Exploring Food Waste

Investigating the Variability and Consensus in the Current Landscape of Definitions

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Degree project/Independent project • 30 credits
Swedish University of Agricultural Sciences, SLU
Faculty of Natural Resources and Agricultural Sciences
Sustainable Food Systems – Master's Programme
Molecular Sciences, 2024:29
Uppsala, 2024

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Credits:	30 credits
Level:	Second cycle, A2E
Course title:	Master thesis in Food Science
Course code:	EX0875
Programme/education:	Sustainable Food Systems – Master's Programme
Course coordinating dept:	Department of Molecular Sciences
Place of publication: Year of publication:	Uppsala 2024

Title of series: Molecular Sciences
Part number: 2024:29

Keywords: Food loss, Discourse analysis, CDA, Sustainability, Questionnaire study

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Abstract

The challenge of defining food waste is pivotal to global sustainability efforts, as clear and transparent definitions are essential for accurately monitoring and reporting progress towards Sustainable Development Goal 12.3, which aims to halve per capita food waste by 2030. This paper investigates the varying definitions of food waste, exploring their commonalities and differences through a discourse analysis of academic and institutional sources. A comprehensive literature review identified key definitions and highlighted the prominence of this issue over the past decade. A 4-axis conceptual model—Scope, Destination, Nutritional Density, and Edibility—was used to dissect these definitions. The discourse analysis revealed significant gaps, such as the frequent omission of nutritional density considerations. Additionally, a survey involving 103 experts, primarily from Europe (89%), provided insights into their view on food waste through a series of questions based on a 4-axis conceptual model. The findings reveal significant variability in some respects, such as the inclusion of drinking water (37%) and crops left in the field due to diseases or pests (52%), as well as in the categorization of final destinations for food waste, including animal feed (61%) and food exceeding individual nutritional needs (44%). A broad consensus was observed on some aspects, such as including later stages of the food supply chain from processing/wholesale to households (98% - 99%) and excluding tap water (3-12%) or wild berries (7%). The study highlights the lack of a standardized methodology when defining food waste, emphasizing the importance of both inclusion and exclusion in building a clear framework. Such an approach could improve the effectiveness of reduction strategies and enhance global sustainability efforts. Future research should continue to explore this issue, incorporating diverse stakeholder perspectives and emerging technologies.

Keywords: Food loss, Discourse analysis, CDA, Sustainability, Questionnaire study

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1. Introduction

The challenge of defining food waste is pivotal to global sustainability efforts and is underscored by several projections and remarks from the global community. The United Nations (UN) estimates that the global population will reach 11.2 billion by 2100, amplifying the significance of addressing food waste given that nearly one-third of all food produced globally is lost or wasted (UN 2017). This inefficiency within our food systems not only jeopardizes food security, as it could potentially feed millions of people, but also exacerbates environmental degradation due to wasted resources like water, land, and energy used in food production (FAO 2011). Moreover, food waste contributes significantly to greenhouse gas emissions when discarded food decomposes in landfills (IPCC 2019). Therefore, understanding and defining food waste is important for devising effective policies and strategies to mitigate these issues and track progress towards global sustainability goals (Parfitt et al. 2010; Teigiserova et al. 2019).

A clear understanding and definition of what constitutes food waste are essential for effectively addressing this global challenge. If key components of food waste are excluded from the scope, it can lead to an underestimation of the issue, missing intervention points and undermining efforts to reduce waste. Conversely, if the definition is too broad, it may dilute the focus on the most actionable areas, potentially leading to mistrust among stakeholders. Disparities in definitions, such as the inclusion or exclusion of animal feed in the calculations of food waste, can significantly impact the perceived magnitude of the problem. For instance, the Institution of Mechanical Engineers (2013) cites a range of 30-50% (or 1.2-2 billion metric tonnes) of all food produced never fulfils its intended purpose of being consumed, based on data from FAO (2011) and Lundqvist et al. (2008), which inherently differ in their definitions of food waste. Specifically, Lundqvist et al. (2008) account for animal feed in their estimation of waste, whereas FAO (2011) factors it out during their calculations. This discrepancy—whether to include animal feed as food waste—can significantly alter the perception of waste levels. Therefore, establishing conformed and transparent definitions tailored to specific purposes is crucial for creating comparable studies. Matching the definition and scope of food waste to the objectives of each study ensures meaningful comparisons across time, space, supply chain stages, or commodities, and facilitates policy development.

The pressing concern of food waste has drawn the interest of numerous researchers, who often encounter a shared challenge, the absence of standardized definitions for food waste, hindering its effective quantification and management. Teigiserova et al. (2019), Lemaire and Limbourg (2019), Parfitt et al. (2010), Girotto et al. (2015), O'Connor et al. (2023), and Stöckli et al. (2018) all stress the crucial need for uniformity in definitions to synchronize calculations and address food waste, a key to developing sustainable valorisation strategies and achieving the UN Sustainable Development Goal 12, which emphasizes sustainable consumption and production.

Teigiserova et al. (2019) delve into how the clarity of food waste definitions is pivotal for aligning reporting practices and enhancing the usability of food waste in the bioeconomy which according to EU "covers all sectors and systems that rely on biological resources (animals, plants, micro-organisms and derived biomass, including organic waste), their functions and principles" (EC 2018). Their research suggests that well-defined terms are crucial for the successful development of sustainable food waste biorefineries, pointing towards a more efficient and sustainable utilization of food waste as a valuable feedstock.

Girotto et al. (2015) on a similar topic explore the transformative potential of repurposing food waste into biofuels, biomaterials, and other high-value products, underscoring the challenge posed by the lack of a generally accepted food waste definition. This gap impedes harmonized waste quantification, as mentioned in the beginning, and the development of effective strategies for its management and valorisation. By advocating for a universally accepted definition, they argue for enhanced industrial utilization of food waste, highlighting specific opportunities for conversion into valuable resources. This approach, they suggest, could significantly contribute to environmental sustainability by promoting more efficient uses of waste.

Expanding on the complexities of food waste definitions, Lemaire and Limbourg (2019) examine the implications of ambiguity and lack of standardization in the definitions of food loss and waste. They point out that such lack of clarity contributes to discrepancies in data gathering, which in turn impedes the formulation and implementation of effective management and reduction strategies. Their research emphasizes the importance of establishing clear definitions to facilitate progress in sustainable consumption and production practices.

Parfitt et al. (2010) highlight the significant challenges in managing food waste globally due to the absence of a standardized definition. The lack of comprehensive data, reliance on outdated estimates, and complexities of food supply chains exacerbate the issue.

In contrast, Thyberg and Tonjes (2016) investigate the wider ramifications of definitional ambiguity on policy development and public perception towards food waste. Their research emphasizes the importance of a clear and cohesive

understanding of food waste for the creation of sustainable policies and practices, considering factors such as the modernization of food systems and socio-demographic trends.

Lastly, O'Connor et al. (2023) and Stöckli et al. (2018) address the challenges posed by the absence of standardized food waste definitions, particularly concerning the management and quantification of food waste across the supply chain. O'Connor et al. focus on the agricultural stage, pointing out how differing terms and definitions complicate research and policy efforts. Meanwhile, Stöckli et al. shed light on the impact of definitional clarity on developing strategies to reduce household food waste, emphasizing the necessity of clear, universally accepted definitions for effective intervention.

Summarizing, this study builds upon the critical issues of definitional ambiguity highlighted by previous research, particularly the lack of consensus on food waste definitions. Despite growing attention to food waste, there is still a gap in knowledge regarding the full spectrum of definitions used across scientific literature and by food waste experts, as well as the frequency and context in which these definitions are applied. Differences in how the scope of food waste is defined can significantly affect the reported quantities and complicate efforts to formulate effective reduction strategies. A narrow definition risks overlooking important sources of waste, whereas a broader definition may provide a more comprehensive understanding necessary for designing impactful interventions. This inconsistency challenges the development of cohesive policies, ultimately affecting the efficiency of global food waste management initiatives.

Research aim

The aim of this study is to describe the current discourse on food waste definitions by analysing definitions from various organizations, identifying their commonalities and differences, and addressing the lack of comprehensive understanding of these definitions in both scientific literature and expert discussions. The study also aims to describe and categorize experts' opinions on food waste definitions and explore the potential for consensus that could guide effective policy formulation and management strategies. The overall aim is to contribute to the development of standardized and actionable definitions that could enhance sustainability efforts.

2. Methods

This chapter outlines the methodological approach taken in this study to investigate food waste definitions. The research process involved four key steps (Figure 1):

4-Axis conceptual model

The study as a concept, originated from the 4-axis conceptual model by Eriksson (2024) (Figure 2). It is a visualisation of what should be included in a definition of food waste, and it is used as a basis to analyse the definitions selected in this report. This model encompasses Scope, Destination, Nutritional Density, and Edibility, providing a structured framework to identify and compare key components of various definitions.

Literature review

A systematized literature review was conducted to investigate the discourse on food waste definitions and identify and compile existing definitions from a range of academic, institutional, and policy sources. This review provided the foundation for the subsequent discourse analysis, ensuring that a broad spectrum of perspectives was considered.

Discourse analysis using the 3-dimensional of Critical Discourse Analysis (CDA) by Norman Fairclough

Following the literature review, Norman Fairclough's 3-dimensional CDA model was applied (Fairclough 2013). This model examines the text (definitions), the discursive practice (how the definitions are produced and utilized), and the social practice (the broader social and cultural context). The CDA approach allowed for an analysis of the language and context of food waste definitions, highlighting how different interpretations can influence policy and practice.

Questionnaire study

To complement the discourse analysis, a questionnaire study was conducted among researchers and experts in the field of food waste. The questionnaire gathered insights into their perceptions and priorities regarding food waste

definitions across various dimensions. The responses were analysed to understand the level of consensus and variability among experts, providing a practical perspective to the theoretical analysis.

By integrating these methods, the study aimed to provide a comprehensive understanding of the complexities and variabilities in food waste definitions. As for clarity and consistency, this study refers to food loss and waste simply as food waste. The following sections describe each method in detail, beginning with the 4-axis conceptual model.

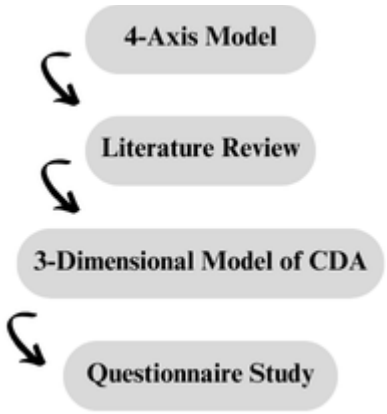

Figure 1. Visual representation of the methods used for investigating the landscape of food waste definitions.

2.1 4-Axis Conceptual Model

To address the complexities and disparities in food waste definitions, this study employs the concept of the 4 axes in Eriksson's model (Figure 2) to guide the discourse analysis, while a modified version of the initial model structures the questionnaire study (Figure 10). The 4 axes—Scope, Destination, Nutritional Density, and Edibility—provide a conceptual framework to systematically identify and compare key components of food waste definitions. Each axis represents a critical dimension where interpretations of food waste can differ considerably, influencing the efficacy of policies and strategies designed to reduce food waste.

Scope

The scope of food waste definitions can differ considerably, referring to various stages of the food supply chain where waste occurs. Definitions may include losses from agricultural production, post-harvest handling, processing, distribution, retail, and consumer levels. Variability in scope can lead to significant differences in reported food waste quantities and hinder the formulation of comprehensive reduction strategies. A narrow scope may exclude significant sources of waste,

while a broad scope may capture a more holistic view of the problem, essential for creating effective interventions.

Destination

The destination axis pertains to where food waste ends up, influencing how it is categorized and measured. Definitions may vary in whether they include food diverted to animal feed, composting, energy recovery, or other uses as waste. These differences can impact the perceived success of waste diversion programs and policies, as well as the overall understanding of waste levels.

Nutritional Density

Nutritional density refers to the consideration of the nutritional value of wasted food. Some definitions focus purely on the mass or volume of waste, potentially overlooking the loss of nutritional content. This dimension is important for understanding the impact of food waste on food security and public health. For instance, wasting highly nutritious foods like fruits and meat has different implications compared to wasting foods with lower nutritional value.

Edibility

The edibility axis addresses whether food waste definitions include inedible parts of food, such as peels, bones, and shells. Some definitions include all parts of the food, while others focus only on the edible portions. This distinction affects waste quantification and the development of reduction strategies, as inedible parts are often unavoidable. Including or excluding these parts can lead to different estimates of waste and influence policy decisions.

Motivation for the 4-Axis Conceptual Model

These four parameters were chosen because they represent the most significant areas of variability in food waste definitions. Each axis highlights a dimension where differences in interpretation can lead to inconsistencies in data collection, reporting, and policy implementation. By analysing definitions across these 4 axes, this model aims to provide a comprehensive framework that can identify commonalities and differences, ultimately contributing to the development of more harmonized and actionable food waste definitions.

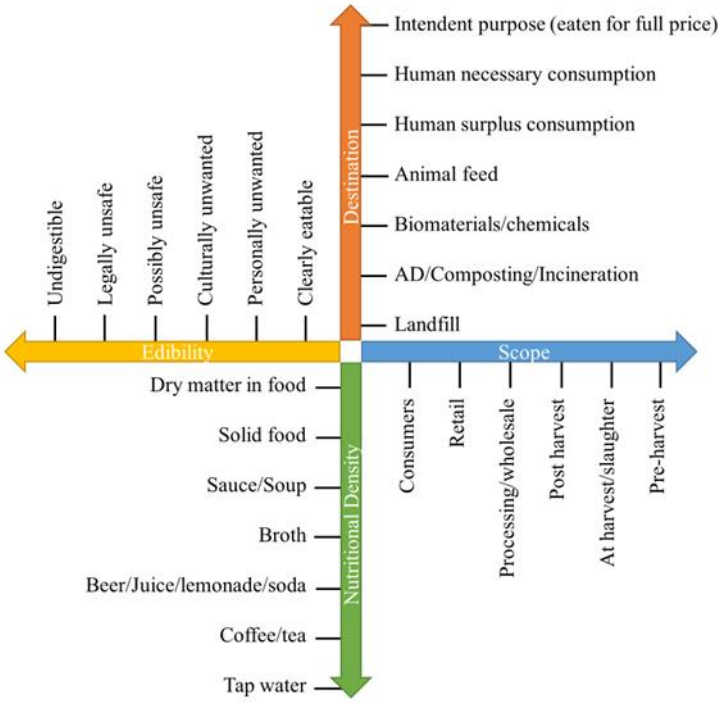

Figure 2. 4-axis conceptual model used as a role model for investigating food waste definitions through the discourse analysis and modified for the purpose of the questionnaire study (Eriksson 2024).

2.2 Literature Review

The initial step involved a search on the Web of Science (WoS) database for relevant articles discussing the issue of multiple food waste definitions. The keywords used were “food waste” AND definition. The initial search yielded 143 results, which were refined by selecting only review articles, narrowing the results to 27. After reviewing the titles and abstracts, 9 articles were identified as addressing the problem arising from having a multitude of food waste definitions. The publication years for these articles ranged from 2010 to 2023, indicating that this issue has been prominent for over a decade.

Subsequently, a search was performed in official documents and working papers from entities such as the EU Parliament, FAO, USEPA, WRAP, WRI, FLW Standard, and EU FUSIONS. The most recent documents mentioning a food waste definition were selected for the purpose of this study and the selected definitions are listed in Appendix 2.

The literature review laid the groundwork for the subsequent steps in the study, ensuring that the analysis was grounded in a comprehensive understanding of existing definitions and the broader discourse on food waste.

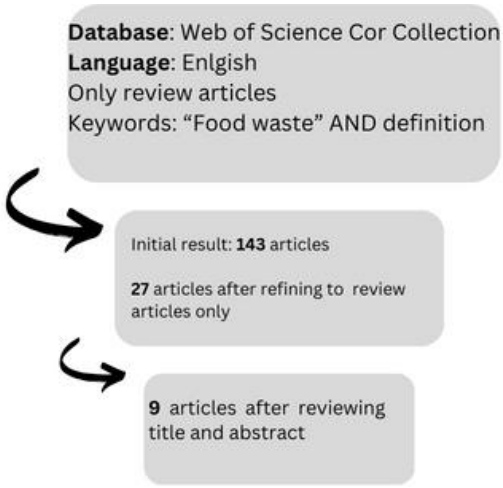

Figure 3. Flow chart of literature review.

2.3 Discourse Analysis

This study utilized a dual approach to analyse the definitions of food waste: the 4-axis conceptual model and Norman Fairclough’s 3-dimensional Critical Discourse Analysis (CDA) model (Figure 4). These models were used alongside each other in the textual analysis to determine how the definitions correspond to the 4 axes. Fairclough's model served as the foundation and was adapted to fit the understanding of the food waste definitions subject, interpreted according to the study's perspective.

Textual Analysis

The first layer of Fairclough’s model, textual analysis, served as the basis for examining the language used in food waste definitions. This analysis was aligned with the 4 axes of the conceptual model: Scope, Destination, Nutritional Density, and Edibility. The objective was to identify key phrases and elements within the definitions and assess their inclusivity and scope, determining how comprehensively they address the aspects of food waste identified by the 4-axis model.

Discursive Practice

In the second layer, discursive practice, the production and dissemination processes of the food waste definitions were examined. This involved investigating the authors, their institutional affiliations, and the channels through which the definitions were propagated, such as reports and working papers from various organizations. The acknowledgments list was particularly useful in this analysis, as it revealed the collaborative efforts behind the definitions. By analysing the

affiliations and contributions of those acknowledged, insights were gained into the network of experts, potential biases, and influences from different institutions. This understanding helped to uncover the dynamics and power structures within the discourse community, shedding light on the priorities and perspectives that shape these definitions.

Sociocultural Practice

The third layer, sociocultural practice, explored the societal and cultural contexts in which the food waste definitions are employed. This analysis examined the utilization and impact of the definitions across different stakeholders, including governmental bodies, NGOs, and local communities. The aim was to highlight the practical application of the definitions and their role in shaping policies and practices related to food waste management and sustainability.

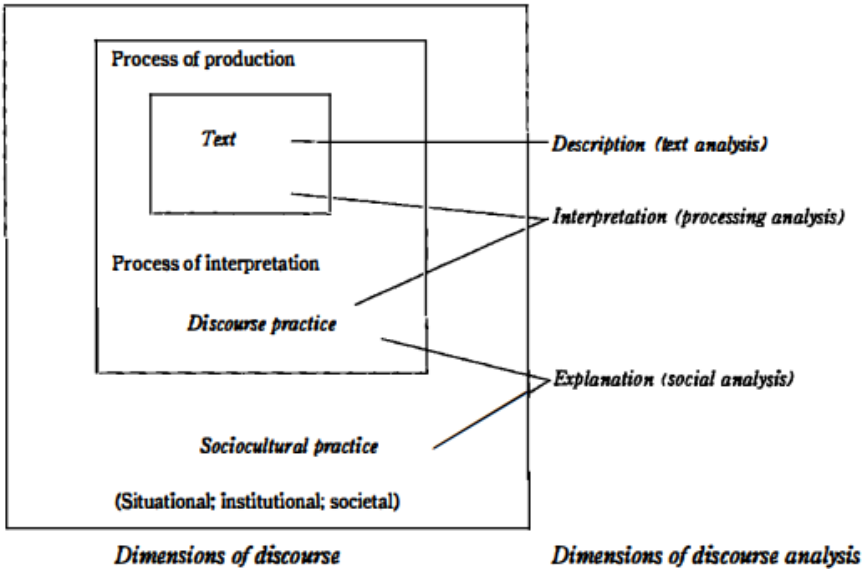

Figure 4. 3-dimensional model of Critical Discourse Analysis by Norman Fairclough (Fairclough 2013).

2.4 Questionnaire Study

Complementing the discourse analysis part and to further answer the research aim, the 4-axis conceptual model (Figure 2) was modified and utilized as foundation to formulate the questionnaire. The survey was constructed and distributed via the Netigate platform, while a sample of the it can be found in Appendix 1.

The targeted respondents consisted of authors from selected reports and working papers examined in the initial phase of the study, as well as experts actively engaged in food waste research. In total of 253 questionnaires were dispatched, receiving

103 responses—a 40% response rate. For the analysis, data was used even from partially completed questionnaires to gather as much material as possible.

2.4.1 Integration of 4-Axis Conceptual Model with Questionnaire Study

A modified version of the 4-axis conceptual model was used as a foundation to structure the questions in the questionnaire, ensuring that each aspect of the food waste definitions was systematically explored. Specifically:

Scope

Questions were designed to cover various stages of the food supply chain, from production to consumption. For example, questions about food waste occurring in households, retail, processing, and preharvest levels aimed to determine the extent and commonality of definitions regarding the scope of food waste.

Destination

The questionnaire included questions about the final destination of food waste, such as landfill, composting, or animal feed. These questions helped evaluate how experts perceive different waste management practices in the context of defining food waste.

Nutritional Density

Respondents were asked about their view on including different food items based on their nutritional content, such as beverages, cooking oil, and sauces. This helped gauge expert opinions on whether nutritional density should influence what is considered as food waste.

Edibility

Questions related to inedible parts of food, like bones, peels, or culturally unwanted food, were included to assess whether experts believe such items should be categorized as food waste.

These specific alignments between the modified 4-axis conceptual model and the survey questions ensure that the study thoroughly investigates how different dimensions of food waste are understood by experts, thus facilitating a structured analysis of the discourse around food waste definitions.

3. Results

3.1 First Layer – Text Analysis

Through the literature review 10 food waste definitions were selected for examination, 2 from scientific papers and 8 from institutions and organizations (Appendix 2). The text analysis of these definitions, guided by the 4-axis conceptual model, revealed distinct patterns and variations across different sources. The findings are presented and categorized following the 4 dimensions: Scope, Destination, Nutritional Density, and Edibility. A comprehensive comparison can also be seen in Table 1.

Scope

The definitions varied significantly in scope. While some definitions, like those from the EU FUSIONS and FLW Standard, encompass the entire food supply chain, others, such as the FAO and UNEP definitions, focus predominantly on the retail and consumption stages. This variation in scope reflects different emphases on where in the supply chain food waste is most important or manageable according to each institution.

Destination

There was a broad range of destinations for food waste identified in the definitions. For instance, the EU FUSIONS and WRAP definitions included recovery options such as composting and anaerobic digestion. USEPA definition was the only one to include food donation as management solution. Meanwhile, WRI definition did not mention any specific method for managing food waste. The diversity in destinations suggests varying approaches to managing food waste, from sustainable practices to more traditional disposal methods.

Nutritional Density

Most definitions did not explicitly address the nutritional density of food waste. However, by encompassing a wide range of food types, from processed to raw, intended for human consumption, the definitions implicitly acknowledge varying

nutritional densities. This lack of specificity may reflect the complexity of categorizing food waste based on nutritional content.

Edibility

The treatment of edibility in the definitions ranged considerably. Some definitions, such as those by UNEP, EU FUSIONS and FLW Standard, include both edible and inedible parts of food waste, while others, like the FAO definition, primarily focus on food initially fit for human consumption, thus excluding inedible parts. This axis highlights the varying perceptions of what constitutes food waste in terms of its potential for consumption.

These findings illustrate the diverse ways in which food waste is conceptualized by different organizations and researchers. The variation across the 4 axes – Scope, Destination, Nutritional Density, and Edibility – not only reflects the complex nature of food waste as an issue but also underscores the challenges in formulating a universally accepted definition. Each definition brings its unique perspective, contributing to a multifaceted understanding of food waste.

Table 1. Text analysis of food waste definitions using the 4-axis conceptual model, aligned with the first layer of Fairclough's 3-dimensional CDA model.

Definition (Source)	*Scope*	*Destination*	*Nutritional Density*	*Edibility*
FAO (2011)	*Focus on consumer and retail level*	*Disposal due to spoilage/oversupply; includes non-food use redirection (e.g. feed, bioenergy)*	*Broad range, unspecified*	*Primarily edible food; includes losses due to spoilage*
Beretta et al. (2013) (FAO 2011 as basis)	*Focus on consumer and retail level*	*Disposal or redirection to non-food uses*	*Broad range, unspecified*	*Both edible and inedible parts of food considered*
WRI (2013)	*Retail and consumption stages predominately; includes pre-consumer stages*	*Primarily disposal but no specific methods mentioned*	*Broad range, unspecified*	*Focus on edible food; food non intended for human consumption excluded*
EU FUSIONS (2014)	*Covers entire food supply chain*	*Recovery or disposal (e.g. composting, landfill, bioenergy, etc.)*	*Broad range, unspecified*	*Both edible and inedible parts considered*

FLW Standard (2016)	*Covers entire food supply chain*	*Various, including animal feed, composting, bioenergy*	*Broad range, unspecified*	*Both edible and inedible parts considered*
WRAP (2018)	*Covers entire food supply chain*	*Various methods (e.g. an. digestion, bioenergy etc.); excludes surplus food, feed, bio-based materials*	*Broad range, unspecified*	*Both edible and inedible parts considered*
Teigiserova et al. (2019) (FLWS 2016 as basis)	*Based on FLWS; expanded to include non-mature animals/fish*	*Recovery and disposal methods; includes bio-based materials*	*Broad range, unspecified*	*Both edible and inedible parts considered*
UNEP (2021)	*Retail, food service, households; includes inedible parts*	*Landfill, combustion, compost, etc.*	*Broad range, unspecified*	*Both edible and inedible parts considered*
New EU Reporting Guideline (2022)	*Retail, food service, household*	*Various end destinations (e.g. landfill, composting)*	*Broad range, unspecified*	*Both edible and inedible parts considered*
USEPA (2023)	*Covers entire food supply chain*	*Includes donation, animal feed, composting, landfill, etc.*	*Broad range, unspecified*	*Both edible and inedible parts considered*

3.2 Second Layer – Discourse Practice

Fairclough's 3-dimensional model of Critical Discourse Analysis (CDA) was adapted to fit the context of analysing food waste definitions. Discourse practice typically involves examining the production and dissemination processes of texts. For this study, this was interpreted to include an analysis of the authorship and acknowledgments within the documents. The acknowledgments sections of the documents were analysed to identify common contributors and their affiliations, which reveals the network of experts involved in the creation of these definitions as seen in Figure 5. This approach helps to understand the potential biases, influences, and power structures embedded within the discourse community.

To better understand these influences, the findings are categorized into the 4 axes of the conceptual model: Scope, Destination, Nutritional Density, and Edibility.

Scope

The scope of the definitions analyzed reveals significant variations based on the focus of each initiative. USEPA and FLW Standard adopt a comprehensive scope, encompassing food losses throughout the entire supply chain—from production to consumption. This broad focus aims to foster international cooperation and establish universal standards for food waste quantification, encouraging detailed inventories that cover various supply chain stages.

Contrarywise, UNEP and Beretta et al. adopt more targeted scopes. UNEP emphasizes managing food waste at consumer-oriented levels—including households, retail, and the food service industry—reflecting a focus on localized and practical solutions for reducing waste. Similarly, Beretta et al. analyzes food losses specifically within the Swiss value chain, addressing national-level challenges and emphasizing local solutions. This variation in scope reflects differing institutional priorities, influenced by regional contexts and goals, whether they aim to provide global guidance or address specific regional issues.

Destination

Regarding the destination axis, the collaborative network revealed that certain organizations are connected through shared authorship, which can influence how waste destinations are conceptualized. For instance, FLW Standard shares 6 authors with WRI and 4 with UNEP. This interconnection suggests that the concept of destinations—such as landfill, incineration, or composting—may have a level of consistency across these definitions.

WRAP and EU FUSIONS emphasize sustainable practices as part of their definitions, while excluding food redistribution from their scope. The shared contributors across these initiatives likely influence the focus on recovery methods, such as anaerobic digestion or energy production, which aligns with sustainability efforts and resource conservation.

Nutritional Density

While nutritional density is not explicitly addressed, the involvement of certain authors across multiple definitions suggests an indirect influence on how nutritional considerations might be treated. While WRI mentions the loss of mass, caloric, and nutritional value, yet it does not explicitly consider nutritional density as a key metric in determining what constitutes food waste.

The absence of explicit attention to nutritional density across most definitions might reflect the primary focus areas of the contributors involved in these initiatives. Given the shared authorship between organizations like FAO and WRI, the emphasis appears to be on the quantity of food wasted and its impact rather than the nutritional quality of food being lost. Thus, nutritional considerations have not emerged as a central concern in shaping the definitions analysed here.

Edibility

On the subject of edibility, FLW Standard and UNEP share 4 common authors, suggesting a continuity of ideas regarding the inclusion of both edible and inedible components in the definitions of food waste. The collaboration between these organizations indicates that their definitions are more comprehensive, potentially including both edible food waste and non-edible by-products like peels, bones, and shells.

FAO and WRI's shared authorship may contribute to definitions that focus more on food intended for human consumption, thus emphasizing the edible parts. This emphasis aligns with public engagement efforts that target reducing consumer-level food waste. The varying involvement of shared authors, therefore, influences whether the focus is placed on edible parts alone or if inedible parts are also included, reflecting differences in how food waste is conceptualized across different contexts.

These interconnections among the author lists indicate a level of consensus-building and collective shaping of ideas in the field of food waste. They reflect a discourse practice where knowledge is not created in isolation but is the product of collaborative efforts, shared research, and ongoing dialogues among experts and policymakers. The shared authorship serves as a proxy for understanding how specific elements of food waste definitions—such as Scope, Destination, Nutritional Density, and Edibility—are influenced by collaborative networks.

While these connections help us understand the collaborative nature of food waste definition development, there remain notable differences due to regional focuses, target audiences, and specific goals of each report analysed. Consequently, these findings highlight both the consensus and the divergences in how food waste is defined and addressed, shaped by the institutional and collaborative networks behind each definition.

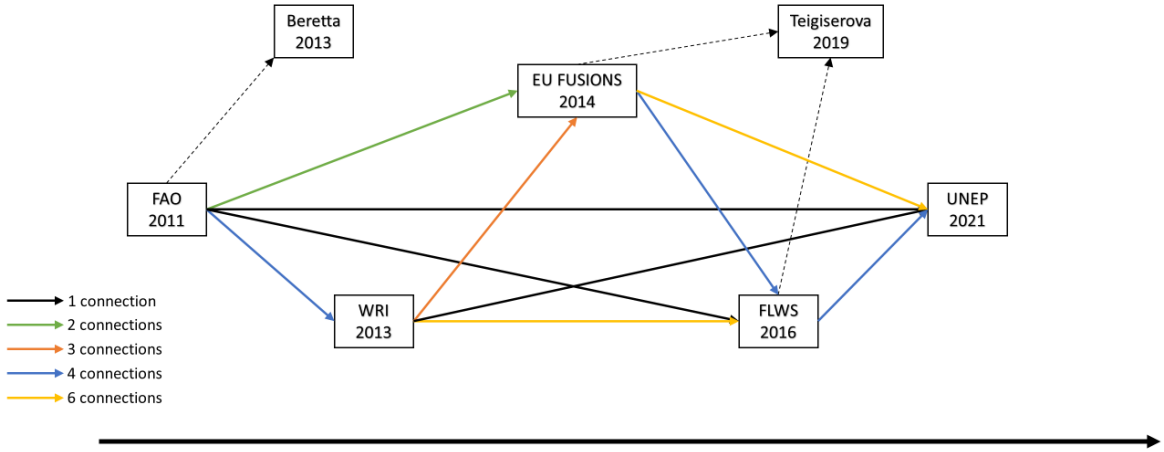

Figure 5. Visual representation of common authors behind the food waste definitions selected, following the second level of analysis per the 3-dimensional model of CDA (discourse practice).

3.3 Third Layer – Sociocultural Practice

The exploration of the food waste definitions and initiatives reveals how sociocultural factors shape the overall discourse on sustainability and waste management. Table 2 provides an overview of the intended audience and main objectives of each report analysed, based in Fairclough's 3-dimensional model of CDA. The findings are categorized according to the 4 axes—Scope, Destination, Nutritional Density, and Edibility—to better understand how different initiatives contribute to defining and addressing food waste at multiple levels of society.

Table 2. Analysis of the target audience and primary goal of each report from which food waste definitions were extracted, based on the third layer of Fairclough's 3-dimensional CDA model.

Initiative	*Year*	*Target Audience*	*Primary Focus & Goal*
FAO	*2011*	*International community*	*Highlights global food loss impacts; fosters dialogue and cooperation for waste reduction*
WRI	*2013*	*Governments, businesses, civil societies*	*Provides solutions for food loss waste reduction; emphasizes collaborative efforts for sustainability*
Beretta et al.	*2013*	*Swiss stakeholders*	*Analyses food losses in the Swiss food value chain and offers reduction strategies*
EU FUSIONS	*2014*	*European Union member states*	*Seeks to harmonize food waste definitions and data comparability across the EU*

FLW Standard	*2016*	*Global entities*	*Establishes universal standards for food waste quantification and reporting*
WRAP	*2018*	*Businesses in food production, distribution, and hospitality*	*Promotes sustainable resource use and active waste reduction strategies; aligns with SDG 12.3*
Teigiserova et al.	*2019*	*Waste management sectors, bioeconomic developers*	*Explores conversion of inedible food waste into bio-based products; aims to reshape perceptions of waste*
UNEP	*2021*	*Households, retail, food service industries*	*Offers methodologies for measuring food waste to facilitate global reduction efforts*
EU Reporting Guideline	*2022*	*Policymakers*	*Equips policymakers with tools for effective food waste monitoring and prevention; focuses on edible waste*
USEPA	*2023*	*Policymakers, waste management sectors*	*Introduces a framework for assessing environmental impacts of waste management; promotes sustainable practices*

Scope

Starting with scope, FAO targets the international community, providing a foundational global perspective that underscores food losses across the supply chain. Their scope aims to foster international cooperation and enhance dialogue regarding food waste reduction.

FLW Standard and EU FUSIONS adopt broad scopes, targeting global entities and European Union member states, respectively. The FLW Standard aims to establish universal standards for food waste quantification and reporting, encouraging detailed inventories that span different stages of the supply chain. EU FUSIONS, meanwhile, focuses on harmonizing definitions across the EU to enhance data comparability and support effective policymaking.

Contrarywise, definitions like those of UNEP and Beretta et al. focus on specific segments of the supply chain. UNEP, targeting households, retail, and food service industries, emphasizes practical, localized solutions for measuring and managing food waste, especially in consumer-oriented contexts. Beretta et al. addresses food losses specifically within the Swiss value chain, providing insights tailored to Swiss stakeholders and aiming at waste reduction within a national context.

Destination

Initiatives such as WRAP, which targets businesses involved in food production, distribution, and hospitality, and EU FUSIONS focus on sustainable waste management practices, including composting, anaerobic digestion, and bioenergy

production. These definitions emphasize treating food waste as a resource to be recovered, aligning with sustainability goals and promoting responsible practices.

USEPA, with a target audience including policymakers and the waste management sector, introduces a comprehensive framework for assessing the environmental impacts of various food waste management pathways. This includes landfill, incineration, and composting and emphasizes balancing environmental, economic, and social considerations in managing food waste.

The FLW Standard and UNEP, with a range of disposal methods from landfill and incineration to composting and AD, underscore the importance of accountability in food waste reporting. Their definitions ensure that waste management practices align with broader sustainability goals, providing clear guidelines for transparent food waste management that suits their respective target audiences.

Nutritional Density

The nutritional density aspect is notably underrepresented across most definitions. FAO, WRI, and FLW Standard focus predominantly on reducing the volume of food waste without explicitly addressing its nutritional content. This gap is reflective of the primary goals of these initiatives, which tend to focus more on quantitative aspects of food waste, such as volume and mass, rather than on the qualitative nutritional value of the discarded food.

Edibility

On the topic of edibility, initiatives like FLW Standard, WRAP, and EU FUSIONS explicitly include both edible and inedible parts of food waste, promoting a comprehensive approach to waste reduction that aligns with sustainability efforts to manage organic waste effectively.

In contrast, FAO and WRI emphasize food that is intended for human consumption at the time of disposal, focusing predominantly on edible parts. This narrower focus aims for household-level waste reduction campaigns and makes these definitions relatable for the general public. However, this approach may limit the broader potential of reducing overall organic waste, as it excludes inedible parts that are nonetheless significant contributors to the organic waste stream.

Concluding, the diversity in scope, destination, nutritional density, and edibility reflects the institutional priorities of each initiative, driven by their distinct target audiences—from international communities and businesses to national stakeholders and policymakers.

3.4 Questionnaire Study

The questionnaire study conducted among researchers and experts in the field of food loss and waste generated insightful data on the perceptions and priorities regarding food loss and waste definitions across various dimensions: Scope, Nutritional Density, Edibility, and Destination. Regarding demographics, 94 participants provided information, residing in 21 countries. The majority were based in Europe (89%), followed by North America (5%), Africa (3%), and Asia (2%) (table 3). Sweden had the highest representation with 44 individuals (46.81%). Regarding professional background, the participants predominantly came from academia (58%), followed by NGOs (16%), private companies (8%), and national or local authorities (3%). The expertise of the respondents covered various stages of the food system, including consumer level (29%), retail (20%), distribution (14%), processing/wholesale (11%), and primary production (18%), while 8% of them gave answers such as the whole food supply chain, information systems, or storage in developing countries (table 4). On average, participants had 13 years of experience in their respective fields, with a range from 0.5 to 42 years. Although the study provided valuable insights, the predominantly European and academic representation limits the comprehensiveness of the global perspective on food waste definitions.

Table 3. Geographic representation of the questionnaire respondents.

	Countries	*Respondents*	*%*
Europe	*16*	*84*	*89%*
N. America	*1*	*5*	*5%*
Africa	*2*	*3*	*3%*
Asia	*1*	*2*	*2%*

Table 4. Demographics of the survey respondents regarding their profession and stage of the food supply chain they work.

Academia	*NGO*	*Private Company*	*National or Local Authorities*	*Food Business*	*Other*
57	*16*	*8*	*3*	*0*	*15*
58%	*16%*	*8%*	*3%*	*0%*	*15%*
Consumer level	*Retail*	*Distribution*	*Processing/Wholesale*	*Primary Production*	*Other*
44	*30*	*22*	*17*	*28*	*11*
29%	*20%*	*14%*	*11%*	*18%*	*7%*

Starting with the scope of food loss and waste (Figure 6), there is an almost unanimous agreement (98%) that food bought and discarded in households is considered food loss and waste among experts. In the retail sector, there was an almost complete agreement (99%) among the recipients. The same trend continues in the part of storage and transportation between stages of the food supply chain (98%), and on the processing or wholesale level (99%). Given that early definitions of food waste typically include food intended for human consumption that is wasted at the consumer and retail levels, it is somewhat curious that these figures did not reach a full consensus. When it comes to the preharvest level, it was separated into crops left on the field due to low market prices or demand, where 85% of experts agreed on defining these as food loss and waste, and lastly due to diseases or pests where the respondents were divided (52%). On the last part, the target group was asked if they define wild animals and berries that are lost in nature as food loss and waste. For these last two questions, there were 3% and 7% positive answers respectively.

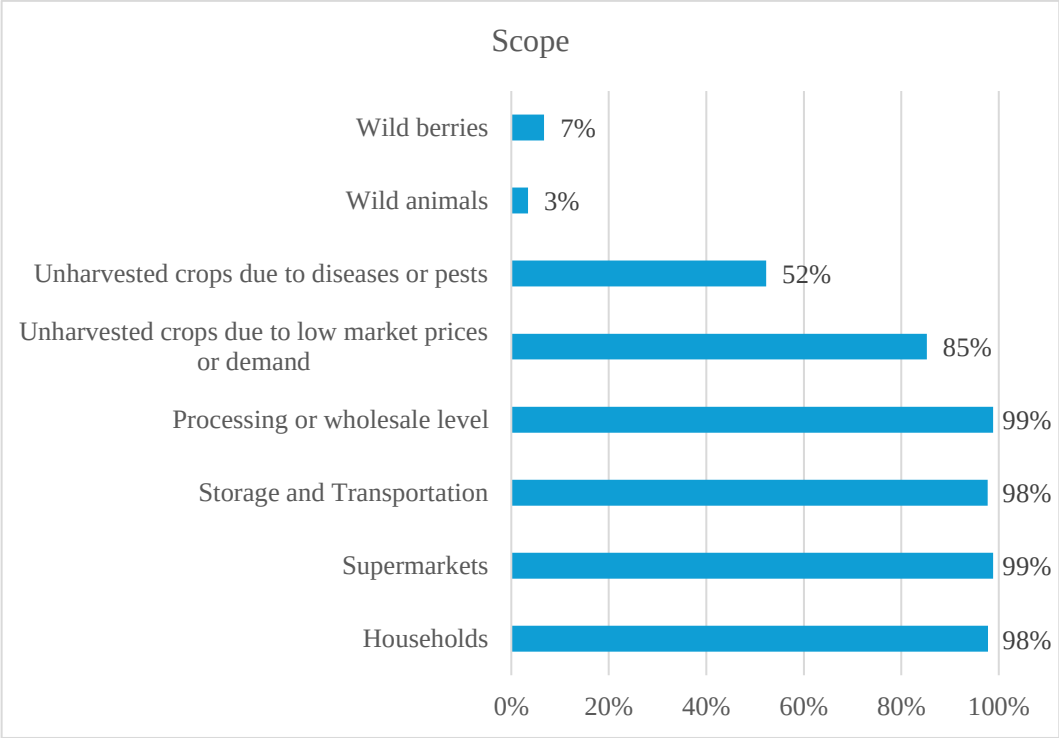

Figure 6. Percentage of experts considering different stages of the supply chain as contributing to food waste.

Moving on to the nutritional density (Figure 7), on the first question about solid food when discarded, 99% of respondents agreed on that being defined as food loss and waste. Following up, liquid food waste gathered substantial agreement, with sauce having 98%, and alcoholic and regular beverages 91% and 93% respectively. Coffee and tea followed with 93%, meanwhile cooking oil received only 56% acceptance from the experts. Drinking water and water from the kitchen tap received more acceptance from the target group (37% and 12%). 10% of the recipients defined cooking water as food waste, meanwhile water from the bathroom sink tap had the lowest percentage in this category (3%).

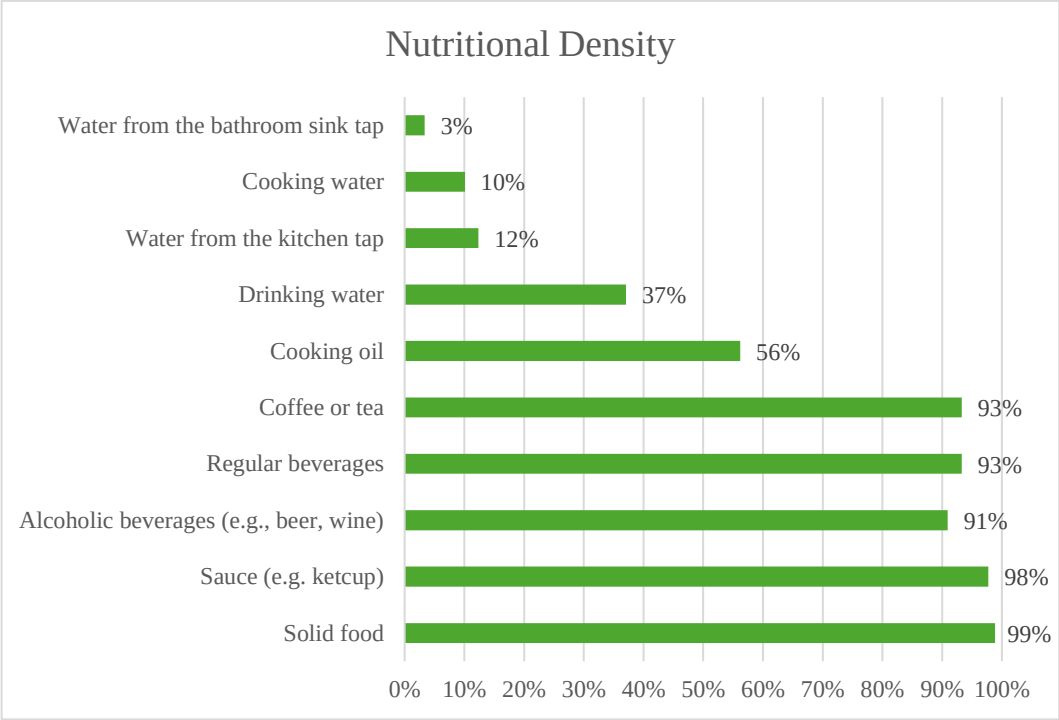

Figure 7. Percentage of experts considering specific aspects of nutritional density as part of food waste.

Regarding edibility (Figure 8), clearly eatable but discarded and food you do not like received complete agreement (100%) with culturally unwanted food following with 84%. Food past “Best before” and “Use by” date had high acceptance among experts, receiving 94% and 97% respectively. Chewing gum received one the lowest agreements in this category, with 28% of experts defining it as food waste. Moving on, there is a decline in acceptance in the category of partly digestible and undigestible parts of food (63% and 40%). Concluding this section, parts removed from animals (feathers, fur, skin etc.) received the least number of positive answers gathering only 11%.

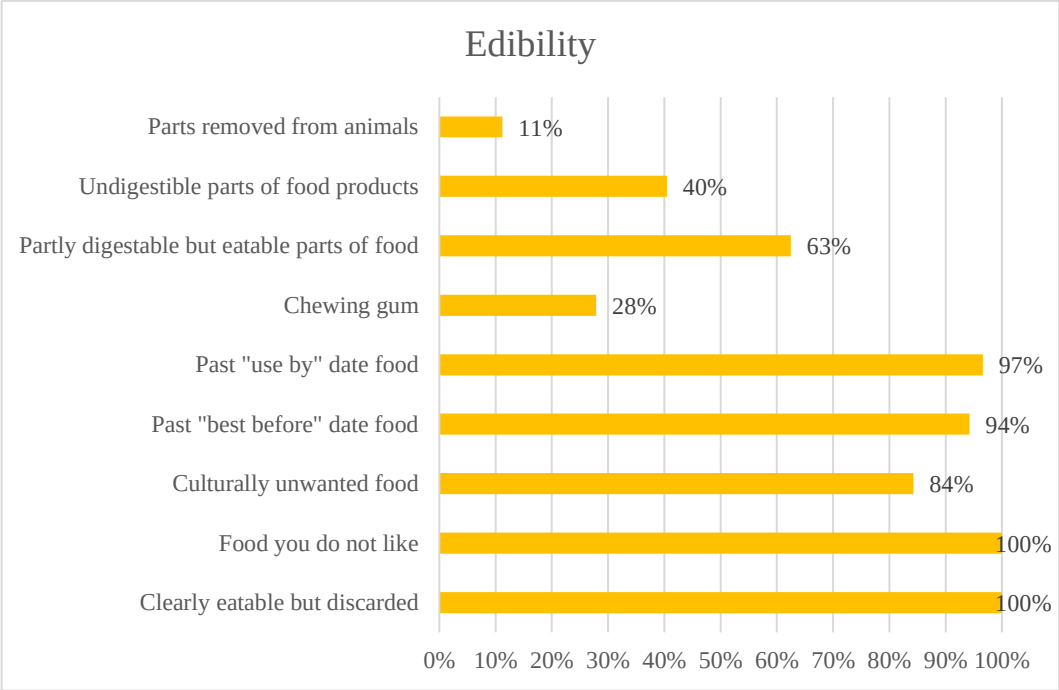

Figure 8. Percentage of experts considering whether various edible and inedible parts should be considered as food waste.

Turning now to the destination of food waste (Figure 9), food that ends up in landfills was considered as food waste by 99% of the experts. This high agreement continued in incineration collecting 92%. Composting and anaerobic digestion were close in positive answers (87% and 86%). Biomaterial and chemical production followed with 74%, meanwhile, animal feed received 61%. Food exceeding individual nutritional needs came next with 44% of agreement. Food donations, food sold on discount and food rescued from the bin received the least number of positive answers in this section of the study (6%, 1%, and 18%).

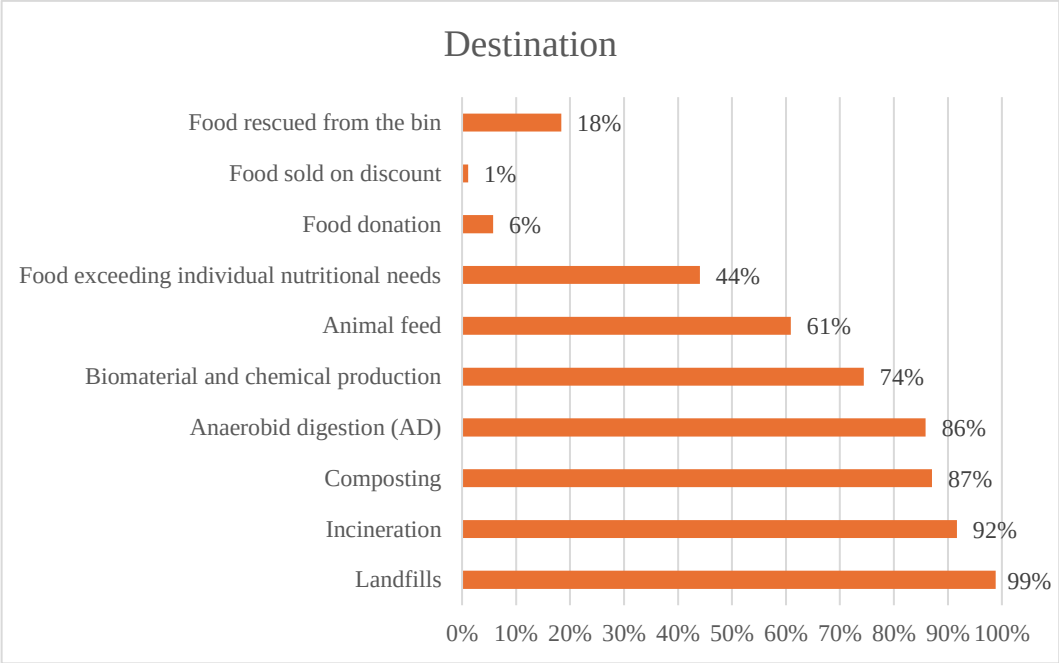

Figure 9. Percentage of experts considering various disposal and recovery methods for food waste.

Reaching the conclusion of the questionnaire results, the study provided valuable insights into experts' opinions on various aspects of food loss and waste—covering the stages of the food supply chain, the categorization of food based on nutritional density and edibility, and potential destinations for food waste. The different perspectives on the value of inedible food parts and unconventional destinations, such as food exceeding individual nutritional needs or food rescued from bins, underscore areas that require further investigation and targeted policy development. The updated 4-axis conceptual model (Figure 10) now reflects the specific survey questions, with the spread of responses categorized by levels of agreement: low (0-30%), moderate (30-70%), and high (≥70%). Since most questions have responses clustering around these percentages, they seem like a logical option. This distribution provides a clear visualization of the consensus among experts and highlights key areas of divergence that merit closer scrutiny.

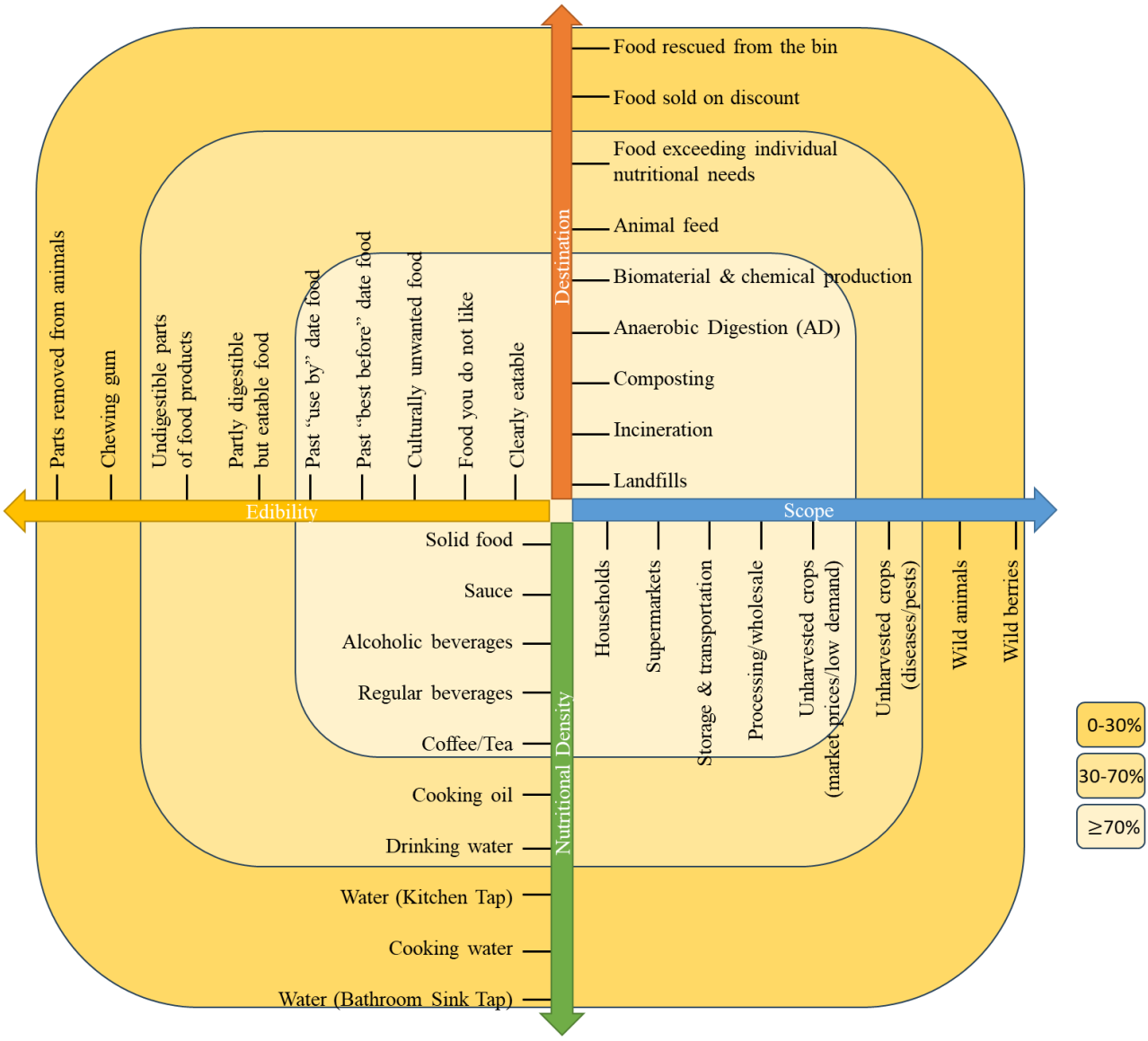

Figure 10. Overview of expert responses on food waste categories, organized according to the modified 4-axis conceptual model. Responses are classified into low (0-30%), moderate (30-70%), and high (≥70%) categories across the axes of Scope, Destination, Nutritional Density, and Edibility.

4. Discussion

This study underscores the need for clear and transparent definitions of food waste, a cornerstone issue for global sustainability efforts. The current lack of universally accepted definitions significantly hampers effective waste management and undermines international strategies aimed at reducing food waste. By integrating discourse analysis of scientific review articles with questionnaires of experts in the field, a wide range of perspectives on what constitutes food waste has been discovered, revealing disparities across different areas of the food system. As the global population continues to soar and the demand for food intensifies, addressing food waste becomes increasingly critical. A transparent and clear methodology of defining food waste is necessary to ensure consistent and effective waste reduction strategies globally.

The variation in the scope of food waste definitions identified in the results—ranging from the entire food supply chain to specific stages like retail and consumption—mirrors the disparities discussed in the literature. For instance, while 98% of experts agreed that food discarded in households constitutes food waste, there was a notable divide on crops left on the field due to diseases or pests, with only 52% classifying these as food waste. This highlights the complexity and variability in defining food waste and aligns with the findings of Thyberg and Tonjes (2016), who explored the implications of food waste definition ambiguity on policy development and waste management strategies. Their analysis underscores how varying interpretations of what constitutes “food waste” can significantly impact the development of strategies aimed at its reduction, emphasizing the crucial role of a clear and cohesive understanding in advancing sustainability goals.

The findings on nutritional density and edibility further elaborate on the definition challenges. For example, while solid food and sauces were unanimously categorized as food waste when discarded (99% and 98%, respectively), items like chewing gum and tap water from the bathroom sink gathered significantly less agreement (28% and 3%, respectively). The concept of including chewing gum and drinking water was based on their inclusion in the food regulation EC (2002) and the guidelines on reporting data on food waste according to EU (European Commission, Eurostat, 2022). This variance underscores the difficulty in applying a one-size-fits-all approach to food waste definitions, as emphasized by Teigiserova

et al. (2019) regarding the need for uniformity in definitions for effective valorisation strategies.

Moreover, the inclusion or exclusion of animal feed in food waste calculations, highlighted in the introduction, is demonstrated by the diverse treatment of food waste destinations in this study. While landfill and incineration were widely recognized as destinations for food waste (99% and 92% agreement, respectively), the categorization of animal feed (61% agreement) and food exceeding individual nutritional needs (44% agreement) as destinations reflect the ongoing debate and complexity in defining the endpoint of food waste.

These findings, drawn from the methodological integration of Eriksson's 4-axis conceptual model and Norman Fairclough's CDA framework, not only provide empirical data that echo the concerns raised in the introduction and literature review but also deepen our understanding of the dynamics shaping food waste definitions. The diverse perspectives revealed through the questionnaire study, particularly on less conventional items and destinations, highlight critical areas for further investigation, policy development, and the need for transparency in food waste definitions to enhance global food waste management strategies effectively.

Throughout this research, the aim was to introduce a novel approach by combining discourse analysis with a multi-dimensional conceptual model to examine the complex definitions of food waste across various organizations. By integrating a range of expert opinions and analysing food waste definitions from diverse sources, this approach enhances our understanding of the definitional nuances that influence global policies and sustainability initiatives. The findings contribute to the broader discourse on food waste, providing a solid basis for developing more comprehensive and adaptable waste reduction strategies.

Additionally, the questionnaire study conducted as part of this research has revealed a consensus among experts on several key aspects asked of what constitutes food waste, highlighting common perspectives across different contexts. This engagement with experts enriches the existing knowledge base, offering new insights into the points of convergence and areas of ongoing debate regarding food waste definitions. These insights help to clarify the current state of consensus and point to areas where further standardization and discussion are needed. Through this analysis, the study adds to a more nuanced understanding of food waste as a complex issue involving socio-economic and environmental dimensions.

Limitations

Due to the selection of the methods, this study comes with some limitations. The reliance on a questionnaire to gather experts' perspectives may not fully capture all viewpoints across the diverse spectrum of stakeholders involved in food waste management. The predominantly European and academic representation of respondents limits the comprehensiveness of the global perspective on food waste

definitions. Additionally, the selected participant pool, although expert, represents a specific segment of the academic and institutional landscape, potentially neglecting critical insights from practitioners and other organizations actively engaged in food waste reduction efforts.

Moreover, the findings in the first part are open to criticism due to the subjective nature of the qualitative method of analysis selected. The methodology, combining Fairclough's 3-dimensional CDA model with the 4-axis conceptual model, provides a novel approach but also limits the study to the constructs and limitations inherent in these analytical frameworks. Furthermore, the dynamic and evolving nature of food waste discourse suggests that findings may need to be revisited as new policies, technologies, and societal shifts emerge. Acknowledging these limitations is crucial for situating the study's contributions within the broader dialogue on sustainable food systems and underscores the need for ongoing research to encompass a wider array of perspectives and methodologies.

Future Research

Looking ahead, future research in the realm of food waste definitions should broaden its scope to include a diverse array of voices—from consumers and food industry professionals to policymakers and other organizations. Longitudinal and comparative studies on the evolving nature of food waste discourse across different cultural and regulatory landscapes could highlight the impact of standardized definitions on global sustainability efforts.

A useful parallel is the Life Cycle Assessment (LCA) methodology, which standardizes the inclusion of "everything from the cradle to the grave" but allows studies to transparently set specific system boundaries. Similarly, establishing a comprehensive and clear definition for food waste, while allowing individual studies to clearly define their specific boundaries, could enhance comparability and coherence in food waste research and policy development.

Future research should also explore the deliberative processes behind defining food waste by examining the proceedings of relevant meetings and conferences. Investigating the feasibility of a common definition at the European level could further this effort, examining how a broad and inclusive definition can be adapted to meet diverse stakeholder needs.

Overall, these research directions underscore the need for a comprehensive approach to refining food waste definitions. This approach aims to deepen conceptual understanding and drive meaningful action towards establishing clear definitions that enhance global sustainability efforts

5. Conclusions

This study aimed to describe the current discourse on food waste definitions, analyse expert opinions, and explore the potential for consensus, ultimately contributing to a clearer understanding of the complexities involved.

The diversity of definitions used by different institutions reveals the varied priorities in the global discourse on food waste, ranging from policy-making to sustainability goals. These definitions reflect differences in scope, edibility, and final destinations, influencing the discourse on effective food waste management strategies. The findings from the discourse analysis demonstrate that food waste definitions are shaped by institutional goals and regional contexts, contributing to differences in their practical applications.

The questionnaire study provided valuable insights into experts' opinions on various aspects of food loss and waste. High levels of agreement were observed on defining food waste at the consumer and retail stages, indicating areas of alignment that could form a foundation for standardized methodologies. However, aspects such as water use, food donation, and wild berries received very low levels of agreement (0-30%), suggesting these elements are considered largely outside the scope of food waste by most experts. Low to moderate agreement (30-70%) was found in more complex areas like preharvest losses, pointing to the need for further dialogue and examination. The importance of distinguishing between elements that are "clearly in scope" and those that are "clearly out of scope" is crucial, as is the use of transparent criteria to ensure consistency and clarity.

The study's findings highlight that rather than pursuing a universally accepted definition, a standardized methodological approach emphasizing transparency in defining food waste scopes could be more beneficial to global sustainability efforts. Such an approach will help ensure that food waste studies are comparable, adaptable, and more effectively address regional and context-specific needs, facilitating global management strategies.

In conclusion, this study contributes to the discourse on sustainable food systems by emphasizing the importance of transparent and well-defined definitions in food waste studies, ensuring that future research is comparable and supporting coherent policy development and effective global strategies for food waste reduction.

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Popular science summary

Food waste is a major issue impacting the environment and food security, but what exactly counts as food waste? This study delves into the complex world of food waste definitions, revealing how different organizations and experts view it. By examining a range of sources and conducting a survey among experts, the study found that there is a high level of agreement on some areas of the definitions, while in others it is absent. This lack of consensus makes it challenging to create effective policies and strategies to reduce food waste.

For instance, while most experts agree that food thrown away by households is waste, there is less agreement on whether crops left in the field due to disease or pests should be considered waste. The study also found that many definitions do not take into account the nutritional value of wasted food, which can be important for understanding the full impact of food waste.

To tackle food waste effectively, a clear and transparent methodology for defining food waste is needed. This will help align efforts across different sectors and countries, making it easier to measure and reduce food waste. Future research should aim to include more diverse perspectives and consider new technologies that can help manage food waste better. By working together and standardizing the approach, significant strides can be made in reducing food waste and protecting the planet.

Appendix 1

1. Introduction

Welcome to our survey!

This study is conducted by the Swedish University of Agricultural Sciences (SLU). In this survey we use the term "Food loss and Waste" (FLW), and the goal is to see how different experts define food loss and waste.

The duration of the survey is 5 to 10 minutes.

Thank you in advance for your participation and for supporting our research project!

Please get in touch with us regarding any questions or concerns:

Theodoros Vasileiou - thou0001@stud.slu.se

Mattias Eriksson - Mattias.Eriksson@slu.se

The participation in this survey is voluntary. All data collected in this survey will be treated anonymously and stored until this research project has been finalised.

We would therefore kindly ask you to agree to the terms and conditions of participation:

- ☐ I have read and understood the presented information and agree to participate in this study.
- ☐ I don't agree or don't want to participate in the study.

2. Occupation

This part contains non-compulsory questions about your profession and years of experience in the field.

_____

_____

_____

_____

_____

What is your current country of residence?

In which category would your profession fit in? (multiple answers possible)

- ☐ Academia
- ☐ NGO (non-governmental organization)
- ☐ Private Company

- ☐ National or Local Authorities
- ☐ Food Business
- ☐ Other (please specify) _____

How many years of experience do you have in this profession?

_____
_____
_____
_____
_____

In which sector of the food supply chain do you have expertise? (multiple answers possible)

- ☐ Consumer level
- ☐ Retail
- ☐ Distribution
- ☐ Processing/Wholesale
- ☐ Primary Production
- ☐ Other (please specify) _____

3. Definitions of Food Loss and Waste p1-5

This section of the questionnaire focuses on the various sectors of the food supply chain
where food loss and waste can occur. We are interested in understanding your perspective on how different stages—from production to consumption—contribute to overall food loss and waste.

Do you consider food bought and discarded in households as food loss and waste?

☐ Yes ☐ No

Do you consider food being discarded in supermarkets as food loss and waste?

☐ Yes ☐ No

Do you consider food losses during storage and transportation between stages of the food supply chain as food loss and waste?

☐ Yes ☐ No

Do you consider food being discarded in the processing or wholesale level as food loss and waste?

☐ Yes ☐ No

Do you consider crops left on the field, due to low market prices or demand, as food loss and waste?

☐ Yes ☐ No

Do you consider crops left on the field, due to diseases or pests, as food loss and waste?

☐ Yes ☐ No

Do you consider wild animals dying before being hunted for their meat as food loss and waste?

☐ Yes ☐ No

Do you consider wild berries in the forest that wither before being harvested as food loss and waste?

☐ Yes ☐ No

4. Definitions of Food Loss and Waste p2-5

This section includes questions that relate to the nutritional value of food items commonly found in waste streams. We aim to gather your expert opinion on the role that nutritional density should play in the definition of food loss and waste.

Do you consider solid food when discarded as food loss and waste?

☐ Yes ☐ No

Do you consider chewing gum when discarded as food loss and waste?

☐ Yes ☐ No

Do you consider sauce (e.g., ketchup, mayonnaise) when discarded as food loss and waste?

☐ Yes ☐ No

Do you consider cooking oil after being used and discarded as food loss and waste?

☐ Yes ☐ No

Do you consider alcoholic beverages (e.g., beer, wine) when discarded as food loss and waste?

☐ Yes ☐ No

Do you consider beverages like lemonade or soda when discarded as food loss and waste?

☐ Yes ☐ No

Do you consider coffee or tea when discarded as food loss and waste?

☐ Yes ☐ No

Do you consider cooking water poured out after boiling pasta as food loss and waste?

☐ Yes ☐ No

Do you consider drinking water when discarded as food loss and waste?

☐ Yes ☐ No

Do you consider water from the kitchen tap when discarded as food loss and waste?

☐ Yes ☐ No

Do you consider water from the bathroom sink tap when discarded as food loss and waste?

☐ Yes ☐ No

5. Definitions of Food Loss and Waste p3-5

This section of the questionnaire addresses questions related to the edibility of food and its impact on being categorized as waste. We would like to understand your perspective on how different states of edibility — from inedible to perfectly consumable — are factored into defining food as loss and waste.

Do you consider food that is clearly eatable but discarded (e.g., excess restaurant portions) as food loss and waste?

☐ Yes ☐ No

Do you consider food you do not like (e.g., leftovers, bruised fruits) when discarded as food loss and waste?

☐ Yes ☐ No

Do you consider culturally unwanted food (e.g., animal organs, blood) when discarded as food loss and waste?

☐ Yes ☐ No

Do you consider food that is possibly unsafe for consumption (past best before date) when discarded as food loss and waste?

☐ Yes ☐ No

Do you consider food that is legally not sellable but eatable (past use by date) when discarded as food loss and waste?

☐ Yes ☐ No

Do you consider partly digestable but eatable parts of food (e.g., peels and fruit pits) when discarded as food loss and waste?

☐ Yes ☐ No

Do you consider undigestible parts of food products (e.g., bones, eggshells) when discarded as food loss and waste?

☐ Yes ☐ No

Do you consider parts removed from animals (e.g., feathers, fur, skin, hoofs, horns) when discarded as food loss and waste?

☐ Yes ☐ No

6. Definitions of Food Loss and Waste p4-5

This segment of the questionnaire deals with the ultimate fate of food loss and waste. We seek your expert opinion on the various destinations for food loss and waste, from recycling processes such as composting or anaerobic digestion to disposal methods like incineration or landfill.

Do you consider food that ends up in landfills as food loss and waste?

☐ Yes ☐ No

Do you consider food that goes to incineration as food loss and waste?

☐ Yes ☐ No

Do you consider food that goes to composting as food loss and waste?

☐ Yes ☐ No

Do you consider food that goes to anaerobic digestion (AD) as food loss and waste?

☐ Yes ☐ No

Do you consider food being used for biomaterial and chemical production as food loss and waste?

☐ Yes ☐ No

Do you consider food being used for animal feed as food loss and waste?

☐ Yes ☐ No

Do you consider food exceeding individual nutritional needs as food loss and waste?

☐ Yes ☐ No

Do you consider food donated to people as food loss and waste?

☐ Yes ☐ No

Do you consider food being sold on discount as food loss and waste?

☐ Yes ☐ No

Do you consider food that has been rescued from the bin as food loss and waste?

☐ Yes ☐ No

7. Definitions of Food Loss and Waste p5-5

This final section is devoted to general questions about the definitions of food loss and waste you encounter or apply in your professional practice. We are interested in learning if there is a specific definition that you utilize in your daily work.

Do you use any specific food loss and waste definitions in your daily work?

☐ Yes ☐ No

If you answered yes in the previous question, could you describe which definition you use?

_____

_____

_____

_____

_____

Thank you for your time and for participating in our study about food loss and waste definitions!

Appendix 2

FAO 2011

Food losses refer to the decrease in edible food mass throughout the part of the supply chain that specifically leads to edible food for human consumption. Food losses take place at production, postharvest and processing stages in the food supply chain (Parfitt et al., 2010). Food losses occurring at the end of the food chain (retail and final consumption) are rather called "food waste", which relates to retailers' and consumers' behavior. (Parfitt et al., 2010).

"Food" waste or loss is measured only for products that are directed to human consumption, excluding feed and parts of products which are not edible. Per definition, food losses or waste are the masses of food lost or wasted in the part of food chains leading to "edible products going to human consumption". Therefore food that was originally meant to human consumption but which fortuity gets out the human food chain is considered as food loss or waste even if it is then directed to a non-food use (feed, bioenergy…). This approach distinguishes "planned" non-food uses to "unplanned" non-food uses, which are hereby accounted under losses.

WRI 2013

"Food loss and waste" refers to the edible parts of plants and animals produced or harvested for human consumption but not ultimately consumed by people. It represents a decrease in the mass, caloric, and/or nutritional value of edible food intended for human consumption at any stage in the food value chain.

Food loss and waste apply to food products in the value chain starting from the moment that:

- Crops are ripe in the field, plantation, or orchard;
- Animals are on the farm—in the field, sty, pen, shed, or coop—ready for slaughter;
- Milk has been drawn from the udder;
- Aquaculture fish are mature in the pond; and
- Wild fish have been caught in the net

The value chain ends at the moment food products are consumed by people, discarded, or otherwise removed from the food chain intended for direct human consumption. Therefore, food that was originally meant for human consumption

but is removed from the food chain is considered food loss or waste, even if it is then used as animal feed or bioenergy.

Food loss and waste can occur at each stage of the food value chain. Some examples of how they can occur at each stage are:

- During production or harvest in the form of grain left behind by poor harvesting equipment, discarded fish, and fruit not harvested or discarded because they fail to meet quality standards or are uneconomical to harvest.
- During handling and storage in the form of food degraded by pests, fungus, and disease.
- During processing and packaging in the form of spilled milk, damaged fish, and fruit unsuitable for processing. Processed foods may be lost or wasted because of poor order forecasting and inefficient factory processes.
- During distribution and marketing in the form of edible food discarded because it is non-compliant with aesthetic quality standards or is not sold before "best before" and "use-by" dates.
- During consumption in the form of food purchased by consumers, restaurants, and caterers but not eaten.

Food loss and waste do not include:

- By-products—such as bones, organs, skins, seeds, peels, hulls, and bran—that could be considered unavoidable food waste because in specific supply chains they are not intended for human consumption and are discarded or used in non-food products;
- Surplus food that is redirected to food banks and subsequently eaten by people;
- Food grown intentionally for feed, seed, or industrial use; and
- Overconsumption beyond recommended caloric needs.

Beretta et al. 2013

The definition employed in this paper refers to food which is originally produced for human consumption but then directed to a non-food use or waste disposal (e.g. feed for animals, biomass input to a digestion plant, disposal in a municipal solid waste incinerator).

Food losses are grouped into three categories, based on the definitions in Quested and Johnson (2009):

1. ***Avoidable losses*** refer to food and drink thrown away because they are no longer wanted, e.g. because they perished or exceeded their date of expiry. Most avoidable losses are composed of material that was, at some point prior to disposal, edible, even though a proportion is not edible at the time of disposal due to deterioration (e.g. rotting, decomposition).
2. ***Possibly avoidable losses***, in contrast, refer to food and drink that some people eat and others do not (e.g. apple peels), or that can be eaten when prepared in

one way but not in another (e.g. potato or pumpkin skins), or that is sorted out due to specific quality criteria (e.g. bent carrots).

3. ***Unavoidable losses*** comprise waste arising from food and drink preparation that is not, and has not been, edible under normal circumstances. This includes apple cores, banana skin, tea leaves, coffee grounds, and inedible slaughter waste. Additionally, harvesting, storage, transportation, and processing losses that are not avoidable with best available technologies and reasonable extra costs are also classified as unavoidable.

This definition of food losses differs from that in Gustavsson et al. (2011) by including the unavoidable losses, which are omitted in the cited study.

According to Gustavsson et al. (2011), food waste is often used for food losses occurring at the end of the food value chain (retail and final consumption), where most losses are caused by wasteful behaviour. Nevertheless, in this paper both terms are used synonymously and refer to all food losses, because a distinction between wasteful behaviour and other reasons for food losses was difficult to perform.

EU FUSIONS 2014

"Food waste is any food, and inedible parts of food, removed from the food supply chain to be recovered or disposed (including composted, crops ploughed in/not harvested, anaerobic digestion, bio-energy production, co-generation, incineration, disposal to sewer, landfill or discarded to sea)".

Drink and liquid waste, fish discarded to sea and waste of any materials that are ready for harvest, but which are not harvested, are included in FUSIONS's definition of food waste, making its perimeter wider and broader than many other existing definitions. FUSIONS also considers inedible parts of food (e.g. skin, bones…) as food waste in order to support the development of resource efficient and sustainable food systems in the EU.

FLW Standard 2016

Food: Any substance—whether processed, semi-processed, or raw—that is intended for human consumption

"Food" includes drink, and any substance that has been used in the manufacture, preparation, or treatment of "food".

Food loss and waste (FLW): Food and/or associated inedible parts removed from the food supply chain.

Comment

For the sake of simplicity of expression, the FLW Protocol uses the phrase "food loss and waste" and the abbreviation "FLW" as shorthand. It does not differentiate between "food loss" or "food waste".

The FLW Standard can be applied to both food and/or associated inedible parts removed from the food supply chain. In order to be in conformance with the FLW

Standard, an entity is required to identify whether it is accounting for and reporting on both of these material types, only food, or only associated inedible parts. The choice an entity makes is a function of its goals for quantifying FLW.

There is no universal agreement on what "destinations" of food and associated inedible parts that are removed from the food supply chain are to be considered "loss or waste".

While the FLW Standard's definitions align with the FAO's definitions for "food," "inedible parts," and "food supply chain," the FAO's use of the term FLW refers only to "food" and therefore excludes inedible parts. Moreover, FAO's definition of "loss and waste" encompasses all 10 destinations defined by the FLW Standard.

The FLW Standard can be used across the alternative definitions for food loss and waste.

Destination refers to where material removed from the food supply chain is directed. There is a range of possible destinations, which represent a range of alternative uses and potential value. The 10 categories used in the FLW Standard are:

- Animal feed
- Bio-based materials/biochemical processing
- Codigestion/anaerobic digestion
- Composting/aerobic processes
- Controlled combustion
- Land application
- Landfill
- Not harvested/plowed in
- Refuse/discard/litter
- Sewer/wastewater treatment

WRAP 2018

Food waste**:** Food* and the inedible parts of food removed from the food supply chain to be recovered or disposed of (including - composted, crops ploughed in/not harvested, anaerobic digestion, bioenergy production, co-generation, incineration, disposal to sewer, landfill or discarded to sea). This definition excludes waste prevention activities, namely where surplus food is redistributed for human consumption, or surplus food / inedible parts are diverted to produce animal feed, or used for bio-based materials/biochemical processing (where material is converted into industrial products)

* Food (i.e. product intended for human consumption) includes that which is still suitable for consumption when it is disposed of (i.e. would be regarded as 'edible') and that which may no longer be suitable for consumption at the point of disposal

(i.e. would be regarded as no longer edible or 'non-edible', for example due to it passing a 'use by' date or being spoiled)

Teigiserova et al. 2019

The two most widely used food waste definitions in Europe are those of the FUSIONS project (applied in the EU-28 countries) (Östergren et al., 2014), and of the FLW Protocol (WRI, 2016). The EU project FUSIONS defined food waste as "food and inedible parts of food removed from the food supply chain", where food has or had the potential to be eaten. This encompasses any food waste that has been lost or diverted from the food supply chain, excluding pre-harvest crops and pre-slaughtering animals, which are labelled as "not mature". The food waste may be disposed or recovered through a variety of technologies/techniques, including "composting, crops ploughed in/not harvested, anaerobic digestion, bioenergy production, co-generation, incineration, disposal to sewer, landfill or discarded to sea" (Östergren et al., 2014).

While the FLW Protocol definition also includes inedible parts of food, it expands the end-of-life treatment by including "bio-based materials/biochemical processing, controlled combustion, land application, and refuse/discard/litter" (WRI, 2016). The boundaries of the FUSIONS and FLW Protocol exclude the biomass not directly intended for human consumption, such as crops intentionally grown for bioenergy, animal feed, and industrial use. The FLW Protocol is supported by a steering Committee involving institutions such as the World Resources Institute (WRI), the UK Waste and Resources Action Programme (WRAP), the FUSIONS project, the United Nations Environment Programme (UNEP) among others (FWL, 2013).

In this study, we build on the definition of the FLW Protocol, i.e. inedible and unavoidable parts of processed food items are "food waste", even if used for the production of biochemicals and biomaterials. We propose a slight adaptation by including animals and fish dying prior to leaving the farm ("non-mature dead animals and fish" in FUSIONS) as "food waste", as proposed in Hartikainen et al. (2018). The definition boundary considered in this study is represented in Fig. 1. It should also be highlighted that this review does not distinguish between food loss and waste due to a lack of transparency and inconsistencies (e.g. using different or overlapping definitions) found in the reviewed literature. In scientific literature, authors often do not clearly define the difference between food loss and waste or account for both of them aggregated.

UNEP 2021

"food waste" is defined as food (see below) and the associated inedible parts removed from the human food supply chain in the following sectors:

Retail, Food service , Households

"Removed from the human food supply chain" means one of the following end destinations: landfill; controlled combustion; sewer; litter/discards/refuse; co/anaerobic digestion; compost / aerobic digestion; or land application.

Food is defined as any substance – whether processed, semi-processed or raw – that is intended for human consumption. "Food" includes drink, and any substance that has been used in the manufacture, preparation or treatment of food. Therefore, food waste includes both:

- "edible parts": i.e., the parts of food that were intended for human consumption, and
- "inedible parts": components associated with a food that are not intended to be consumed by humans. Examples of inedible parts associated with food could include bones, rinds and pits/stones.

EU Reporting Guideline 2022

Food (or 'foodstuff') means any substance or product, whether processed, partially processed or unprocessed, intended to be, or reasonably expected to be ingested by humans.

Edible food parts are the components associated with a food, in its fresh mass status, that are usually consumed by humans, either as-is (raw consumption) or after processing or cooking. The definition of edible food parts might differ from country to country, or from region to region, according to local culture and habits.

Food encompasses food as a whole, along the entire food supply chain from production until consumption. Food also includes inedible parts, where those were not separated as by products from the edible parts when the food was produced (including all the stages of production, processing and distribution), such as bones attached to meat destined for human consumption, orange peels, seeds... According to General Food Law Regulation (Regulation (EC) No 178/2002, namely GFLR), food includes water intended for human consumption, drink, chewing gum and any substance including water, incorporated into the food during its manufacture, preparation or treatment. Food must not include feed, live animals not placed on the market for human consumption, plants prior to harvesting (also for the case of plants not harvested for economical reasons), medicinal products, cosmetics, tobacco and tobacco products, narcotic or psychotropic substances, residues and contaminants.

Food waste is any food that has become waste under these conditions:

1. it has entered the food supply chain,
2. it then has been removed or discarded from the food supply chain or at the final consumption stage,
3. it is finally destined to be processed as waste.

Therefore, food waste can comprise items which include parts of food intended to be ingested (edible food) and parts of food not intended to be ingested (inedible food).

USEPA 2023

"Wasted food" is defined as food grown for human consumption that is not used for its intended purpose and is managed in a variety of ways, such as donation to feed people, creation of animal feed, composting, anaerobic digestion, or disposal in landfills or controlled combustion facilities (U.S. EPA 2023a). Wasted food can be generated at any stage of the supply chain, from farm to consumer. Examples include unharvested crops; by-products from food and beverage processing facilities; unsold food from retail stores; or plate waste, uneaten prepared food, or kitchen trimmings from restaurants, cafeterias, and households. Wasted food includes parts of food deemed edible and those deemed inedible, such as shells, bones, pits, or peels. Food crops grown for other purposes, such as biofuels or animal feed, is excluded from the definition.

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