to the local waste tax, in favour of food companies who donate their food surplus to charities or to be used as animal feed.

4- *Encourage donations for human consumption of the surplus (through a collective organization) by reuse, use of apps and / or donation to charities.*

Different options are available for bakeries to make their bread and bakery product surplus available for human consumption. Charity organizations are active to promote and facilitate the redistribution of fresh products surplus to people in need. In particular, the aim of this activity is to enhance collaboration between bakeries and beneficial organizations. Other strategies to divert the surplus from becoming waste are the production and sale of breadcrumbs as well as the use of apps (e.g., Too Good To Go) to sell the daily surplus at a discounted price by the end of the working time. During the discussion with the bakeries, various problems were perceived to arise concerning these two options. In the case of the breadcrumbs, its selling price per kilogram is higher than the common bread since it includes also production costs. Also, not all the surplus can be used for the production of breadcrumbs (e.g., focaccia bread cannot be used). Anyway, they do not apply a common price.

Using an app to sell the surplus is a viable innovative solution to avoid surplus and to make a partial profit, although different organizational problems arise from the bakeries which hinder the use of app. In this case the main objective is to improve the ability of bakeries to sell the daily surplus, even at a discounted price, in order to avoid managing it as a waste.

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5- *Suggest collective actions against food waste at a municipal level (together with CNA).*

The last activity has the aim to promote the cooperation as a network of bakeries, and together with the CNA, of collective actions and proposals. One key issue is to lobby for the full implementation of the Italian law against food waste, which foresees (Article 17 of the Law No. 166 of 19 August 2016) that municipalities can apply a reduction of the waste tax to food companies which regularly donate food surplus to charities for human consumption or to use it as animal feed. In this process, the role of business associations like CNA is pivotal to push local policymakers to support these practices. Another focal point is the involvement of citizens by organising events and activities to promote education on the food waste issue and to advertise prevention strategies, to push a behavioural change in consumers. In this way, citizens will be more aware of the issue and, as a consequence, they may change their expectations (for example, related to full shelves) and therefore support actions against bread waste at the bakery level.

Summary

In Italy, 84.1% of fresh bread is produced by small craft bakeries and 43.1% is directly sold at these bakeries' stores. Twelve small bakeries, located in the northern part of Lazio Region, Italy, and associated to CNA, the Italian Confederation of Craft Trades and Small- and Medium-Sized Enterprises, participated in three rounds of stakeholder dialogue organised in the LOWINFOOD project. The objective was to understand the causes of the bread surplus and waste and to identify possible actions to reduce it. The stakeholder dialogue allowed to identify the main issue related to loss and waste in the bread value chain in Italy – the prevention and management of surplus production. The dialogue continued with the definition of a roadmap to reduce the surplus and waste of bread. In Italy there is no data available on the quantification of bread surplus, loss or waste; therefore, the same bakeries were asked to report on a daily basis, through a diary, the quantity of bread produced in surplus, and the destination of these products. The roadmap is composed of five actions, all listed in Table 1. The actions are focused on the bakeries, consumers and institutions, and they have different timeframes for their implementation: where short-term refers to less than two years, medium-term between 2-5 years, and long-term is over five years. Also, the easiness of implementation is indicated, in order to better achieve the reduction and the reuse of surplus of bread and bakery products by all stakeholders involved in the process.

Table 1 – Actions in the Italian roadmap

Action	Stakeholder(s) involved	Timeframe for the implemen-tation	Easiness of implemen-tation	Type of impact (beyond environmental)*	EU Waste Framework Directive
1 - Measure daily surplus	Bakeries	Short	Feasible	Economic / Social	Prevention

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2 -Encourage daily orders to plan sales	Bakeries / Consumers	Short	Feasible	Economic / Social	Prevention
3 - Increase consumer awareness	People / Institutional	Medium	Feasible with efforts	Social	Prevention
4 - Encourage donations for human consumption	Bakeries / Institutional	Medium	Feasible with efforts	Social	Reuse
5 - Suggest collective actions against food waste at a municipal level	Institutional / Bakeries	Medium	Feasible with efforts	Legal	Prevention

*) As food waste reduction is usually considered to have environmental impacts, environmental impact is not listed here for each action.

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3. Roadmap for tracking and reducing bread waste in Finland

Description of the bakery sector in Finland

In Finland, the bakery sector is the biggest area of the food industry (measured by the number of companies and the number of units) (Hyrylä, 2021). The industry is characterized by a few nationally (some even internationally) operating large industrial bakeries, regional bakeries, and very many local small bakeries. There is usually at least one bakery in every city and municipality. The companies are often traditional – some have been in operation since the 1850s – and family-owned. The competition between bakeries is tough as hundreds of bakeries compete for less than half of the market share.

The bread culture in Finland is rich and dates back centuries. The bread culture also varies from area to area. For example, in Eastern Finland, the bread culture is mostly based on traditional rye bread, whereas in Western Finland, spiced and sweet bread containing syrup, raisins or cumin are more popular (Leipätiedotus, 2022a). Today, consumers expect a large variety of bread to be available in stores. Also, as people have moved from an area to another, they hope the bread they remember from childhood to be available in their local shop. As a result, many bakeries deliver their local products nationwide and even small bakeries and shops tend to have a wide assortment of various bread types.

In Finland, sales of fresh (soft) bread account for over 90% of bakeries' turnover (Hyrylä, 2021). Majority of this bread is sold pre-packaged and at retailers. In addition to retailers, bakeries sell their products through their own shops (often attached to the bakery) and cafeterias. One recent trend in the bakery industry in Finland has been the rise of shop-in-shop bakeries. A bakery runs a small baking unit at a supermarket, often branded under the bakery's own brand. The bakery is in charge of estimating the demand for the products and receives payment from the retailer for those items which have been sold. In these, bread is baked throughout the day on-site and individual items can be sold also unpackaged (the customer packs it on-site). In addition to these shop-in-shops, some retailers have their own baking units inside their stores where bread is baked throughout the day and sold individually (often unpackaged), but – in contrary to the shop-in-shop bakeries – the financial burden for any unsold products lies at the retailer. In addition to selling to consumers through the aforementioned channels, bakeries also sell to catering industry (e.g., restaurants), either directly or through food service wholesalers, and to public sector actors (e.g., hospitals, schools).

Relevant stakeholders for the roadmap in Finland

In Finland, stakeholder dialogues for the bread value chain actors included two types of activities – online workshops organised for bakeries as well as interviews with bakeries and retailers (for a detailed description of the method, see deliverable D3.1). Four online workshops with 2-4

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bakeries and a representative from the Finnish Bakery Federation were held in January–September 2022. In addition, six interviews were held with other bakeries and four with retailers in May–September 2022. The interviews with bakeries focused mostly on large bakeries, whereas the participants in the online workshops were small to medium-sized bakeries. The retailer interviews included representatives from all three major food retailers in Finland and managers with various positions in the organisation.

Relevant stakeholders identified in the stakeholder dialogues for the reduction of bread waste along the bread value chain in Finland are listed in Table 2. Besides the obvious stakeholders involved with the bread value chain (e.g., bakeries, retailers, consumers) who have the possibility to directly impact the amount of bread waste, list includes some key stakeholders that have an indirect effect on the opportunities the value chain actors have in their bread waste reduction.

Table 2 – Key stakeholders for the roadmap in Finland

Stakeholder	**Description**
Bakeries	The bakery market consists of bakeries with varying sizes. There are currently over 600 bakeries operating in Finland (Hyrylä, 2021). The two biggest bakeries – Fazer Bakery Finland and Vaasan (part of Lantmännen Unibake) – have a joint market share of over 50 per cent (Tammilehto, 2019). Two third of the bakeries are micro-sized, employing less than 10 people (Hyrylä, 2021). Therefore, the competition between bakeries is high.
Retailers	The food retailing market is highly concentrated in Finland. The two largest retailers (S Group and K Group) accounted for a joint market share of over 82% in 2021 (NielsenIQ, 2022). The third largest retailer, Lidl, had a market share of 9.6%. Majority of bakeries in Finland sell their products through some of these retailers, and therefore their role is essential in the bread surplus and waste reduction along the whole value chain. Fresh bread and bakery products were identified as the relatively largest product group producing retailers' food waste and edible food waste in Finland in 2019 – about 5 percent of total sales volume (Riipi et al., 2021).
Consumers	In 2021, Finnish consumers ate fresh bread about 41 kilograms per person, equal to about four slices of bread per day (Leipätiedotus, 2022b). Of this, 34 kg per person consist of bread baked in Finland. Bread is also one of the most wasted product categories in households in Finland. In a recent study that weighed and categorised food waste in two large cities in Finland, 3.6-4.2 kg of bread was wasted per person per year (Riipi et al., 2021).
Suppliers of raw materials (flour)	Quality of raw materials (especially flour) have an important role in the quality of the finished product and thus in the bread loss and waste prevention.
Food packaging suppliers	As a majority of bread in Finland is sold pre-packaged, new packaging innovations have an important role to play in how well the bread preserves its quality. This has an effect on the bread waste especially at retailers and at households.

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Actors utilising the bread surplus (e.g., food banks)	In Finland, there is a relatively long tradition of donating food to charity. The first food aid organisations were established in the 1990s during the recession period. It is estimated that there are currently about 1,000 charity organisations in Finland in the area of food aid (Ruoka-apu.fi, 2022). About 90% of these actors rely on the redistribution of surplus food from retailers and manufacturers, and bread is among the most donated food categories (Korpela, 2020). As of December 2021, food system actors, such as food producers and retailers in Finland are required to redistribute their surplus food items to human consumption, unless it leads to food safety risks or unreasonable costs for the actor.
Policymakers	In Finland, there are many regulations that guide the actors in the food system. Some of these regulations have been identified to increase the amount of food wasted (Hietala et al., 2018). In the case of bread waste, the data indicates that especially the Finnish Food Authority – related to food labelling regulations – would have a role to play in bread waste reduction. Currently, the food labelling regulations are seen – especially at small bakeries - to complicate the recycling of bread surplus or losses back into production as the ingredient list on the packaging cannot be easily adjusted to accommodate recycled materials (see also point 12 in the roadmap).
The Finnish Bakery Federation	The Finnish Bakery Federation (FBF) was established in 1900 to look after the professional and economic interests of bakeries in Finland (Suomen Leipuriliitto ry, n.d.). Currently, due to their member base, their interests lie mostly in small and medium-sized bakeries.

Roadmap actions suggested for bakeries in Finland

The roadmap for bakeries in Finland consists of six actions (1-6) detailed below.

1. Bread loss and waste analytics to direct strategic and operational activities

1a. Measuring the amount of bread waste. Based on the stakeholder dialogues, it seems that not all – especially small – bakeries in Finland yet systematically track the amount of bread loss and waste in their production as well as surplus bread. However, as one interviewee nicely put: 'What you measure, you develop.' The act of measuring – and thus tracking – the amount of bread loss, surplus and waste is the cornerstone of waste-reducing activities and the first step in the process where bread waste analytics (metrics) start to direct the bakery's operations at both strategic and operational level. When initiating systematic measuring routines, the bakeries should analyse and decide on the level of waste measurement – taking into account which type of information would serve their purposes the best. Should they measure loss, waste and surplus at the level of individual products? At the level of product categories? By product line? By production process stages? Furthermore, the bread loss, waste and surplus measuring activities should be integrated into the daily practices of the company, involving all relevant people, and creating clear routines for relevant tasks.

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1b. Utilising the data on bread waste. Another important aspect is how to benefit from the bread waste metrics the most. First, as the waste measurements start to compile, the bakery receives important knowledge about the production from the bread loss reduction point-of-view. Analysis should be directed into the questions: What explains the amounts of loss, waste or surplus (i.e., why there is bread loss, waste or surplus)? Are there specific problem areas and if so, what can be done to overcome the problems? Secondly, as more data comes in, analysing deviations (i.e., periods where atypical amount of loss, waste or surplus has occurred) becomes more important. Systematic learning from the mistakes, but also from successes should be continuous and natural part of the waste analytics utilisation. Finally, the work done for creating waste analytics in the bakery should become visible not only to all employees of the company, but also (at least to some extent) to external stakeholders. Especially for larger bakeries, waste analytics should be reported in annual (sustainability) reports.

2. Creating a zero-waste culture throughout the organisation

Closely related to waste analytics, is how the issue of bread loss, waste and surplus reduction is brought to the attention, practices, and mindset of the organisation. Taking part in waste reduction activities – i.e., a zero-waste culture – should become part of the organisational culture in the bakeries. In a zero-waste culture:

- All employees at all levels of the organisation are engaged in the process of bread loss and waste reduction – it is also everyone's responsibility to take part.
- Rewards for good performance related to loss and waste reduction could be introduced – available to any employee regardless of task or level. The rewards could be based on the bread waste analytics.
- Proposing initiatives for bread loss and waste reduction should be made easy and could become part of the reward system. Every initiative is analysed for its feasibility.
- Bread loss and waste reduction issues become part of personnel training, including orientation of new employees to their tasks.

3. From tacit knowledge to shared knowledge (forecasting and production)

Despite technological advances regarding automatization of production, there is still a lot of human know-how involved in the production of bread. However, it seems that in bakeries, this knowledge often is tacit knowledge, i.e., some people possess skills learned over the years that are crucial for their task, but this knowledge is not well documented nor always shared. This can contribute to bread loss, waste, and surplus, as the people with the most knowledge might not be available all the time. Therefore, in order to reduce bread loss, waste, and surplus, bakeries should identify areas of know-how that are critical for the emergence of the bread loss, waste and surplus (bread waste analytics can also help in this). Based on the stakeholder dialogues, knowledge related to forecasting the production as well as to some areas of production, such as

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the practices of dough-making, were identified to be important for knowledge sharing. For example, some participants had noted that in their bakery the accuracy of the forecasts gets worse if the person usually in charge of them is absent (e.g., on holiday). This shows then in the amount of surplus bread production. After the knowledge areas and tasks have been identified, the expertise related to the task should be explicitly documented (as much as it is possible) so that substitutes or new employees are better able to grasp the essential knowledge. After this has been done, it is also easier to spot any problems and to systematically and continuously analyse any deviations from the normal and how to learn from mistakes. What happened? What can we do otherwise in the future? If the problem had been detected earlier, what could have been done? If the problem was detected early enough, were the people involved able to correct the course and 'save' the dough or bread from becoming wasted? How can we adjust the production in order to avoid similar problems in the future?

4. Waste reduction integrated into product development processes

4a. Developing new products. When new products are developed in bakeries, bread loss and waste reduction aspects should be in the focus of the product development process. Examples to consider include: How to finetune the recipe so that the bread preserves and keeps its quality better for longer? How is hygiene in the production of this bread best maintained (for example, is slicing of the bread needed, as slicing also creates opportunities for poorer hygiene)? What kind of packaging preserves this bread the best? When a newly developed bread product moves from test (small) batches to a longer production line, the recipe might not work anymore, which creates losses in production. Therefore, all newly developed products should first be introduced in production with as small batches as possible to test their applicability to longer production lines. Analysis should be made about the amount of losses during this test production and whether adjustments to recipe or production process (e.g., equipment) are needed.

4b. Reutilisation of production waste or surplus. Circular economy principles through reuse of resources should be integrated also into product development. Can possible loss, waste or surplus created during the production process be re-used in the production of the same or another product in the bakery? Our data indicates that especially in larger bakeries, this is currently more feasible, but smaller bakeries struggle with facilities as well as with food labelling legislation (see also point 12).

5. Developing the brand of the bakery – assortment and waste-reducing products

5a. Critical evaluation of the width of product assortment. Due to the richness of the bread culture as well as high competition between large number of bakeries in Finland, it is typical for many bakeries to have a relatively wide product assortment, often consisting of various types of bread baked with different cereals (rye, oat, wheat, barley), sweet and salty pastries or cakes and cookies. From the bread production point of view, this often creates problems, especially in

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smaller bakeries. They need their production facilities and bakers to produce several different products with different properties, each requiring different baking procedures. For example, their ovens might bake several types of products at the same time, and as time for baking varies per product type, the person in charge of the oven must be careful not to overbake any product. Therefore, cutting down the number of products in the assortment would decrease the risks for losses during production. Also, estimating the demand would be easier for a smaller assortment, thus reducing surplus. Therefore, it is recommended that bakeries critically evaluate their current product assortments to see whether there is possibility for cutting down the number of products. As especially small bakeries supply their bread to local retailers, the bakeries could also discuss their branding with them. For which products are we most known for? Which products are the ones with the most positive feedback from our customers? Which products do we have the most expertise about? What kinds of products do other (local) bakeries produce?

5b. Role of waste-reducing products in branding. If the product development (see point 4b) and legislation (see point 12) allows, waste-reducing products could become part of bakeries' product assortment. If a product utilises potential loss, waste or surplus in its production, it is recommended that it is clearly branded as such, thus normalising the reuse of resources (i.e., circular economy principles) in the bakery sector. This branding can go also beyond bakeries' own products, for example to create co-branded products with breweries that could produce beer out of surplus or wasted bread. In other food industries in Finland, products utilising losses or waste in production have been created and heavily branded as food waste reduction related and circular economy friendly products. However, the baking industry still has room to build new branding based on circular economy principles.

6. Communicating to consumers about bread waste reduction

6a. Giving advice how to preserve the bread best. Bakeries have the best knowledge on how their products preserve the best. However, this knowledge should be systematically shared for consumers as well, to reduce bread waste at the household level. This includes for example how and where to best store the bread (e.g., in room temperature or in a refrigerator) or reminding the consumers about the possibility of freezing the product. This communication could be done by giving tips on the bread's packaging. Furthermore, giving these tips should become essential part of situations where a bakery representative meets consumers, for example when salesclerks or sales demonstrators meet consumers either at bakery's own store(s) or at retailers' stores. For bread sold at shop-in-shop bakeries (at supermarkets) this communication to customers is also important, as the bread sold in them is not always pre-packaged.

6b. Best before, but good also afterwards. For pre-packaged bread in Finland, best-before dates are in use. However, the consumers often perceive this date as the use-by date and throw away products past that date. Bakeries should communicate to consumers on the bread packaging that the date is just an estimate; that bread (especially when preserved the best) can be eaten

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after that date; that bread used after the date can still be good; and that consumers should rely more on their senses to estimate the edibility of bread. Also, they could provide tips for consumers how to use bread past their best days, for example by giving recipes how to utilize dried bread.

The actions for bakeries are summarized in Table 3, outlining also the stakeholder(s) involved, the timeframe for the implementation (where short refers to less than two years, medium to 2-5 years and long to over 5 years), easiness of implementation, type of impact, as well as the level of the action according to EU Waste Framework Directive.

Table 3 – Suggested roadmap actions for bakeries in Finland

Action	Stakeholder(s) involved	Timeframe for the implemen-tation	Easiness of implemen-tation	Type of impact (beyond environmental)	EU Waste Framework Directive
1. Bread loss and waste analytics to direct strategic and operational activities	Bakeries	Short	Relatively easy	Economic	Prevention
2. Creating a zero-waste culture throughout the organisation	Bakeries	Short to medium	Easy with some effort	Social	Prevention
3. From tacit knowledge to shared knowledge (forecasting and production)	Bakeries	Short to medium	Easy with some effort	Social	Prevention
4. Waste reduction integrated into product development processes	Bakeries	Short	Relatively easy	Economic/ Social	Prevention / Re-use
5. Developing the brand of the bakery – assortment and waste-reducing products	Bakeries / (Retailers)	Medium	Relatively difficult	Social / Economic	Prevention / Re-use
6. Communicating to consumers about bread waste reduction	Bakeries / (Consumers)	Short	Easy	Social	Prevention

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Roadmap actions suggested for retailers in Finland

The roadmap for retailers in Finland consists of four actions (7-10), detailed below.

7. Developing ordering and forecasting

7a. Placing orders earlier to bakeries. In Finland, the retailers typically send their (daily) orders for bread 24 or 48 hours before they should be delivered. However, as the production process for bread usually takes more than 24 hours, the bakeries need to start making the dough before an order is placed. Bakeries typically make their own forecasts of the demand – how much bread should be put into production, how much resources should be used (e.g., labour, raw materials) in order to meet the retailers' orders. This imbalance in the ordering-production schedules often results in under- or over-production of bread at the bakeries. Therefore – and especially as forecasting systems for retailers develop (see point 7b) – it would be essential that retailers would place their daily orders for freshly-produced bread earlier.

7b. Developing the sales forecasting system (e.g., through Artificial Intelligence). Even though retailers in Finland already use highly educated forecasting systems to estimate their sales (the basis for placing orders for food suppliers), the stakeholder dialogues indicate that retailers would benefit from developing their forecasting system specifically for bread, i.e., to take into account the special characteristics of fresh bread compared to other food categories. As an example, even though a bread would have its best-before date in three-to-five days, consumers often choose the freshest bread which leaves those packages with nearby best-before dates unsold. This customer preference is not always taken into account in the ordering, according to some experiences heard from the bakeries. Also, detailed analysis of any deviations and/or problems in the forecasting system is encouraged in order to make it a constantly learning system, specifically about the demand for bread.

7c. Evaluating the role of humans and automatics. In Finland, the role of humans and automatics in both forecasting and ordering systems varies from retailer to retailer. Some have chosen more automatic systems whereas others have some human labour involved. All these strategies leave room for an error, and therefore it is suggested that the role of automatics and humans is constantly evaluated at retailers – based also on feedback from bakeries – in order to come up with the most accurate system.

7d. Developing solutions for bakeries to offer surplus batches. In the stakeholder dialogues, the bakeries felt that currently there are not necessarily very agile solutions to offer surplus batches they might have to retailers. Therefore, it is suggested that retailers should develop solutions for bakeries (and/or other food suppliers) separate from their regular daily ordering system, that would enable bakeries to offer any surplus batches from their production. Currently, much of this work is done by telephone, as bakeries call their local retailers. However, a technical solution

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such as a platform could be a feasible option to implement this. On the other hand, this action might incur a risk that these surplus batches result in more surplus bread at the retailers.

8. Improved mutual sharing of information

Bread waste and its reduction measures to be included on the agendas of regular meetings between bakeries and retailers. Currently – even though not part of daily information sharing – it seems that there are regular meetings between retailers and bakeries where they discuss for example the sales of the products. However, it is suggested that the bread surplus and waste reduction measures at the bakery-retailer interface (e.g., related to accuracy of the orders, amount of bread waste/surplus at retailers, the width of product assortment) are given more focus on the agendas of these meetings. The stakeholder dialogues indicate that retailers and bakeries have different areas of knowledge that currently are not shared – but when shared could reduce the surplus and wasted bread at both bakeries and retailers. The bakeries have special knowledge on how to forecast the sales of their bread (e.g., how weather affects demand of bread) whereas the retailers have also access to customer data (e.g., through loyalty cards) and how demand for bread fluctuates in relation to other products. Mutual sharing of this information would foresee some improvements regarding bread surplus and waste at both retailers and bakeries.

9. Assortment management and empty shelves

9a. Optimising the width of the product assortment in the bakery section for fresh bread. Typically, in a large supermarket in Finland, the bread section consists of hundreds of different types of bread products. Usually there are some nationally recognised, high-volume products available throughout Finland that are set on the assumption that they can never run out-of-stock at the retailers, whereas the remaining assortment consists of regional or local specialties, often from other regions as well. However, managing this wide assortment has an effect on the amount of bread surplus and waste. Often the wider the product assortment, the more difficult the assortment management. Therefore, it is suggested that also retailers critically evaluate the width of their product assortments. Optimising the width of the product assortment could be based on analysing customer data, amount of bread surplus/waste, local bread culture, as well as customer wishes received. The supervisor or manager of the bakery section of the supermarket or store is also a key actor in this and thus should be involved in the decision-making.

9b. Communicating to customers about empty shelves (includes also shop-in-shop bakeries). Apart from some shop-in-shop bakeries, currently there are no signs signalling to customers that empty shelves in the bread section usually mean that there is no bread surplus or waste for that particular product. The signs should encourage customers to look for the next best alternative to their favourite bread (and that way, start experimenting with new bread flavours and bakeries). With data driven business, this concept could be even further developed in the future so that the signs dynamically create recommendations for available substitute products, for example based

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on an analysis of customer data. As the shop-in-shop bakeries and retailers' own baking units are in charge of filling their shelves, this action point concerns also shop-in-shop bakeries and retailers' own baking units.

10. Evaluation of purchase contract terms – the 'bread waste guarantee'

In Finland, the Food Market Act from 2018 states that retailers cannot return unsold food products to the supplier without paying for them. However, it seems that especially when bakeries have new products to offer to retailers, or when they are expanding their sales to new areas, bakeries want to take their share in the sales risk and possible risk of overestimating the demand. In these cases, a bakery and a retailer may jointly agree on using contracts (referred to as 'bread waste guarantees') where the retailer agrees to pay the bakery for only those items which have been sold. However, the unsold bread stays at the retailer and follows the same waste management stream as any other product. These arrangements, are however, somewhat problematic from the bread waste reduction point-of-view. Therefore, it is recommended that the 'bread waste guarantee' only to be used in special conditions and for as limited period as possible. As bread-specific forecasting methods (including AI) develop in the future, there might be less need for these agreements as the demand for new types of products can be forecasted with better accuracy both at bakeries and retailers.

The actions for retailers in Finland are summarized in Table 4, outlining also the stakeholder(s) involved, the timeframe for the implementation (where short refers to less than two years, medium to 2-5 years and long to over 5 years), easiness of implementation, type of impact, as well as the level of the action according to EU Waste Framework Directive.

Table 4 – Suggested roadmap actions for retailers in Finland

Action	Stakeholder(s) involved	Timeframe for the implemen-tation	Easiness of implemen-tation	Type of impact (beyond environmental)	EU Waste Framework Directive
7. Developing ordering and forecasting	Retailers (Bakeries)	Short to medium	Easy with some effort	Economic	Prevention
8. Improved mutual sharing of information	Retailers Bakeries	Short	Relatively easy	Economic / Social	Prevention
9. Assortment management and empty shelves	Retailers (Consumers)	Short to medium	Relatively difficult	Economic / Social	Prevention
10. Evaluation of purchase contract terms – the 'bread waste guarantee'	Retailers Bakeries	Short	Easy	Legal	Prevention

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Roadmap actions suggested for other stakeholders in Finland

Finally, five actions (11-15) are suggested in the roadmap for other stakeholders, detailed below.

11. *Testing and giving specific information on the quality of raw material (e.g., flour) for each batch (SUPPLIERS OF RAW MATERIALS)*

    The quality of raw materials used was perceived to be essential. Some of the largest bakeries have their own mills to source flour from, but a majority of the bakeries rely on external suppliers. Especially due to the war in Ukraine, bakeries – especially those with gluten-free products – are now struggling to find suppliers of quality raw materials. The problem from the bread loss and waste point-of-view is that quality may vary from batch to batch and supplier to supplier, so that bread recipes or production equipment may need adaptation to maintain the quality. Stakeholder dialogues revealed that bakeries do not always receive as detailed information (specifications) of the materials as they would like from the suppliers. This creates problems in the bread production, as a previously used recipe might not work for the raw material with different specifications, which creates second-grade products or even bread losses or waste.

12. *Easing on legislation related to food labelling for those bakery products that re-use bread losses, waste or surplus from elsewhere in the production (POLICYMAKERS)*

    The legislation on food labelling was perceived especially in small and medium-sized bakeries to create barriers to utilise surplus or second-grade material back in production. The food labelling legislation states how the ingredients list (including allergens) as well as the nutrient profile of the product should be printed on the packaging. Due to the recent problems with availability of raw materials, the policymakers have eased on some of the legislation. In order to encourage bakeries to create new solutions to utilise surplus in production, products with this production method could be given a status where food labelling is easier and the legislation eased (for example, with a label 'Waste-reducing product').

13. *Increasingly communicate to bakeries about food waste reduction (THE FINNISH BAKERY FEDERATION)*

    It is suggested that FBF increasingly communicates about bread waste reduction actions to their members and facilitates formation of networks for those members interested in sharing their best practices (e.g., through mentoring). FBF's activities (e.g., publishing a bakery trade magazine eight times a year and organising events for its members) make them a key player to communicate about food waste reduction actions to their member bakeries.

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14. *Develop food packaging especially for bread (FOOD PACKAGING SUPPLIERS)*

As a majority of bread in Finland is sold pre-packaged, the role of food packaging suppliers is important in order to improve the preservability of bread. It is recommended that food packaging suppliers develop their packaging especially for bread also from the bread waste reduction point-of-view. This can be done in cooperation with bakeries, as they possess knowledge about the special properties of various types of bread.

15. *Develop new solutions to address bread surplus redistribution and re-use (VARIOUS ACTORS, SUCH AS FOOD BANKS)*

A recent act (978/2021) on waste in Finland (as of December 1st, 2021)[4] requires actors in the food industry to redistribute their surplus food primarily to human consumption unless this incurs food safety risks or unreasonable costs for the actor. However, currently there are regional differences in how efficiently surplus bread can be distributed to people in need. In some areas, the challenge is that food banks receive so much surplus bread from bakeries that they reject bread donations from retailers. In these cases, new solutions should be developed for retailers' surplus bread. These solutions should be mostly directed to the higher levels of the waste hierarchy, so that if donation to humans is not possible, bread is for example used to feed animals or processed into other products utilised by humans (such as brewing beer from surplus bread). In some areas, the food banks would like to receive more bread donations than they currently have. In this case, it is suggested that better coordination between food banks and retailers/bakeries is developed.

The actions for other stakeholders in Finland are summarized in Table 5, outlining also the stakeholder(s) involved, the timeframe for the implementation (where short refers to less than two years, medium to 2-5 years and long to over 5 years), easiness of implementation, type of impact, as well as the level of the action according to EU Waste Framework Directive.

Table 5 – Suggested roadmap actions for other stakeholders in Finland

Action	Stakeholder(s) involved	Timeframe for the implemen-tation	Easiness of implemen-tation	Type of impact (beyond environmental)	EU Waste Framework Directive
11. Testing and giving specific information on the quality of raw material (e.g., flour) for each batch	Suppliers of raw materials / (Bakeries)	Short to medium	Easy with some effort	Economic	Prevention

[4] https://finlex.fi/fi/laki/alkup/2021/20210978

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12. Easing on legislation related to food labelling for those bakery products that re-use bread losses, waste or surplus	Policymakers	Short to medium	Easy with some effort	Legal	Re-use
13. Increasingly communicate to bakeries about food waste reduction	The Finnish Bakery Federation / (Bakeries)	Short	Easy	Social	Prevention / Re-use
14. Develop food packaging especially for bread	Food packaging suppliers / (Bakeries)	Short to medium	Easy with some effort	Economic	Prevention
15. Develop new solutions to address bread surplus redistribution and re-use	Food banks / NGOs / Municipalities / Circular economy businesses	Short to medium	Relatively easy	Social / Economic	Prevention / Re-use

Summary

In Finland, the bakery market consists of two large industrial bakeries and several hundreds of smaller bakeries. Typically for Finland, fresh bread is sold pre-packaged mainly at retailers' stores. The retailers are also mainly responsible for the further management of any surplus bread. It is important to note that from bread waste reduction point-of-view, the actions that can be taken by small bakeries are different from the larger bakeries. For example, larger bakeries often already have their quality control systems in place which allow also the systematic measurement, tracking, and analysis of bread loss and waste during the production. Also, larger production lines enable large bakeries to utilize the waste from production to be re-used in the production of the same item, whereas in smaller bakeries where a wider variety of products are produced, this solution is not always possible. In the roadmap for Finland, 15 actions in total have been suggested – six for bakeries, four for retailers, and five for other stakeholders. The roadmap is based on discussion on the current problems and future solutions for bread loss, waste and surplus reduction and prevention in the bread value chain in Finland. These discussions were conducted in four online workshops organised by LOWINFOOD researchers for small and medium-sized bakeries as well as in six interviews for mainly large bakeries and four interviews for retailers.

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4. Roadmap for tracking and reducing bread waste in Sweden

Description of the bakery sector in Sweden

The bakery sector in Sweden includes bakeries of different sizes, applying different structures to their organisations with regards to, for example, sales channels and geographical areas of operation. Pre-packaged bread constitutes the largest share of the bread market, corresponding to approximately 80% of it, and the rest is made up of mainly smaller bakeries and artisan bakers (Brancoli, 2021). Out of the share of pre-packaged bread, the three market leading bakeries in the country together account for about 85% of it while the remaining 15% are mainly comprised of retailers' private labels and smaller bakeries. Geographically, smaller bakeries operate on a local or regional level depending on the size of the bakery while the three market leading companies supply their products across the country.

The three largest bakeries, along with a few more local bakeries, apply a reversed logistics to their operations, known as a take-back agreement (TBA) model. This entails a responsibility of the bakery to order, deliver and place their products in the supermarket shelves as well as to remove any unsold bread. Apart from the practical issues of delivering and removing their products, the bakeries operating according to the TBA business model are also held responsible for the unsold bread, both financially and from a waste management perspective. This way of managing bread infers that bread surplus is separated from other waste generated at the retailers, which opens up possibilities for higher valorisation measures regarding the waste. This is considered a strength of the TBA. Meanwhile, when all management of the bread falls into the hands of the bakeries, retailers become limited in their abilities to take any waste reducing action themselves. When also lacking clear economic incentive to do so, the power dynamic of the TBA also becomes a risk factor for increased waste at the supplier-retailer interface where the retailers have the power to decide which brands and which breads are sold at their stores.

The different sides to the TBA business model, currently applied as common practice in the greater part of the Swedish bakery sector, have previously been identified as a source of polarising concerns among stakeholders. Some believe it to be the best way possible to both enable bakeries to satisfy their customers and keep waste levels down. Others believe that the TBA is instead a key driver of waste in the business and that there are other ways to manage the bread that would lead to reduced waste levels while still maintaining customer satisfaction. The Swedish stakeholder dialogue of T3.2 have therefore to a great extent revolved around the issues of the TBA business model and whether its nature keeps the bread waste to the lower margins or if it is rather a driver of it. Additional issues on measures that could be taken regardless of applied business model have also been discussed, providing suggestions with diverse degrees of foreseen urgency, feasibility and waste reduction potential.

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Relevant stakeholders for the roadmap in Sweden

Since the Swedish bread supply is mainly concentrated to a few large actors, those can be considered as the primary stakeholders for reducing waste along the bread value chain – especially regarding post primary production stages. These stakeholders, who are directly involved in the bread value chain and who are seen as relevant for reducing waste within it, include bakeries, retailers and logistics partnering companies. Since three bakeries together account for about 85% of the market for pre-packaged bread, or about 68% of the total bread market, these are naturally the main stakeholders to consider when addressing issues regarding bread waste reduction at any larger scale. Similarly for the retailers whose role is to sell the bread to the consumers, the entire market is composed of only a few companies which are all relevant to include in the discussions. Apart from bakeries and retailers there are also two main logistics partnering companies who deliver products to the retailers. One is contracted by bakeries and supplies only bread and bakery products while the other supplies all kinds of products to primarily two retail chains. Considering the essence of logistics which the bread value chain entails, these stakeholders are also important to involve in the discussions. Additionally, local actors, such as the charity organisation 'City Mission' or farmers who can provide alternative pathways for waste management at higher levels of the food waste hierarchy are also relevant to consider. As are policymakers who are not directly involved in the value chain but can provide support for the ones who are.

Out of the possible relevant stakeholders listed above, retailers, logistics partners and the three market leading bakeries along with one smaller one, have been involved in the discussions forming the roadmap. As described in D3.1, discussions with Swedish stakeholders were held as one-on-one conversations through three rounds of discussions. In the first round, which took place between November 2021 and February 2022, nine companies (four bakeries, four retailers and one logistics partner) participated. The topics discussed revolved around the participants' views on bread waste, drivers behind it and possible ways to prevent and/or reduce it. Due to external circumstances, such as supply issues following the war in Ukraine, as well as limited commitment to the project and time constrains, two of the previously engaged participants dropped out from the second round of discussion (February 2022–May 2022). With the participants still engaged, issues and solutions suggested by the stakeholders in the first round were discussed further. The third and final round of the stakeholder dialogue took place in August and September 2022. The discussions focused on the content of the roadmap where participants were asked to elaborate on their previous suggestions of waste reducing actions and put them in context of feasibility, timeframe and foreseen impact on waste levels.

Roadmap actions suggested for bakeries in Sweden

During the Swedish stakeholder dialogue, general drivers of bread waste were identified and, from that, multiple suggestions on how to reduce and prevent waste generation along the value

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chain were presented and discussed. All suggested actions for bakeries are summarised in Table 6. For the bakery production stage, losses of bread were explained to be associated with equipment and machinery deficiencies, the processes of testing new products as well as start-up and shutdown of machinery. Suggested waste reducing actions therefore revolved around production line improvements, including upgrading of equipment and revising quality standards. However, considering the large scale in which the participating bakeries operate in, upgrading any equipment is associated with large investments and is therefore implemented with thorough contemplation and regarded to be a long-term solution with rather low feasibility, although with a foreseen big impact on waste levels. Instead, a more feasible and cost-efficient action was presented – to examine issues related to quality requirements in the production line. Identifying waste reducing actions where the efficacy and the payback of the investment is sufficient, for example, what could be done with bread that does not meet the quality standards or revise what the quality standards actually infer, is explained to be a more feasible way of reducing production bread loss in the short-term.

Although having its potential to improve, the production stage is according to the participating stakeholders not the primary source of bread loss and waste. The most frequently suggested actions for bakeries were concentrated to the supplier-retailer interface, partly because this is where all participants are operating, but also because it is considered as somewhat more feasible to enforce actions here rather than in production or waste treatment stages. The suggested actions included limiting product assortments and volumes put in the shelves, standardising communication of 'best-before' dates instead of 'date of production' on the packaging, and to test alternative models for bread supply that does not rely on TBA practices. From the discussions it was, however, clear that apart from agreeing upon the issues of product assortment and shelf volumes, the stakeholders had divided opinions.

One factor driving the generation of bread surplus and waste, frequently mentioned in the dialogue, is the wide assortment of products presented in the supermarket shelves. For the bakeries, a wide assortment is important due to sales aspects and high competition of shelf space, and for the retailers a wide assortment is important to attract consumers. The issue itself is explained to lie both in a broad variety of different types of bread, differing between bakeries, and in that several bakeries along with the retailers' private labels all offer the same kind of bread for other bread types. To solve the issue, bakeries explain that they continuously are updating their product portfolios where they replace low rotating products with new ones, and all stakeholders declare to have continuous dialogues about the width of the assortment and possible ways to adjust it in order to reduce surplus and waste. However, the efficacy of these dialogues is told to differ between different stores, mainly depending on the individual retailer's interest in the subject which presents a room for improvement. What must also be considered regarding product assortment is the competition between different bakeries and that a functioning competition is an essential aspect of the Swedish market system which makes it difficult to enforce any greater changes.

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Modifications applied to the current TBA model was another suggested action for reducing bread waste. Testing or implementing a new business model without the TBA in place would possibly reduce surplus and waste volumes considerably according to some participants, while others believe that such action would rather lead to increased bread waste. A shift would nevertheless require high effort from stakeholders and possibly outside support through, for example, legislation or policy recommendations. Furthermore, as long as opinions within the business are divided as they currently are, the stakeholders advocating for a shift also recognise that it is in the end very unlikely to happen when not all actors involved are open to test or implement an alternative system. They therefore recognise that a focus on improvements within the existing practices would be more efficient and feasible for achieving a reduction of bread waste.

In contrast to changes in the current business model, the suggestion to standardise communicating only the best-before date and not to emphasise the production date on the packaging is an action that bakeries could enforce with a relatively higher feasibility. Today, both ways of communicating are applied where commonly bread that is frozen after production uses the 'best-before' option, and bakeries who transport and deliver their bread fresh opt for emphasising the 'date of production' alternative (although also including the best-before date in the margin). Emphasising the freshness of the product (date of production) rather than when its quality starts to decrease (best-before date) is by several participants assumed to influence consumer behaviour negatively and to contribute to wastage, which it is why they suggested that communicating the best-before date should be set the standard for bakeries in general. However, for bakeries who previously have been using bake day as a primary source of communicating the freshness of the bread, this could be somewhat difficult since they internally must coordinate their supply and adjust ways of operating in certain areas. Additionally, some bakeries are very committed to relying on the production date, as are many consumers who want the information of when the bread is produced rather than the alternative. The timeframe and feasibility of standardising best-before date therefore depends on the bakery and the scale in which it would be implemented. If the action were to be enforced throughout the entire business, the timeframe would likely be longer and with a lower feasibility.

Other suggested actions to be taken by bakeries or logistics partners who are responsible for the management of bread surplus and waste were targeted towards the waste treatment. In the current system, which is assumed to allow for higher valorisation methods to be applied, the bakeries direct their surplus bread primarily to animal feed or ethanol production. According to the waste hierarchy of EU's Waste Framework Directive, directing the surplus bread to animal feed is the better option out of the two. However, some bread, either losses from production or surplus from supermarkets, is also directed to reuse for human consumption through local collaborations with actors such as the City Mission, which is a more preferred option according to the waste hierarchy as well as the stakeholders. Surplus bread or dough from production also has a possibility to be upcycled and used as an input to new food products. Suggestions and declared intentions from participants are therefore to increase these kinds of collaborations and

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seek for alternative waste management options. To which extent this is possible and what impact it would have highly depends on the geographical location that the bread is derived from; if such options are locally available and how much of the bread can be managed and actually used for the intended purpose.

Table 6 – Suggested waste reducing actions for bakeries in Sweden.

Action	Stakeholder(s) involved*	Timeframe for the implementation	Easiness of implementation	Type of impact (beyond environmental)	EU Waste Framework Directive
Upgrade production equipment	Bakeries	Long-term	Difficult	Economic	Prevention
Revise quality standards	Bakeries	Short-term	Medium	Social / Economic	Reuse / Prevention
Limit assortments	Bakeries / Logistic partners / Retailers	Short-term	Medium / Difficult	Social / Economic	Prevention
Standardise best-before date	Bakeries / Policymakers	Long-term	Difficult	Legal / Social	Prevention
Alternative waste management	Bakeries / Logistic partners / Local actors (charities)	Short to long-term	Medium / Difficult	Social / Economic	Reuse
Alternative model for commercial practices (without TBA)	Bakeries / Logistic partners / Policymakers	Long-term	Difficult	Legal / Possibly other	Prevention

Roadmap actions suggested for retailers in Sweden

A consensus amongst the bakeries is that the more data they have access to, the more accurate forecasts and orders they can make which are important aspects for keeping overproduction and thereby waste rates down. With the TBA system allowing for the bakeries to have a good insight to sales data regarding how much bread is sold and how much is returned, most information is available. However, one point of improvement that bakeries explain would allow for even better forecasting and also better planning of routes is the access to Point of Sales (POS) data which is owned by the retailers. This information could help optimising deliveries, i.e., when the bread shelves need to be restacked, and complementing the data bakeries already have for ordering volumes. The argument is supported by the logistics partner in the value chain and the retail chains also acknowledge that access to data is an important aspect when working to optimise orders and reduce overproduction as well as returns and waste. However, the solutions to this

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issue proposed by the retail chains are somewhat diverse. Some consider the best solution to be that instead of bakeries managing the orders, each store should manage their own orders since they have good access to all data required for optimising prognoses and that the automatic ordering system they use for other products would help facilitate this. Another participant states that sharing POS data with the bakeries would be a good solution to reduce bread surplus, but that it would require all retail chains to commit to such an approach for it to be efficient since during one round of deliveries the suppliers visit different retail chains. Other retail chains, however, explained this to be difficult to achieve due to organisational structures of the chains where each store or region stands as the owner of its own data and a central decision that all stores must share their data is difficult to enforce from a legal perspective. Sharing and getting access to POS data is therefore considered an action to be somewhat difficult to accomplish as a general solution, but at a local level suppliers and retailers could make own arrangements which in a way is what any central agreement would lead to in the end as well.

Like the issue on product assortment, limiting the volumes of bread that are placed in the supermarket shelves is something several participants have mentioned throughout the discussions as a measure to reduce bread surplus and waste. The bakeries explain that the issue primarily lies in a demand from the consumers who want to have an extensive assortment of products and not want to be presented with empty or half-empty shelves in the stores. This can in turn lead to store managers then wanting to keep the shelves stacked at all times to attract consumers which results in a pressure on the suppliers to overfill the shelves. Suppliers describe themselves to be somewhat restricted in their abilities to influence this issue alone and therefore promote a collaborative approach together with the retailers to solve it. One concrete action to deal with the request for high shelf volumes, suggested by all stakeholders, is to adjust the shelves in the supermarkets where the bread is placed by two easy measures. One would be tilting the shelves which would allow for bread to slide to the front edges to provide the impression that the shelf is stacked and that the consumer is always presented with fresh bread. The second suggested measure is to place pictures of bread in the bottom of each shelf which also would give an illusion of constantly filled shelves. These actions would enable suppliers to adjust the volumes of bread in stores to expected sales while the store managers and consumers would be visually satisfied with filled shelves and could reduce their demands for overstocked shelves. However, participants recognise that enforcing this action at a larger scale will take time, although probably without being too difficult to achieve with regards to receiving compliance amongst concerned actors. A summary of suggested actions directed to retailers is presented in Table 7.

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Table 7 – Suggested waste reducing actions for retailers in Sweden.

Action	Stakeholder(s) involved	Timeframe for the implementation	Easiness of implementation	Type of impact (beyond environmental)	EU Waste Framework Directive
Share POS data	Retailers	Short- to mid-term	Medium	Economic / Legal	Prevention
Reduce demands	Retailers / Consumers	Short- to long-term	Medium	Social / Economic	Prevention
Adjust shelves	Retailers / Bakeries / Logistics partners	Mid- to long-term	Medium	Social / Economic	Prevention

Roadmap actions suggested for other stakeholders in Sweden

The most essential aspect required for reducing waste along the bread value chain in Sweden is better and closer collaboration between actors directly involved in the chain, i.e., bakeries, retailers and logistics partnering companies. According to the stakeholders, a central constraint in the current system is the lack of overall collaboration and communication. Regionally, suppliers and some retailers can show a good collaboration in for example discussions on shelf volumes, assortments and data sharing, while at other places there are little to no sufficient discussion at all. It would therefore be a valuable action to include external support that could coordinate standpoints and requests from all actors and facilitate a good, common discussion. How this kind of action would influence the actual waste is difficult to estimate. It would still be up to each company, bakery as well as retailer, to take responsibility and to enforce any waste reducing action. Additionally, the feasibility of finding or assembling an organisation of such kind is also unclear. However, there are already established trade associations within the bakery sector as well as in the retail sector. Promoting these organisations to join forces on the point of issue regarding bread could be a possible solution.

Besides the waste reducing actions within the line of supplier-retailer interface, stakeholders also acknowledge the room for improving the management of bread taken back from the retailers. Today, the vast majority of bread unsold at the supermarkets is directed to ethanol production and some also to animal feed. In some respects, these are good options, but in others there might be better alternatives available. Finding and, again, establishing collaboration with local external actors that can take care of the surplus bread could for instance reduce transports and provide treatment options higher up in the food waste hierarchy. A commonly mentioned alternative direction is towards charity organisations such as the City Mission. Even though a source reduction of waste is the most preferable option, stakeholders explain that when operating under TBA, a certain level of surplus is always desirable for the sake of profit and keeping customers satisfied. Some stakeholders also elaborated on the role of legislation in the waste management;

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that there should be some sort of consequence if exceeding a certain level of waste or surplus at the retailers. Finding a good way to manage the returned (surplus) bread is therefore an important aspect for utilising the input resources to the most sufficient degree. Organisations like the City Mission becomes an important actor in this regard since they then must care for the surplus bread and manage it in a way that allows for fulfilling the intended purpose.

Table 8 presents the suggested actions directed to other stakeholders associated with the Swedish bread value chain.

Table 8 – Suggested actions for other stakeholders in Sweden.

Action	Stakeholder(s) involved	Timeframe for the implementation	Easiness of implementation	Type of impact (beyond environmental)	EU Waste Framework Directive
Coordinate and facilitate better discussion / collaboration	Bakeries / Logistics partners / Retailers / Trade associations	Short- to long-term	Easy / Medium	Social / Economic	Prevention / Reuse
Improve waste management	Bakeries / Logistics partners / Local actors (charities)	Mid- to long-term	Medium / Difficult	Social / Economic	Reuse

Summary

Altogether nine companies active in the Swedish bread value chain took part in the discussions and provided their views on drivers of bread waste and possible ways to reduce it. Opinions on issues and drivers of bread waste were found to be both unanimous and dividing between stakeholders, where the disagreements primarily referred to the being or non-being of the TBA business model as a common practice. This issue was however declared to be difficult to act on since opinions on the matter differ between stakeholders. Some consider that a system without the TBA in place would be both possible to achieve and result in less bread waste, while others consider this suggestion to be very difficult to achieve and that it also would result in increased waste levels. To address this discord between stakeholders, an upcoming report (due in October 2023) will, as part of T3.1 in the LOWINFOOD project, present findings from simulations that test different business model scenarios applied to the Swedish bread supply chain, including ones with and without the TBA in place. The objective of T3.1 is to demonstrate how the different business model scenarios would affect waste levels in the Swedish bread supply chain and from that be able to provide empiric support to future discussions amongst stakeholders.

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The different opinions between stakeholders participating in the dialogue were also found to be an underlying cause to insufficient discussions amongst the actors in the value chain. The general conclusion was therefore that more plausible waste reducing actions should focus on those feasible to implement within the current system. Suggested actions within the TBA system included improving production lines, with a primary focus on quality standards and equipment upgrading, reducing assortments and volumes put in the supermarket shelves including the demand for it, communicating best-before date instead of production date, adjusting bread shelves at retailers, making data more transparent through sharing POS data and, finally, finding alternative pathways for surplus bread from bakeries as well as for bread taken back from the retailers. Common denominators between most of these suggested actions are collaboration and communication. A key factor for making changes and reducing bread waste in the Swedish bread value chain is therefore to find better ways for stakeholders to collaborate which might require the support of external actors. If this were established, achieving a reduction of bread waste would very likely become more feasible and successful. Figure 3 illustrates a summary of the suggested actions and which actor/-s each of them relates to.

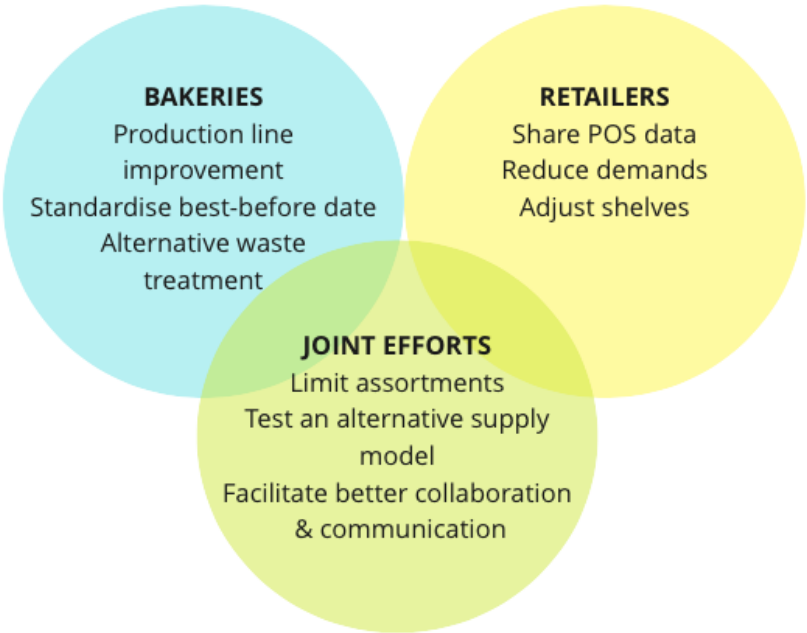

Figure 3. Output of the Swedish stakeholder dialogue; suggested actions for reducing waste in the Swedish bread value chain.

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5. Conclusions

Bread is an important part of food culture in Europe, and unfortunately it is also one of the most wasted food categories. The causes for this vary by market, but some of the reasons can be traced to lack of collaboration between actors along the value chain. In T3.2 of LOWINFOOD, an objective was set to identify new solutions to bread loss and waste prevention and reduction by organising stakeholder dialogues for bread value chain actors in Italy, Finland, and Sweden. The dialogues included discussions about the current hotspots of bread loss and waste and how they could be addressed. As a result of the dialogues, three roadmaps were developed – one for each country. Even though the actions in each roadmap are somewhat different, some joint conclusions can be made.

First, systematically *measuring the amount of bread loss, surplus and waste is the first key action* to be implemented. During the dialogues it has become apparent that there are differences not only between countries in how advanced the actors are in measuring and tracking these, but also between actors within a country. Whether a small or a large company, whether a bakery or a retailer, systematically measuring and tracking the wasted amounts is the key to directing attention and developing solutions to the issue. Increased requirements for Member States to report their food waste amounts to the European Commission are directing actors towards measuring their waste, but benefits of this for individual businesses must be made more explicit. It is however not only *how and what* the actors measure, but also *how the generated data is then best utilised* to prevent the waste in the first place.

Second, fresh bread as a food category has some unique characteristics that create challenges for its production and sales from the waste reduction point-of-view. Production of bread requires a relatively long time period – usually the production process must be started before the orders from customers (retailers or consumers) have come in. Therefore, the role of forecasting the demand as well as the timeframe for placing the orders is of essence. In order to make the production-demand ratio as accurate as possible, *orders should come early* and *forecasting methods* for the sales should be further *developed*.

Third, the stakeholder dialogues revealed differences between how the markets for bread function in the three countries. Market practices, such as various business models, agreements between bakeries and retailers, or different sales channels create various market-level norms and day-to-day practices that should be considered when developing actions and policies for the actors in the bakery sector. Also, understanding the different bread culture of each country is important. Despite these differences at the market level, the stakeholder dialogues have demonstrated that enhancing *cooperation among actors of the bread value chain* seems to be a promising strategy to create waste prevention actions. However, this strategy can be somewhat difficult to apply, as competition between actors is tough and often cooperation is perceived to

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hurt the competitive position of the actor. One practical form of cooperation suggested in the roadmaps is increased sharing of data between actors. It seems that *the more data and insights are shared between the actors in the value chain, the better* for bread loss and waste prevention.

Fourth, it is apparent from the roadmaps that *bakeries and retailers should start to take more responsibility in educating consumers* about the issues related to bread waste. This includes changing the type of date labels and communicating about their meaning, communicating about the role of empty shelves as well as giving advice how to preserve the bread the best at home. Also, when bakeries sell their products directly to consumers, the cooperation between them is crucial, for example to let consumers understand the value of the product and the importance to avoid producing surplus and waste.

Furthermore, re-use of surplus bread by humans and its effective distribution between bakeries, retailers, and charity organisations seems to incur some challenges in all three countries. Therefore, there is need to enhance *coordination between the actors involved in food aid* to improve the efficiency of redistributing the surplus to those in need. Institutions such as bakery associations or municipalities may help in this. Bakeries and retailers may be interested in cooperating with charity organisations to donate their surplus, but institutions and policymakers should provide them help, for example by creating infrastructures or giving incentives.

On a final note, preventing food waste can be at odds with companies' other business objectives, especially with economic goals, such as growth of business and increase in sales. Some of the actions suggested in the three roadmaps – such as cutting down on large assortment or aiming for empty shelves – include these value trade-offs that the stakeholders should be aware of and ready to solve. On the other hand, due to the war in Ukraine, currently many food system actors in Europe, including bakeries, are struggling with rising costs and poor availability of raw materials. Especially in this hard period, many bakeries can no longer bear the costs of wasting bread. Thus, it is time for bread value chain actors to direct their full attention to preventing and reducing food waste, as waste reduction improves not only the sustainability, but also the profitability of the company. In conclusion, we hope that many of the actions in the three roadmaps – despite the differences in the bread markets and cultures – are applicable to other contexts and thus offer potential to generate new ideas and learnings across countries in order to prevent and reduce bread waste and losses along the bread value chain.

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References

Associazione Italiana Bakery Ingredients (2022). AIBI: Pane alimento-rifugio anche nei momenti di crisi. https://www.assitol.it/aibi-pane-alimento-rifugio-anche-nei-momenti-di-crisi/

Benozzo, M. (2011). Il reso del pane nei rapporti tra panificatore e rivenditori al dettaglio: alimento, mangime, rifiuto. Rivista di Diritto Alimentare, 3.

Brancoli, P. (2021). Prevention and valorisation of surplus bread at the supplier-retailer interface. (Doctorial). University of Borås. [2022-04-25]

Brancoli, P., Lundin, M., Bolton, K., & Eriksson, M. (2019). Bread loss rates at the supplier-retailer interface – Analysis of risk factors to support waste prevention measures. *Resources, Conservation and Recycling, 147*, 128–136. https://doi.org/10.1016/j.resconrec.2019.04.027

Hietala, S., Riipi, I., Välimaa, A. L., & Kataja, J. M. (2018). Lainsäädäntötarkastelulla ruokahävikkiä pienemmäksi – Lexfoodwaste -hanke. [Food waste reduction by developing legislation – Lexfoodwaste project]. Publications of the Government's analysis, assessment and research activities 23/2018. Prime Minister's office. https://tietokayttoon.fi/documents/10616/6354562/23-2018-Lexfoodwaste.pdf

Hyrylä, L. (2021). *Leipomoala – paikallisuudesta kansainvälisyyteen* [*Bakery sector – from local to international]*. Centre for Economic Development, Transport and the Environment of Southeast Finland. (MEAE Sector Reports 2021:5). Ministry of Economic Affairs and Employment of Finland. http://urn.fi/URN:ISBN:978-952-327-998-8

I.Stat (2017). Occupazione per branca di attività e popolazione. Istituo Nazionale di Statistica, Italy. Data available online at http://dati.istat.it/

Korpela, E. (2020). Leipäjonojen piti olla väliaikainen tuki, mutta ruoka-apua tarvitsee yhä suurempi joukko – tutkijat kertovat, kuinka köyhyys nujerretaan. YLE News (The Finnish Broadcasting Company), October 12th, 2020. https://yle.fi/uutiset/3-11571688

Leipätiedotus (2022a). Suomalainen rikas leipäkulttuuri [Finnish rich bread culture]. Press release, July 5th, 2022. https://www.leipatiedotus.fi/medialle/tiedotteet/suomalainen-rikas-leipakulttuuri.html

Leipätiedotus (2022b). Kotimainen vaalea ruokaleipä maistuu suomalaisille [Finns like the taste of domestic white bread]. Press release, April 5th, 2022. https://www.leipatiedotus.fi/medialle/tiedotteet/kotimainen-vaalea-ruokaleipa-maistuu-suomalaisille.html

Närvänen, E., Mesiranta, N., Mattila, M., & Heikkinen, A. (2020). Introduction: A framework for managing food waste. In E. Närvänen, N. Mesiranta, M. Mattila, & A. Heikkinen, *Food Waste Management* (pp. 1-24). Palgrave Macmillan. https://link.springer.com/chapter/10.1007/978-3-030-20561-4_1

NielsenIQ (2022). Grocery shop directory 2021. Press release, May 19th, 2022. https://www.epressi.com/tiedotteet/kauppa/paivittaistavaramyymalarekisteri-2021.html

Riipi, I., Hartikainen, H., Silvennoinen, K., Joensuu, K., Vahvaselkä, M., Kuisma, M. & Katajajuuri, J. M. (2021). Elintarvikejätteen ja ruokahävikin seurantajärjestelmän rakentaminen ja

LOWINFOOD has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101000439.

ruokahävikkitiekartta. Luonnonvara- ja biotalouden tutkimus 49/2021. Luonnonvarakeskus. http://urn.fi/URN:ISBN:978-952-380-241-4

Ruoka-apu.fi (2022). Ruoka-avun tilannekatsaus: Kevät 2022. Ruoka-apu.fi and Sininauhaliitto. Published April 28th, 2022. https://ruoka-apu.fi/wp-content/uploads/2022/04/Ruoka-avun-tilannekatsaus-2022.pdf

Suomen Leipuriliitto (n.d.). The Finnish Bakery Federation. https://www.leipuriliitto.fi/in-english/

Tammilehto, P. (2019). Kaksi suurta kisaa markkinaykkösen paikasta – Fazer ja Vaasan hallitsevat puolta Suomen leipäkaupasta. Kauppalehti, June 14th, 2019. https://www.kauppalehti.fi/uutiset/kaksi-suurta-kisaa-markkinaykkosen-paikasta-fazer-ja-vaasan-hallitsevat-puolta-suomen-leipakaupasta/aa4f4fdf-8ef9-438e-bb5b-1abf14366b43

LOWINFOOD has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101000439.