BREADCRUMB

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DELIVERABLE 2.1

EU Estimates of FW generated due to Marketing Standards and Sense making

Project title	**BR**inging Evidence-b**A**se**D** food **C**hain solutions to prevent and **R**ed**U**ce food waste related to **M**arketing standards, and deliver climate and circularity co **B**enefits		
Project acronym	BREADCRUMB		
Call topic	HORIZON-CL6-2023-FARM2FORK-01		
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D2.1 – EU ESTIMATES OF FW GENERATED DUE TO MARKETING STANDARDS

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LIST OF ABBREVIATIONS

Abbreviation	Description
GA	Grant Agreement
FW	Food Waste
MS	Marketing Standards
FMS	Food Marketing Standard
FMSIG	Food Marketing Standard Interest Group
EAB	External Advisory Board
WP	Work Package
T	Task
EU	European Union
PP	Primary Producer
PM	Processor and Manufacturer
FL	Food Loss
FLW	Food Loss and Waste
FW-FMS	Food Waste due to Food Marketing Standards
FSC	Food Supply Chain
JRC	Joint Research Centre
FAO	Food and Agriculture Organization

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EXECUTIVE SUMMARY

This report scrutinizes the intricate relationship between food waste (FW) and food marketing standards (FMS). The task set out to identify and map the current landscape of food waste data, and challenges associated with accounting methodologies on FW directly related to marketing standards at various stages of FSC at EU level. This report has explored the multifaceted dynamics of FW with distinction at five different commodities: Fruits and vegetables, Eggs, Meat (bovine, poultry), Cereals and Fish.

The research employs a mixed-methods approach to data collection, utilizing surveys and interviews with stakeholders at the EU and national level across five commodities of the BREADCRUMB project. The methodology encompasses a literature review of qualitative and quantitative data reported on FW due FMS, nine in-depth qualitative interviews specifically designed for this task 2.1, in-depth interview data and survey data from 106 participants related to task 2.1 in the collaborative work with WP1 task 1.3.

Despite a considerable body of literature associating marketing standards with FW, it can be concluded that there is a considerable lack of reliable and quantifiable data. This in turn significantly hampers the ability to comprehensively assess the environmental, economic, and social ramifications of this issue. Consequently, the current understanding of the magnitude of FW consequences remains limited. The scarcity of quantifiable data was exemplified by the survey result that showed that only 25% of stakeholders measure FW in general. Furthermore, this is even lower if we factor in the tracking of rejected food products which are the result of marketing standards. In addition, a number of interviews request were rejected due to their inability to provide data of such. However, with a limited number of data available as well as the top-of-the-head approximations from interviewees reveal alarming figures. FW can be as high as 15-20% while filleting and trimming due to the marketing standards in fish. Moreover, the findings reveal significant inconsistencies in the definitions, measurements, perceptions and uncoordinated interlink and lack of effort regarding FW due to marketing standards.

This research report contributes to the development of the discourse and the understanding of FW management by highlighting the urgent need for standardized methodologies and collaborative approaches among all stakeholders in the FSC. It emphasizes the importance of integrating waste management into operational strategies, rather than treating it as a secondary concern, thereby paving the way for innovative solutions and improved data collection practices.

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1. INTRODUCTION

1.1 BREADCRUMB's objectives and approach

The general objective of the BREADCRUMB project, as outlined in the Grant Agreement (GA), is to: *"Provide an empirical, evidence-based understanding of the purpose and nature of food marketing standards (FMS) and their role in generating food waste (FW), propose interventions that balance the goal of reducing FW with other objectives of the standards, and support food chain stakeholders in maximizing the business potential of suboptimal foods"* (Grant Agreement, Part B, p. 3/41).

The GA outlines the following steps for the project: "(i) develop a comprehensive understanding of marketing standards and identify those most relevant to FW generation; (ii) produce evidence-based estimates of the FW generated as a result of these standards; (iii) offer solutions to mitigate the negative effects of marketing standards on FW, grounded in a solid understanding of the mechanisms driving FW and the trade-offs involved with other objectives (re-balancing marketing standards); (iv) enhance the market potential of 'suboptimal' foods; (v) provide guidance to food businesses, consumers, standard owners, and policy makers on how to prevent or reduce FW related to marketing standards" (Grant Agreement, Part B, p. 7/41).

The BREACCRUMB project targets five food commodities; fruit and vegetables, cereals, fish, meat and eggs.

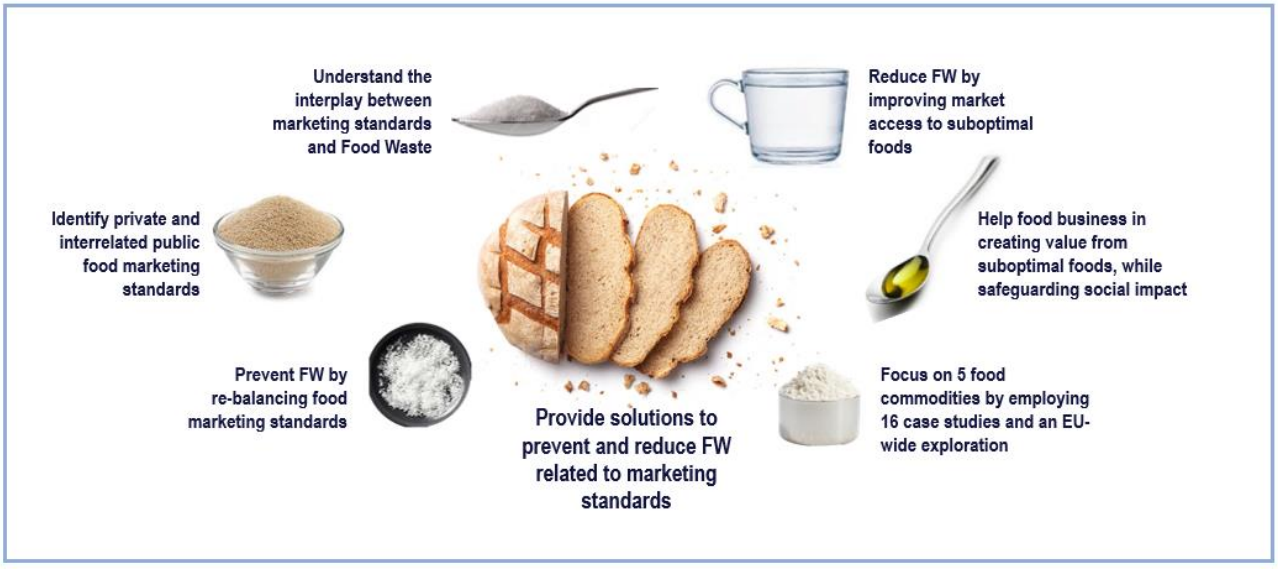

Figure 1: BREADCRUMB project at a glance

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(Source: Grant Agreement, Part B, p.5/41)

To meet its objectives and follow the project's methodological framework, BREADCRUMB will build on existing research linking marketing standards and FW, generate new evidence on the impact of these standards on FW, apply advanced modelling techniques that combine behavioural and economic theories to develop solutions, evaluate the business potential of non-optimal but still edible food based on research findings, and integrate the research outcomes into innovative products (Grant Agreement, Part B, p. 7/41).

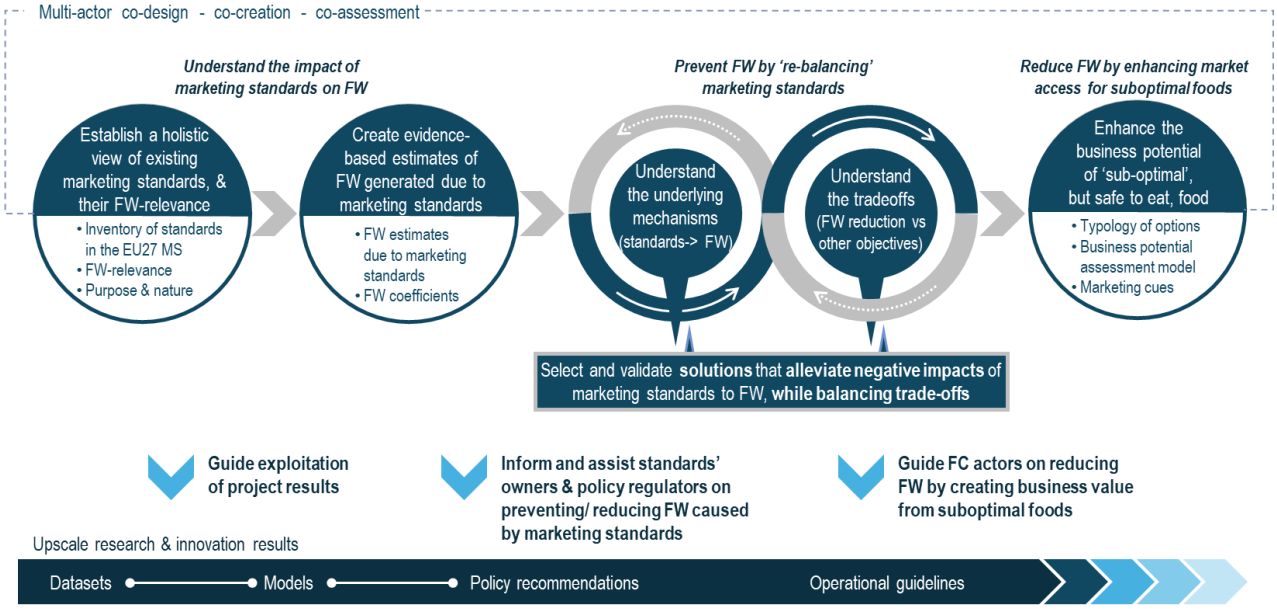

Figure 2: The concept and approach of BREADCRUMB

Source: Grant Agreement, Part B, p.8/41

Additionally, the project aims to incorporate a gender perspective and apply intersectional analysis throughout its activities. These elements are crucial for gaining a deeper understanding of how marketing standards influence food choices, usage, and waste (Grant Agreement, Part B, p.8/41).

To validate its results, the project will use various methods involving external participants:

- External Advisory Board (EAB: 6 members: researchers and practitioners with diverse expertise);
- Food Marketing Standards Interest Group (FMSIG: 25 members: representatives from food businesses, civil society organizations, FW entrepreneurs, policy actors, and the Joint Research Centre).

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- Consultation events, such as workshops, to expand the validation process with a broader range of stakeholders.

BREADCRUMB is structured into six work packages (WPs), each with specific objectives, tasks, and deliverables aimed at achieving the project's overall goals.

1.2 Some key Definitions

1.2.1 Food Marketing standards (FMS)

Marketing standards are obligatory rules or optional reserved terms aiming to address the expectations of consumers and to improve the economic conditions for the production and marketing as well as the quality of agricultural products.[1] They establish rules regarding product characteristics and other requirements that must be met for both EU-produced and imported products to enter and circulate within the EU market.

- **Public Food Marketing Standards:** Public FMS are **obligatory** regulations enforced by government agencies or international bodies that establish baseline (minimum) criteria for product quality, labelling, and performance (Mancini, 2019) (BREADCRUMB D1.2)
- **Private Food Marketing Standards:** Private FMS refer to standards developed and operated by entities other than public government bodies - this can include individual companies, food manufacturers, non-governmental organisations, industry associations, farmers, and retailers (Henson & Humphrey, 2010);(BREADCRUMB D1.2). They operate within a legal framework but are **voluntary** in nature.

1.2.2 Food or Foodstuff

“Any substance or product, whether processed, partially processed or unprocessed, intended to be, or reasonably expected to be ingested by humans”.[2]

[1] BREADCRUMB Grant Agreement, Annex I, Part A, page 2; electronic version page 98.
[2] Regulation (EC) No 178/2002 of the European Parliament and of the Council of 28 January 2002 laying down the general principles and requirements of food law, establishing the European Food Safety Authority and laying down procedures in matters of food safety (OJ L 31, 1.2.2002) (Article 2, page 7): https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32002R0178&from=EN

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- **Includes** drink (as well as water), chewing gum, and any substance intentionally incorporated into the food during its manufacture, preparation or treatment.
- **Does not include** feed, live animals (unless they are prepared for placing on the market for human consumption), plants prior to harvesting, medicinal products, cosmetics, tobacco and tobacco products, narcotic or psychotropic substances, residues and contaminants.

1.2.3 Waste and Food Waste (FW):

- **Waste:** "Any substance or object which the holder discards or intends to or is required to discard".[3]
- **Food waste (FW):** "All food as defined in Article 2 of Regulation (EC) No 178/2002 of the European Parliament and of the Council that has become waste".[4] FW has been defined in Article 2 of Regulation (EC) No 178/2002 to include inedible parts, where those were not separated from the edible parts when the food was produced - such as bones attached to meat destined for human consumption for example - FW can thus also be comprised of items which include parts of food intended to be ingested and parts of food not intended to be ingested.[5]
- **Food waste measurement:** According to the EU commission delegation decisions supplementing directive "The amounts of FW shall be measured in metric tons of fresh mass".[6]

[3] Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008 on waste and repealing certain Directives (OJ L 312, 22.11.2008) (Article 3, page 3): https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:02008L0098-20180705&from=EN

[4] Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008 on waste and repealing certain Directives (OJ L 312, 22.11.2008) (Point 4a, page 4): https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:02008L0098-20180705&from=EN

[5] Commission Delegated Decision (EU) 2019/1597 supplementing Directive 2008/98/EC as regards a common methodology and minimum quality requirements for the uniform measurement of levels of food waste (Number 2, page 77): https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32019D1597

[6] Commission Delegated Decision (EU) 2019/1597 supplementing Directive 2008/98/EC as regards a common methodology and minimum quality requirements for the uniform measurement of levels of food waste (Article 2, page 79): https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32019D1597

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Food waste **does not include**:[7]

- Losses at stages of the food supply chain (FSC) where certain products have not yet become food as defined in Article 2 of Regulation (EC) No 178/2002, such as edible plants which have not been harvested,
- By-products from the production of food that fulfil the criteria set out in Article 5(1) of Directive 2008/98/EC, since such by-products are not waste,
- Agricultural material referred to in Article 2(1)(f) of Directive 2008/98/EC and animal by-products referred to in Article 2(2)(b) of Directive 2008/98/EC,
- Non-food materials mixed together with food waste (e.g. soil or packaging), Several types of food, which are usually discarded as or with wastewater, such as bottled drinking and mineral water, beverages and other liquids (due to the lack of measurement methods which would ensure sufficient levels of confidence)
- Substances that are destined for use as feed materials.

1.3 Objectives of Task 2.1 (T2.1): EU datasets collection, pre-processing and sensemaking

Task 2.1 (T2.1) ran from M4 to M10 of the project. **This task generally aimed to identify and estimate FW related to FMS. The task looked at both the EU level as well as on the individual Member States level,** using two data collection methods; (i) desktop research, examining results of previous/ongoing research reported in scientific journals and/or project deliverables; and (ii) in-depth interviews with food chain stakeholders.

The research objective of the task (T2.1) are twofold: (i) To estimate the amount of FW generated due to FMS on the EU level and (ii) To understand the mechanism used for FW data collection (FW accounting mechanisms) and their interpretation of FW in relation to FMS by food chain stakeholder.

More specifically, the following research questions were examined.

The methodological approach for the first research question was to research and extract as proxy data from scientific article, grey literature, unpublished data within the scope of 5 commodities as

[7] Commission Delegated Decision (EU) 2019/1597 supplementing Directive 2008/98/EC as regards a common methodology and minimum quality requirements for the uniform measurement of levels of food waste (pages 77-79): https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32019D1597

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much as possible for quantitative analysis and modelling that influence FW generation due to food marketing standards (FW-FMS).

i. To estimate the volume of FW generated because of FMS at the EU level:
   - What are the estimates of FW related to FMS in Fruits and vegetables, eggs, meat (bovine, poultry), fish and cereals?
     a. How is FW measured and accounted for in the context of FMS of 5 types of commodities researched for BREADCRUMB project?
     b. What are the FW proxy data in relation to FMS for 5 commodities researched in the project at EU organizational level?

The second research question is the subsequent result of research questions to supplement the data and further understanding of data unavailability.

ii. To explore the methods used for collecting FW data (FW accounting methods) and how FW is interpreted in relation to FMS by five commodity sectors at the EU level:

a. How do food chain stakeholders across five commodity sectors perceive the relationship between FW and FMS?

b. What are the experiences and perspectives of food chain stakeholders regarding the impact of FMS on FW?

1.4 Crucial links of T2.1 and other task in the BREADCRUMB project

The inter-related nature of tasks in the BREACRUMB project is aimed at ensuring a holistic approach to understanding FMS and their relation to FW generation at local, national and EU level. T2.1 focus on getting the estimates of FW due to FMS at the EU level as well as understanding the FW accounting mechanisms implemented. T2.1 builds on T1.2 which presents a preliminary conceptual model outlining the potential impact of the categories of FMS specified in Regulation (EU) 1308/2013 on FW generation referred to as the "A Conceptual Model of Links Between the Categories of FMS and FW", *(see appendix 9.1 A preliminary conceptual model (output of T1.2))* and a data collection methodology built in T1.3. The insights generated from T2.1 will be integrated with empirical insights generated by the case studies in T2.3 and both will serve as input for T2.4 which is aimed at providing overall evidence-based estimates of FW generated by FMS.

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1.5 Deliverable 2.1 (D2.1) structure

The report is structured to provide a comprehensive exploration of the BREADCRUMB project, focusing on the relationship between FMS and FW. It begins with an **Executive Summary** and an **Introduction,** outlining the project's objectives, key definitions, and the purpose of Task 2.1 (EU datasets collection and analysis). The **Methodology** section details the approach for data collection, including literature reviews, surveys, and interviews, followed by **Findings and Analysis** that estimate FW due to FMS across 5 key commodities (fruits/vegetables, cereals, eggs, fish, meat). It also explores insights from interviews and surveys, addressing FW accounting mechanisms, supply chain dynamics, and the economic impacts of FMS.

The report ends with **Conclusions and Recommendations**, focusing on data gaps and proposing future research and policy directions. Additionally, the Appendix includes criteria for article inclusion, a list of reviewed articles, letter of invitation for interview, consent form, survey questions, T2.1 interview questions, frameworks on the food supply chain (FSC), and further details on marketing standards related to specific commodities.

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2. METHODOLOGY FOR DATA COLLECTION

The methodology section of this report elaborates on all the activities, methods and measures that have been applied to collect the data needed to fulfil T2.1. The methodology for T2.1 was developed based on 4 complimentary approaches to meet the research objectives: i) Review of scientific articles and grey literature, ii) Collection of survey data conducted in synergy with T1.3 to expand data sources, iii) semi-structures interviews for T2.1 and iv) extraction of semi-structured interview data related to task T2.1 from T1.3.

The approach of T2.1 was to research at the European level from an overall perspective by collecting information from umbrella organizations (international business interest as well as public interest organisations). So, that it can be distinguishable from T2.3. Since, the T2.3 according to the protocol is performing task of estimation of FW by collecting data at a case Study level (i.e. organization level) parallelly at the similar project months on 5 commodities of the BREADCRUMB project. Given the constraints of time and resources for data collection was concentrated mainly on collecting data through a literature review. Furthermore, the process of data collection for estimation and sensemaking was complemented with the help of in-depth interviews as a part of T 2.1 as well as interview data from ongoing parallel task of WP1 (T1.3).

The figure 3.1.1 below encompasses the structure and timeline followed to complete the task 2.1. The timeline is divided into three phases based on the type of task performed.

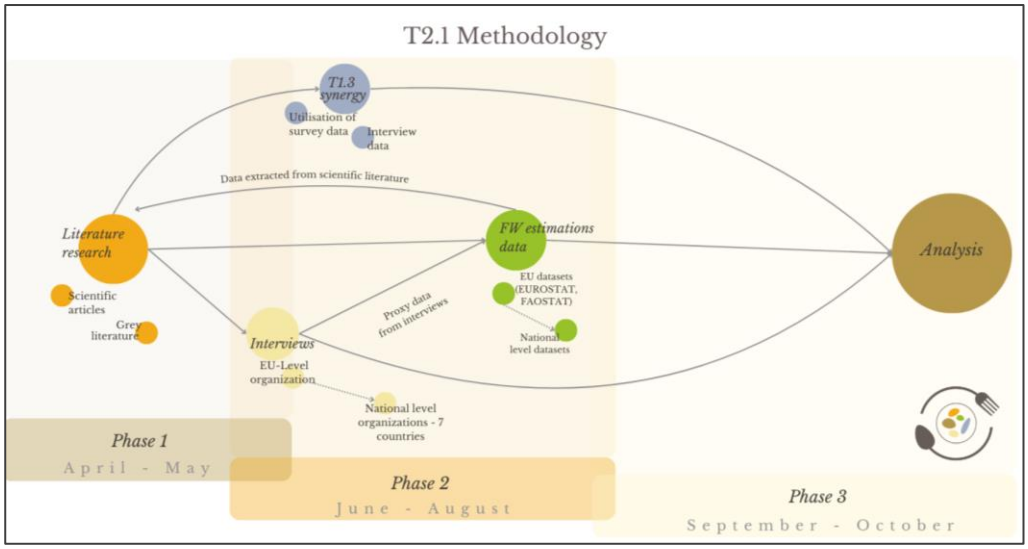

Figure 3: Illustration of methodology followed to complete T2.1

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2.1 Review of scientific articles and grey literature to build foundational knowledge:

A search process of academic data was conducted across interdisciplinary electronic databases including Web of science, Science Direct and Scopus. The search was not limited to any publication date or specific research study or project. It covered three main aspects:

- the combination of OR/AND factor for the five food commodities: fruit and vegetables, egg, cereal, fish and meat ("bovine" "poultry")
- the combination of OR/AND factor for words *"oddly shaped", "suboptimal", "aesthetical imperfections", "cosmetic specification", "B-class", "Second class", "Wonky", "Abnormal", "imperfect", "aesthetically challenged", "Inglorious"*. These words derived from research articles that deals with marketing standards in relation to FW, especially in relation to fruits and vegetables (Aschemann-Witzel et al., 2019; Louis & Lombart, 2018; van Giesen & de Hooge, 2019)
- combination of OR/AND factor of word/s *"Food waste",* "*Food marketing standards*", "Quality Standard", "EU" referring to the EU27 countries

On the selected articles both forward and backward search techniques were utilized to ensure a comprehensive review. In the backward search, references cited in each selected article were examined to identify foundational studies and key research that shaped the topic. The forward search involved using databases like Google Scholar, national databases *(e.g. Statistics Denmark)* to find more recent articles that cited the selected studies, helping to capture ongoing debates and recent developments. Titles and abstracts were initially screened, serving as a basis for subsequent full-text evaluation. A set of *Inclusion and exclusion criteria for articles* were set (Please see appendix 9.2). The search resulted in an *appendix 9.3 List of final articles used for literature review* and an in-depth analysis of selected documents.

The literature review contains a total of 25 documents spanning various types of publications including scientific articles, research papers, reports, reviews, and guidance documents. The focus of these documents is on FW, primarily within the European context. Scientific articles and research papers constitute a significant portion of the literature on FLW, characterized by their peer-reviewed nature and publication in esteemed academic journals. These works primarily emphasize empirical research, comprehensive reviews, and critical evaluations of FLW throughout various stages of the food value chain and across diverse geographical regions. In total, there are 13 scientific articles and research papers categorized as follows: four articles focus on empirical analyses, one article

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presents qualitative research, two articles provide case studies, three articles offer reviews and critical analyses, while the remaining three include explorative studies, feasibility studies, and mass flow analyses. Notable academic journals that publish such research include Ecological Indicators, Resources, Conservation & Recycling, the British Food Journal, the Journal of Cleaner Production, Marine Policy, Environmental Science and Technology, and the American Journal of Applied Sciences.

In addition to scholarly articles, reports produced by governmental agencies or research institutions play a crucial role in the discourse surrounding FW. These reports offer in-depth analyses, project findings, and recommendations for measuring FW. A total of 10 reports have been identified, originating from reputable organizations such as the Department of Agriculture and Fisheries in Flanders, the Nordic Council of Ministers, the Danish Centre for Food and Agriculture, and the European Commission.

Furthermore, guidance documents and protocols serve as essential resources, providing standardized methodologies and recommendations for the reporting and quantification of FW. Three such documents have been noted, issued by authoritative entities including the European Commission and the Food Loss and Waste Protocol.

One of the objectives of T2.1 was to estimate FW related to FMS at the European level. However, during the literature review and data collection phases conducted in April and May, we encountered a significant deficiency in the availability of articles that explicitly provided quantified data on FW attributable to marketing standards *(see section Insights of Literature* and *appendix 9.3 List of final articles used for literature review).*

2.2 Synergies with T1.3 to expand the data sources

2.2.1 Survey data

To foster synergy with T1.3, we identified stakeholders and entities that collect relevant data beyond our Case Study partners. This method was incorporated to identify the potential entities for data collection, facilitating a comprehensive understanding of FW measurement and the monitoring of FMS. The collaboration with T1.3 was primarily focused on a series of inquiries, including whether companies measure FW, whether they track the alternative route of surplus food in their respective organizations, and to create an overall understanding of the scope of FW accounting system in four food chain stages as mentioned *(see appendix 9.4 Survey Questions relevant for T2.1).* The survey

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questions associated with the study were formulated as multiple-choice questions, specifically framed as binary responses to facilitate the collection of quantitative data regarding the relevant inquiries needed for T2.1.

In cases where respondents did not answer the question: *"Is the amount of food waste generated within your entity measured?*", missing answer by respondents were treated as "*No*". Missing answers could be due to several reasons, such as the respondent being unaware of their company's FW tracking or uncertainty regarding that matter and irrelevant simply FW is not measured. Since the questions were not mandatory, respondents could skip those that were irrelevant, such as the question on commodities like eggs - if their company did not operate in egg sector, respondent skipped the question, so *"missing"* data. Similarly, if the company did not measure FW, it was assumed as irrelevant, thus, the lack of a response was considered equivalent to a *"No".*

2.2.2 Interview data

It is imperative to recognize that there is an absence of a standardized measurement systems for FW linked to food marketing standards (FMS). Nonetheless, the existence of FMS result in the creation of "by-products", "sub-optimal products" or "rejected products" that are assigned a lower value but are obviously not FW. While it is evident that FMS play a role in the generation of FW, precise quantification of the volume of waste produced remains elusive. This situation prompts critical inquiries regarding the disposition of products that are deemed unacceptable under existing marketing standards, as well as the degree to which alternative solutions, policies, and practices aimed at mitigating FW are developed and effectively operationalized. Thus, the interview data from T1.3 seeks to address the several pertinent objectives, notably the correlation between marketing standards and waste generation, the handling of surplus food that fails to meet FMS, and the obstacles encountered in the implementation of measures to calculate FW. The aim of this exploration is to yield a comprehensive understanding of the challenges associated with developing measurement tools and methodologies for assessing due to FMS. Ultimately, the analysis of interview will help to identify focal areas that require attention order to be able to measure FW related to food marketing standards.

It is important to note that the participants in the T2.1 interview were representatives of association at EU and national level, who might not be engaged in valorisation activities and whose knowledge might be primarily on the aggregated level. Consequently, the interviews done as part of task T1.3, predominantly from the private sector, were deemed more suitable and applicable for achieving this

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objective. The insights garnered from these private sector interviewees also serve as the foundation for our subsequent recommendations.

Three questions were asked in the T1.3 as a part of T2.1 as can be seen in the fact box *(Figure 3.2)* below.

Questions asked in T1.3 as a part of T2.1

(WP 4 / T2.1) What happens with the products that do not fulfil the food marketing specifications? (HIGH) {Follow-up questions to spur discussion: Are the products donated for example? Or used perhaps in another capacity – such as valorization initiatives? Are there other actions taken? If yes, can you say more about them? If no, why not?}

(T2.1) Can you provide examples of how adherence to these standards has either increased or reduced food waste?

(T2.1) Are there specific policies or practices that have been effective in mitigating food waste while maintaining compliance with these standards?

2.3 Framework for extraction of data for FW estimation

The process of quantitative data collection began through literature review and desktop research and supported by identified EU-level umbrella organizations and national level association. This included EU level associations for five commodities groups. As a starting point the possibility of obtaining FW datasets related to FMS from these umbrella organization[8] were explored, however we were unable to obtain such data at the EU level. As a result, national-level entities were listed, for instance; meat association from project partners affiliated country, and checked if they could provide the FW-FMS dataset at national level. Once again, unable to obtain FW data that quantifies the FW at the national level. However, the list of EU and National level entities proved to be useful to reach out for the interviews for the task which is described further *(see section sub-section Semi-structured interviews for qualitative insights).*

The dataset was compiled in Excel sheet *(see attached appendix 9.8*), integrating data from multiple relevant sources: data from EU Commission (EUROSTAT); data from FAO Food balance Sheet

[8] Umbrella organization is an association related to five commodities (FV, Meat, Cereals, Eggs & Fish) operating at EU level and/or beyond, who are formally representing and coordinating their activities and resources in their respective field of commodities in EU and/or beyond.

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(FAOSTAT) and data extracted from various scientific literature, reports and other documents listed *(See appendix 9.3 List of final articles used for literature review).* FAOSTAT formed the basis of the dataset, supplemented by EUROSTAT and quantitative data from the insights of review of literature. The compiled dataset is organized into five commodities groups, followed by specific food items within EU27 countries.

Data from EUROSTAT was obtained on: Total production for the food items of the interest in EU 27 countries for Reference years of 3 (2021-2023). Similarly, data from FAOSTAT was obtained on: Total production, Domestic Supply Quantity, Feed, Losses/FW, Processed, Other uses (non-food), Residuals, Food (for human consumption), for the food items of the interest in EU27 countries for Reference years of 3 (2020-2022).

To supplement the dataset with FW-FMS, relevant literature was explored to extract the proxy information in relation to either total production, percentage or amount of FW, and percentage (in reference to amount calculated) or amount of FW due to the FMS in the five commodities.

FW quantification due to the FMS was not possible to obtain from neither EUROSTAT nor FAOSTAT so it was supplement by using proxy data on FW (%) from either literature review or interviews. Relevant data from literature review and interview extracted and updated on various reference year and geographical proximity, where actual FW data is not available. Extensive cleaning and processing of data harmonization such as, on measurement unit to make unified measurement which is 1000t (thousand tons); adding 5 commodities group of the interest followed by adjusting name of the different food items if the naming have different format in the datasets; for instance, cucumber, poultry, Barley, Grapes, Anchovy, Bovine, Apple, Tomatoes; are finally grouped into five commodities groups. The estimate of the quantification of the FW due to the FMS started by making overviews of the information on either amount, or percentage of the FW-FMS in specific food items within the Five commodities groups. The FW-FMS estimation was presented in reference to total production (Tp) or Domestic Supply Quantities (DSQ) of the food item. For instance, tomatoes & products that have data on FW-FMS were calculated. Based on the reference data or proxy data, the blanket approach to EU27 countries were conducted to reflect the amount of the FW-FMS.

2.4 Semi-structured interviews for qualitative insights

The interviews for T2.1 began after a comprehensive desktop review of both grey literature and scientific articles. The insights from the literature review served as the foundation for the methodologies employed in the collection and execution of the interviews. As it became evident that

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FW data due to FMS related to these commodities was not readily available, our focus shifted towards gathering information regarding the measurement mechanisms currently in place across various entities. This involved an exploration of the accounting methods and tools implemented at the EU level. It is well established that numerous tools exist for quantifying FW, and by mid-2022 (Directorate-General for Health and Food Safety, 2024), EU member states are mandated to report FW data to the EU. However, an examination of the status reports reveals a lack of categorization of FW into distinct groups, particularly concerning marketing standards. Therefore, it is imperative to ascertain whether such categorization is indeed available for FMS. Moreover, while a substantial body of literature addresses FLW in general, there is a notable scarcity of research specifically focused on FW related to FMS. Ambiguities persist regarding the definition of FW in the context of marketing standards, particularly in relation to food safety considerations.

Thus, the interviews aimed to i) Collect information and quantitative data pertaining to issues related to FMS at the EU level, ii) gain an understanding of the mechanisms employed in the collection of FW data. A key focus was obtaining information on food waste that could facilitate the quantification or estimation of food waste levels, including metrics such as the total amount of food waste, the percentage of food waste, and the proportion of food waste in relation to a reference year and quantity.

The interviews explored four main key themes: (see appendix Interview Questions for T2.1)

- The integration of FW into FMS.
- The availability of accounting and measurement tools for these commodities.
- The percentage of food waste present in each of the five commodities.
- The perception of how FMS impact food waste, and insights in the monitoring and measuring of FMS-related food waste.

2.4.1 Sampling of informants for the interviews

Sampling of informants for the interviews started with contacting the entities from the list of EU level umbrella organization *(see Appendix 9.9 Template to report EU level organization)* followed by National level organization/associations *(see appendix Template to report National level organization)* of which response rate was very low. The process continues by identifying and contacting relevant entities that operate within the area of five commodities through the network of

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the project partners. We have ensured that at least a participant represents one of the five commodities. Based on the experience of sampling informants, the following reflection can be made.

Prior to initiating contact with entities at the European Union (EU) level, all partners involved in the task were engaged in outreach efforts directed towards individuals and organizations within their respective networks that operate in the food and waste sectors. The objective of this outreach was to identify organizations and individuals within those organizations who possess data on FW, particularly in relation to food waste. For instance, the Environmental Agency in Denmark is responsible for collecting data on FW and employs external contractors to conduct surveys and interviews for data acquisition. It is to be noted that national organizations lack the authority to mandate participation in food waste quantification efforts, as such participation is voluntary. Additionally, these organizations do not possess standardized methods for segregating various types of waste such as waste generated due to FMS. Consequently, data collection predominantly focuses on total food waste, without differentiation of the underlying causes, across various stages of the food supply chain.

By the end of May and the beginning of June, we commenced the process of listing and contacting EU-level entities, reaching out to approximately 30 organizations across five commodities, ensuring that a minimum of five entities were contacted for each commodity. The selection of these entities was based on our existing network and connections, as well as desktop research and insights provided by case study partners. The challenges posed by the summer holiday period, which delayed response times, many of the contacted entities declined our requests due to time constraints, while others indicated a lack of information regarding FW quantities; several entities did not respond at all.

In the subsequent phase of outreach, we directed our efforts towards national-level organizations. The selection of these organizations was based on the countries of the project partner organizations affiliated with Task 2.1, which includes seven partners. We endeavored to mobilize case study partners to facilitate outreach to various national-level associations. However, given that this outreach commenced in mid-July during the summer holiday season in Europe, it proved challenging to establish contact with these entities. Nonetheless, we reached out to 41 entities across five commodities. Specifically, we contacted 17 entities within the fruit and vegetables sector, resulting in three interviews. For the egg sector, we engaged with eight entities, which resulted in three interviews being conducted. The predominant reasons given for interview refusals included a

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perceived lack of relevant data on FW or the perceived absence of methodologies within their systems to provide such data. (see detail in Table 3.1)

Similarly, we contacted six entities in the cereals sector for interviews, regrettably, no informants from these entities were willing to participate in interviews or did not respond. In the fish and meat sectors, we were able to conduct one interview each with entities among five in the fish sector and three in the meat sector contacted. Lastly, we contacted two organizations that were not associated with any specific commodity and were therefore indicated as 'All commodities,' resulting in one successful interview

Feedback from our contact partners provided insights into the reasons for the lack of interest. Notable reasons included:

i. The entities did not possess data related to FW in accordance with market standards, with one entity actively attempting to conduct interviews with farmers to gather such data;
ii. The entities were not sufficiently large to collect FW-FMS.
iii. An association don't deal with this "problem" directly siting, their primary focus was on enhancing operational practices for their member organizations; and
iv. Their unwillingness to share such sensitive information regarding FW.

Table 1: List of National entities contacted

Sector	National entities contacted	Interviews conducted
Fruit and vegetable	17	3
Eggs	8	3
Cereals	6	0
Fish	5	1
Meat	3	1
All commodities	2	1

2.5 Scope and limitations

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Understanding the consumer is key in the retail sector and thus intrinsically linked to the behavior of consumers and their intentions to purchase products. It is beyond doubt that FMS, particularly those related to aesthetic properties, are contributing to the shaping of consumer perceptions, choices and behaviors. However, this influence falls beyond the immediate scope of the task when considering the broader picture at the EU level. It is important not to conflate this task with WP3 which delves into Food Chain actor's behavior and WP4 which primarily focuses on consumer attitudes and behaviors related acceptance of suboptimal foods. Each work package has distinct objectives and methodologies and mixing them could lead to confusion and inefficiencies. Moreover, quantifying the impact of FMS at the household level requires a different set of methodological approaches. This task does not have the time and resources to undertake such detailed quantification. Similarly, the task also excludes the loss at pre-harvest although these are direct result of FMS, the task of FW estimation at its purest form doesn't include, stating FW doesn't include "Losses at stages of the food supply chain where certain products have not yet become food as defined in Article 2 of Regulation (EC) No 178/2002, such as edible plants which have not been harvested". Therefore, while acknowledging the potential influence of FMS on consumer perceptions and considerable loss at the pre-harvest, this task will not delve into the quantification of FW at the household level and loss at the pre-harvest. However, T2.1 will delve into other FSC stages encompassing primary production (excluding pre-harvest loss), processing & manufacturing, retail and other distribution (including wholesale), and food services.

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3. INSIGHTS FROM LITERATURE

The issue of FW has gained growing attention, especially within the European Union (EU), due to its implications for sustainability, economics, and social equity. Emerging studies are starting to focus on how FMS, particularly those regarding aesthetics, contribute to FW (Plazzotta et al., 2017) (K Roels & D Van Gijseghem, 2017) report that FMS, which dictates the appearance of products, led to the rejection of otherwise edible food. Studies by (Aschemann-Witzel et al., 2018; Aschemann-Witzel, Giménez, et al., 2020; Aschemann-Witzel, Otterbring, et al., 2020), (Jaeger et al., 2018) and (de Hooge et al., 2017) further emphasize that consumer perceptions, shaped by these FMS, drive demands for visually perfect products, thus exacerbating FW. According to Roels and Van Gijseghem (2017) FMS governing the quality and presentation of food products often results in the rejection of perfectly edible food items due to aesthetic criteria.

This literature review explores the connection between FW and FMS, summarizing key research findings, methodologies, and gaps in the current literature.

3.1 Food Waste and Food Marketing Standards

Emerging studies are shedding light on how aesthetic, and quality criteria influence the disposal of food products (Agnusdei et al., 2022; Nes & Ciaian, 2021; K. Roels & D. van Gijseghem, 2017). Caldeira et al. (2019) conducted an analysis of FW quantification methods within the EU, demonstrating that fruits and vegetables represent substantial contributors to waste, particularly during the stages of primary production and consumption (Caldeira et al., 2019). But it does not break down the causes of waste such as FMS. In a separate study, Lanfranchi et al. (2014) assessed FW in retail environments in Sicily, pinpointing inadequate inventory management and cosmetic defects as critical issues (Lanfranchi et al., 2014). Plazzotta et al. (2017) offered insights into the management of fruit and vegetable waste, specifically concerning fresh-cut salads, and elaborate on the considerable waste generated as a result of aesthetic standards. Redlingshöfer et al. (2017) reported on food loss occurring in the upstream phases of the supply chain in France, addressing the complexities associated with quantification and the implications of food marketing standards.

Ramírez-Rodríguez et al. (2024) explored FW in the wild-caught fish sector in Spain, highlighting the impact of regulatory frameworks and food safety concerns on waste generation. Furthermore, Xue et al. (2017) reviewed FLW data across 84 countries, emphasizing the challenges related to data consistency and the correlation between gross domestic product and household FW. Derqui et al.

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(2016) investigated FW within Spanish food service companies, revealing a predominant focus on economic criteria over social and environmental considerations.

3.2 An Overview on quantification methods

The use of data in studies often has significant limitations, primarily due to the methodologies employed and the inherent uncertainties in the data sources. For instance, estimates of product quantities may be over or under-estimations since they are not always based on statistical sources (Caldeira et al., 2019). Additionally, data sets might be built upon older studies or using various, country specific coefficients which makes the results not being representative of the entire EU (Agnusdei et al., 2022; Caldeira et al., 2019). This issue is compounded by the reliance on rough regional estimates that fail to account for country-specific circumstances, highlighting the need for a more tailored approach to improve data quantification.

Quantitative studies on the impact of FMS on FW have employed various methodologies either stand alone or in combination. Methodologies include direct measurement (e.g. weighing waste, counting, waste composition analysis (WCA), assessing volume, garbage collection) and indirect methods (e.g. surveys, estimation based on existing data, case studies, and life cycle assessments (LCAs), Mass balance) (De Laurentiis et al., 2023; Gustavsson et al., 2014; Hanson et al., 2016; Tostivint et al., 2016), such as those presented by Caldeira et al. (2019) and Hoehn et al. (2023). For example, a study conducted by Stangherlin et al. (2019) utilized a LCA approach to quantify FW in the supply chain of fresh fruits and vegetables in Italy. Hoehn et al. (2023) assessed existing methodologies for quantifying FLW, identifying the lack of a standard approach. De Laurentiis et al. (2020) present a model based on Material Flow Analysis to estimate FW generation in EU Member States, detailing methodological updates for improved accuracy. Lastly, Caldeira et al. (2021) compared two modeling approaches for estimating FW in the EU, highlighting the limitations of waste statistics compared to Material Flow Analysis. Overall, these studies underscore the complexity of FW issues, without mere mention of FMS.

This overview shows that recent literature is beginning to highlight the significant role of FMS in relation to FW within the FSC. The literature review reveals an emphasis on developing measurement methodologies and identifying commodity stages in the FSC where waste occurs. The body of work provides detailed insights into FW volumes in the EU region and emphasizes the need for standardized approaches to data collection and reporting (Beausang et al., 2017; De Laurentiis et al., 2023; Gustavsson et al., 2014; Patinha Caldeira et al., 2017).

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3.3 Impact of Food Marketing Standards Across Different Sectors

Several studies (Agnusdei et al., 2022; Beausang et al., 2017; Normann et al., 2019; Plazzotta et al., 2017; Redlingshöfer et al., 2017; K. Roels & D. van Gijseghem, 2017) delved into various dimensions of FW and its ramifications for sustainability, with a particular emphasis on the fruit and vegetable supply chains. Agnusdei et al. (2022) investigated the environmental sustainability of FW in Italy, underscoring the significance of the water footprint and consumer perceptions that contribute to waste associated with cosmetic FMS. Their study identifies deficiencies in existing policy frameworks that could facilitate the reduction of FW. Additionally, another study by Beausang et al (2017) examined FW in the context of soft fruit and vegetable farms, emphasizing the detrimental effects of cosmetic FMS and the necessity for improved data collection.

In Flanders, in Belgium, Roels and Van Gijseghem (2017) found that around 10% of produce is lost at the sales stage due to aesthetic standards, with crops like carrots, cauliflower, and apples experiencing even higher losses. The study provides detailed numbers on sales losses due to cosmetic quality standards for various crops. **On average, farmers reported a sales loss of about 10% across all crops.** For vegetables, the average sales losses were 13.9% for cauliflower, 11.5% for zucchini, 12.6% for celeriac, 13.3% for carrots, 7.1% for leek, 5.0% for celery, 5.6% for Belgian endive, 7.8% for cabbage, 8.6% for beans, 7.3% for parsley, and 2.5% for tomatoes. For fruits, the average sales losses were nearly 20% for apples, with more than 1/5 of respondents reporting losses exceeding 40%, 11.7% for pears, and 6.5% for strawberries. The main reasons for these sales losses were reported to climatological production circumstances (81%), pests and diseases (37%), seeds and varieties (10%), and defects due to harvesting processes (10%). This finding illustrates the critical impact that FMS can have on what products are deemed acceptable for sale. Although the report suggests that FW in the horticulture sector amounts to approximately 283,000 tons, it is important to underline that the report calculated food loss at pre-harvest stage and the animal feed is considered as FW. Another study also suggests that FW from fresh produce (especially in onion and carrots) in the primary production sector is being influenced by FMS. Despite these findings, there has been no emphasis put on estimation or quantification of the impact of FMS on FW (Franke et al., 2016).

The report of Nes and Ciaian (2021) provides a broad overview of economic literature on FMS, including their potential impacts on sustainability suggesting that removing these FMS could reduce FW. However, they suggest a potential link between FMS and FW without providing solid quantification, only referencing the grading-related losses from other studies, which vary from 3%

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for tomatoes to 24% for lettuce. They also underscore the counterfactual scenario of the impact of the FMS stating that if no public or private FMS exist, the introduction of FMS may increase FW by excluding products with defects or undesirable aesthetics.

According to the case study reports in the Nordic countries (Franke et al., 2016), losses in the main cereals commodities sector (Rye, Oats, Barley, & Wheat) was reported to be 4% to 23% after post-harvest for example due to sorting and storing. However, these side flow varies depending upon the country e.g. Denmark as 5% to Sweden 23%, and also can vary due to side flow treatment. If we take Sweden as reference country (it's at the high end of the FW categories), out of 23% of side flow from total production; 39% is lost, 44% used for animal feed, 4% heating and fuel, 13% other purposes (Franke et al., 2016). However, the report does not mention explicitly the reason of the losses, so it is difficult to estimate the effect of the FMS but only presumed based on the some of the reason mentioned in the causes of the side flow. It is also reported that, due to the possibilities of using some of the cereals commodities for the animal feed, the primary producers do not consider most of their side flow as a FW.

The literature research highlights a significant lack of data on FW within the meat industry, particularly in relation to FMS. However, examining the overall patterns of FW in the meat sector can offer important insights. According to Caldeira et al (2019) the consumption stage is responsible for the largest share of FW generation in the meat sector. However, the processing and manufacturing (PM) stage also generates a significant amount of FW, especially inedible parts, such as bones, blood, inedible organs, and skin. A high share of these by-products (assumed to be 80%) is used in other industries and therefore is not accounted as waste. Additionally, a significant amount of meat (26.4 million tonnes at EU level) is used for animal feed and non-food purposes at the processing and manufacturing stage(Caldeira et al., 2019). Despite this, there is a lack of specific connection to food marketing standards and if and/or how much of this meat was discarded for non-food purposes due to not complying with FMS (Patinha Caldeira et al., 2017).

Concerning to the Anchovy, 93.6% of FW generated at primary production is related to EU regulations 2019/1241, almost 100% of the FW in the Wholesale/suppliers is related to FMS, whereas 25% of the FW in the Retail and supermarket is related to mostly private marketing standards (FMS)(Ramírez-Rodríguez et al., 2024).

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There is a notable lack of research on the impact of FMS on FW in the cereal, meat, fish, and egg sectors. This section underscores the need for further investigation into these underexplored areas to better understand the full scope of FMS influence across different food categories.

3.4 Challenges and Knowledge Gaps

Understanding and quantifying FW linked to FMS faces significant obstacles due to fragmented data and inconsistent definitions. The studies by Franke et al. (2016), Nes & Ciaian (2021), Normann et al. (2019), Redingshofer et al. (2017) and Roles & van Gijseghem (2017) often rely on estimations, varying methodologies, and divergent terms, making cross-comparisons difficult. For example, concepts like “sales losses” (waste from unsold produce due to cosmetic standards), “side flows” (removed food during primary production), and “loss factors” complicate the classification of waste.

Derqui et al (2016) mentions that FW can be referred to by various terms, such as waste, wastage, loss, leftovers, and others, which complicates comparisons across studies. Similarly, it also highlights the differences on FW definitions as per FAO definitions and EU Fusions definitions. The lack of uniform definitions contributes to a confusing landscape where the boundaries become blurred, making it difficult to form a unified understanding across the EU. The lack of standardized definitions is further highlighted by Derqui et al. (2016) and the Danish Environmental Protection Agency (2024), who highlights the lack of consensus and stress the need for a unified approach to defining FW.

Many studies in this field struggle with limited and inconsistent data, often due to regional estimates or older studies. For example, estimates may be based on outdated or non-statistical sources (Caldeira et al., 2019; Agnusdei et al., 2022; Redlingshöfer et al., 2017), leading to challenges in accurately assessing FW. Furthermore, research on FW often focuses on specific food categories—particularly fruits and vegetables—while other sectors remain understudied.

The literature review reveals a significant gap in comprehensive research that connects FW to FMS highlighting the **geographical disparities**. Agnusdei et al. (2022) and Plazzotta et al. (2017) discuss the impact of aesthetic quality standards but do not thoroughly explore their connection to regulatory frameworks. Additionally, much of the research is concentrated in Western Europe, leaving Eastern Europe underrepresented. This geographic disparity highlights the need for more inclusive studies that reflect the diversity of agricultural practices and consumer behaviors across the EU.

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Moreover, when analyzing research on food waste, it is crucial to consider the system boundaries defined by the scope of the study. These boundaries can vary significantly depending on whether specific elements of the food system, such as production, processing, distribution, or retail, are included or excluded. For example, some studies may focus exclusively on FW at the farm level, thereby omitting other stages like transportation or consumer-level waste. Additionally, these boundaries can be delineated by geographical regions or specific value chains, thereby limiting the analysis to a particular area or product type, such as fruits and vegetables (Franke et al., 2016; Lanfranchi et al., 2014; K. Roels & D. van Gijseghem, 2017).

As further stated, items downgraded to lower quality class are typically redirected for animal feed, but the report highlights a significant lack of numerical data regarding FW attributed to these cosmetic standards. This has been further emphasized by Derqui et al. (2016) that discussed various drivers of FW, including FMS, particularly emphasizing that rigid food procurement specifications can lead to waste when products do not meet the aesthetic standards required for sale (Derqui et al., 2016). However, it does not provide specific quantification of FW directly attributable to FMS.

Furthermore, while several studies have identified the relationship between FMS and FW, there is a lack of consensus on the extent of the impact. For instance, a study by Parfitt et al. (2010) estimated that FMS could account for up to 20% of FW in the EU, while another research suggests that the number may be lower (Garrone et al., 2013). This discrepancy underscores the necessity for standardized methodologies in quantifying FW attributable to FMS, which would enable more accurate comparisons across studies. Many articles also highlight the challenge in accessing reliable data, which often leads to uncertainties in quantification due to the lack of systematic reporting on FW (Redlingshöfer et al., 2017) and emphasize the need for standardized protocols for measurement (Xue et al., 2017). Hoen et al. (2023) notes that a significant number of studies rely on surveys, which can underreport FW, however, in contrast, expresses the confidence in the FAO Food Balance sheets as a primary data source[9].

Despite the growing body of research in methods of quantification of FW, there remains significant gaps in the literature regarding the quantification of FW due to FMS. Little available data consist of estimations from proxy data, modeling, and literature data rather than solid research, complicating the understanding of the issue. Likewise, many studies have focused on specific food categories,

[9] https://www.fao.org/faostat/en/#data/FBS

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such as fruits and vegetables, while there is limited research on other food groups that may also be affected by marketing standards.

The findings revealed that compliance with FMS accounted for a significant proportion of FW, emphasizing the need for a reevaluation of FMS. While significant strides have been made in quantifying FW and understanding its causes, there remain critical gaps in the literature that warrant further investigation. While several articles (Caldeira et al., 2019; Derqui et al., 2016; Lanfranchi et al., 2014; Plazzotta et al., 2017; Redlingshöfer et al., 2017; Xue et al., 2017) acknowledge that FMSs influence FW, they do not provide explicit numerical quantification related to FMS. As the EU continues to prioritize sustainability and waste reduction, the role of FMS must be critically examined to ensure that they align with broader goals of minimizing FW and promoting a more sustainable food system. Comprehensive studies that encompass a broader range of food categories, geographic regions, and methodological approaches are essential for developing effective strategies at all stages of FSC including consumer level. As a survey by van Herpen et al. (2019) explored consumer attitudes towards FW and FMS, revealing that many consumers are unaware of the impact of these regulations on FW levels.

In the light of findings from the literature review, one must ask the subsequent question mentioned in section Objectives of Task 2.1 (T2.1): EU datasets collection, pre-processing and sensemaking , which will be answered by interviews and survey data in the following section.

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4. FINDINGS AND ANALYSES

The findings and analyses section presents the results of data collected through desktop research, literature review, interviews and surveys following the scientific methods explained in Methodology section. The following section provides a descriptive and in-depth analysis of estimation of FW of the five commodities, survey results in synergy with T1.3, and analysis of interview conducted in connection with T2.1 and T1.3.

4.1 Estimation of FW due to FMS in FIVE commodities

The majority of available data comes from primary producers, with few commodities represented at other stages of the FSC levels, such as processing, manufacturing, retail, and distribution (including wholesale). The table 5.1 shows the proxy or reference data used for estimation of food waste in respective five commodities researched in BREADCRUMB project. There are total of five: two literature articles (Franke et al., 2016; Sarroca et al., 2022), two interview[13&15] sources from T2.1 and one from unpublished data recorded by project partner as part of European project "FOODGUARD". The data are nonexistence to represent the differences of various geographical regions, countries, food items of the five commodities of the project. Thus, unavailability of proxy data for estimation and modelling, a blanket approach was used for the subsequent food estimation regarding FMS, if applicable based on data availability in FAOSTAT[9] and EUROSTAT[10].The overview highlights the importance of collecting FW data at every FSC level due to FMS. The data presented in table 5.1 shows the uncertainty and lack of data availability on FW-FMS as indicated by review of literatures *(see section Insights from the literature review)*.

The readers are strongly advised to draw conclusions cautiously on the reported estimated FW data in this finding and analyses section on five commodities due to risk of over/ under calculations. The estimation doesn't take account into critical variables such as consumer behaviour, geographical locations, cultural context, population size, economic factors, thus, it cannot be generalized. The result in estimated quantity of FW-FMS directly corelates with the amount of production, thus, it is not comparable among countries, however, it can indicate the magnitude of problem.

[10] https://ec.europa.eu/eurostat/web/main/data/database

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Table 2: Reference data for FW-FMS estimation of five commodities

Food items	FW-FMS	FSC Stages	Reference year & Geographical regions	Reasons for FW	Data sources	Food items per FAOstat and EUROstat
Tomatoes (Open field)	10.19%	Primary producers	2021, Spain	Excess product to market, a wholesale trade requirement such as aesthetics, prices (75.5% of 4.1% waste)	Sarroca et al. (2024)	Tomatoes & Products[11]
Vegetables (pre-packed leafy vegetables)	15-20%	Primary producers	2024, Greece	Sorting during processing and returns for short shelf life or not meeting buyer FMS	Data collected by project partner	Vegetables and others[12]
Meat	6.5%	All FSC stages	2024, Spain	Mismatch between orders and production, and cutting technique	Interview[13]	Bovine meat[14] & Poultry meat[14]

[11] **Tomatoes & Products consists of**: Tomatoes; Juice, tomato, concentrated; Juice, tomato; Tomatoes, paste; Tomatoes, peeled.

[12] **Vegetables & Others consist of:** Cabbages and other brassicas; Artichokes; Asparagus; Lettuce and chicory; Spinach; Cassava leaves; Cauliflowers and broccoli; Pumpkins, squash and gourds; Cucumbers and gherkins; Eggplants (aubergines); Chillies and peppers, green; Onions, shallots, green; Garlic; Leeks, other alliaceous vegetables; Beans, green; Peas, green; Vegetables, leguminous nes; String beans; Carrots and turnips; Okra,; Maize, green; Sweet corn frozen; Sweet corn prep or preserved; Mushrooms and truffles; Mushrooms, dried; Mushrooms, canned; Chicory roots; Carobs; Vegetables, fresh nes; Vegetables, dried nes; Vegetables, canned nes; Juice, vegetables nes; Vegetables, dehydrated; Vegetables in vinegar; Vegetables, preserved nes; Vegetables, frozen; Vegetables, temporarily preserved; Vegetables, preserved, frozen; Vegetables, homogenized preparations; Watermelons; Melons, other (inc.cantaloupes); Coffee, substitutes containing coffee

[13] Source: Breadcrumb_IDI_T2.1_Meat_03

[14] **Bovine meat and Poultry meat** from FAOSTAT food balance sheet of Domestic supply Quantities.

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Food items	FW-FMS	FSC Stages	Reference year & Geographical regions	Reasons for FW	Data sources	Food items per FAOstat and EUROstat
Shell Eggs	2-3%	All FSC stages	2024, EU	Broken during transportation, and eggshells while making egg products.	Interviews[15]	Hen eggs in shell, Fresh
Rye*	1.5%[16]	Primary producers	2016, Nordic Countries	Harvesting technique, weather conditions and quality problems (mainly protein content)	Frankie et al. (2016)	Rye
Oat*	1.5%	Primary producers	2016, Nordic Countries	Harvesting technique, weather conditions and quality problems (mainly protein content)	Frankie et al. (2016)	Oat
Wheat*	1,5%	Primary producers	2016, Nordic Countries	Harvesting technique, weather conditions and quality problems (mainly protein content)	Frankie et al. (2016)	Wheat
Barley*	1.5%	Primary producers	2016, Nordic Countries	Harvesting technique, weather conditions and quality problems (mainly protein content)	Frankie et al. (2016)	Barley
Fish	13%	Primary producers (aquaculture)	2024, Greece	Trimming and filleting	Data collected by project partner	Aquaculture[17]

[15] Source: Breadcrumb_IDI_T2.1_eggs_01
[16] 1.5% is defined as “food waste” in Frankie et al. (2016), however, FW are accounted after the “side flow” percentage, which means it doesn’t fulfill the certain criteria to make it FW. However, the article doesn’t explicitly mention the reasons of FW. Thus, it was assumed as FW due to FMS.
[17] **Aquaculture** consists of total production of fish, crustaceans, molluscs and other aquatic organism from aquaculture “fish farming”, excluding hatcheris and nurseries.

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4.1.1 Estimation of FW due to FMS on Fruit and vegetables (FV)

The estimation of FW-FMS in FV sector was calculated on total production[18] of both "Tomatoes & Products"[11] and "Vegetables and others"[12]. FW estimation due to FMS on *"Tomatoes and Products"* for year 2022 was calculated in reference to *"Tomatoes (open field)"* waste of 10.19%. As reported by Sarroca et al. (2022) , the 75.5% of total 13.5% FW was due to FMS.

Whereas the estimated FW-FMS in the *"Vegetables and others"* category was reference to aggregated 17.4% (average of 15-20%) FW on leafy vegetables at a producer and processor level in Greece for 2024 *(source: Data from the EU project FOODGUARD.* The main cause of the FW in the vegetables sector is reported as sorting during processing and returns for short shelf life for not meeting buyer FMS. Thus, reference percentage was taken as FW-FMS.

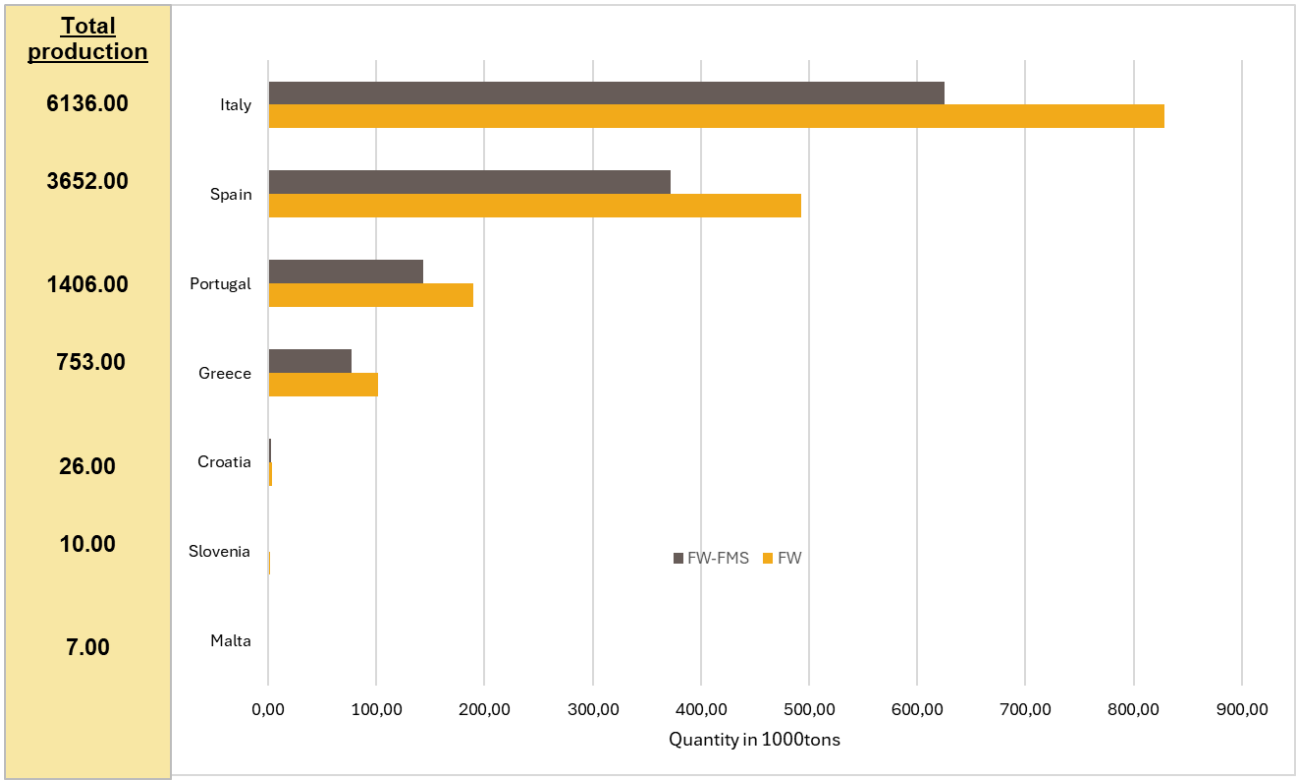

Figure 4: Estimated FW-FMS of "Tomatoes & Products" for 2022 (x1000 tons)

[18] **Total Production** is from reference year of 2022. Source: FAOSTAT-Food Balance Sheet

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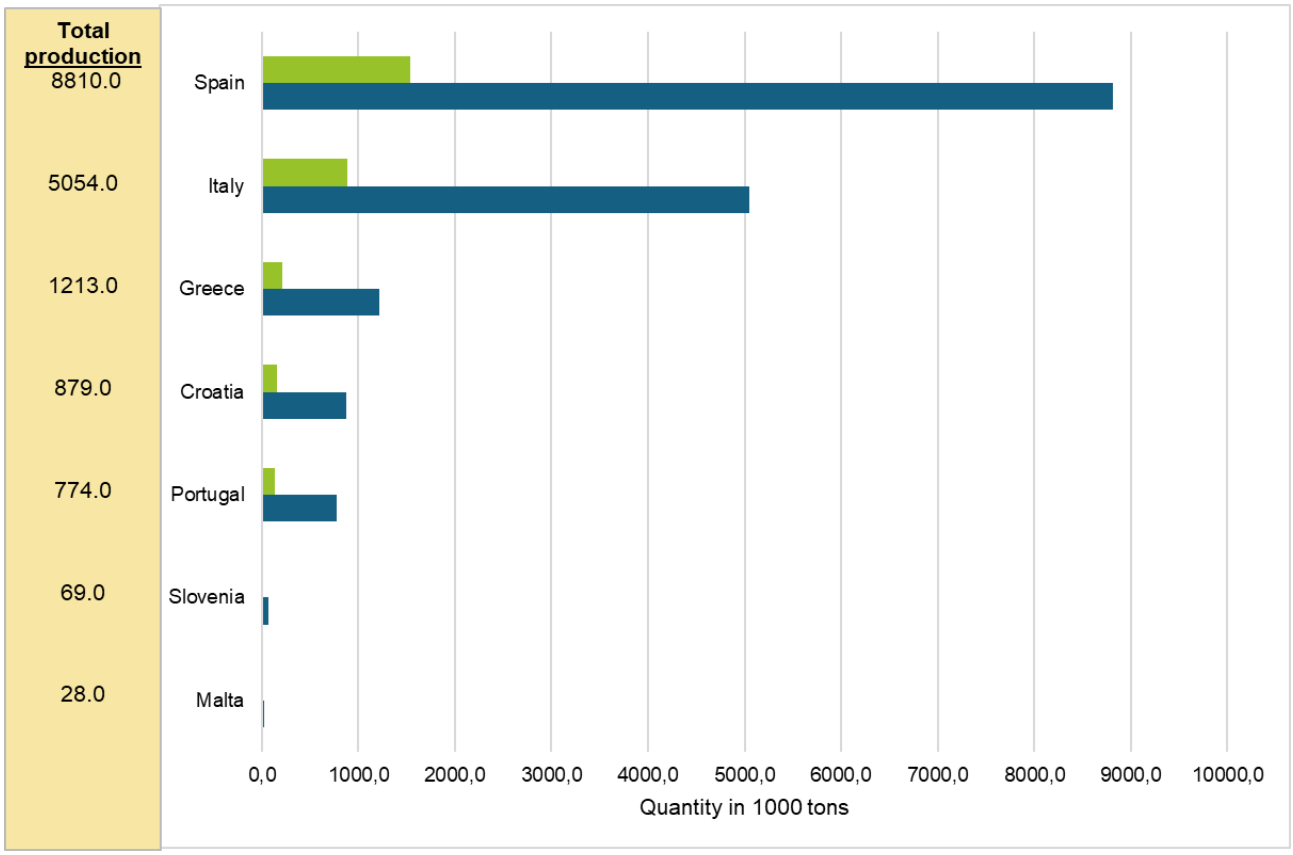

Figure 5: Estimated FW on "vegetables & Others" for 2022

4.1.2 Estimation of FW due to FMS on Cereals

Franke et al. (2016) reported, 4% “side flow” percentage and 1.5% food waste in Rye, Barley and Oats, whereas 14.0% of side flow and 1% of food waste in Wheat in Nordic countries. The food waste percentage was referenced as FW due to FMS as stated, the side flow happens due to low-quality deficiency (e.g. protein and starch quality) as well as by wildlife damage, thrashing and weather conditions. Most of the side flow measure were not being harvested “left in the field”, used for animal feeds, used for heating and fuel, and other purposes. Hence, it can be abstracted that the food waste percentages were calculated after the harvest due to not meeting the FMS for human consumption. However, it is not conclusive whether the waste was intended for human consumption. Since, there was significant difference in side flows within a Nordic countries, Denmark 5% to Sweden 23%, the reference data was used to estimate the FW-FMS for Nordic countries (Denmark, Finland and Sweden) of EU27.

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Table 3: Estimated FW-FMS in Cereals in Nordic Countries of EU27 for 2016 (1000 tons).

	Total production[19]				FW-due to FMS[16]			
Nordic Countries	**Rye**	**Oats**	**Barley**	**Wheat**	**Rye (1.5%)**	**Oats (1.5%)**	**Barley (1.5%)**	**Wheat (1.0%)**
Denmark	570.49	298.41	3903.67	4152.65	8.56	4.48	58.56	41.53
Finland	88.01	1086.12	1600.92	834.44	1.32	16.29	24.01	8.34
Sweden	101.60	826.90	1537.90	2841.60	1.52	12.40	23.07	28.42

4.1.3 Estimation of FW due to FMS on Eggs

The report by (Cladeira et al., 2019) shows that primary producer has a waste of 0.3 Mt and processing and manufacturing 0.1Mt at EU level for 2011. Of a total waste of 6.2 Mt this amount equates to 6.45% waste at two FSC level mentioned. The estimated FW calculation was conducted for primary producer and processor and manufacture due to availability of proxy data to calculate FW-FMS on shell egg at this level. Since, data on amount of shell eggs being sold at other stages of supply chain was not available due to the significant portion of eggs transformed to egg products and it no longer being a shell egg, estimation of FW-FMS was irrelevant. It is reported from the interviews (*Source: Breadcrumb_IDI_T2.1_Eggs_01*) that 2-3% of total eggs (shell) produced are wasted or downgraded to class B, which can be considered as FW-FMS. It should be noted that the waste percentage mentioned above was for all FSC level, and 0,5% -1,8% become unfit for human consumption due to food safety issue and considerable amount were used as fodder.

[19] Source: EUROSTAT. Total production “Harvested production in EU standard humidity (1000t)”

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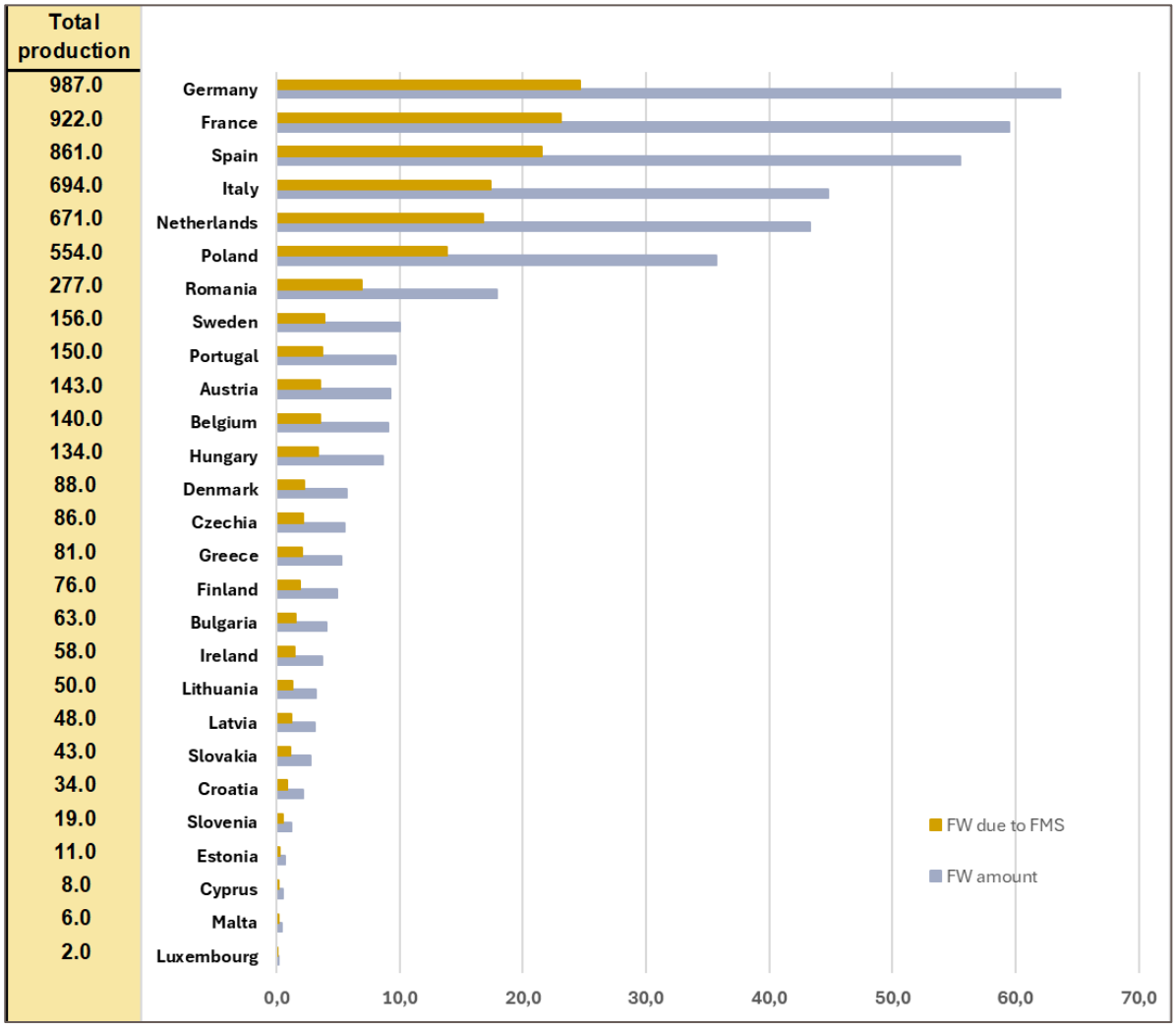

Figure 6: Estimated FW and FW-FMS in eggs sector at primary producers in EU27 (1000 tons)

The FW-FMS in the egg sector was calculated as 2.5% as average waste from the total production[20], based on the data from the interviewee estimation of 2-3% waste. *"They say it's around 2 or 3% and a lot of farmers collect these eggs even and send them again away as … well goes into the animal feed." (Sources: Breadcrumb_IDI_T2.1_Eggs_01).* Although, the figure provides the estimation of FW-FMS, it cannot be accounted wholly for FW-FMS as per interviewee the products can't be used for human consumption and most of the side flow are used for animal feeds. Nevertheless, the estimated food waste and FW-FMS were calculated to show the extent of waste in EU27 countries.

[20] Total production from reference year of 2022 (source: FAOSTAT-Food Balance Sheet) (1000tons)

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Since, the interviewee was representing association working at EU with DG Sante, DG Agri for the betterment of egg sector *(source: Breadcrumb_IDI_T2.1_Eggs_01).*

4.1.4 Estimation of FW due to FMS on Fish

According to the work for the EU project FOODGUARD (received from the collaborative work with one of the project partner in task T2.1), primary production in the Aquaculture sector reported as 13.0% of FW due to FMS as per 2024. The main reason of the FW is filleting and trimmings as per requirements due to private marketing standards in the sector. Thus, the FW-FMS was estimated on the total primary production[21] of aquaculture[17] from reference year 2022.

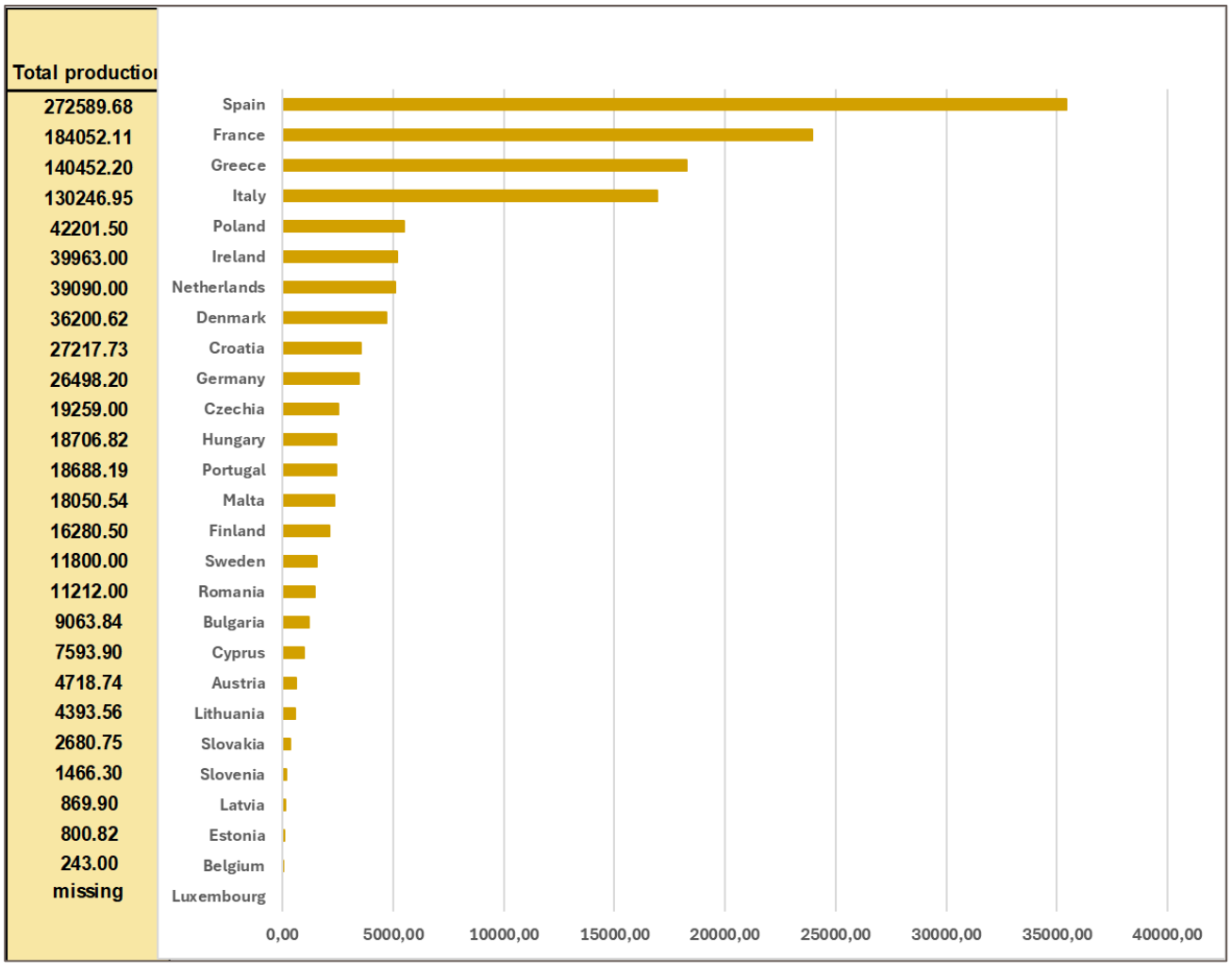

Figure 7: Estimated FW-FMS in aquaculture at a primary producer in EU27 for 2022 (1000 tons

[21] Total primary production in 1000tons from reference year 2022 (source: EUROSTAT)

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4.1.5 Estimation of FW due to FMS on Meat and/or poultry

It is estimated that total FW is in the meat sector from entire supply chain on reference year of 2011 as much as 23% of the production (14.2 MT FW out of 61.7MT) (Caldeira et al 2019). The presented amount/percentage cannot be directly attributed to FMS, besides 80% of those waste was used for animal feed.

The FW-FMS in meat sector was provided as 6.5% along whole supply chain including consumer level interviewee represented at product and processer association in the meat sector *"the waste of meat and meat products of around 6 and a half percent. I insist that these are not sector-specific data, but rather data for the entire food chain, including the consumer" (Source: Breadcrumb_IDI_T2.1_Meat_03)*. The amounts of the FW were calculated from Domestic Supply Quantity (DSQ) rather than total production in the country, as the FMS percentage was given for whole FSC level. Although, many variables play significant role in estimating actual FW-FMS, the following estimation were based on the fact that the mentioned FW occurred during processing as per retailer requirements and assuming the requirements level were similar in all EU27 countries.

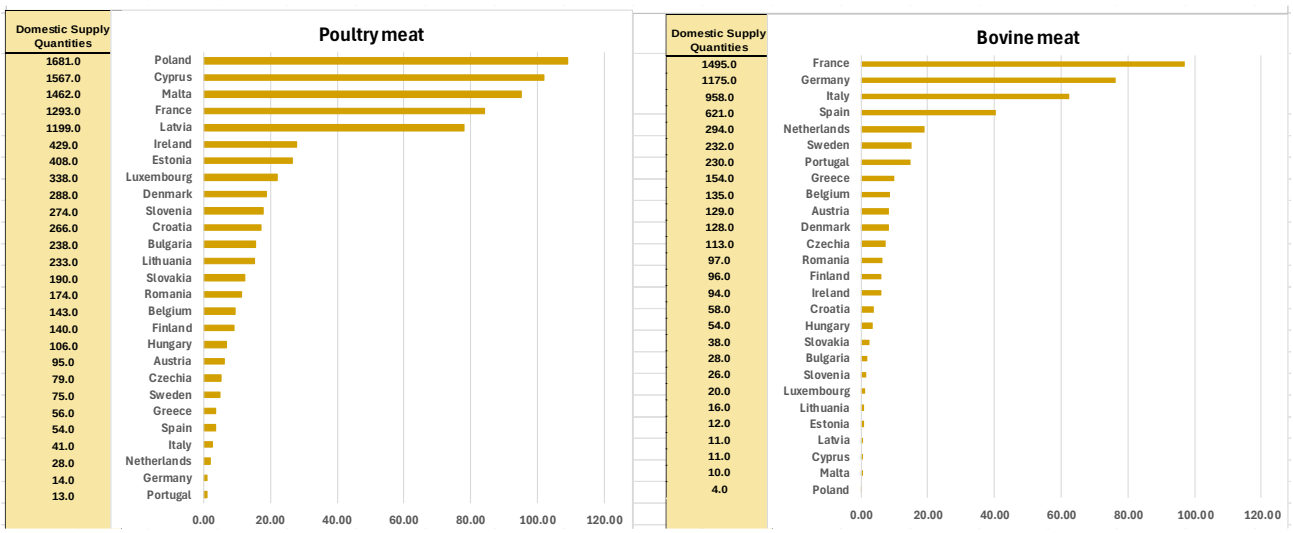

Figure 8: Estimated FW-FMS in poultry and bovine in EU27 for 2022 of Domestic supply quantity (1000tons)

4.2 Survey results on FW measurements status among private entities

As described in the methodology section of (see section "3. methodology"), the result is presented based on the questions relevant to task 2.1 (see survey questions in appendix "survey Questions". The figure 5.5 shows a distribution of survey participants according to their level of geographic and FSC operation. Although, there is low representation of entity operating "internationally within the EU", if we merge the "internationally within and outside of the EU", it is even representation of the

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entities. On the other side of pie chart, only 1% of restaurants and food services are represented, whereas highest 42% are represented from primary productions in the survey analysis.

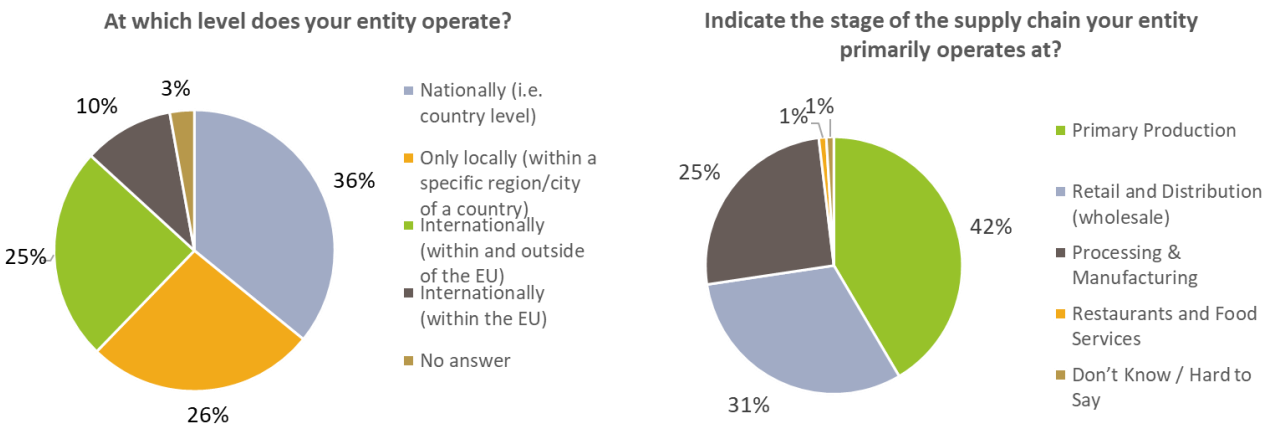

Figure 9: Distribution of survey participants (n=106) based on geographical and FSC level of operation

One of the biggest revelations of this survey was the percentage of stakeholder not measuring FW in their entities *(see figure 5.6: Food waste measurement based on entities).* Of all surveyed stakeholder, 2/3rd of the stakeholder does not measure FW which is similar among all the FSC level.

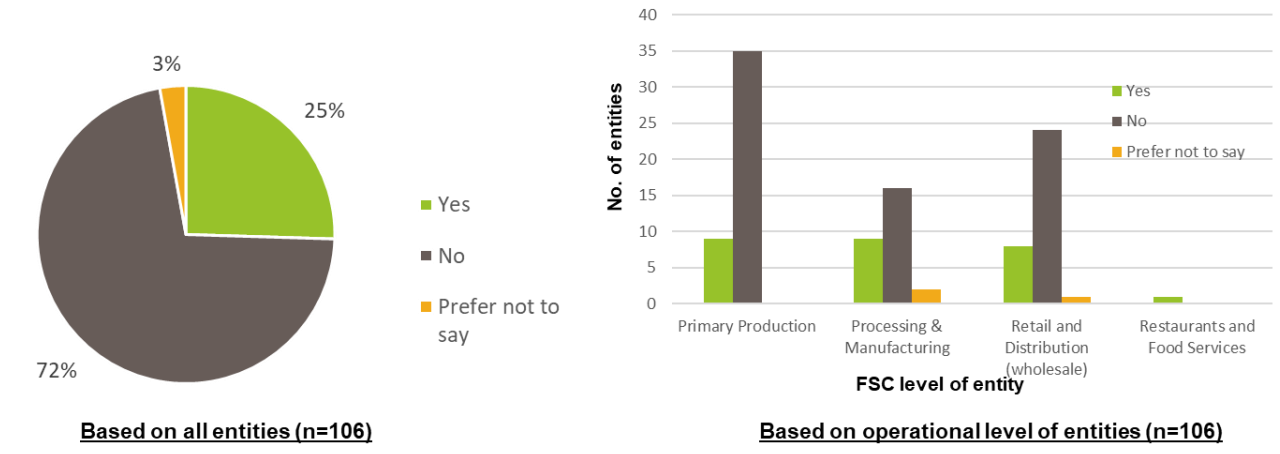

Figure 10: FW measuring entities based on FSC operational level

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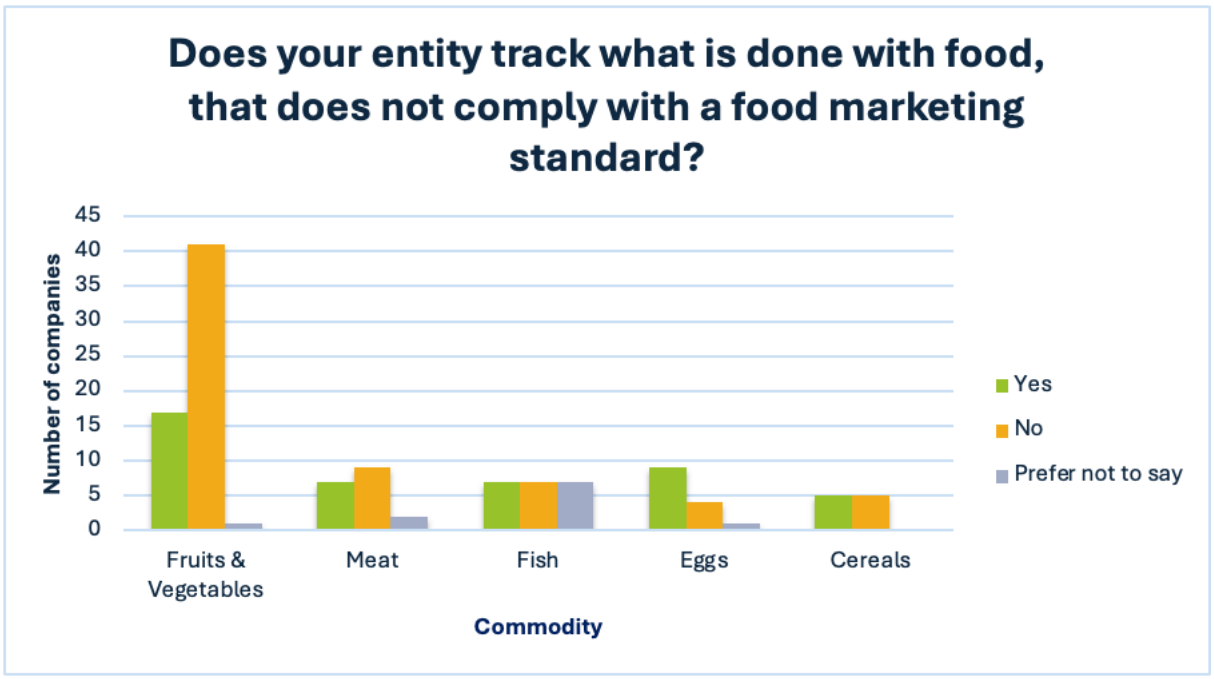

Figure 11: Entities tracking food rejected due to FMS in five commodities

Figure 12 illustrates tracking of food that does not comply with FMS across various food commodities. The data from the survey indicates that substantial number of companies who participated in the survey do not monitor food that fails to meet FMS. Specifically, for fruits and vegetables, 41 companies do not track such food, whereas only 17 do. In the case of meat, nine companies do not track, while seven do. For both fish and cereals, there is an equal distribution of companies that monitor and those that do not monitor. Only for the egg sector there are more companies (n=9) that monitor the paths of food that doesn't comply with FMS than who does not (n=4). A minor proportion of companies prefer not to disclose their tracking practices, with the highest number (n=7) for fish.

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Figure 12: Entities tracking food rejected due to FMS based on FSC level

Figure 13 outlines tracking practices by FSC level. For all 3: primary production, processing & manufacturing, and retail & distribution, the majority of companies claim not tracking the paths of food not compliant with FMS. It reveals that Primary Production has the highest number of companies not tracking non-compliant food (30), compared to 14 that do. For Processing & Manufacturing The number for tracking and not tracking are as follows: for Processing & Manufacturing – 8 and 16; for Retail & Distribution – 8 and 25. The survey did not extensively cover the restaurants and food services sector, resulting in a response from only company that tracks non-compliant food. 3 companies from processing & manufacturing sector prefer to not disclose details of their practices.

Further analysis of the survey shows the need for high urgency for action for the commodity of fruits and vegetables, as more than half of the respondents said that they are not tracking food waste yet. This is rather surprising since this commodity is the must studied on in literature. In comparison to the egg industry seems to be more active in measuring food waste, as 64% claimed that they are doing so. In total it needs to be taken into consideration that more respondents from the commodity fruits & vegetable have done the survey 59 in total and from the egg industry 20 in total.

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4.3 Analysis on qualitative data

This part on qualitative data examines the understanding of FW, the role of FMS across various food commodities, the influence of different supply chain actors and the significance of alternative markets. The findings are derived from a combination of nine interviews (Table 1) with industry stakeholders, including producers, retailers, processors, and government representatives, covering food commodities such as eggs, fish, meat, fruits, and vegetables. Additionally, data from T1.3, which includes 31 interviews, further enriches the analysis.

Table 4: Summary of key information on interviewed stakeholders

Interviewee	Organization type/ Country	Experiences with FMS/ Measuring of FW	Commodity	Stage in FSC	Informants' role and responsibility
BREADCRUMB_IDI_T2.1_Eggs_01	Associations/ EU	Yes/Yes	Eggs	Producer PM	Collaboration and communication with EU level organization such as DG AGRI, DG SANTE, DG TRADE
BREADCRUMB_IDI_T2.1_All_02	Retail/DK	Yes/Yes	All	Retail	Sustainability & Quality Manager
BREADCRUMB_IDI_T2.1_Meat_03	Associations	Yes/Yes	Meat	PM	R&D
BREADCRUMB_IDI_T2.1_FV_04	Associations	Yes/Yes	FV	PM Wholesaler	Managing product satisfaction
BREADCRUMB_IDI_T2.1_FV_05	Governmental	Yes/Yes	FV	All	Managing a research project in cooperation with a food retail company
BREADCRUMB_IDI_T2.1_FV_06	Cooperatives/ES	Yes/Yes	FV	All	Quality manager for suppliers and customer
BREADCRUMB_IDI_T2.1_Fish_07	Associations	Yes/Yes	Fish	Producer	President of Fisherman association
BREADCRUMB_IDI_T2.1_All_08	Government	Yes/Yes	All	All	Consultant for private FMS
BREADCRUMB_IDI_T2.1_Fish&Meat_09	Private company	Yes/Yes	Fish & Meat	Producer Wholesaler	Food products criteria, legislation and processing

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4.3.1 Role of defining FW

The interviews revealed the fact that there seems to be a lack of consistent definition for FW, with industry actors often holding diverse perspectives on what constitutes FW. For instance, in the egg sector, a clear definition of ‘cracked’ or ‘dirty’ eggs is absent. This can cause discussion with the control authorities and lead to more FW. On the other hand, well-established practices for labelling, collection, preservation, and cold chain management help minimize FW by ensuring product quality throughout the FSC. In the fish sector challenges arise related to FW throughout the supply chain, from production to consumption partly caused by strict legislative standards. Such legislative standards are there to safeguard food safety but in practice they often tend to complicate efforts to minimize FW. In the FV sector a distinction is made between inedible waste (e.g. apple cores) and visually imperfect yet edible products. Some informants argued that FMS often led to the rejection of perfectly good produce based solely on appearance of the food. Overall, it seems clear that the standards are mainly there for other reasons than to minimize waste and optimize resource utilization.

“We would have to differentiate between two things, what already... begins to be unhealthy.”, “Fruit that is good, but since it does not have a beautiful appearance, it is to make it easier, because it is no longer useful.”

BREADCRUMB_IDI_T2.1_FV_06

Role of guidelines and FW measurement tools

The need for establishment of protocols and/or guidelines to identify the causes and quantities of FW was a common theme among interviewees. They suggested that standardized methodologies with clear guidelines for data collection and analysis, could lead to more effective strategies for FW reduction. The need for a unified approach, within each food commodity is portrayed as essential for creating a clearer picture of the industry's FW challenges.

"It would be essential, we should have something that we can, that is simple, that is, that we can have a true picture as quickly as possible. It would be very convenient to have that information and to have a guide to help you when it comes to having some kind of information to prevent losses."

BREADCRUMB_IDI_T2.1_Fish_07

A major challenge across the FSC is the lack of consistent systems for measuring FW. The absence of industry-wide standards complicates efforts to track FW and assess the impact of FMS.

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Interviewees expressed dissatisfaction with current methods, noting that better data collection and real-time tracking are needed.

“There are records of waste, but we have a problem with those records. We now have more tools than being able to make this information be processed in real time.”

BREADCRUMB_IDI_T2.1_FV_06

"We have a lot of standards. Yes, you can say we have what we call our product quality requirements. Our standards reflect what our consumers expect from us. We’ve always aimed to stay ahead of legislation whenever we identified a problem that we could help address."

BREADCRUMB_IDI_T2.1_All_02

While some organizations have FW records, they face issues with the accuracy and usability of the data. Regulatory hurdles, particularly at the national level, also hinder efforts to improve FW measurement. Some interviewees pointed out that while EU regulations set a framework, it is often national legislation that complicates the efforts to reduce FW further. An interviewee, who is the head of the product responsibility and quality department of their institution, provided insights into the mechanisms and systems in place regarding FMS. They describe the importance of establishing FMS for suppliers to ensure product quality and sustainability. The interview highlighted how these FMS are not only regulatory requirements but also customer-driven, reflecting consumer expectations.

"We have a lot of standards. Yes, you can say we have what we call our product quality requirements. Our standards reflect what our consumers expect from us. We’ve always aimed to stay ahead of legislation whenever we identified a problem that we could help address."

BREADCRUMB_IDI_T2.1_All_02

There is a conflict between commercial interests and sustainable practices, with the sector focusing on maximizing profits at the expense of visibility into total FW generated. Additionally, prioritizing production (and maximizing profit) over FW management presents a barrier, especially when having to manage diverse client requirements. Some interviewees demonstrated a strong commitment to minimizing FW by providing detailed metrics, but others, particularly in the egg sector, were sceptical about the need for further measurement systems due to cost concerns and the administrative burden associated with these initiatives.

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“Putting in place such a mechanism costs money, and nobody wants to spend money. I don't see the need to put figures. What would we gain if we would have a system in place?”

BREADCRUMB_IDI_T2.1_Eggs_01

In the fishing sector, the lack of data on fish waste highlights a critical area for improvement, despite some efforts such as the use of organic waste containers in ports. This suggests some level of awareness and monitoring.

"We certainly don't have them [data on fish waste]. There is very, very little fish that goes into those containers, so it is a bit of a demonstration that at least in the first sale there is no waste of fish."

BREADCRUMB_IDI_T2.1_Fish_07

The need for resources to implement robust systems can be challenging for smaller companies, which often lack the personnel and technical capacity to do so effectively. This disparity can lead to underreporting and mismanagement of FW. The need for accessible and user-friendly tools to facilitate accurate measurement and management of FW across all company sizes was emphasized.

“Of course, in medium-sized and large companies... It is important that they adjust their margins well, because otherwise they can immediately get into financial problems There are computer tools today that help to control, but if computer tools have to be fed with data and they are not fed with data, you can have a very good tool, but it does not work.”

BREADCRUMB_IDI_T2.1_Meat_03

4.3.2 Role of FMS in different commodities

4.3.2.1 Eggs

Interviewees from the egg industry emphasize the challenges posed by regulatory definitions that classify byproducts such as eggshells as waste. The industry views these byproducts as useful, indicating a need for clearer regulatory alignment to capture the true value of such products. This calls for more efforts to coordinate efforts in this file between the regulatory level and the practice level.

"We call that (read: eggshells) a byproduct and it's a valuable byproduct. Egg shells can be used into animal feed as a calcium source. That is the only change in definitions in the marketing sense, I would see. For the rest the marketing standards are very clear."

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BREADCRUMB_IDI_T2.1_Eggs_01

4.3.2.2 Fish

In general data points to the fact that the fish sector faces challenges related to FW throughout the supply chain. This is the case all the way from production to consumption. Interviewees highlighted the importance of identifying the stages in the value chain where FW occurs, noting that regulations, consumer behavior, and biological factors all contribute to FW. By understanding the stages better possible actions along the chain can better be put in place.

"From the producer to the consumer, product is lost along the way…Food waste is food that could be eaten but is wasted in his way to consumers or in consumer stage."

BREADCRUMB_IDI_T2.1_Fish_07

Interviews revealed distinct perspectives regarding the challenges of identifying alternative lower-value chains. The regulations governing FMS are notably stringent, with rigorous quality control measures being applied to fish, including parameters such as organoleptic properties and biochemical composition. These guidelines cascade from retailers down to suppliers, wholesalers, processors, and manufacturers, ultimately affecting the primary producers i.e. fisherman or aquaculture farmers.

Bureaucracy is perceived as a significant hurdle, particularly concerning the re-evaluation of rejected products. This illustrates how administrative challenges can exacerbate FW by making it difficult for stakeholders to navigate processes that could otherwise mitigate FW. These challenges highlight the need for streamlined protocols that facilitate better management of seafood products. It also highlight the need for multi actor approaches in the value chain to find more sustainable solutions.

"Bureaucracy is a major handicap. To send this to another place, I have to do so much paperwork, that it is already spoiled."

BREADCRUMB_IDI_T2.1_Fish_07

The fish value chain due to its special nature including short shelf lives in general face very specific challenges. Fishermen typically sell their catch to wholesalers or retail suppliers. However, they often lack alternative options for utilizing fish that do not meet the established FMS, resulting in significant FW. Although some aquaculture farmers can repurpose substandard fish into such as fish meal, this is not universally applicable.

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"We have different internal standards, in terms of organoleptic controls, controls of the biochemistry of the muscle itself, of the fish once it is dead and, as I said, that at the end gives us a final grade of this product that makes us decide the final destination. Depending on what is not complied product goes to destruction."

BREADCRUMB_IDI_T.1.3_3_Producer_Aquaculture

From the perspective of wholesalers, the regulatory framework is perceived as "quite normal". They emphasize that fishermen must either comply with the FMS to avoid overfishing or harvesting immature fish. One wholesaler has witnessed FW firsthand and gave the following opinion:

"I have seen containers of fish thrown away… All this fish will no longer be able to breed or do anything, it is already dead and in the garbage."

BREADCRUMB_IDI_T1.3_2_Wholesaler_Fish

Sometimes wholesalers purchase more fish than necessary due to the high number of fishing boats, complicating supply and demand management. However, they can leverage their connections across various industries and retailers, and sometimes even end consumers often using platforms like WhatsApp to facilitate sales of surplus fish following a close to real time logic.

"Sometimes I buy a lot and I use my contacts, I move around more to get the product sold quickly, I call the hotel and catering business, the companies I work with on commission, I make offers in the store."

BREADCRUMB_IDI_T1.3_2_Wholesaler_Fish

In the retail sector, the acceptance of fish products is governed by strict criteria. Retailers typically require that products meet precise FMS, leading to a binary outcome of either acceptance or rejection. The retailer argues that stringent regulation is there to fundamentally protect consumer health, resulting in a preference for products that align with their established quality benchmarks. But one retailer has successfully implemented the "Too Good to Go" app to sell fish from their stores. Once fish products arrive at distribution warehouses, there is often insufficient time and management capacity to address items that do not conform to FMS. Thus, it seems, according to the interviewee, that the retailer does not account for the FW nor the economic burden.

"Either they have it perfect, or it is rejected. So, it is the distributor's responsibility. … No, as I told you, time is tight. The fish arrives at one o'clock in the morning, it must pass quality control, make

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invoices and put in vans and at six/seven o'clock in the morning it leaves the platform…I could tell you that 99% of the product is returned to the supplier, that is the norm. It is left in the chamber if the supplier has already left the facilities once the first inspection has been done, but if not, it is returned to the supplier in the same transport."

BREADCRUMB_IDI_T.1.3_4_Retail_Fish

4.3.2.3 Meat

The meat sector experiences lower levels of FW compared to other sectors due to the higher economic value of meat. However, FMS related to classification criteria and appearance/consistency seems to be the key FMS categories driving FW. Yet, stakeholders are often more motivated to find ways to utilize every part of the animal. There is a greater emphasis on utilizing byproducts, such as for instance bones, in processed food or pet food. However, the relationship between FW and food safety in this sector remains significant.

"The food marketing standards (related to meat) and food waste are very related to food safety. However, the food waste in this sector is lower than in others due to the higher economic value of it."

BREADCRUMB_IDI_T2.1_Meat_03

One interviewee advocated for the development of simpler, more intuitive tools that can be easily adopted by operators to assist in decision making. By suggesting the use of for example a balance sheets to track raw material purchases against final products, a practical approach for companies to identify waste and inefficiencies. The emphasis on user-friendly technology indicates a recognition of the need for better training and resources to empower employees in managing FW effectively. It also emphasises the need for technology and innovation in the field.

"I think that the best way to be able to develop them is to have a balance sheet that allows you to demonstrate, hey, look, I buy so much raw material, and now I buy so much final product. It is true that years ago some tools started to appear, some simpler or more intuitive programmes."

BREADCRUMB_IDI_T2.1_Meat_03

Fruit and Vegetables

"In general, there must be better guidelines on how to measure waste."

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BREADCRUMB_IDI_T2.1_FV_05.

The FV sector faces unique challenges due to outdated sets of FMS that do not seem to align with modern consumer expectations. One interviewee reflected on the impact of FMS on FW, noting that while these FMS are useful from an aesthetic point of view , they need to be updated to better reflect contemporary consumer perceptions and realities in agriculture. Retailers play a significant role in setting FMS, often leading to the rejection of perfectly edible products based on appearance.

"We have stayed a bit in the model of 25 years ago. …There are many times that it is the chains themselves that tell you what they want."

BREADCRUMB_IDI_T2.1_FV_04

One interviewee shared an example of how consumer behavior apparently began to shift when lower-quality products (or B-products) were introduced, ultimately leading to an increase in FW. As lower-quality products become more common, consumers might start to reject perfectly good products, believing they are less desirable. This example illustrates how the introduction can change consumer expectations and purchasing habits. It underscores the need for a more nuanced understanding of how FMS affect both producers and FW generation.

"In the end, it was actually the producer who asked us to stop selling the second-class carrots. It creates food waste, but it also helps the primary producer to get a higher price for his products. People were just changing the carrots they were buying from the straight ones to the twisted ones."

BREADCRUMB_IDI_T2.1_All_02

Additionally, pesticide regulations also affect FW of fresh produce in the FV sector. Stringent requirements, which include strict limits on pesticide residues, imposed by retailers (through private FMS) often lead to an increase in FW along the FSC.

"We have certain demands regarding pesticide use that are above market levels, which can sometimes cause food waste in the value chain. … We want our producers to be extra careful when using pesticides. By asking them to ensure that we find only half the allowed level, we know they will be more cautious."

BREADCRUMB_IDI_T2.1_All_02

Role of supply chain dynamics

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Collaboration among producers, retailers, and regulatory bodies is seen as crucial for effective FW management. This calls for a rethinking of the governance structure in value chains and opens up important questions such as how different actors can cooperate better in a complex multi-actor environment. Open communication channels among stakeholders can help identify potential issues early in the supply chain, allowing for proactive solutions to prevent waste. For instance, if retailers provide feedback to producers about consumer preferences, producers can adjust their offerings accordingly. Communication gaps between these stakeholders often increase the issue of FW, as misalignment of FMS and expectations can lead to inefficiencies in the supply chain. For instance, if producers are unclear about the FMS they need to meet, they may produce items that do not align with retailer expectations, resulting in increased waste

"There is a kind of ongoing dialogue between us and the slaughterhouses. We need to couple them with some other competences... We can't solve it here."

BREADCRUMB_IDI_T2.1_Meat&Fish_09

Insights from interviews with suppliers, distributors and producers generally revealed that they feel slightly burdened about the situation of having the responsibility of managing FMS by having to take out products that are not meeting the expectations due to norms that according to them might not be up fair and just. If, for instance, a product does not meet the criteria set by these private FMS, it is simply returned to the suppliers, distributors, or producers. One interviewee reflected on the economic ramifications of FW, particularly how losses are felt more acutely down the supply chain, affecting producers the most. They emphasize the importance of measuring FW for financial reasons.

"Yes, because of course, all this entails economic losses, for everyone and the lower down, the worse. When the farmer arrives, in short."

BREADCRUMB_IDI_T2.1_FV_06

The role of intermediaries in sorting and rejecting products that do not meet FMS was highlighted by one interviewee. Suggesting that a more collaborative approach could lead to better utilization of products that would otherwise be wasted. The responsibilities of these intermediaries are perceived as crucial in understanding where FW occurs. Examples of intermediaries include suppliers, brokers, wholesalers. The role of intermediaries is also viewed as critical, as they are often the first point of contact for sorting and rejecting products. The interview revealed that these intermediaries may not

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take responsibility for what happens to rejected products, which can lead to further FW. Therefore, the interviewee stressed the need for a shift in industry practices to better utilize products that do not meet FMS. They suggest that a collaborative approach among all stakeholders could lead to better outcomes for waste management.

"I think that more than a matter of how to measure those values, it is more a matter of how the dynamics really change. There are so many things... And evidently the position and interests of each one almost never coincide."

BREADCRUMB_IDI_T2.1_FV_04

There are also structural challenges within an organization that can inadvertently lead to FW. The complexity of marketing strategies and promotional offers plays a role in FW generation, suggesting that FMS need to be re-evaluated.

"Sometimes we know that these extra products we take in, they will not sell. It creates some food waste somewhere else. There's a lot of speculation going on in the food industry that might cause some waste somewhere in the system."

BREADCRUMB_IDI_T2.1_All_02

One interviewee described challenges of mismatches between production and demand, particularly in the context of operational inefficiencies i.e. tight production schedules. These mismatches can lead to either surplus production or shortages, both of which can result in FW. This narrative points to the need for improved communication and forecasting methods within the FSC to enhance efficiency and reduce FW.

4.3.2.4 Role of the retailer and food service sector

The initial observation from interviews with retailers and food service professionals is that they perceive FW as minimal in the stages before the serving. However, a deeper analysis of the interviews presented a more nuanced picture, identifying potential actions to address FW. They acknowledged that FMS can be both preventive, reducing FW, and counterproductive in some cases. For instance, an interviewee noted how FMS related to banana ripeness helps reduce FW, as allowing the sale of green bananas extends their usability because they can ripen in-store.

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"We accept the green bananas, and it will reduce food waste because if we were to accept only yellow or brown bananas, they would reach the stores, ripen too quickly, and ultimately contribute to food waste."

BREADCRUMB_IDI_T1.3_18_Retail_All Commodities.

Private FMS, often set by retailers, are identified as significant drivers of FW. While private FMS can impose additional requirements that may lead to FW, they also serve as preventive measures that enhance food safety, which resonates the point of overlap of food safety and FMS. While these FMS aim to ensure product quality and safety, they often lead to unnecessary FW when they are overly strict or change unexpectedly. Interviewees pointed out that private FMS sometimes have a greater impact on FW than public FMS.

"I say it is more difficult to accept a product than to reject it. I always find a reason to reject and dispose of it (biogas plant). I think it will become more difficult in the future because there is more and more black-and-white thinking"

BREADCRUMB_IDI_T1.3_5_PP and PM and Retail_Fruits and Vegetables

"In the past, eggs were always used as consumption eggs, and it was not a difference. Legislation came in place and to value the eggs you can't put in a box. The food marketing standards made regulations in order to have practice being put into legislation."

BREADCRUMB_IDI_T2.1_Eggs_01

Similarly, the extended shelf life of products was highlighted as a key factor in reducing FW, especially in food service where timing and product longevity are crucial. Complex logistical challenges necessitate careful consideration of timing and product longevity to reduce FW.

"This underscores the necessity of having the correct number of days for product usability, as it significantly influences the volume of food waste we experience"

BREADCRUMB_IDI_T1.3_31_Food Services_All Commodities.

According to interviews, in the food service sector, compliance with established FMS can be linked to a decrease in FW. One informant for instance noted that the superior quality of raw products supplied, enabled their full utilization in food preparation processes.

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"Compliance with these standards has certainly reduced the amount of waste, as the raw materials supplied are of appropriate quality. We have been able to fully use them in the preparation of food"

BREADCRUMB_IDI_T1.3_19_Food Services_All Commodities

Interviewees from the retail and food service expressed a strong interest in donating to food banks, social entities (such as food sharing local organizations), as well as selling surplus products at reduced prices on online platforms such as "Too Good to Go" to mitigate FW. While this approach is not a direct consequence of FMS, it stems from the shorter shelf life of certain products and an oversupply of goods.

For instance, "Too Good to Go" has reportedly saved over 121 million meals in 2023 (Too Good to, 2022). Similarly, Fødevarebanken, the leading food bank in Denmark, reports that it has saved over 1,562 tons of surplus food, equating to more than 3.9 million meals. This raises the question of whether these meals are directly influenced by FMS and whether they are genuinely being salvaged. These initiatives indicate a reduction in FW within the retail and wholesale sectors, as interviewees noted that products are either blocked from reaching consumers or redirected towards them.

"Take the bad apple out and donate the rest or try to close it (bag) and sell it for a reduced price."

BREADCRUMB_IDI_T1.3_30_Retail_All Commodities

4.3.2.5 Role of the consumer

Consumer expectations regarding the appearance and quality of products play a significant role in driving FW. Products that do not meet aesthetic FMS are often rejected, even when they are still edible. Educating consumers about the realities of FW and the safety of products past their sell-by dates could help reduce FW at the consumer level. The impact of consumer behavior on FW, for instance on the misconceptions of egg expiration dates. Many consumers discard eggs based on sell-by dates, despite the eggs being safe for consumption beyond those dates. This underscores the importance of food literacy and consumer education in reducing FW at the household level.

"Consumers think ohh it's already bad and they cannot consume anymore. The industry saves eggs for around six months, but then it's stored at a low temperature. There are a lot of food literacy programmes to understand how what the eggs can be consumed."

BREADCRUMB_IDI_T2.1_Eggs_01

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The consumer expectations are translated into the company's FMS and practices towards consumer concerns about food safety and quality, often exceeding legal requirements. This customer-centric approach of building trust while shaping the company's operational strategies by stricter regulations.

"From our company's perspective, we are owned by our customers. It's about building trust. I think they are not in all aspects high enough, no."

BREADCRUMB_IDI_T2.1_All_02

"I think there is a more direct relationship between the consumer's perception and what the chains demand of us. The consumer opts for what shines."

BREADCRUMB_IDI_T2.1_FV_04

4.3.3 Role of revalorization and alternative markets

Suppliers face additional administrative costs when seeking alternative resale methods for rejected products, often leading to lower revenues. Some producers even must bear the associated costs related to product returns, making it unappealing to market non-compliant food items. In high-demand retail sectors, price deductions may occur for rejected products.

"From time to time, we get products that are not according to the requirement. We have announced that these products are coming. So yeah, then of course it's very difficult for us to return it… In most cases, we do our outmost to receive products and find a solution, but of course, if we paid for a larger quality, we receive a deduction."

BREADCRUMB_IDI_T1.3_30_Retail_All Commodities

However, processors tend to prioritize valorisation and the development of alternative lower-value side streams due to their FW concerns. When products return to processors due to non-compliance with shelf life or packaging standards, they can be repackaged and resold, discounted, donated, or disposed of, depending on their condition. Products that remain safe and of good quality are repackaged, while those with a short remaining shelf life may be sold to less demanding customers or donated. Products that cannot be repurposed are discarded as non-recyclable waste.

"The products are sent back to different destinies depending on their characteristics. Products that have been affected during transport, but whose quality and food safety have not been compromised,

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are repackaged and sold, otherwise they must be thrown away. Those that have a residual shelf life that is too short for the client but still sufficient to consume can be sold to customers with less demand, sold through discounting or donated to charity… non-recyclable waste because separating the product from the packaging would require an effort that cannot be economically justified."

BREADCRUMB_IDI_T1.3_20_PM_FV

Similarly, rejected products at the primary producer level are handled for repurposing, resale, or discarded as pre-harvest loss, which is not accounted for in FW quantification. Producers express frustration with the industry's standardization of products year-round, which neglects seasonality and diminishes the variety of seasonal produce. They advocate for promoting seasonal items to enhance consumer experience, support local farmers, and reduce the environmental impact of importing out-of-season products.

"We compost what we don't sell."

BREADCRUMB_IDI_T1.3_24_PP_Vegetables

"The harvest goes directly to the ground."

BREADCRUMB_IDI_T1.3_28_PP_Fruits

Existing regulations create burdens for revalorizing rejected products, particularly regarding food donations, due to complex documentation and VAT implications, highlighting the need for policy reform to facilitate food redistribution. This illustrates how national legislation can hinder efforts to reduce FW by making it more cost-prohibitive to donate food rather than dispose of it.

"If we want to combat food waste even more, it needs to be cheaper for us to get rid of the food waste. The demand for documentation is sometimes so high that it's cheaper to throw it away. We have been struggling a lot with VAT."

BREADCRUMB_IDI_T2.1_All_02

4.3.4 Recommendations

The findings emphasize the complexities of FW in relation to FMS across different food commodities.

"It's a very complex issue. I honestly don't know how it could be addressed."

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BREADCRUMB_IDI_T2.1_FV_04

The interplay between food waste and food marketing standards requires a nuanced understanding of the specific challenges faced by different sectors within the food supply chain. Drawing from these insights, we identified recommendations aimed at addressing those challenges. The five key recommendations include:

1. **Develop consistent definitions of FW** to better reflect industry realities. However, these interviews show the difference in the various food commodity. Thus, uniformity through the different food commodities seems impossible. To better understand the actual impact of FMS, it is crucial to examine the processes involved in the food chain, including how products flow and where potential bottlenecks occur
2. **Improve FW measurement tools and methodologies** to enable more accurate data collection, integrating food safety to enhance compliance. Interviewees advocated for the development of simpler, more intuitive tools. In these efforts the assistance and support that can be provided from digital technologies and automatization should not be overlooked.
3. **Enhance collaboration across the FSC** to align standards and practices more effectively. This includes creating accessible, user-friendly tools for companies of all sizes to measure and manage FW (+ FW-FMS). Interdisciplinary approaches and cross-sector collaboration were emphasized to drive innovation in FW reduction and food safety, with a focus on continuous improvement and adaptation.
4. **Focus on consumer education** to reduce FW at the consumer level**.** This action could be integrated into broader initiatives many cities are taking to tackle food waste, where food councils, Living Labs, and participatory citizen engagement strategies are utilized. In particular the potentials of integrating consumer education in the Education for Sustainable Development actions (ESD) and the SDG teaching at school should be utilized as much as possible and ideally be part of the commissions effort to update food education for young people and at schools.
5. **Encourage the efforts to revalorize rejected products** through the development of more effective regulatory frameworks and alternative markets. The discussion around alternative markets for rejected products is promising, suggesting that there are pathways to reduce waste if better systems are established. However, the interviewees emphasize the current lack of clear guidelines and documentation practices hindering progress. Potential

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improvements in governance structures for multi-actor cooperation in value chains should be investigated, with actions taken based on these new insights.

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5. CONCLUSION

The complexities surrounding food waste and its relationship with marketing standards underscore a pressing need for a comprehensive and unified approach to understanding and addressing this critical issue. The findings of this study elucidate significant inconsistencies in how food waste is defined, measured, and perceived across various stakeholders in the food supply chain (FSC). These inconsistencies not only complicate the efforts to quantify food waste attributed to marketing standards but also hinder the development of effective strategies for its reduction.

One of the most alarming revelations from this research is the substantial lack of empirical data regarding the volume of food waste linked to marketing standards, along with the absence of standardized measurement systems for it. This lack of measurement is particularly concerning, as it suggests that stakeholders are operating without a clear understanding of the scale of the problem. The interviews conducted for this study further highlight the challenges faced by stakeholders in providing data, with many unable to quantify the waste generated at their respective levels of the FSC. Moreover, an examination of the status reports reveals a lack of categorization of FW into distinct groups, particularly concerning marketing standards. This lack of reliable data, also from the review of literature, is a significant barrier to developing targeted interventions and policies aimed at reducing food waste. The report consistently points to the difficulties stakeholders face in accurately measuring food waste within the entire FSC. The absence of standardized systems for recording and reporting waste in current systems do not adequately address the complexities of food waste generation, particularly as it relates to marketing standards.

In light of these findings, it is imperative for all stakeholders in the FSC to prioritize waste management as a key component of their operational strategies, rather than relegating it to an ancillary concern. Ultimately, a more nuanced understanding of food waste and its relationship with marketing standards is essential for developing effective interventions and policies. This understanding should be grounded in robust data collection practices, standardized definitions, and collaborative efforts among all stakeholders in the FSC. By addressing the inconsistencies and gaps identified in this report, the report urgently highlights the need for a coordinated approach to tackling food waste linked to marketing standards. Therefore, by prioritizing standardized methodologies, enhancing data collection practices, and fostering collaboration among stakeholders, it is possible to create a more comprehensive understanding of food waste and implement targeted interventions that address this critical issue. The report ends its conclusion with recommendation in the following section.

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6. RECOMMENDATIONS

6.1 Policy Recommendations

Establish Standardized Food Waste Measurement Protocols regarding Marketing standards: The interviews reveal significant inconsistencies in how food waste is defined, documented, and measured across different sectors of the food supply chain. This lack of standardization complicates efforts to understand and address food waste effectively across the value chain.

- The use of adaptable and standardized tools and methodologies for measuring food waste should be created and mandated across all sectors and FSC. These tools should be user-friendly and with consistent definitions of food waste that account for byproducts, wastage, feed across various stages of the supply chain. This will help to accurately categorize and measure food waste. Tools should as much as possible take advantage of sensor and digital technology to minimize workload.
- Barriers at various stages and across sectors should be identified and analyzed in more detail and barriers and challenges in managing food waste, including regulatory, technological, and operational challenges should be mapped This could be done in targeted and specialized project environments.

Marketing standards should account for the seasonality change while creating marketing standards:

- **Impact of FMS should account for Food Loss**, absolute calculation based on the Food Waste definition do not provide an accurate representation. It is not cost effective for farmers to harvest the product if doesn't fulfill the FMS imposed by its buyers
- **Strengthening the role of public procurement:** Although it is a widely held opinion that Food service sector have a low amount of food waste due to FMS, that is still worked to be done in the public service sector. A growing number of cities have urban food waste strategies on the agenda, making it straightforward and obvious to engage stakeholders in discussions about food waste in relation to standards. It is also straightforward to standardize and coordinate efforts to collect more and better data on food waste amounts in public food service value chains.
- **Support Technological Innovation and metrology.** Since data is tracking in many value chains at since logical progress has made a range of technologies available this should be taken

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advantage of. Technologies, such as artificial intelligence, natural language processing, image recognition and risk assessment tools offer considerable advantages and we'll be able toenhance the accuracy and efficiency of food waste measurement and management.

- Since data is being tracked across many value chains and significant progress has made various technologies available, this opportunity should be taken advantage of. Technologies such as artificial intelligence, natural language processing, image recognition, and risk assessment tools offer considerable advantages and can significantly enhance the accuracy and efficiency of food waste measurement and management.
- **Promote Collaboration and communication throughout the FSC**: Encourage collaboration among Primary producers, Processor and Manufacturer, Retailer and distributor, Food services as well as consumer to share best practices and develop comprehensive strategies for rejected food products.
- **Provide Training and Resources at Primary producer level**, especially in the fish sector, where a significant amount of fish is not valorized, as well as for small processors, manufacturers, and suppliers. Offer training programs and resources to help stakeholders implement valorization methods and develop the technical capacity to utilize smart technology. Additionally, ensure that stakeholders have the technical and practical ability to access market dynamics in real time.
- **Communicate economic Impact of Food Waste on Different Stakeholders:** Analyze the economic consequences of food waste for various stakeholders, including farmers, processors and manufacturers, supplier, distributor, wholesaler, retailers, and consumers. Use economic modeling and Case studies to quantify the financial impact of food waste and identify cost-effective waste reduction strategies, which will be undertaken in WP3.
- **Disintegrate the Food Safety and Marketing Standards** in Fish and Meat sector: Ensure that food waste measurement protocols disintegrate food safety and marketing standards to improve overall compliance and reduce waste without compromising safety. Most of the research and interview interlink food safety with marketing standard, thus, it blurs the line making it difficult to measure the FW due to FMS.
- **Rething definitions of unavoidable waste** – like filleting and bones, eggshells. As per the definitions they are considered waste, but for a distributor, wholesaler and processing and manufactures it’s not considered waste, this could be a reason so many of them want to avoid the accounting of food waste.

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- **Separate the food safety and marketing standards** in Fish and Meat sector Ensure that food waste measurement protocols separate food safety from marketing standards to improve overall compliance and reduce waste without compromising safety. Most of the research and interview interlink food safety with marketing standard, thus, it blurs the line making it difficult to measure the FW due to FMS.
- **Rethink definitions of unavoidable waste** – like filleting waste and eggshells, these materials are considered waste according to definitions; however, for distributors, wholesalers, processors, and manufacturers, they are not seen as waste. This perspective could be a reason why many of them want to avoid accounting for food waste.

6.2 Implications for subsequent WPs

- **Focus on economic implications of quality standard**: Beside the primary producer, the PM, retailer, food services have a solid grasp of the economic implications, since they directly purchase and sell product. Their loss is calculated in monetary terms. They understand what works and what does not. However, this is not the case for primary producers. Thus, the economic losses they face could offer new insights into marketing standards. As we know, many products that do not meet quality standards are downgraded to Class II, Class III, or used as animal feed. While this is not technically food waste, it represents a significant loss in economic value. Therefore, further analysis of the impact of food waste due to food marketing standards should focus on the economic implications within the EU supply chain. Work Packages (WPs) and Task Packages (TPs) working on balancing trade-offs and business potential should aim to understand the economic consequences of marketing standards, particularly the costs incurred by producers.
- **Consumer awareness on misconception of food safety and expirations date in regard to marketing standards:** Although T2.1 does not delve into the consumer level of FSC, the interviewee, especially from retail and food service sectors indicated the vital role of food safety and expiration dates. Thus, educational interventions that examine the role of consumer behavior in food waste generation—particularly focusing on misconceptions about food safety and expiration dates—could improve market access to suboptimal foods.

6.3 Potential topics for further research

- **Explore the valorization challenges and opportunities** for valorization to reduce food waste in the fishing industry, including the role of regulatory frameworks and market dynamics, particularly among primary producers such as fishermen, wholesalers, and distributors, to gather insights.

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- **Assess the impact of EU marketing standards on food waste across diverse agricultural regions**: The literature review indicates that there is limited study conducted on regional differences in food waste. The EU has various agricultural regions, with varying degrees of production, climate, and food culture. Thus, the study focused on agricultural could highlight the existing regional disparities in agricultural practices and consumer behaviors, emphasizing the need for comprehensive data that encompasses a wider geographical scope. The study will fill the gap in literature regarding the impact of marketing standards on food waste in underrepresented regions.
- **Initiate a comprehensive study to identify the barriers** for food waste measurement. Our survey shows that the majority of respondents cannot indicate that their food waste is measured. As food waste measurement is the basis to identify the amount of food waste due to food marketing standards, this future research could be very valuable to identify the reasons for the development of valorization and solutions. Future research could investigate why only 25% of the respondents could state that food waste is measured in their entity.

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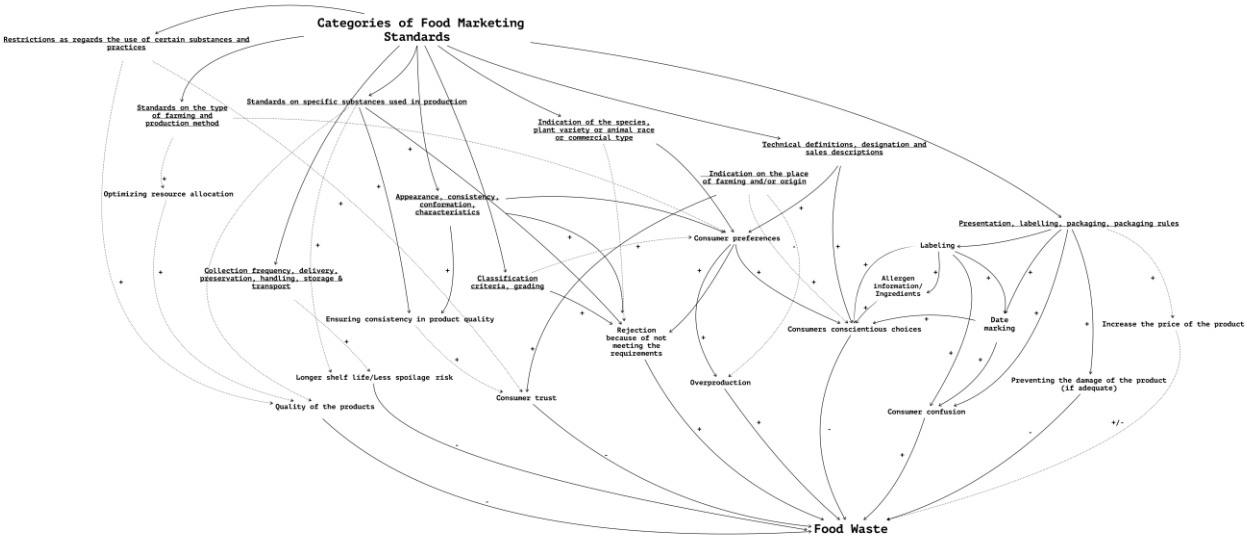
8. APPENDIX

8.1 A preliminary conceptual model (output of T1.2)



8.2 Inclusion criteria and exclusion criteria

The following inclusion criteria for the screening process was adopted.

i) The article/report must mention at least one of the following marketing standards in FIVE commodities “FV, Cereal, Eggs, Meat and Fish”

   a. The technical definitions, designation and sales description

   b. Classification criteria, grading

   c. Indication of the species, plant variety or animal race or the commercial type

   d. Presentation, labelling, packaging, marking, year of harvesting

   e. Criteria such as appearance, consistency, conformation, product characteristics and the percentage of water content

   f. Specific substances used in production (i.e. quantitative content, purity, identification)

   g. The type of farming and production method

   h. Coupage of must and wine

   i. The frequency of collection, delivery, preservation and handling, the conservation method and temperature, storage and transport

   j. Indication on the place of farming and/or origin

   k. Restrictions as regards the use of certain substances and practices

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l. Specific use

m. The conditions governing the disposal, the holding, circulation and use of products.

ii) The article/report must contain food waste estimation or Food waste quantification regardless of methods used.

iii) Exclusion of two food supply chain "Primary production and pre-harvest" and "Food preparation and consumption at a household"

iv) Quantification/estimation should be OR/AND in "metric tons", "tons", "tonnes", "kg" of fresh mass and "percentage" or "fraction" indicated by its reference year and production.

v) Definition of food waste must follow as per the definition and description written on the "Key definitions/terminology" of the report.

vi) Exclusion of report and articles other than affiliated partners in T2.1 i.e. Danish, Spanish, French, German, Slovenian & Italian.

8.3 List of final articles used for literature review

SN	Short reference	Title of the literature	Short description and its relevance	Type of literature
1	Agnusdei, G. P. et.al (2022)	Towards circular economy in the agrifood sector: Water footprint assessment of food loss in the Italian fruit and vegetable supply chains	The empirical research paper explores the relationship between food waste and environmental sustainability in the Italian fruit and vegetable supply chains, with a particular emphasis on the water footprint of food loss as one of the mechanisms of quantifying and tracking the FLW.	**Scientific article -** Empirical analyses
2	Beausang, Hall and Toma (2017)	Food waste and losses in primary production: Qualitative insights from horticulture	The article investigates food waste and losses within the primary production on soft fruit and vegetable farms, and provide in-depth qualitative insights into the impact of different causes, including food marketing standards, on food waste at the primary production level.	**Scientific article – Qualitative** Research
3	Caldeira, C. et.al. (2019)	Quantification of food waste per product group along the food supply chain in the European Union: a mass flow analysis	Review article/policy brief focusing on food waste reduction strategies and quantification methods across EU, providing a comprehensive overview of the stages in the food supply chain where waste occurs and suggesting strategies for reduction.	**Scientific article –** Mass Flow Analysis

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4	Caldeira, C.et al. (2021)	Grown and thrown: Exploring approaches to estimate food waste in EU countries	The paper presents two modelling approaches to estimate food waste in EU countries: based on Material Flow Analysis (MFA) and waste statistics. MFA approach combines statistical information on the production and trade of food products with food waste coefficients. The waste statistics are the secondary database on FLW.	**Scientific article –** Research Article
5	Cane, M., & Parra, C. (2020)	Digital platforms: mapping the territory of new technologies to fight food waste	The paper study and explore that importance of new technologies in the fight against waste, using digital platform to manage food and to eliminate the loss in surplus product. The study shows that digital platforms are essential tools to fight against food waste, preventing certain products from being considered unfit for human consumption.	**Scientific article –** Research Article
6	Catchpole, T. L. et. al. (2017)	The challenges of the landing obligation in EU fisheries	Feasibility study conducted on the impact of the new Common Fisheries Policy (CFP), especially the rule requiring catches in regulated fisheries to be landed and counted against quotas of each Member State-called “Minimum Conservation Reference Size (MCRS)”.	**Scientific article –** Feasibility Study
7	Derqui, B. et.al. (2016)	Towards a More Sustainable Food Supply Chain: Opening up Invisible Waste in Food Service	The study conducted explorative research with qualitative and quantitative data through in-depth semi-structured interviews and an open questionnaire with top Spanish food service companies.	**Scientific article –** Explorative Study
8	Hoehn, D. et.al. (2023)	A critical review on food loss and waste quantification approaches: Is there a need to develop alternatives beyond the currently widespread pathways?	The study performs an assessment of 237 studies in the field, aiming to identify existing FLW quantification methodologies as well as to find out the need of developing alternative paths.	**Scientific article –** Critical Review
9	Lanfranchi, M., Giannetto, C., & De	Analysis and models for the reduction of food waste in organized	Focuses on analyzing food waste within large-scale retail outlets in eastern Sicily, based on data from 13 retail stores collected over a five-year period (2009-2013).	**Scientific article –** Research Article

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	Pascale, A. (2014)	large-scale retail distribution in Eastern Sicily		
10	Plazzotta, Manzocco and Nicoli (2017)	Fruit and vegetable waste management and the challenge of fresh-cut salad	The article highlights the significant amount of waste generated in the fruit and vegetable sector, especially in industrialized countries, due to factors such as programmed overproduction and quality standards (fruits and vegetables that do not meet aesthetic standards) set mainly by retailers. Additionally, the paper's examination of alternative uses for substandard produce offers practical insights that can inform strategies to minimize food waste.	**Scientific article –** Review
11	Ramírez-Rodríguez et. al. (2024)	Food waste in high income countries: Spanish fish value chain as a case study	The study aims to better understand the flow of fresh fish along its value chain and Food Waste drivers and incidence in the wild-caught fish sector for high-income regions in Spain. The study collects qualitative and quantitative data, the methodology combined a literature review, analysis of secondary databases, material flow analysis (MFA) with the year 2022 as a time frame, in-depth interviews, direct measurements and surveys.	**Scientific article –** Case Study
12	Redlingshöfer, B., Coudurier, B., & Georget, M. (2017)	Quantifying food loss during primary production and processing in France	The study addresses key questions on how FLW can be measured, the role of reuse and recycling in reducing food loss, and the challenges of quantification in industrialized countries by in-depth analysis of food loss during the upstream stages of the food supply chain in France, specifically during primary production and processing.	**Scientific article –** Empirical Analysis
13	Xue, L. et. al. (2017)	Missing Food, Missing Data? A Critical Review of Global Food Losses and Food Waste Data	The paper provides a comprehensive review of 202 publications which reported FLW data for 84 countries and 52 individual years from 1933 to 2014 on different parts of food value chain (including data from EU), highlighting the significant challenges in data consistency, coverage, and quality.	**Scientific article –** Critical Review
14	Caldeira, C. et al. (2017)	Food waste accounting Methodologies,	The paper summarizes the outcomes of a workshop on food waste accounting co-organized by the EU Commission's Joint	**Report; Scientific article**

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	Corrado, S. et.al. (2019)	challenges and opportunities; Food waste accounting methodologies: Challenges, opportunities, and further advancements	Research Centre and Directorate-General on Health and Food Safety with the aim of stimulating harmonization of methodologies, identifying challenges, opportunities, and further advancement for food waste accounting and resents methodological aspects, e.g. system boundaries, reliability of data, accounting of water flows, to ensure better support to food waste policy design and interventions.	
15	Borum, A. et. al. (2018)	Food waste in the Danish primary production and food industries	The report seek to provide a basis for estimating the scale of food waste generated in the Danish primary production and food industries. The five overall food product categories were investigated.	**Report**
16	De Laurentiis, V. et.al. (2023)	Building a balancing system for food waste accounting at national level	This report has developed a model based on Material Flow Analysis (MFA) to estimate food waste generated in the Member States (MSs) at food group level for the different stages of the food supply chain: primary production, processing and manufacturing, retail and distribution, households and food services consumption.	**Report**
17	EUC-Knowledge Center (2020)	Brief on food waste in the European Union	The brief report brings together knowledge and scientific evidence from within and outside of the European Commission in a transparent, tailored and concise manner, to inform policymaking on the bioeconomy.	**Report**
18	Franke, U. et.al. (2016)	Food losses and waste in primary production: Data collection in the Nordic countries	Report of first attempt to quantify food waste in primary production in the Nordic countries of Denmark, Finland, Norway and Sweden; which resulted in a suggested definitional and methodological framework for future food waste studies in primary production.	**Report**
19	Miljøstyrelsen (2024)	Kortlægning af madaffald i primærproduktionen samt forarbejdnings- og fremstillingssektoren (Food Waste in Primary Production	The report by Danish Environmental Protection Agency contains a mapping of food waste from the primary production as well as from the processing and manufacturing sector in Denmark for 2022. with the purpose to meet the EU's delegative decision on the area with special focus on requirements for the method of stating food waste.	**Report**

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		as well as processing and the manufacturing sector)		
20	Nes, K., & Ciaian, P. (2021)	Marketing standards for food products – A review of literature	The report provide an overview of economic literature on marketing standards in the food supply chain by (i) providing analyses on economic concepts and the impact of marketing standards and (ii) by narrowing the focus of their impact on sustainability.	**Report**
21	Roels, K., & Van Gijseghem, D. (2017)	The impact of cosmetic quality standards on food losses in the flemish fruit and vegetable sector: summary report	The report shows that, Cosmetic quality standards for fruits and vegetables are specific requirements with regard to color, shape and size which often linked to sale losses of about 10%. However, cosmetic quality standard and the quantification of the consequence is very limited.	**Report**
22	Gustavsson, J. et al. (2014)	FUSIONS Definitional Framework for Food Waste - full report	The project report that aims to contribute to the harmonization of food waste monitoring; feasibility of social innovative measures for optimized food use in the food supply chain and the development of a Common Food Waste Policy for EU regions.	**Project Report**
23	Hanson, C. et.al. (2016); Protocol, F. L. W. (2016).	Food Loss and Waste Accounting and Reporting Standard; Guidance on FLW Quantification Method- Supplement to the Food Loss and Waste (FLW) Accounting and Reporting Standard	The FLW Protocol which developed the global FLW Accounting and Reporting Standard for quantifying food and/or associated inedible parts removed from the food supply chain. The report present the Accounting and Reporting steps and method of quantifying FLW.	**Project Report**
24	EUC-EUROSTAT (2022)	Guidance on reporting of data on food waste and food waste prevention according to Commission Implementing	Practical guidance on reporting of data on FLW according to EU Commission implementing Decision.	**Guidance Document**

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		Decision (EU) 2019/2000		
25	FUSIONS, E. (2016)	Food waste quantification manual to monitor food waste amounts and progression.	The document is a manual that provides practical guidelines for Member States on the quantification of food waste at different stages of the supply chain, covering three main activities: - Quantifying food waste in each sector (i.e. stage) of the food chain; - Combining sectorial quantifications using a common framework at national level; - Reporting the results of the national food waste quantification study at country level.	**Project Deliverable**

8.4 Survey Questions relevant for T2.1

Q. At which level does your entity operate?
- Only locally within a specific region/city of a country
- At the national (i.e. country) level
- Internationally (within EU)
- Internationally (within and outside of EU)
- Choose not to answer

Q. Indicate the stage(s) of the supply chain your entity operates at? (*Mark all that apply)*
- Primary Production
- Processing & Manufacturing
- Retail and Distribution (wholesale)
- Restaurants and Food Services
- Don't Know / Hard To Say

Q. Does your entity operate with the following food commodity? Fruits and/or Vegetables
- Yes
- No

Q. Does your entity operate with the following food commodity? Meat (poultry, bovine or pork)
- Yes
- No

Q. Does your entity operate with the following food commodity? Fish
- Yes
- No

Q. Does your entity operate with the following food commodity? Eggs
- Yes
- No

Q. Does your entity operate with the following food commodity? Cereals
- Yes
- No

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Q. Is the amount of food waste generated within your entity measured?

- Yes
- No
- Prefer not to say

Q. Does your entity track what is done with food that does not comply with a food marketing standard?

- Yes
- No
- Prefer not to say

8.5 Interview Questions for T2.1

(Each interviewing partner should adjust the interview questions based on the interviewee expertise and their respective commodities.)

Introductory Questions:

The purpose of the introductory questions is to verify the participants' understanding of the interview topic and to identify their and their organization's areas of expertise.

Introduction ***questions:***

It is important to double record the information. Firstly, conduct a thorough desktop research and then ask the informant

1. Could you please briefly describe your role and responsibilities within your organization (or company)?

2. Which food commodity(-ies) does your organization operate with?
    a. And with actors from which stage of the supply chain (i.e. primary production, processing & manufacturing, retail and distribution (wholesale), restaurant and food services)?

Opening Questions

Objective: To establish their (interviewee's) understanding of FMS related to their sector for further discussion, if required interviewer can be specific in certain FMS to their sector commodities.

3. Can you describe your experience with food marketing standards in the [*interviewee sector-commodity*] sector, particularly in the [*specific part of the value chain if one particularly relevant for the interviewed]*?

4. What is your experience with measuring and accounting for food waste due to marketing standards?

(Main questions should be sent prior to interview)

Main questions

Theme: Interpretation of FW due to MS

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5. Can you describe how is food waste being interpret in your organisation/in the sector *[refer to specific commodity, expertise]*, and how well do you believe this definition aligns with EU marketing standards? Please provide a brief explanation.

6. What steps does your sector take when food is rejected due to not meeting marketing standards?

Theme: Accounting and measurement

7. Why is it relevant to measure and account for food waste in the context of food marketing standards?
    a. How does your sector use that information of FW data?

8. What methods do you or others in the sector currently use to measure and account for FW?
    a. Generally
    b. Due to FMS

9. In your experience, what are the main barriers or difficulties faced by *[refer to the commodity sector/organization]* when it comes to measuring and accounting for food waste in compliance with food marketing standards? Please provide a brief explanation.
    a. How frequently do you face those barriers?

Theme: Estimation **of FW due to FMS**

10. What percentage/proportion of food products are affected by FMS? Could you tell us about your total production?

11. What percentage/ proportion of FW is due to MS in your sector? Could you tell us about the total production or total FW in the sector? *(Note: The intention of the question is also to find out how they arrived at that number "%of FW due to MS)*

12. Could you elaborate on the share of FW in each supply chain?
(Here the intention is to find out the FW in each part of the supply chain)

Theme: Perspective and experiences

13. How do you perceive the impact of food marketing standards on food waste
    a. Can you provide examples or instances where these standards have influenced your practices?

14. How satisfied are you with the current methods or tools available for measuring and accounting for food waste in accordance with food marketing standards?
    a. Can you elaborate why/why not?

15. Future Directions; What can be done to properly monitor/ measure/ account for FW generated due to FMS?
    a. What areas of the sector would you suggest reconsidering due to the above-mentioned?

Follow-up to Q: Do you believe that there is a need for clearer guidelines or regulations regarding the measurement and accounting of food waste in relation to food marketing standards. Why?

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8.6 Letter of invitation for interview

Dear (Name of person or organization),

I hope this email finds you in good health and high spirits.

I am (Name of a contacting person), working on (briefly describe your work about BREADCRUMB and in general). It is a pleasure to e-meet you.

I am writing to kindly request an interview with you, given your unique expertise in the field of (highlight their expertise and affiliation). Your insights and perspectives would be invaluable for our EU Research Project BREADCRUMB, which aims to explores the relationship between food marketing standard and food waste across all stages of the value chain. We believe that your contribution would significantly enhance the depth and quality of our research.

Any information shared during the interview will be treated with the utmost confidentiality. You have the right to withdraw your statement without reason and not to answering specific questions. **Unless if you would like to be acknowledge for your commitments to the common good.** Our research findings will be disseminated through academic publications, presentations, or other scholarly means, ensuring that your insights reach a wider audience and thereby becomes actionable.

Could we arrange a convenient time and method (in person or via video call) for the interview, **preferably before mid-August**? I anticipate that the interview will take approximately 45 minutes.

I hope you will consider this interview request and should you require any further information, please do not hesitate to contact me at (Contacting person email/ phone number). We understand that your time is valuable, and we are flexible to accommodate your preferences.
Sincerely,

(Your Name and organization)

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8.7 Consent form and participant information sheet for T2.1

BREADCRUMB

BRinging Evidence-bAseD food Chain solutions to prevent and RedUce food waste related to Marketing standards, and deliver climate and circularity co Benefits

PARTICIPANT INFORMATION SHEET

Dear participant,

Welcome to the BREADCRUMB project. We are conducting an in-depth interview study to explore the impact of food marketing standards on food waste generation. Your participation is crucial in helping us understand how the currently existing food marketing standards of five food sectors (fruit and vegetables, cereals, meat, fish and eggs) impact the generation of food waste at the various stages of the supply chain. This project, led by a team of researchers dedicated to advancing knowledge on food marketing standards and food waste, aims to uncover valuable insights that can inform future policies and technological developments. We invite you to contribute to this important research and appreciate your time and input.

In this letter, you will receive information about the purpose of the project, the data collection and processing activity, what your participation will involve, and your rights. Before you agree to participate in this interview (by signing CONSENT FORM below), it is important that you **please read this information form carefully**. If anything is not clear, please do not hesitate to ask questions. Contact information can be found at the very end of this information sheet.

Project description and the purpose: BREADCRUMB (https://www.breadcrumb-project.eu) aims to provide an empirical evidence-based understanding and purpose of Food marketing standards (FMS), along with their influence on the generation of food waste (FW). Its goal is to suggest interventions that strike a balance between the aim of FW reduction and other standards-related objectives, while assisting food chain participants in maximizing the commercial viability of less-than-optimal food products.

The BREADCRUMB project is led by ILVO (Flanders Research Institute for Agriculture, Fisheries and Food) in Belgium and data collection. Research team from the University of Copenhagen will be responsible for collecting and processing data and expected to conduct about 7 to 10 in-depth interviews with participant from relevant organization across Denmark. The primary purpose of the interview in this phase of data collection is to gather information for:

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1. To estimate the food waste (FW) generated due to marketing standards at EU level
2. To understand the FW accounting mechanism and their interpretation of FW due to FMS.

What does participation involve for you? The interview may be conducted virtually or in-person. The information obtained in the interview will be strictly about food marketing standards and is **expected to take approximately 60 minutes**. In case translation between different languages is needed, the interview may last a little longer. If you permit, your answers will be recorded via sound recording and transcribed. If you are not comfortable with sound recording, detailed written notes will be taken.

What personal information will be collected and the purpose: During the interview, we expect to collect/record following personal information about the participant in relation to the organization of the interest for this research:

Your name and email address for the communication purposes;
Name of the organization and your designation (role and responsibilities) in the organization;
Audio/voice recording (only if you allow to record it)

We will process your personal information based on your consent. Your Name, Organization name and Email will only be use for communication purpose if needed until data are anonymised. Your role and responsibility in the organization is relevant for data analysis. Audio/Voice recording (if we agree to record) will be machine transcribed and is relevant for reliability and validity of the data collection.

Data processing description: Data is stored at the secure drive (S-drive) in the University of Copenhagen in a personally referable condition until data are transcribed and anonymised [by 31/10/2024]. Once the data has been anonymized to prevent participant identification, we will share it with 20 other project partners from the project which are also listed here (https://www.breadcrumb-project.eu/consortium/): ILVO (Belgium), VLTN (Belgium), UNIBO (Italy), ITC (Slovenia), CREDA (Spain), AINIA (Spain), CSCP (Germany), MCH (Portugal), AVEC (Belgium), VN (Slovenia), ZT (Slovenia), ANECOOP (Spain), OPPPB (Spain), NN (Spain), LF (Denmark), LN (Germany), MENSANA (Slovenia), FEBEV (Belgium), FENAVIAN VZW (Belgium), PNO Innovation SL (Spain).

Personal data will be processed in accordance with the European data protection legislation (General Data Protection Regulation – GDPR) and will only use your personal data for the purpose stated in this information letter.

The project will end in December 2026. All project data will be stored only for the minimum period required to complete the research activities, which is 3 years, and in accordance with the accounting rules that apply under Horizon 2020, no longer than five years from the end of the project, when it will be deleted.

Privacy and rights according to the personal data regulation: As long as individuals can be identified in the collected data, you have a number of rights which are described in more detail according to the University of Copenhagen's privacy policy:

Data access - Registered persons can contact the person responsible for the study [contact below] in order to obtain a copy of the registered information until personal data is anonymized [31/10/2024].

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Correction of information - If participants believe that incorrect information has been provided, they can ask to have the information corrected until personal data is anonymized [31/10/2024].
Withdrawal of consent and deletion of information - The registered persons has the right to request that information be deleted, revoke consent, or change the information until personal data is anonymized [31/10/2024] and this can be done by contacting Professor Bent Egberg Mikkelsen: bemi@ign.ku.dk.
Objection - Participants in the study do not have the right to object to the processing of information included in a research project after personal data has been anonymized [31/10/2024].
Complaints about data handling - Registered persons can complain about the processing of the information to the Data Protection Officer (DPO) at the University of Copenhagen by writing to: dpo@adm.ku.dk or the Data Protection Authority by writing to: dt@datatilsynet.dk

Potential benefits or risks of participation: Your involvement contributes to advancing scientific understanding, developing evidence-based solutions to combat food waste, and benefiting society. There are no foreseeable risks in participating in this survey.

Participation is voluntary: **Your participation is completely voluntary**, and there will be no negative consequences for declining to participate or withdrawing from the study at any time. You have the right to refuse to answer any questions you are uncomfortable with or to skip any sections. If you chose to participate, you can withdraw your consent at any time until data are anonymised [31/10/2024] without giving a reason. There will be no negative consequences for you if you chose not to participate or later decide to withdraw.

Responsible for the storage and processing of personal data

The University of Copenhagen, CVR number 29979812 is responsible for the processing and handling of personal data in the study/research project. The study is led by Professor Bent Egberg Mikkelsen, who can be contacted at: Address: Rolighedsvej 23, 1958 Frederiksberg C, Email: bemi@ign.ku.dk Mobile: 0045-25 38 43 66

Kind regards,

(Please write down the NAME and contact detail of the researcher who is contacting the participant)

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CONSENT FORM

Selecting **"Yes"** below indicates that:

- You have received and read the information in the BREADCRUMB Information sheet.
- You understand the procedures described above and the expected duration of the storage of the data.
- You approve that the data or information you have provided can be shared and analysed for research purposes as stated in information sheet.
- You have been given the opportunity to ask questions.
- You voluntarily agree to participate, and you understand your rights according to the personal data regulation as stated in the information sheet.
- You understand that your personal information will be treated and handled in accordance with the provisions of the EU General Data Protection Regulation (Reg. 2016/679);
- You are at least 18 years of age.

Please mark **"yes"** if you consent (agree) or **"no"** if you do not consent.

o Yes

o No

Name of Participant: _____

Name of the organization: _____

Participant's Signature: _____

Date: _____

Name of Researcher: _____

Researcher's Signature: _____

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Date: _____

8.8 Template of list of entities at EU level

	Commodity	Organization	Stages of Supply chain	Description	Contacted (Y/N)	Comments/ Remarks
1	Cereals			Association of cereals, rice, feedstuffs, oilseeds, olive oil, oils and fats and agrosupply trade	Y	did not reply
2	Cereals			European Association - flour sector	y (10 July)	not available to participate -
3	Cereals				y (10 July)	did not reply
4	Cereals		Wholesaler and importer	International grain wholesaler in the EU	y (10 July)	did not reply
5	Cereals			Cereal association	y (10 July)	did not reply
6	Cereals			Association of Bakers	Y	
7	Cereals			Association of confectionery industries	Y	
8	Eggs			Commission	Y	
9	Eggs			Processors association	Y	Willing and is in contact
10	Eggs			Trade association	Y	
11	Eggs			Union of wholesale with eggs, dairy	Y	
12	Fish			An association representing fish processors and traders in the EU	Y	Recontacted in August
13	Fish			An association of national organizations representing fishing enterprises within the European Union	Y	Recontacted in August
14	Fish			An organization focused on aquaculture research and development	Y	They reject the interview becasue of lack of alignment with our topic and their work
15	Fish			An organization representing fish producers' groups	Y	
16	Fish			An organization representting the interests of small-scale fishers across multiple EU Member States	Y	Recontacted 01/08/2024 but on leave until midle august
17				An organization establishing hubs across different sea regions to drive innovation in sustainable business models, short food supply chains, and consumer engagement	Y	Recontacted in August
18	Fish			Organization to monitor the fisheries and aquaculture sector in Europe aims to improve market transparency and support business decisions and policy-making	Y	Response: wouldn't be able to provide with inputs about practices along the chain

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19	Fruit and vegetables			process fruit and vegetable	Y	They are checking internally who of their industry contacts could contribute to our interview (06.08.)
20	Fruit and vegetables		production	Association focused on fresh produce	Y reminder 22/7	
21	Fruit and vegetables		Production	Organization focused on the EU Fruit and Vegetables	Y	
22	Fruit and vegetables			An association representing the fruit juice industry in Europe	Y	Recontacted in August
23	Meat			A coalition of unions representing the livestock and meat trade sector in Europe	Y	
24	Meat			A center for collaboration within the meat processing industry in Europe	Y	
25	Meat (Poultry)			An association representing the live poultry and hatching egg industry in Europe	Y	
26	Meat			Non-profit network of meat industries	Y	
27	Meat			Organization focused on beef value chain and sustainability in the sector	Y	
28				Organic production	Y	We received the contact details of a colleague with expertise in food waste, however she is on vacation until 26.08.
29			Food service		Y reminder 22/07	
30	general		producers	Organization focused on farmers and cooperatives	Y	We received an out-of-office notification until 18.08.
31	general		production	Association of the food and drink industry	Y reminder 22/07	

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8.9 Template of List of entities at National level

no	Commodity	Name of organisation	Stages of Supply chain	Short description	Partner in charge	Contacted (Y/N)	Comments/ Remarks
1	Eggs		Producers, Processor & Manufacturer	A trade organization for the egg industry in a specific country. Its goal is to manage the collective political interests of its members, both domestically and internationally, and to promote the production and sale of local eggs and egg products.		Y	
2	Cereals		Producers, Processor & Manufacturer	One of the oldest societies focused on cereal research in the world. It has a cross-disciplinary approach. Members are interested in various areas, including cereal grain production, plant breeding, genetics, and pathology; the production of bread, pasta, biscuits, malt, or bioenergy; nutritional aspects such as fibers, minerals, vitamins, and health benefits; anti-nutritional factors like phytic acid and mycotoxins; as well as socio-economic aspects		Y	
3	Meat	Processor & Manufacturer	An industry organization for specific country's cooperative and private slaughterhouses and companies that process and sell slaughterhouse products.			Y	
4	Meat (Poultry)		All	Representing the entire production chain in the specific country's slaughter poultry sector, i.e. from hatcheries and farmers to slaughterhouses and related companies.		Y	
5	Fish		Producers	A fishing association that brings together fishermen in a specific country. With strong collaboration with local fishing groups and member vessels, one of the largest fishing associations in the EU.		Y	

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6	F & V		Producers	It represents the horticulture industry in a specific country, producing a wide range of products, including trees, plants, vegetables, herbs, mushrooms, fruits, and berries. There are approximately 800 nurseries in the country. The horticulture industry grows high-quality products that address health, climate, and environmental challenges. Currently, there is significant emphasis on increasing the consumption of fruits and vegetables, expanding forest areas, and prioritizing green spaces both outdoors and indoors		Y	
7	Fruits and Vegetables (FV)		Processor & Manufacturer			Y	Interview done and uploaded
8	Fruits and Vegetables (FV)		Wholesaler & Retailer	A group that has been providing fruits and vegetables for many years, offering personalized service tailored to each customer and supplier. They adapt their operations to meet specific needs and support clients throughout the process, ensuring close, familiar interactions and attention to detail.		Y	Interview done and uploaded
9	Fruits and Vegetables (FV)		Association	A national interprofessional organization based in a specific city, representing the entire citrus sector of a country through associations involved in production and marketing, integrating the value chain of citrus.		Y	
10	Fruits and Vegetables (FV)		Association	A national organisation, which is committed to becoming a leading association in response to the needs of citrus producers, traders and processors in a specific country.		Y	

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11	Fruits and Vegetables (FV)		Association	Interprofessional organization for fruits and vegetables in a specific country. Its goal is to unite the entire greenhouse fruit and vegetable sector and serve as a key representative for consumers, institutions, and the EU in advocating for the sector. It emphasizes the strengths of the industry and promotes research and investment in innovation.		Y	
12	Fruits and Vegetables (FV)		Association	Interprofessional Organization which represents in an integrated manner the entire value chain of different fruit, made up of the associations of the production and marketing of both products.		Y	
13	Eggs					Y	no response
14	Eggs					N	
15	Eggs					Y	Willing but not confirmed
16	Eggs					Y	Scheduled for interview
17	Eggs					Y	No response
18	Eggs					N	This organization has been in contact in relation to T1.3, and therefore, has not been contacted.
19	Fruits and Vegetables (FV)			Research and policy advice on rural areas, agriculture, forests and fisheries and published. They were part of the pact against food waste in a specific country.		Y	Interview is done, not uploaded yet
20	Eggs		Association	Major organization in a specific country that represents the interests of the egg industry. It acts as a key platform for stakeholders, including producers, processors, and retailers, to collaborate on		Y	No answer yet

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				matters related to egg production, marketing, and sustainability.			
21	Eggs		Association	Leading organization in a specific country that represents the interests of the poultry sector. It includes various stakeholders, such as poultry farmers, processors, and marketers, and serves as an important platform for collaboration and dialogue within the industry		Y	No answer yet
22	Eggs		Association	Association focused on preserving various breeds of poultry that are bred according to specific standards. An important aspect of the organization's work is the conservation of ornamental and wild poultry species, which many members actively pursue		Y	replied,not interested
23	Meat		Producer Association	Meat association, mainly companies from one country		Y	Done by 30/08
24	Fish		Fishermen association	Fishermen association		Y	Done by 27/08
25	Fish		Producers, Processor & Manufacturer Association			Y	Previously contacted but they reject
26	Fish		Aquaculture association			Y	Previously contacted but they reject
27	All commodities			Association of food companies in a specific country, represents over 20 sectors that produce high-quality and innovative food and beverages in a specific country.		Y	replied, lack of data
28	All commodities			It is a public agency responsible for waste management and soil remediation in the Flanders region of Belgium.		Y	replied, lack of data
29	F&V			Association of farmers active in some communities in a specific country.		Y	replied, lack of data
30	Fish					Y	replied, lack of data

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31	F&V		Association			Y	
32	F&V		Distribution			Y	
33	F&V		Distribution			Y	
34	F&V		Primary prod			Y	
35	F&V		Primary prod + distribution			Y	
36	F&V		Primary prod + distribution			Y	
37	F&V		Wholesale			Y	
38	F&V		Wholesale			Y	
39	Cereals					Y	
40	Cereals					Y	
41	Cereals					Y	
42	Cereals					Y	
43	Cereals					Y	

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