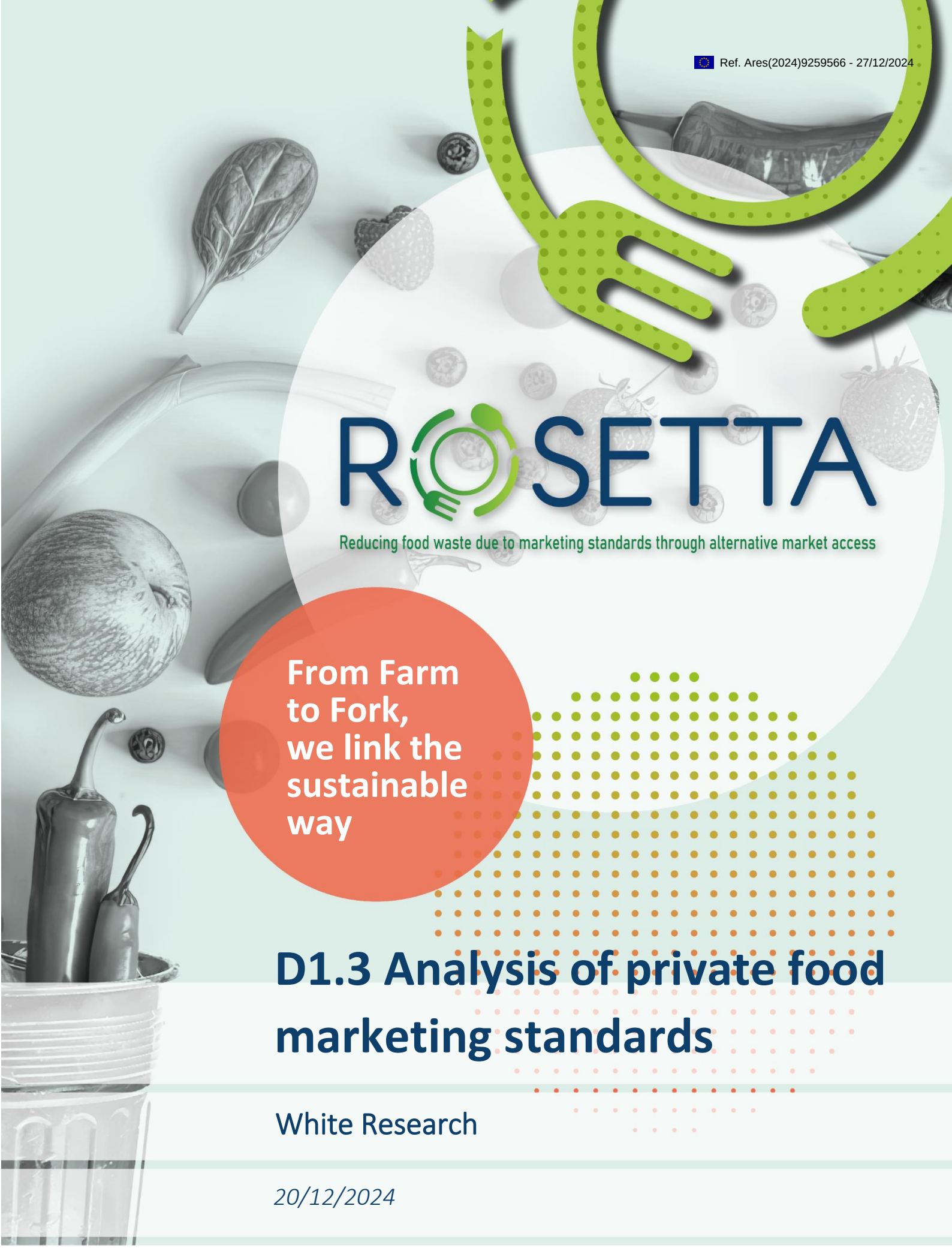

ROSETTA

Reducing food waste due to marketing standards through alternative market access

From Farm to Fork, we link the sustainable way

D1.3 Analysis of private food marketing standards

White Research

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Table of Contents

Table of Figures

List of Tables

Abbreviations

Table 1: Abbreviations

NGOs	Non governmental organisations
SQF	Safe Quality Food
BRC	British Retail Consortium
BSE	Bovine Spongiform Encephalopathy
IFS	Global Standard for Food Safety and International Food Standards
PRL	Pesticide Residue Limit
MQS	Minimum quality standards
PPL	Private product label
UNECE	United Nations Economic Commission for Europe
NTBs	Non-tariff barriers
SPS	Sanitary and phytosanitary
CAP	Common Agricultural Policy

Executive Summary

This deliverable offers an examination of private marketing standards and their impact on the food industry, food waste, and consumer behaviour. The analysis focuses on understanding the role, objectives, and evolution of private marketing standards, their interaction with public standards and their relation to food waste. The report combines findings from a mixed methods approach including a literature review, a consumer survey conducted in 10 European countries with 3,500 respondents and interviews with relevant stakeholders.

Key findings include:

- **Private marketing standards:** These standards, developed by private actors such as retailers and food producers, have evolved from safety regulations to covering quality as well as social and environmental aspects.
- **Impact on food waste:** The report highlights that marketing standards contribute to food waste by rejecting suboptimal but safe-to-eat foods. These include fruits, vegetables, and meat that differ from the ideal appearance or are close to their expiration dates. Stricter cosmetic standards create higher rejection rates along the supply chain, from primary production to retail.
- **Consumer Behaviour:** The consumer survey revealed different levels of acceptance for suboptimal foods across EU countries and food commodities. Cultural and socio-economic factors, such as limited financial resources, were found to influence consumer attitudes toward food waste.
- **Marketing standards and sustainability:** The report reveals the need for marketing strategies that align with regional cultural values to effectively promote food waste reduction.
- **Challenges and future trends:** The report highlights the need for collaborative efforts across the supply chain, refining standards to align private marketing standards with food waste reduction and sustainability goals.

Overall, this analysis provides essential insights for policymakers, industry stakeholders, and consumers, revealing the role of private standards in food quality, consumer behaviour, and waste management.

More specifically this report includes:

- ***Chapter 1:*** This chapter includes a short description of private marketing standards and their evolution.
- ***Chapter 2:*** In this chapter, we define private food marketing standards and explore the reasons behind their development. It covers the establishment processes, the differences between process and product specification standards, and the various types that exist. Additionally, it includes how these standards interact with public standards and their contributions to food waste along the value chain, from primary production to consumers. Finally, it also includes key points from stakeholder interviews as well as insights on food policy, industry trends, and future challenges regarding standards.
- ***Chapter 3:*** This chapter focuses on private marketing standards specific to different food commodities.
- ***Chapter 4:*** This chapter examines consumer's food waste, the issue of suboptimal foods, and provides insights into consumer behaviour.
- ***Chapter 5:*** This chapter presents the findings from our consumer survey.
- ***Chapter 6:*** The final chapter summarises the key conclusions.

Annex:

Annex I: This Annex includes the detailed thematic analysis of the literature review, performed in the framework of the project with the use of AI and machine learning.

Annex II: This Annex presents indicative lists of key food marketing standards identified per food commodity by related actors.

Annex III: Survey's questionnaire

1. Introduction

Private food marketing standards play a key role in food industry practices and affect many aspects from the quality and safety of the products to the competition and pricing. This report explores the private food marketing standards, their roles, objectives, evolution and establishment, interrelation with public standards and their impact in food waste across the food value chain. By understanding their effect on consumer preferences, we gather insights on how these standards are integrated into products and how they affect food waste.

The deliverable is based on the findings from a mix of methods:[1]

A) ***Literature review:*** A literature review took place based on a variety of sources, including (i) peer-reviewed academic journals, (ii) scholarly books, (iii) research blogs, and (iv) grey literature such as publications and websites from governmental and non-governmental organisations, firms, and media outlets. Content, thematic and network analyses were performed in order to gain an understanding of the private food marketing standards as well as their relation to food waste.

B) ***Interviews with stakeholders across the food supply chain:*** Fifty interviews took place in the 5 pilot use cases of ROSETTA project with stakeholders along the value chain aiming to understand the way stakeholders describe their experiences with regards to the imposing of marketing standards. This deliverable includes some major results from the interviews concerning the private marketing standards. The overall methodology and analysis of the interviews can be found in ***D1.2.*** *Analysis of EU, international and national marketing standards.*

C) ***Consumer survey:*** A consumer study was conducted across 10 different European countries, including our 5 pilot areas, gathering a total of 3,500 responses (approx. 350 per country). The survey focused on measuring consumption patterns, perceptions of food waste, and the demographic and psychometric factors that influence consumer behaviour. The findings from this survey provided insights with regards the consumer behaviour and highlighted the key factors that drive decision-making and shape perceptions around food waste, marketing standards and suboptimal foods.

[1] Our findings provide a clearer understanding of how private marketing standards shape consumer behaviour and impact food waste. By conducting literature review, engaging stakeholders across the value chain in interviews, and surveying a large group of consumers, we moved from theoretical analysis to practical validation. This process helped us elevate the TRL to 4, adding a valuable layer of empirical insight to our work.

2. Private food standards

2.1 Definition of private food standards

Over the last decades, private food standards have emerged as a significant means of market governance and control. Although, these standards were firstly developed in order to address the food safety problem[2], they evolved into schemes with a broader scope that address food quality, social or environmental issues along the food value chain.

Private standards are a set of rules or norms about the minimum requirements of products, food processes and producers, and they are developed by private food value chain actors, such as food producers, non-governmental organisations (NGOs), industries, associations, farmers, retailers and food service providers[3].

These private schemes consist of their internal governance structures and procedures that ensure the conformity with the rules and requirements of the respective standard, ***and are usually voluntary***, offering the potential users the freedom to decide whether to comply with them. In contrast, compliance with public standards is obligatory in the legal sense, as they are imposed by public authorities that are traditionally been seen as the responsible body for the preservation and protection of human health[4,5,6]. The implementation of these standards is enforced through official inspection of facilities, equipment, and food products, resulting in possible fines or other legal penalties if the requirements are not met. ***Private standards on the other hand, usually emerge from a coordinated process which involves the participation of several actors from the food market such as industry and trade organisations, with or without the participation of the government or a public entity, with the aim of addressing several issues in the food value chain***. Private food marketing standards which are developed by institutions such as Safe Quality Food (SQF) or British Retail Consortium (BRC) are clear examples of voluntary schemes that aim to ensure food safety and quality in a specific sector of the food value chain. Through the process of the development of these standards, the associations aim to achieve consensus on the technical specifications that address their needs. ***Although the implementation of these standards is voluntary, the majority of the buyers chooses to apply them in their organisations in order to gain the economic advantage that is associated with the standardisation and market requirements***[7].

[2] Bain C, Ransom E, Higgins V (2013) *Private agri-food standards: contestation, hybridity and the politics of standards*. Int J Sociol Agric Food 20(1):1–10

[3] Havinga T. (2018) *Private Food Safety Standards in the EU*. Regulating and Managing Food Safety in the EU, 6, 11-38

[4] Antle, J.M. (1995) *Choice and Efficiency in Food Safety Policy*, AEI Press, Washington DC

[5] Henson, S.J. & Caswell, J.A. (1999) *Food safety regulation: An overview of Contemporary Issues,* Food Policy, 24, 589-603

[6] Caswell, J.A. & Johnson, G.V. (1991) *Firm Strategic Response to Food Safey and Nutrition Regulation*. In Economics of Food Safety. Elsevier Science Publishing Company, New York

[7] Henson, S. (2008) *The Role of Public and Private Standards in Regulating International Food Markets.* Journal of International Agricultural Trade and Development. 4 (1):63-81

2.2 Evolution of private standards in food industry

The significance of private standards in food safety governance, along with other sectors, has been extensively documented over the past years[8,9,10,11]. Their widespread adoption across various branches of the food industry in numerous European countries has been notable, where private standards have played a pioneering role in modernising food regulation. Therefore, any analysis of food safety regulation within the EU must not confine itself solely to public legislation but should also encompass private standards.

Several factors have created a positive environment for the development of private food standards. Firstly, the ***increasing globalisation of food supply chains*** has made it challenging for both the food industry and national governments to ensure the safety of food products. With production sites and food supply chains spread out around the world, some locations and processes might not be closely monitored. To keep control, retailers and manufacturers who source globally search for alternative methods, while national governments face barriers since they are limited within their national borders[12,13,14,15]. Secondly, ***the strengthened economic influence of supermarket chains*** has enhanced the adoption of private food standards[16,17]. Additionally, as companies in the food retail industry merge and grow, several large players have emerged that operate in multiple countries, which gives them a strong influence in the market. Thirdly, ***the growing public concerns about food safety*** after scandals like BSE, dioxin, E. coli, and salmonella have pushed the food industry to take steps to rebuild and maintain consumer trust[18,19,20,21]. Lastly, ***perceived shortcomings in governmental regulation***, particularly evident in responses to crises like the BSE outbreak, have prompted criticism from both consumer organisations and the food industry, highlighting the ineffectiveness of public food standards

[8] Bain C, Ransom E, Higgins V (2013) *Private agri-food standards: contestation, hybridity and the politics of standards*. Int J Sociol Agric Food 20(1):1–10

[9] Busch L, Bingen J (2006) *Introduction: a new world of standards*. In: Bingen J, Busch L (eds) Agricultural standards: the shape of the global food and fiber system. Springer, Dordrecht, 3–28

[10] Henson S, Humphrey J (2009) *The impacts of private food safety standards on the food chain and on public standard-setting processes*. Paper Prepared for FAO/WHO

[11] van der Meulen B (2011) *Private food law. Governing food chains through contract law, selfregulation, private standards, audits and certification schemes*. Wageningen Academic Publishers, Wageningen

[12] Hatanaka M, Bain C, Busch L (2005) *Third-party certification in the global agrifood system*. Food Policy 30(3):354–369

[13] Henson S, Humphrey J (2010) *Understanding the complexities of private standards in global agrifood chains as they impact developing countries*. J Dev Stud 46(9):1628–1646

[14] Oosterveer P (2005) *Global food governance*. Wageningen university, Wageningen

[15] van Waarden F (2011) *Varieties of private market regulation*. In: Levi-Faur D (ed) Handbook on the politics of regulation. Edward Elgar, Cheltenham, pp 469–485

[16] Burch D, Lawrence G (2005) *Supermarket own brands, supply chains, and the transformation of the agri-food system*. Int J Sociol Agric Food 13(1):1–18

[17] Marsden T, Lee R, Flynn A, Thankappan S (2010) *The new regulation and governance of food*. Routledge, New York

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[19] Fulponi L (2006) *Private voluntary standards in the food system: the perspective of major food retailers in OECD countries*. Food Policy 31(1):1–13

[20] Henson S, Humphrey J (2010) *Understanding the complexities of private standards in global agrifood chains as they impact developing countries*. J Dev Stud 46(9):1628–1646

[21] van der Kloet J (2011) *Transnational supermarket standards in global supply chains: the emergence and evolution of GlobalGAP*. Recht der Werkelijkheid 32(3):80–99

in ensuring food safety and control global food supply chains[22,23,24]. These circumstances have fostered the evolution and widespread adoption of private food marketing standards.

Although the rise of private food safety standards began in the 1990s, they are not entirely novel within the food industry. Historical precedents include long-standing quality control mechanisms implemented by manufacturers, trade associations organisations, especially in the production and trade of perishable foods like milk and meat. These systems often involved certification of producers, manufacturers, traders, as well as product inspections by controlling laboratories. Examples include kosher supervision and French wine appellations.

However, the modern generation of private food standards differs from historical practices in several aspects. Contemporary standards typically entail formal normative documents specifying substantive and procedural norms, international applicability, mandatory third-party certification, coverage of diverse issues, and management by specialised organisations with formalised procedures for standard review, auditing and certification. In contrast, older private food standards were often less structured, focusing on single issues and local markets, with verification and enforcement procedures being either absent or less developed[25].

3. Private food marketing standards

3.1 The development, establishment and motivations behind private food marketing standards

Private marketing standards refer to the guidelines, specifications, and requirements set by private entities—such as retailers, wholesalers, or certification bodies—that go beyond regulations to ensure certain qualities, safety, or ethical considerations for food products, while ***public marketing standards*** are enforced by public regulations and define technical specifications of processes and products in the food industry, ***aiming to establish the minimum safety and quality standards for the food products that are marketed to consumers***[26]. Many actors along the food supply chain may have a number of reasons to impose their own set of rules in the production, packaging and distribution processes, as well as in product specifications. These terms and rules, referred to as **private marketing standards**, are established by private food actors aiming to ensure the safety and standardised quality of food products, while also meeting or even exceeding consumer expectations. **The main reasons for the establishment of these specific demands on products and processes include the following:**

1. **Product differentiation**, helping companies differentiate their products from those of their competitors[27]. Through the establishment of unique quality standards, food supply chain actors

[22] Bernauer T, Caduff L (2006) *Food safety and the structure of the European food industry*. In:Ansell C, Vogel D (eds) What's the beef? The contested governance of European food safety.The MIT press, Cambridge, pp 81–95
[23] Henson S (2011) *Private agrifood governance: conclusions, observations and provocations*. Agric Hum Values 28(3):443–451
[24] Vos E (2000) *EU food safety regulation in the aftermath of the BSE crisis*. J Consum Policy 23:227–255
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[26] Russo, C., Sansone, M., Colamatteo, A., Pagnanelli, M.A., Twum, E.K. (2022), *Benefits and costs of EU marketing standards for agri-food products: Workshop Report*, Russo, C., ed., Publications Office of the European Union, Luxembourg, ISBN 978-92-76-46704-5, doi:10.2760/635080, JRC128162.
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ensure that their products stand out compared to the competition, while also contribute to a strong brand identity, enhancing recognition among consumers.

2. **Price discrimination strategies,** allowing companies to segment the market and charge different prices for their products based on their perceived value [28]. The creation of multiple food product tiers, each meeting different specifications and appealing to different consumer groups, offer a way for companies to bring to the market more premium products, in addition to the basic ones, and justify the increased price for a product with superior attributes.
3. **Cost efficient transportation of uniform products,** which is ensured by the consistency in product characteristics, thus simplifying and reducing the cost of packaging, transportation and logistics [29]. The uniformity and standardisation of products facilitate the process of handling and transporting them, while also offer efficiency and predictability along the supply chain.
4. **Meeting or even exceeding consumers' demand for appealing products,** enhancing consumer satisfaction and brand loyalty [30,31,32]. In addition to the assurance of food safety, consistent adherence to high standards increases the trust of consumers to product's quality and leads to increased purchases.

Specifically for the last reason, it is believed that food supply chain actors set strict quality standards under the assumption that consumers would not choose to purchase products that do not have perfect appearance[33,34]. However, there is an ongoing debate on whether product requirements are imposed by food supply chain actors in order to satisfy the consumers' expectations, or whether food supply chain actors have educated consumers towards expecting food products with appealing appearance and characteristics[35].

Private marketing standards are divided into two categories: **Process standards**, that refer to the processes and activities that must be performed in order to produce and distribute food products of standardised quality, and **Product standards**, that relate to the properties and characteristics of food products. The rise and implementation of process standards (e.g. Fairtrade, Organic, etc.) has ensured the standardisation of food quality and the transparency of food supply chain, but the product standards are more relevant and have greater impact on food waste[36]. The latter include, among others, the date labelling of the product, therefore determining the maximum age of a food product and by when it should be consumed, but also specify

[28] Richards, T. J., Hamilton, S. F. (2020), *Retail price discrimination and food waste*, European Review of Agricultural Economics, 1-36

[29] UBA, 2020. *Umwelt- und Klimarelevante Qualitatsstandards im Lebensmitteleinzelhandel: Ursachen und Losungen*. TEXTE 72. Umweltbundesamt, Bonn, p. 159.

[30] Aschemann-Witzel, J., Jensen, J.H., Jensen, M.H., Kulikovskaja, V., 2017. *Consumer behaviour towards price-reduced suboptimal foods in the supermarket and the relation to food waste in households*. Appetite 116, 246–258. .

[31] de Hooge, I.E., Oostindjer, M., Aschemann-Witzel, J., Normann, A., Loose, S.M., Almli, V. L., 2017. *This apple is too ugly for me*. Food Qual. Prefer. 56, 80–92. https://doi.org/10.1016/j.foodqual.2016.09.012.

[32] Hartmann, T., Jahnke, B., Hamm, U., 2021. *Making ugly food beautiful: consumer barriers to purchase and marketing options for Suboptimal Food at retail level – a systematic review*. Food Qual. Prefer. 90, 104179 https://doi.org/10.1016/j. foodqual.2021.104179.

[33] de Hooge, I.E.; Oostindjer, M.; Aschemann-Witzel, J.; Normann, A.; Loose, S.M.; Almli, V.L. *This apple is too ugly for me! Consumer preferences for suboptimal food products in the supermarket and at home.* Food Qual. Prefer. 2017, 56, 80–92.

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[35] UBA, 2020. *Umwelt- und Klimarelevante Qualitatsstandards im Lebensmitteleinzelhandel: Ursachen und Losungen*. TEXTE 72. Umweltbundesamt, Bonn, p. 159.

[36] Arnold, N. 2022. *Standards and Waste: Valuing Food Waste in Consumer Markets*. Worldwide Waste: Journal of Interdisciplinary Studies, 5(1): 2, 1–14. DOI: https://doi.org/10.5334/wwwj.84

aesthetic specifications such as size, colour, shape etc., therefore being one of the main drivers for the wastage of perfectly edible food, contributing to the overall food waste volumes[37]. Product standards evaluate edible food as worthless because it is too small or too big. Specifically for the agricultural sector, studies have shown that product standards may account for 90% of the waste generated in the production process[38].

Private actors, such as supermarkets, set this type of aesthetic standards and through them, they specify how food products should look like, providing specific requirements that they should meet in order to be marketable[39]. Various studies have shown that the company product specifications of retailers go beyond legal requirements, to ensure that their products characteristics are well above the legal specifications of safety and quality, thus resulting in products being sorted out as food waste at the early stages of the supply chain[40].

Given the fact that many studies have highlighted that marketing standards have a significant impact on food waste, several studies have proposed the amendment of these standards to reduce or prevent food waste[41,42]. There has been an amendment of EU marketing standards in 2008, but the impacts on food waste were limited, due to the fact that the trading sector decided to adhere to private standards, which serve as a guideline between supply chain actors, facilitating the business relationships between producers, processors and retailers[50]. Also, the amendment of specifications regarding the shape or size of products would affect the packaging and transport processes, as these processes are currently standardised to specific characteristics, therefore they cannot handle food products with irregular shape or size[43]. According to the above, private marketing standards are a tool for communicating requirements which are agreed between food supply chain stakeholders, therefore it is suggested that market requirements drive the development of standards and eventually the food waste, and would likely remain the same even if public standards were removed [50].

Voluntary private standards have generally grown in importance as a method of market governance within global food chains[44]. According to Hatanaka[45], companies now use private standards strategically to achieve various objectives, such as entering new markets, coordinating operations, and ensuring quality and safety to maintain or enhance their reputation. This evolution indicates that the role of establishing and monitoring food safety and quality standards has shifted from governmental bodies to private companies, including manufacturers, retailers, and third-party certifiers.

Additionally, consumer perceptions and purchasing behaviours, whether actual or anticipated, greatly influence retailers' decisions. Retailers apply aesthetic standards to accept or reject foods based on the

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[39] Arnold, N. 2022. *Standards and Waste: Valuing Food Waste in Consumer Markets*. Worldwide Waste: Journal of Interdisciplinary Studies, 5(1): 2, 1–14. DOI: https://doi.org/10.5334/wwwj.84

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assumption that consumers prefer products that meet these standards. As a result, it is argued that if consumers were willing to purchase fruits and vegetables that do not meet these aesthetic criteria, retailers would be more inclined to offer such produce for sale. Towards that aim, a lot of farmers have suggested that consumers should be educated regarding "ugly" fruit and vegetables, in order to increase their awareness about cosmetic specifications, which was demonstrated successfully by Intermarche's campaign, the third largest supermarket in France[46].

Food demands are evolving due to changes in lifestyles, demographics, and rising incomes. While quality and safety remain essential for consumers, the importance of specific product attributes and production processes is growing. For example, concerns about animal welfare have led to legislation in the EU regarding the treatment and housing of laying hens, with similar regulations for other farm animals[47].

There is also an increasing concern for environmental sustainability in agriculture, with society holding farmers, manufacturers, and governments accountable for the negative externalities of food production. NGOs play a crucial role in informally monitoring the sourcing behaviours of retailers, both domestically and internationally, encouraging firms to ensure their suppliers adhere to acceptable norms and standards. These evolving demands are reshaping business practices along the food chain[48]. The adoption of private standards and third-party certifications exemplifies the significant changes in how retailers source products. Any mishap in the food chain can severely damage a retailer's reputation due to media coverage, prompting a focus on developing tools to prevent or quickly correct such issues. Sourcing products that meet standards is viewed as a strategy to avoid mishaps and protect their reputation and intangible assets. Consumer attitudes still emphasise government responsibility in the food sector. A survey conducted through representative consumer associations revealed that food safety, environmental effects, and health are major concerns. When asked who should set standards or rules for food safety, quality, environmental effects, labour standards, and animal welfare, all associations agreed it is the government's role to regulate these areas. However, in the area of quality, consumers slightly favour industry self-regulation or private-public partnerships. Integrating government regulations and industry monitoring through quality management systems is a significant step. If consumers are willing to allow partial private sector regulation, private voluntary standard schemes for the food sector could encourage government and industry collaboration, avoiding task duplication and clarifying responsibilities[57].

Retailers serve as gatekeepers to shelf space for foods, deciding what is available to consumers, and they also manage and guarantee food attributes in the distribution process[49,50]. In many industrialised countries, food retailing has become highly concentrated. In Europe, retailer concentration averaged over 50% in 2000, with

[46] NPR, 2014. In Europe, Ugly Sells in the Produce Aisle. [online] Available at: http://www.npr.org/sections/thesalt/2014/12/09/369613561/in-europe-ugly-sells-in-theproduce-aisle. [Accessed 19 December 2016).

[47] Fulponi, Linda. (2007). *The globalization of private standards and the agri-food system*. Global Supply Chains, Standards, and the Poor. 10.1079/9781845931858.0005.

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[49] Dobson, P. and Waterson, M. (1999) *Retailer power: recent developments and policy implications*. Economic Policy 28, 134–164.

[50] Grievink, J.-W. (2003) *The changing face of the global food supply chain*. http://webdomino1.oecd.org/comnet/agr/foodeco.nsf/viewHtml/index/$FILE/GrievinkAb.pdf

some countries nearing 80%. Even in emerging economies like Chile, Argentina, and Brazil, supermarket concentration exceeds 50% and continues to rise[51,52].

Increased market size brings substantial selling power and buying power, enabling retailers to impose product requirements and standards on suppliers. This power has grown with the consolidation of procurement procedures through buyer associations, which often collaborate on price information and act as single purchasing units, especially for private label products[61]. These associations can negotiate concessions, reducing consumer prices and increasing market share. ***Asymmetric market power allows retailers to impose specific requirements on small and medium suppliers without bearing ownership risk***. Retailers can dictate sale conditions and product attributes, often leading suppliers to subcontract production, creating a hierarchy that must follow retailer requirements. Private standards help govern these firm hierarchies along the food chain.

Private standards are becoming global tools for governing the food chain, as leading retailers source products worldwide[53]. These standards can spread to non-lead retailers in both developed and developing countries, though compliance is often less strict in the latter. Harmonising private standards among leading retailers and manufacturers could create a global food standards system, potentially determining who produces what, where, and when[63,54,55,56].

However, logistical support, including information flows, planning, record keeping, transportation, and storage systems, is needed to make these standards operative and efficient. This has led to a proliferation of audit and certification systems necessary for conformity assessment. In global sourcing, innovation and technological advances in supply logistics, standards implementation, and audit/certification systems have raised entry requirements for lead retailer supply chains. The increased use of private standards, combined with stringent management and strategic requirements of value chains, is transforming the agri-food system, making it more dependent on capital, technology, and management skills. As standards shift from product to process perspectives, these elements become even more crucial[57].

Retail sector bargaining power, along with innovations in information systems, tracking and tracing systems, transportation, cold chain, and storage operations, has introduced new ways of monitoring food from farm to fork and new marketing and distribution systems. For instance, Wal-Mart's computerised information and logistics systems have been adopted by retail groups globally. Inventory management approaches like Just in Time and Efficient Consumer Response place additional demands on producers but also stimulate

[51] Dobson, P. (2003) *Buyer power in food retailing: the European experience.* http://webdomino1.oecd.org/comnet/agr/foodeco.nsf/viewHtml/index/$FILE/DobsonPaper.pdf

[52] Reardon, T. and Timmer, C.P. (2007) *Transformation of markets for agricultural output in developing countries since 1950: how have things changed?* In: Evenson, R., Pingali, P. and Schultz, T.P. (eds) Handbook of Agricultural Economics: Agricultural Development, Vol. 3, Elsevier, Holland (In press).

[53] Humphrey, J. and Schmitz, H. (2001) Governance in global value chains. IDS Bulletin 32 (3), http://www.globalvaluechains.org/publications/HumphreyScmitz.pdf

[54] Reardon, T. and Berdegué, J.A. (2002) *The rapid rise of supermarkets in Latin America: challenges and opportunities for development*. Development Policy Review 20, 317–334.

[55] Reardon, T. and Farina, E.M.M.Q. (2002) *The rise of private food quality and safety standards: illustrations from Brazil*. International Food and Agricultural Management Review 4, 413–431.

[56] Reardon, T. and Timmer, C.P. (2007) *Transformation of markets for agricultural output in developing countries since 1950: how have things changed?* In: Evenson, R., Pingali, P. and Schultz, T.P. (eds) Handbook of Agricultural Economics: Agricultural Development, Vol. 3, Elsevier, Holland (In press).

[57] Fulponi, Linda. (2007*). The globalization of private standards and the agri-food system. Global Supply Chains, Standards, and the Poor*. 10.1079/9781845931858.0005.

technological innovation and provide financial incentives to manage product flows, quality, and safety more precisely. These new business practices have increased competition in retailing and enhanced communication and interaction among leading firms to address essential issues like food safety. However, these developments in leading retailer environments do not characterise all food distribution systems. Recent research indicates that in emerging economies like Brazil and mature markets like the USA, both core or lead retailers and medium-scale fringe retailers can coexist [58,59].

Suppliers to niche markets are not held to the same standards as those serving core supermarkets. Even leading firms often adapt standards schemes to local environments due to inadequate suppliers and consumer purchasing power. While core standards are likely to spread to other retailers over time, there is still room for those needing time to upgrade. These fringe markets provide access for a wider set of producers, both domestically and internationally, which should be reconsidered within a development-oriented framework[60].

3.1.1 Categories of private marketing standards

The categorisation of private standards in process and product specifications is significant, in order to understand and distinguish the ones that have greater impact on food waste, and the ones that should probably be reevaluated.

Process specifications standards aim to regulate and standardise the way that food is produced, handled and managed, thus ensuring that the food production processes meet certain criteria, which may include food safety, environmental, social and animal welfare considerations. These standards are also set by private organisations, such as food retailers, processors, or producers, and are adopted by entities that are directly engaged with the issuing organisation. It is important to note that the reach of these standards can be international, as many retailers and food organisations operate globally, which requires the implementation of these standards along their international supply chains. While these standards initially focused mainly on food safety (e.g. the British Retail Consortium (BRC), Global Standard for Food Safety and International Food Standards (IFS)), their focus has since shifted to include environmental protection (e.g. Rainforest Alliance), ethical trading (e.g. FLO standard), animal welfare (e.g. Freedom Food), organic production methods (e.g. IFOAM), and so on[61].

Product specifications standards on the other hand, are concerned with the characteristics and attributes of the final food product. They aim to ensure that food products meet specific quality, safety and nutritional criteria. By implementing these standards, food producers, processors and retailers achieve the same level of quality and uniformity of their food products, thus increasing the consumers' trust in their brand and products. In addition to these criteria, private organisations tend to impose aesthetic or cosmetic requirements on food products, which mainly refer to their appearance. It is important to note that these specifications do not affect the quality and safety of the food products, but only the appearance of the product. For example, these

[58] Chen, A. (2003) *Dominant retailers and the countervailing–power hypothesis*. RAND Journal of Economics. 34, 612–625.
[59] Farina, E.M.M.Q., Nunes, R. and Monteiro, G.A.F. (2004) *Rapid rise of supermarkets and the use of standards in their food product procurement systems in developing countries*. Department of Economics, University of San Paolo, Brazil.
[60] Fulponi, Linda. (2007). *The globalization of private standards and the agri-food system*. Global Supply Chains, Standards, and the Poor. 10.1079/9781845931858.0005.
[61] Spencer Henson & John Humphrey (2010) *Understanding the Complexities of Private Standards in Global Agri-Food Chains as They Impact Developing Countries, The Journal of Development Studies*, 46:9, 1628-1646, DOI:10.1080/00220381003706494

specifications include the calibre (mass & size), colouring, shape and curvature, etc. of a food product [62]. Interviews with producers that supply the supermarket Lidl have shown that the indications regarding product

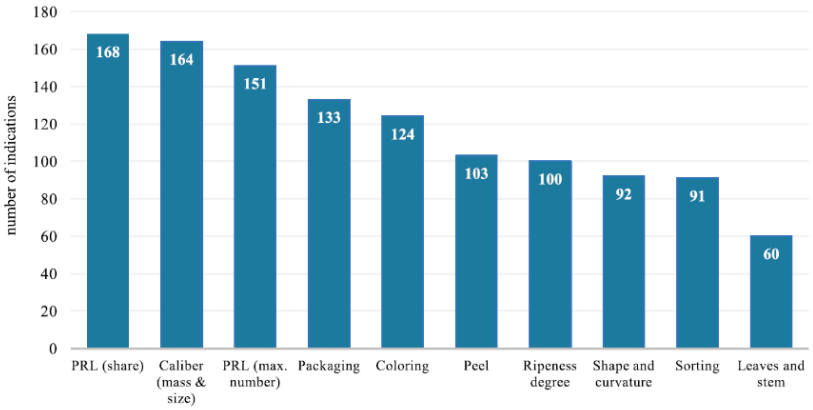

Figure 1. Number of indications about which product requirements the retailer imposes on the respective crop (across all crops supplied to Lidl)

requirements set by retailers reach up to 168 across all crops that are supplied to the supermarket. In Figure 1[63], the number of indications of quality and cosmetic specification set by the retailer are presented. Despite the quality characteristics, concerning the Pesticide Residue Limit (PRL), the indications include specifications about the aesthetic characteristics of the food products, such as colouring and size.

The implementation and compliance with the cosmetic standards result in the rejection of a significant amount of food products that contribute to food waste problem. The fact that product standards evaluate edible food as worthless due to its appearance is worrying, given the fact that food security is a significant issue in modern society [64,65].

3.1.2 Types of private marketing standards

Within the area of private standards, ***three types can be distinguished: Individual firm standards, Collective national standards and Collective international standards***. The first category refers to standards set by individual firms, mostly retailers, and are implemented along their supply chain. These standards are usually communicated to consumers through the labelling of the firm's own products. The second category derives from collective organisations, such as industry associations and NGOs, that operate within the boundaries of the same country, aiming to represent the interests of commercial entities (e.g. retailers, producers, processors etc.) or social and environmental groups. Finally, international collective organisations, such as retailers or producer associations, may set standards that are implemented globally. In table 1, examples of private standards along the food supply chain are presented.

[62] Ronja Herzberg, Anika Trebbin, Felicitas Schneider(2023), *Product specifications and business practices as food loss drivers – A case study of a retailer's upstream fruit and vegetable supply chains*, Journal of Cleaner Production, 417, https://doi.org/10.1016/j.jclepro.2023.137940.

[63] Ronja Herzberg, Anika Trebbin, Felicitas Schneider(2023), Product specifications and business practices as food loss drivers – A case study of a retailer's upstream fruit and vegetable supply chains, Journal of Cleaner Production, 417, https://doi.org/10.1016/j.jclepro.2023.137940

[64] Arnold, N and Loconto, A. 2021. *Serving Magically Perfect Fruit Globally: Local Nesting in Translating Multiple Standards*. Organisation Studies, 42(2): 327–49. DOI: https://doi.org/10.1177/0170840620935858

[65] Johnson, LK. 2020. Produce Loss and Waste in Agricultural Production. In: Routledge Handbook of Food Waste, 81–92. Routledge. DOI: https://doi.org/10.4324/9780429462795-8

Table 2:Examples of private standards in food supply chain[66]

Individual Firm Standards	*Collective National Standards*	*Collective International Standards*
• Nature's Choice/Nurture (Tesco) • Filieres Qualite´ (Carrefour) • Field-to-Fork(Marks & Spencer) • Shared Planet (Starbucks)	• Assured Food Standards • Freedom Food • Qualitat und Sicherheit (QS)	• GlobalGAP • British Retail Consortium Global Standard • International Food Standard • Safe Quality Food (SQF) 1000/2000 • Marine Stewardship Council • Forest Stewardship Council • Rainforest Alliance • SA 8000 • IFOAM standard

3.2 Interaction and interrelationship of private and public marketing standards

In the literature, little attention is paid to the fundamental characteristics of private standards within food markets, and how these characteristics differentiate private standards from both public regulations and other forms of market coordination. The terms private standards and voluntary standards are often used interchangeably. Private standards collectively developed by actors in the private sector are commonly referred to as private voluntary standards[67], implying a comparison between the actions of public authorities, which are enforced by legal measures[68,69], and the domain of voluntary standards, primarily governed by non-governmental entities. However, in practice, this distinction is not always clear, as governments have the authority to establish standards that allow for voluntary compliance, or conversely, they may mandate additional measures to private standards. This leads to four possible combinations of public/private and mandatory/voluntary schemes[70]:

- ***Public, mandatory standards:*** more accurately termed 'regulations'.
- ***Public voluntary standards:*** standards that are created by public bodies but whose adoption is voluntary.

[66] Spencer Henson & John Humphrey (2010) *Understanding the Complexities of Private Standards in Global Agri-Food Chains as They Impact Developing Countries, The Journal of Development Studies*, 46:9, 1628-1646, DOI:10.1080/00220381003706494
[67] OECD (2004) *Private Standards and the Shaping of the Agri-Food System*. OECD, Paris
[68] Black, J. (2002) *Critical Reflections on Regulation*, London: Centre for Analysis of Risk and Regulation, London School of Economics and Political Science
[69] Havinga, T. (2006) *Private Regulation of Food Safety by Supermarkets.*, Law and Policy 28.4: 515-533
[70] Henson, S. & Humphrey (2014) *Understanding the Complexities of Private Standards in Global Agri-Food Chains as They Impact Developing Countries*. The Journal of Development Studies, 46, 1628-1646, DOI:10.1080/00220381003706494

- ***Legally mandated private standards:*** standards developed by the private sector which are then made mandatory by public bodies.
- ***Voluntary private standards:*** standards developed and adopted by private bodies.

EU marketing standards contain several minimum quality standards (MQS) regarding product specifications. ***Through the imposition of MQS it is ensured that the food products consumed in EU are safe*** and above the minimum quality specifications. The imposing of MQS affects significantly the implementation and operation of private standards. European retailers have chosen to follow two general strategies on how they meet the criteria of public standards. **The first strategy includes the increase of the quality of products above the MQS through the implementation of private standards.** By supplying the market with food products above the MQS, retailers ensure that these products are safe and avoid any negative food safety issue that may occur, which could possibly damage their reputation and brand identity. **The second strategy involves the choice of the retailer to offer a product with higher quality than the MQS, in order to introduce a premium private label product (PPL).** The introduction of a PPL product to the market aims to differentiate this product from the more generic products, sold by other retailers. The level of product differentiation is dependent on the competition of retailers in a specific food product category. In general, a low MQS is translated to low cost of differentiating, as the exceedance of this limit is easier, and on the other hand a high MQS provides less incentive for a retailer to pursue product differentiation due to higher costs. Both strategies suggest that a lower level of MQS, such as reduced quality grades in marketing standards, motivates firms to adopt private standards. This motivation derives either from ensuring the reputation of a brand or productor from establishing a private standard to differentiate their products from competitors through a private product label (PPL). Nevertheless, in food markets that lack the presence of MQS, the private standards may emerge to address market failures related to asymmetric information, meaning that, without public MQS, firms will be incentivised to implement private standards because the benefits are more substantial[71].

Public and private marketing standards are often substituting or complementing each other, suggesting that a strategic interaction is taking place between EU and private standards which may often shape the implementation of reforms in EU and national regulatory framework regarding food standards[72]. Both types of standards consist of sets of rules that aim to ensure product and production process quality, while providing customers with optimal food products. Despite that, they exhibit differences in the four following aspects: source, scope, objective and nature, which are compiled and presented in table 2.

Table 3: Differences in aspects between Public and private marketing standards[73]

Aspect	EU marketing standards	Private standards
Source	Legislation	Contractual arrangements

[71] Nes, K. and Ciaian, P., *Marketing standards for food products: A review of literature*, EUR 30904 EN, Publications Office of the European Union, Luxembourg, 2021, ISBN 978-92-76-44466-4, doi:10.2760/991707, JRC126936.

[72] EU Commission (2020, a). *Evaluation of marketing standards (contained in the CMO Regulation, the 'Breakfast Directives' and CMO secondary legislation).* Commission Staff Working Document SWD(2020) 230 final available at https://ec.europa.eu/info/food-farming-fisheries/key-policies/common-agricultural-policy/cmef/products-and-markets/cmo-regulation-breakfast-directives_en

[73] Russo, C., Sansone, M., Colamatteo, A., Pagnanelli, M.A., Twum, E.K., *Benefits and costs of EU marketing standards for agri-food products: Workshop Report*, Russo, C., ed., Publications Office of the European Union, Luxembourg, 2022, ISBN 978-92-76-46704-5, doi:10.2760/635080, JRC128162.

Aspect	EU marketing standards	Private standards
Nature	Mandatory, although they may include voluntary optional terms	Voluntary, although they may be imposed to suppliers
Scope	General (all firms and consumers)	Limited to contractual parties
Objectives	Maximising social welfare	Maximising profits of one or more contractual parties

The aim of public standards is to maximise the social welfare and ensure the provision of healthy and safe food products and are usually issued in order to regulate market operation and resolve any market failure, e.g. asymmetric information[74]. The establishment and enforcement of these standards take place at the responsibility of national governments, public institutions, regional blocks or international institutions. On the other hand, private standards aim to protect and reinforce the reputation of a firm, increase competitiveness, ensure product quality, and complement mandatory public standards. The majority of private standards is not mandatory, however they are usually enforced through contractual agreements, while they can be *de facto* mandatory if a majority of the market adopts a standard as a requirement [75,76]. For example, Walmart has issued various standards regarding supply chain management with the aim to enhance the efficiency and smooth operation of its supply chain, with which all of its suppliers must comply to secure their collaboration with the retail company[77].

Considering the above, it becomes obvious that the presence of both public and private standards is essential, as they are not perfect substitutes, but usually operate as complementary to each other. It is indicated that voluntary standards, including private standards, may develop when public standards are relatively inefficient at meeting consumer preferences, which could occur if these standards are poorly designed or fail to adapt to changing consumer tastes. Another potential reason for the relative inefficiency of public standards compared to private ones may come up from differences in scope. Public standards have a broad scope, applying uniformly to all

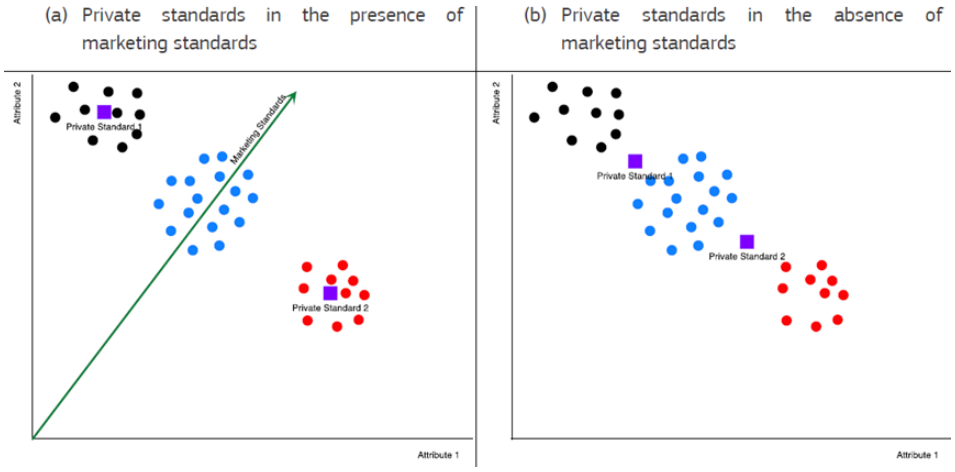

Figure 2. Private and public marketing standards

[74] Hobbs, J. E. (2010). *Public and private standards for food safety and quality: international trade implications*. Estey Journal of International Law and Trade Policy, 11(1753-2016-141207), 136-152.
[75] Henson, S. 2006. *The Role of Public and Private Standards in Regulating International Food Markets*. IATRC Summer Symposium, Food Regulation and Trade: Institutional Framework, Concepts of Analysis and Empirical Evidence. Bonn, Germany, May.
[76] Henson, S., and T. Reardon. 2005. *Private agri-food standards: Implications for food policy and the agri-food system*. Food Policy 30(3): 241-253.
[77] Tesco. 2010. *Tesco Nature's Choice*. http://www.tescofarming.com/tnc.asp (accessed February 3, 2010).

firms and presenting the same grading system to all consumers. In contrast, private standards can have a more limited scope, targeting specific consumer groups whose preferences are not adequately addressed by existing standards[78].

An example of the interaction of public and private standards is presented in Figure 2. The preferences of three consumer groups regarding a specific food product are provided (black, blue and red dots in the above figure). Due to their general scope, public standards have to consider the preferences of all consumers, therefore they are not able to meet the expectations of every consumer group (figure 2a). In this case, private standards (purple dots) emerge in order to represent the expectations of consumers in the two other groups, as due to their limited scope are more efficient in meeting different and more specific consumer needs. On the other hand, during the absence of public standards in the market (figure 2b), private standards will emerge, although in this case they have to consider also the expectations of the three consumer groups, resulting in less efficiency with meeting in total the needs of every group. Through this figure, it becomes clear that the existence of private standards in food market do not imply that public standards are unnecessary, but they usually complement each other. In addition, the existence of private standards is not enough to argue that public marketing standards are ill-designed, meaning that they do not respond efficiently to consumers' expectations. In general, private standards may emerge even in areas where public standards are not ill-designed[79].

3.3 Current status of private marketing standards and relation to food waste

As already mentioned, cosmetic standards that are imposed by private actors in food supply chain may result in the rejection of perfectly edible food, due to specifications that are mainly based on visual appearance: size, colour, shape, absence of defects, etc., therefore having significant effect on food waste. Food loss and waste (FLW) refers to a decrease, at all stages of the food chain from harvest to consumption in mass, of food that was originally intended for human consumption, regardless of the cause. It refers to any food, even the inedible parts of food, which is removed from food supply chain to be recovered or disposed**. In EU, only the term food waste is acknowledged and refers to the loss of food from the production stage up to and including consumption stages**[80].

Private marketing standards are imposed along the food supply chain, therefore are particularly relevant to the generation of food waste in every stage of the chain. Although it is assumed that cosmetic standards have great impact on food waste on the retail sector, they actually have a possible stronger impact on previous stages in the supply chain, such as the production stage[81].

[78] Nes, K. and Ciaian, P., *Marketing standards for food products: A review of literature*, EUR 30904 EN, Publications Office of the European Union, Luxembourg, 2021, ISBN 978-92-76-44466-4, doi:10.2760/991707, JRC126936.

[79] Russo, C., Sansone, M., Colamatteo, A., Pagnanelli, M.A., Twum, E.K., *Benefits and costs of EU marketing standards for agri-food products: Workshop Report*, Russo, C., ed., Publications Office of the European Union, Luxembourg, 2022, ISBN 978-92-76-46704-5, doi:10.2760/635080, JRC128162.

[80] Ronja Herzberg, Anika Trebbin, Felicitas Schneider(2023), *Product specifications and business practices as food loss drivers – A case study of a retailer's upstream fruit and vegetable supply chains*, Journal of Cleaner Production, 417, https://doi.org/10.1016/j.jclepro.2023.137940.

[81] Teuber, R., & Jensen, J. D. (2016). *Food losses and food waste: extent, underlying drivers and impact assessment of prevention approaches*. Department of Food and Resource Economics, University of Copenhagen. IFRO Report No. 254

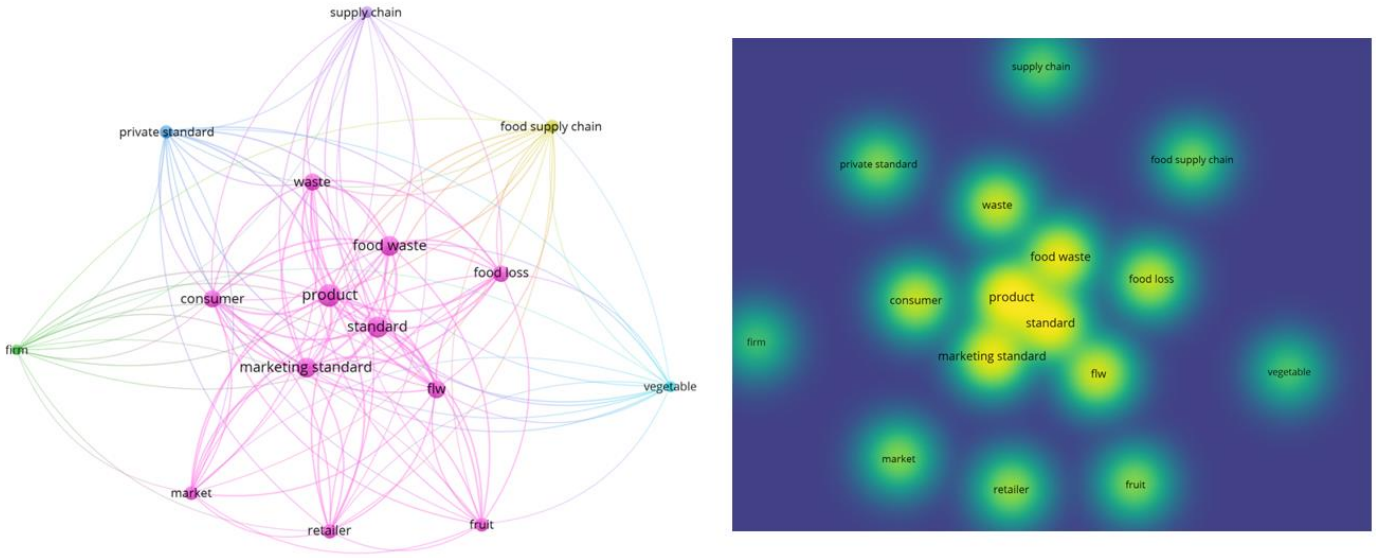

Figure 3.Network analysis in the framework of ROSETTA project, figures extracted by VOSVIEWER

The two figures above, which were extracted by VOSVIEWER[82], which based on the literature review conducted, showcase how closely linked food standards are to food waste within the supply chain. In the network graph a clustering around concepts such as "food waste," "marketing standard," and "product" is observed. The high connection between these terms suggests that marketing standards, are central to discussions on food waste within the literature. The presence of closely linked nodes like "consumer," "retailer," and "vegetable" further indicates that marketing standards have a wide impact across various stages of the food supply chain, from production to retail and consumer levels. The heatmap adds another layer to this by showing how strong these connections are. The brighter spots in the heatmap, which represent stronger connections, confirm that terms like “product,” “standard,” “food waste,” and “food loss” are closely related. This visual clearly shows that marketing standards, which focus on things like the appearance of products, are a major cause of food waste.

Furthermore, thematic analysis of the literature (Annex 1) reveals different popular terms that can be grouped in seven major topics and leading to the following observations:[83]

[82] https://www.vosviewer.com/

[83] The detailed methodology and the results of thematic analysis are outlined in **Annex I**

- ***Cosmetic standards and waste:*** Topics 2 and 3 highlight how cosmetic standards imposed by various authorities (e.g., retailers, national or international bodies) are leading to waste, particularly for fruits and vegetables. These findings suggest a direct link between strict aesthetic standards and food waste.
- ***Certification and governance:*** Topics 5 and 7 focus on the role of certification and governance in influencing the application of marketing standards. This could illustrate how private certification schemes (e.g., Fairtrade) interplay with national and EU standards, potentially influencing food waste reduction strategies.

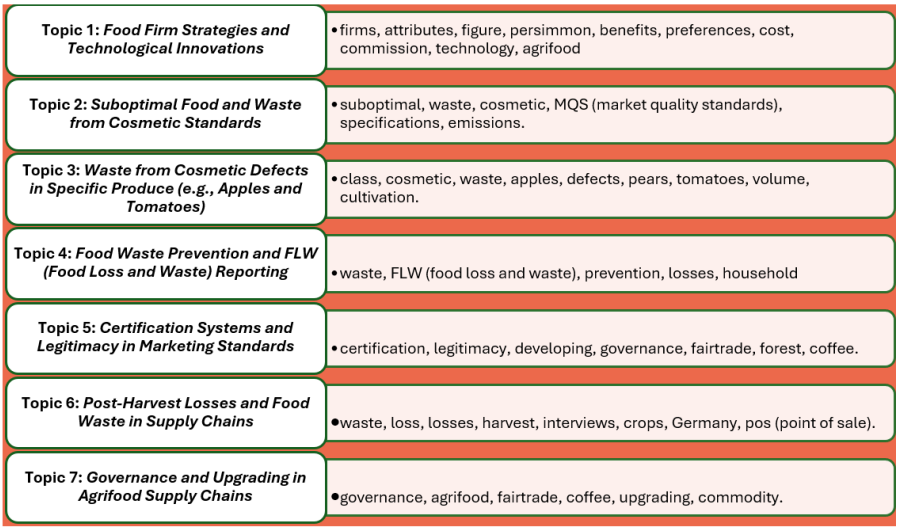

Figure 4. Identified topics from the ROSETTA thematic analysis and top terms under each topic

- ***Supply chain and post-harvest losses:*** Topic 6 discusses the role of post-harvest losses and inefficiencies in the supply chain. This could also address how private standards (or their lack) contribute to these inefficiencies, particularly in developing economies or specific supply chains.
- ***Prevention and reporting:*** Topic 4 brings in the idea of food waste prevention strategies and reporting mechanisms, which are essential in understanding how standards can be reformed to mitigate waste at different levels, including at the consumer level (household waste).

The literature review clearly demonstrates the strong connections between food waste and private marketing standards. To further understand this relationship ***a more detailed view on the impact of marketing standards on food waste will follow, focusing on every stage of the food supply chain.***

3.3.1 Primary production

Many studies have identified aesthetic imperfections as a driver for food waste in primary production, due to the disposal of goods that are not in line with minimum quality standards, shape, colour, size etc[84]. Cosmetic standards, which are usually set by retailers, have been criticised as a major cause for the generation of food waste in the stage of primary production. Reports have identified these standards as the main cause of food waste for vegetables in Germany and potatoes in Scotland[85,86]. Although food waste due to marketing

[84] Segrè, A., Falasconi, L., Politano, A. & Vittuari, M. (2014). *Background paper on the economics of food loss and waste (unedited working paper). Rome: FAO*. Online available at http://www.fao.org/filead-min/user_upload/save-food/PDF/WorkingPaper/Background_Paper_2014.pdf (accessed 10/10/2015).

[85] Göbel, C., Langen, N., Blumenthal, A., Teitscheid, P., Ritter, G., 2015. *Cutting food waste through cooperation along the food supply chain.* Sustainability 7 (2), 1429–1445. http://dx.doi.org/10.3390/su7021429.

[86] Krzynowek, L., Hawkins, J., 2015. *Potato Waste Mapping for the Bioenergy Potential from Waste Potatoes Project*. Scottish Biofuel Programme, Napier University, Edinburgh.

standards has not been widely calculated and reported, in some cases there are evidence which suggest that 40% of harvested produce can be lost from the food supply chain, on this stage alone[87,88]. Moreover, reports from Germany and Netherlands argue that the typical level of food waste due to cosmetic aspects is around 20%[89], while in Spain 16% of persimmon quantity is discarded due to cosmetic standards and is not even paid to primary producers[90].

Reports that conducted interviews with fruit and vegetables producers revealed the assessment from the suppliers' point of view on how likely is that cosmetic requirements may lead to food waste. Figure 5 presents the suppliers' grading of the likeliness of food waste due to cosmetic standards from 1 (unlikely) to 5 (very likely) among various crops, indicating that these standards have a greater impact on some crops (mandarins, carrots, tomatoes) compared to others (avocados, cucumbers), and therefore these crops are more likely to have significant contribution in food waste. For example, carrots and tomatoes are more likely to be thrown away due to not meeting the calibre specifications, in contrast with grapes that usually do not result in food waste. Moreover, these interviews revealed that the transmission of requirements along the supply chain is a major issue that may have a significant impact on food waste as well. Almost 20% of the respondent producers stated that they receive the requirements through an informal verbal way only[91]. In addition to that, the implementation of several marketing practices has great contribution to food waste, as shown in Figure 5. Marketing practices like restrictions in alternative marketing channels, or short-term changes in product requirements are likely to result in the generation of food waste.

[87] Bloom, J., 2011. *American Wasteland: How America Throws Away Nearly Half of its Food (And what We Can Do about it)*. Da Capo Press.

[88] Davis, J., Wallman, M., Sund, V., Emanuelsson, A., Cederberg, C., Sonesson, U., 2011. *Emissions of Greenhouse Gases from Production of Horticultural Products - Analysis of 17 Products Cultivated in Sweden, Emissions of Greenhouse Gases from Production of Horticultural Products*. SIK, Gothenberg, Sweden.

[89] de Hooge, I.E., Van Dulm, E., Van Trijp, H.C.M., 2018. *Cosmetic specifications in the food waste issue: supply chain considerations and practices concerning suboptimal food products*. J. Clean. Prod. 183, 698e709. https://doi.org/10.1016/j.jclepro.2018.02.132

[90] Fernandez-Zamudio, M.-A.; Barco, H.; Schneider, F. *Direct Measurement of Mass and Economic Harvest and Post-Harvest Losses in Spanish Persimmon Primary Production*. Agriculture 2020, 10, 581.

[91] Ronja Herzberg, Anika Trebbin, Felicitas Schneider (2023), *Product specifications and business practices as food loss drivers – A case study of a retailer's upstream fruit and vegetable supply chains*, Journal of Cleaner Production, 417, https://doi.org/10.1016/j.jclepro.2023.137940.

	Apples	Avocados	Cauliflower	Iceberg lettuce	Strawberries	Cucumbers	Mandarins	Carrots	Bell peppers	Peaches/ Nectarines	Tomatoes	Grapes
Shape and curvature	1.7	1.3	1.8	1.7	1.8	1.5	2.1	2.9	2.1	1.9	2.9	1.1
Colouring	1.9	1.5	1.9	1.6	1.8	1.8	2.6	1.9	2.3	1.5	2.9	1.6
Calibre (mass and size)	2.1	1.5	2.3	2.3	1.8	1.5	2.9	3.5	2.5	2.1	3.4	1.5
Peel	1.9	1.8	1.0	1.7	2.0	1.5	3.0	2.2	2.4	2.1	2.5	1.5
Leaves and stem	1.8	1.3	1.3	2.0	1.5	1.5	2.4	1.6	2.1	1.2	2.4	1.3
Ripeness degree	2.0	2.0	1.0	1.4	2.2	1.5	2.4	1.3	2.1	1.3	2.7	2.1
Pesticide residue limit (share)	2.3	1.3	1.4	1.9	2.3	1.8	3.4	1.9	2.6	1.5	2.3	2.4
Pesticide residue limit (max. number)	2.3	1.3	1.5	1.9	2.3	1.8	3.2	2.0	2.9	1.5	2.3	2.4
Packaging	2.3	1.5	1.0	1.6	1.5	1.5	2.0	1.2	1.9	1.3	2.2	1.5
Sorting	2.0	1.3	1.8	2.1	1.9	1.5	2.4	3.3	1.9	1.4	2.4	1.8
Restrictions in alternative marketing channels	1.7	1.3	1.9	2.0	2.1	2.0	2.8	2.5	2.3	1.4	2.4	1.6
Short notice of the actual quantities to be delivered	2.0	1.0	1.5	2.1	2.0	2.5	2.7	2.2	2.2	1.6	3.1	1.4
Short-term changes in product requirements on the part of the retailer	1.7	1.5	1.3	1.5	2.1	2.5	2.3	2.0	1.9	1.3	2.3	1.4
Inconsistencies in calculation between annual planning and called quantities	2.0	1.5	2.0	2.2	2.0	2.8	2.4	2.8	1.9	1.7	3.0	1.5
Return of goods as a result of a complaint	2.0	2.0	2.0	2.1	2.7	2.8	3.1	1.9	2.5	1.7	2.4	2.4
Promotions insufficiently coordinated with production peaks	1.7	1.3	2.8	2.5	2.1	2.8	2.9	2.9	2.7	1.8	2.9	1.8
Insufficient communication between supply chain actors	1.7	1.0	1.8	1.8	1.9	2.8	2.7	2.6	2.3	1.3	2.6	1.4

Figure 5: Mean values of the likeliness of certain requirements or marketing practices to lead to food waste

3.3.2 Wholesalers and processing industry

The wholesaling and processing stage of the food supply chain have also been identified as stages that marketing standards have great impact on food waste[92]. A study on the losses of potatoes at the wholesale and processing stage of the supply chain in Switzerland revealed that for the production of chips a specific potato size is required, therefore the potatoes that have different size are not used and are discarded. Consequently, if a wholesaler trades only in potatoes for the chips industry, the generation of food waste is very high due to the fact that wrongly sized potatoes have to be sorted out. Depending on the products that each company produces, the range of losses among these firms was found to be between 9% and 35%[93].

3.3.3 Retail sector

Marketing standards are cited as a significant factor contributing to food loss and waste (FLW) at the retail level. The prevailing view on the retail sector is that consumers infer freshness from aesthetic perfection, therefore they will avoid purchasing oddly shaped food. Additionally, consumers may choose supermarkets

[92] Teuber, R., & Jensen, J. D. (2016). *Food losses and food waste: extent, underlying drivers and impact assessment of prevention approaches*. Department of Food and Resource Economics, University of Copenhagen. IFRO Report No. 254

[93] Christian W., Gabriele M., Patrik M., Andreas K., Michael S. (2015), *Quantity and quality of food losses along the Swiss potato supply chain: Stepwise investigation and the influence of quality standards on losses*, Waste Management, 46,2015, 120-132

based on the visual appeal of the food products offered, meaning that supermarkets aim to present products with the optimal appearance on their shelves[94,95].

In the vegetable product sector, the primary causes of food waste have been identified as marketing standards set by retailers, along with specific product requirements. This has been similarly observed in Nordic countries by Stenmarck[96], and in industrialised nations generally by Gustavsson[97]. Retailers strive to meet stringent quality standards by presenting products in a manner they believe appeals to consumers. As a result, consumers receive food items that conform to expected appearances, weights, sizes, and shapes, leading farmers to discard large portions of their crops instead of selling them to retailers[104]. Additionally, standardised packaging increases food waste in the vegetable sector. Expert interviews within the vegetable supply chain reveal that direct marketing of vegetables results in less waste compared to other distribution methods. This is because direct marketing reduces the number of intermediaries between growers and consumers, leading to fewer quality checks, fewer quality restrictions, and less transportation that could potentially damage the food[98].

Furthermore, interviews conducted by Göbel[105] highlighted that varying market conditions lead to different standards. When supply is abundant, even products with minor defects are rejected based on these standards. However, during periods of limited supply, products that would typically be deemed unacceptable are often accepted. Additionally, the food industry now demands higher product specifications than in the past, such as specific fat content levels in meat, as indicated from the interviews conducted within the retail sector.

Despite being one of the main drivers for food waste, interviews with suppliers of Lidl have revealed that the product requirements set by the German retailer cannot be viewed as strictly established criteria, but rather as implicit knowledge, meaning that the issue of impact of product requirements on food waste is very elusive and cannot easily be tracked down. This issue, combined with a lack of coordination and information sharing across the supply chain, complicates efforts to address the problem. The same study sought to quantify the proportion of fruits and vegetables that fail to meet product requirements, finding that 15% of total production does not meet retailer specifications and never reaches supermarket shelves. Moreover, the same study highlighted the fact that most of the non-compliant food products are not even harvested, as it does not make economic sense to harvest products that are not going to be sold for a reasonable price[99].

Date labelling is another challenge in this context, and while it is legal to sell products after the "best-before" date in most EU countries, there are no clear guidelines on how to manage such products. Consequently, many

[94] Canali, M. et al., (2014). *Drivers of current food waste generation, threats of future increase and opportunities for reduction. Report from FUSIONS*.
[95] Priefer, C., Jörissen, J. & Bräutigam, K.-R. (2013). Technology options for feeding 10 billion people. Options for Cutting Food Waste.
[96] Stenmarck, A.; Hanssen, O.J.; Silvennoinen, K.; Katajajuuri, J.M.; Werge, M. *Initiatives on Prevention of Food Waste in the Retail and Wholesale Trades*; Swedish Environmental Research Institute: Stockholm, Sweden, 2011.
[97] Gustavsson, J.; Cederberg, C.; Sonesson, U.; van Otterdijk, R.; Meybeck, A. *Global Food Losses and Food Waste. Extent, Causes and Prevention*. Study Conducted for the International Save Food Congress at Interpack 2011, Düsseldorf, Germany; Food and Agricultural Organisation of the United Nations: Rome, Italy, 2011.
[98] Göbel, Christine & Langen, Nina & Blumenthal, Antonia & Teitscheid, Petra & Ritter, Guido. (2015). *Cutting Food Waste through Cooperation along the Food Supply Chain*. Sustainability. 7. 1429-1445. 10.3390/su7021429.
[99] Ronja Herzberg, Anika Trebbin, Felicitas Schneider (2023), *Product specifications and business practices as food loss drivers – A case study of a retailer's upstream fruit and vegetable supply chains*, Journal of Cleaner Production, 417, https://doi.org/10.1016/j.jclepro.2023.137940.

retailers opt not to sell these items due to concerns over product liability and reputation, despite the fact that the food may still be perfectly safe to eat[100].

It must be stressed that marketing and aesthetic standards set by retailers actually have a stronger impact on previous stages in the supply chain (especially primary production) since the production of food products is determined from these standards, meaning that those that do not comply with them do not even reach the retail level[101].

3.3.4 Consumers

The implementation of private marketing standards has a great impact on food waste on households and consumer level. Studies conducted in Denmark and Sweden have revealed that a major driver of food waste on this level is due to the misinterpretation of date labelling, as well as the lack of knowledge about the proper storage conditions of certain food items, such as dairy and meat[102,103].

Regarding the impact of date labels on household food waste, an in-depth study by WRAP provided valuable insights, with an online survey of 2,000 UK consumers revealing that both the "Best before" and "Use by" dates are generally well understood, with at least 70% of participants correctly interpreting them. However, the introduction of additional labels, such as "Display until" decreased the correct responses. It should also be noted that while most respondents could correctly identify the meanings of different date labels when given a list of options, this understanding did not translate to unprompted situations for the majority, indicating that there is a gap between the 'technical' understanding and the practical application of date labels in the daily life of consumers. Moreover, the results showed that the knowledge regarding date labels and storage guidance is different among people according to their age, the product group and risk aversion, revealing that younger consumers tend to rely more on date labels compared to older people. Consumers use differently the date labels among different food products, as there is much stronger orientation on date labelling about dairy or meat, than other food commodities such as cereals[104].

Gobel[105] claimed that products with small optical defects or damaged packaging are not bought by customers, therefore the food supply chain actors do not question the implementation of the product requirements standards. The above study concludes that consumers measure food quality by appearance, and good taste is secondary.

Food products that do not comply with the product specifications, but are still safe to be consumed, are referred to ‘suboptimal foods. Several organisations took initiatives are exploring possible pathways for the

[100] Canali, M. et al., (2014). *Drivers of current food waste generation, threats of future increase and opportunities for reduction. Report from FUSIONS*.

[101] Teuber, R., & Jensen, J. D. (2016). *Food losses and food waste: extent, underlying drivers and impact assessment of prevention approaches*. Department of Food and Resource Economics, University of Copenhagen. IFRO Report No. 254

[102] Danish Agriculture & Food Council (2015). *Food waste in Denmark (in Danish)*. Online available at https://www.lf.dk/Tal_og_Analyser/Analyser/Forbrug_og_detail.aspx

[103] Williams, H., Wikström, F., Otterbring, T., Löfgren, M. & Gustafsson, A. (2012). *Reasons for household food waste with special attention to packaging*. Journal of Cleaner Production, 24, 141–148. http://doi.org/10.1016/j.jclepro.2011.11.044

[104] WRAP (2011a). *Consumer insight: date labels and storage guidance*. Online available at http://www.wrap.org.uk/content/consumer-insight-date-labels-and-storage-guidance

[105] Göbel, Christine & Langen, Nina & Blumenthal, Antonia & Teitscheid, Petra & Ritter, Guido. (2015). *Cutting Food Waste through Cooperation along the Food Supply Chain*. Sustainability. 7. 1429-1445. 10.3390/su7021429.

utilization of these products through alternative marketing channels[106], while supermarket chains aim to sell them through promotion campaigns[107]. A study from de Hooge showed that consumers are generally willing to purchase and consume products that deviate in shape, have passed their best-before date, or have damaged packaging, especially if offered at a discount that reflects the imperfection. However, suboptimality can affect consumer perceptions of taste, attractiveness, and safety, even when the objective quality remains unchanged[108].

3.4 Insights from interviews along the food supply chain

To further strengthen the findings from our in-depth literature review, 50 interviews were conducted under T1.2 in the framework of the ROSETTA project with stakeholders along the food supply chain. During these interviews, dedicated questions were asked to reveal experiences regarding the imposition of private marketing standards, food waste, and the response of industry stakeholders to consumer needs. Below are the key points related to private marketing standards that were revealed. The detailed analysis and results can be found in *D1.2. Analysis of EU, international and national marketing standards.*

- For farmers, retailer-defined standards are more significant than public, emphasising visual appearance, pesticide use, cultivation methods, and traceability.
- Processors prioritise retailer and wholesaler standards, particularly those focusing on packaging and labelling requirements.
- Key reasons for complying with private standards set by partners include ensuring high product quality, enabling premium pricing, enhancing food safety, reducing waste, and supporting sustainability goals.
- Supply chain actors are influenced by customer expectations when establishing their marketing standards.
- Private standards are shaped more by partners—primarily wholesalers, distributors, and retailers—than by public standards.
- In the meat sector, private standards emphasise aspects such as animal breeding and rearing (e.g., feed type and energy use), carcass size and weight, meat cuts, fat content, and traceability.
- Private standards are typically revised in response to unusual events or significant issues (e.g. food safety issue outbreaks).
- In the dairy sector, private standards focus on hygiene, taste, milk type ratios, and residual shelf life.
- Companies monitor competitors when setting private standards, often aligning with or exceeding the stringency of competitors' standards.
- For fruits and vegetables, retailers adjust private standards seasonally, with weather being a key factor influencing revisions.

[106] Arnold, N. 2022. Standards and Waste: Valuing Food Waste in Consumer Markets. Worldwide Waste: Journal of Interdisciplinary Studies, 5(1): 2, 1–14. DOI: https://doi.org/10.5334/wwwj.84

[107] Teuber, R., & Jensen, J. D. (2016). *Food losses and food waste: extent, underlying drivers and impact assessment of prevention approaches*. Department of Food and Resource Economics, University of Copenhagen. IFRO Report No. 254

[108] de Hooge, I.E., Oostindjer, M., Aschemann-Witzel, J., Normann, A., Loose, S.M., Almli, V. L., 2017. *This apple is too ugly for me*. Food Qual. Prefer. 56, 80–92. https://doi.org/10.1016/j.foodqual.2016.09.012.

- Common retailer standards for fruits and vegetables include aesthetic criteria, freshness, packaging, presentation, and ensuring fruits arrive in perfect condition with a guaranteed shelf life.
- Supply chain actors adhere to private standards to maintain business relationships with their partners who impose these standards.
- Compliance with private standards is often verified by internal personnel, such as quality assurance employees.

3.5 Future development and challenges of marketing standards

3.5.1 Food policy and industry trends

Historically, the public sector has been responsible for setting standards for food products. Public food standards are becoming **more performance and process-based** due to closer scrutiny of the WTO and other international food quality standardisation organisations. This is leading to an **increased transparency of public regulatory processes**; however, the same level of transparency might not apply to the enforcement of private standards procedures [109].

On the other hand, private standards have historically been developed by trading organisations, and more recently by private companies and business associations[110]. They have emerged to mitigate regulatory and reputational risks faced by private food companies[111], and have evolved in response to regulatory developments and consumers concerns, thus becoming predominant drivers of the agri-food systems[112]. **Private protocols have developed rapidly and now play an increasingly important role** in the supply of higher quality food products.

Nevertheless, their evolution does not imply that public standards will disappear[113]. Private standards are assuming increasing responsibility on various aspects of food quality, while public institutions are mainly responsible for overseeing the entire food quality system and monitoring the performance of private firms[114][115].

Some public regulations have evolved in order to address **health and environmental goals**. For instance, the EU updated marketing standards of agri-food products to meet consumers' and sustainability needs. In 2023, the existing standards applicable to fruit, vegetables, fruit juices, jams, honey, poultry and eggs, i.e., the so-called '**breakfast directives'**, were modified to help consumers **make more informed and healthier choices**

[109] Smith, G. (2009). Interaction of Public and Private Standards in the Food Chain. Retrievable at: http://dx.doi.org/10.1787/221282527214
[110] European Commission (2019). Evaluation of marketing standards. Retrievable at: DATA (europa.eu)
[111] Smith, G. (2009). Interaction of Public and Private Standards in the Food Chain. Retrievable at: http://dx.doi.org/10.1787/221282527214
[112] Henson, S.J. and Hooker, N.J. (2001). Private sector management of food safety: public regulation and the role of private controls. Retrievable at: Private sector management of food safety: public regulation and the role of private controls - ScienceDirect
[113] Smith, G. (2009). Interaction of Public and Private Standards in the Food Chain. Retrievable at: http://dx.doi.org/10.1787/221282527214
[114] Henson, S.J. and Hooker, N.J. (2001). Private sector management of food safety: public regulation and the role of private controls. Retrievable at: Private sector management of food safety: public regulation and the role of private controls - ScienceDirect
[115] Henson, S. (2006). The Role of Public and Private Standards in Regulating International Food Markets. Retrievable at: Microsoft Word - IATRC Bonn 3_Spencer.doc (ipcinfo.org)

and to prevent food waste[116], while aligning with the Farm to Fork strategy and the UN's Sustainable Development Goals (SDGs)[117]. At national level, some Member States have revised their legislation to foster the development of a sustainable agri-food sector. For instance, the **Netherlands and Germany developed national guidelines on the labelling of vegetarian products** to allow consumers make more informed choices[118].

In parallel, **private standards are also increasingly aligning with sustainable goals**. This is demonstrated by various certifications, including the **Fairtrade Certification**[119], the **MSC certification**[120], the **GLOBALG.A.P.**[121], which aim to promote sustainable development, sustainable fishing and sustainable farming methods by aligning with the UN SDGs as well as national regulations.

The continuous interplay between the two different types of standards encourages them to advance and enhances the likelihood of meeting sustainability goals. In the future, both public and private standards will have to keep evolving according to **consumers' increased knowledge and demand for sustainable products** and will have to adapt to **consumers' changing preferences** overall. Moreover, they will have to provide for sufficient flexibility and follow **technological innovations** to remain effective and relevant[122].

3.5.2 Anticipating marketing standards challenges in the years ahead

Private marketing standards are **not always welcomed by all actors** of the food value chain. Private standards that proliferate in the gap areas created by public institutions are often **highly demanding** and tend to be imposed by large-scale retailers on the suppliers (farmers and processors), who face significant cost implications and struggle to comply with multiple standards imposed by retailers. For instance, in **Greece** the specifications laid down by private standards in the sector of fresh fruit and vegetables are costly and cumbersome, with retailers imposing multiple standards that might differ from those of their competitors. Private standards will thus have to harmonise with public regulations and avoid creating **unnecessary complexity or burden** for suppliers[123].

Both public and private marketing standards will also have to face the challenge related to their **negative environmental impact**. Marketing standards identify 'aesthetic' requirements that potentially cause food loss and waste (FLW), given that all safe food products that do not meet such requirements are disposed. Private

[116] European Union (2023). Regulation (EU) 2023/2429 of 17 August 2023 supplementing Regulation (EU) No 1308/2013 of the European Parliament and of the Council. Retrievable at: Delegated regulation - EU - 2023/2429 - EN - EUR-Lex (europa.eu)
[117] European Commission (2023). Commission updates marketing standards of agri-food products to better address consumer needs and sustainability. Retrievable at: IP_23_2366_EN.pdf (europa.eu)
[118] European Alliance for Plant-based Foods (2021). EAPF Position on the Revision of EU Marketing Standards. Retrievable at: EAPF-Position-on-the-EC-OPC-on-EU-Marketing-Standards.pdf (plantbasedfoodalliance.eu)
[119] Fairtrade International (2024). Monitoring the scope and benefit of Fairtrade: Overview – Monitoring Report, 15th Edition. Retrievable at: Fairtrade-monitoring-report-overview-15th-edition.pdf
[120] Marine Stewardship Council (2023). Celebrating Sustainable Seafood. The Marine Stewardship Council Annual Report 2022-23. Retrievable at: msc-annual-report-2022-2023.pdf
[121] GLOBALG.A.P. (2022). GLOBALG.A.P. Annual Report 2022. Retrievable at: Welcome 2022 – GLOBALG.A.P. Solutions (globalgapsolutions.org)
[122] European Commission (2019). Evaluation of marketing standards. Retrievable at: DATA (europa.eu)
[123] European Commission (2019). Evaluation of marketing standards. Retrievable at: DATA (europa.eu)

standards are even more demanding and thus lead to more negative consequences related to FLW than EU standards[124][125].

Date marking and other time-related requirements present on food labels might also be a potential cause of FLW. Various studies[126, 127, 128, 129] have identified a correlation between date marking and FLW, and marketing standards will have to address this issue in order to decrease the environmental impact of the food sector.

Marketing standards could play a significant role in reducing food waste by addressing inefficiencies and mismatches along the food value chain. For example, revising strict aesthetic requirements for produce can prevent the rejection of edible but visually imperfect items, reducing waste at the agricultural and retail levels. Similarly, standards encouraging better inventory management, improved logistics, and optimised production volumes can help minimise overproduction and spoilage. Aligning these standards with actual consumer needs fosters sustainable practices that cut down avoidable losses throughout the supply chain[130].

A challenge faced by private standards is related to their **voluntary nature**, which does not ensure the achievement of their objectives, given that they rely solely on the voluntary willingness of chain actors to implement such standards[131].

Public standards deal instead with the challenge of having to **meet consumers' expectations while also facilitating trading**. Consumers and business operators might indeed have conflicting preferences in terms of, for example, information on the origin of products or ingredients[132].

Both standards face challenges related to **enforcement** as well as **measuring and monitoring**, and will have to keep looking for with concrete ways for ensuring standards are properly implemented and controlled[133].

[124] Canali, M., Östergren, K., Amani, P., Aramyan, L., Sijtsema, S.J., Korhonen, O., O'Connor, C. (2014). Drivers of current food waste generation, threats of future increase and opportunities for reduction. Retrievable at: Drivers of current food waste generation, threats of future increase and opportunities for reduction — Research@WUR

[125] Vittuari, L., Politano, A., Gaiani, S., Canali, M., Elander, M. (2015). Review of EU legislation and policies with implications on food waste. Retrievable at: 549086 (wur.nl)

[126] Canali, M., Östergren, K., Amani, P., Aramyan, L., Sijtsema, S.J., Korhonen, O., O'Connor, C. (2014). Drivers of current food waste generation, threats of future increase and opportunities for reduction. Retrievable at: Drivers of current food waste generation, threats of future increase and opportunities for reduction — Research@WUR

[127] ICF (2018), Market study on date marking and other information provided on food labels and food waste prevention – Final Report. Retrievable at: Market study on date marking and other information provided on food labels and food waste prevention - Publications Office of the EU (europa.eu)

[128] Holthuysen, N., Kremer, S., Bos-Brouwers, H. (2017). The effect of date marking terminology of products with a long shelf life on the discarding behaviour of consumers. Retrievable at: Modelrapport (europa.eu)

[129] Vittuari, L., Politano, A., Gaiani, S., Canali, M., Elander, M. (2015). Review of EU legislation and policies with implications on food waste. Retrievable at: 549086 (wur.nl)

[130] Claudio Beretta, Franziska Stoessel, Urs Baier, Stefanie Hellweg, Quantifying food losses and the potential for reduction in Switzerland, Waste Management, Volume 33, Issue 3, 2013, Pages 764-773, https://doi.org/10.1016/j.wasman.2012.11.007

[131] European Commission (2019). Evaluation of marketing standards. Retrievable at: DATA (europa.eu)

[132] European Commission (2020). Commission Staff Working Document Evaluation of Marketing Standards. Retrievable at: Evaluation of marketing standards [Regulation (EU) No 1308/2013] (europa.eu)

[133] Evaluation of marketing standards. Retrievable at: DATA (europa.eu)

4. ROSETTA's food commodities

The ROSETTA project focuses on four key food commodities—**fruits and vegetables, dairy products, cereals,** and **meat**—across five pilot areas: **Ireland, Greece, Poland, Spain,** and **Denmark**. This section delves into the insights gained from each of these commodities. ROSETTA partners (FBCD, FRESHIS, CHALK, QPLAN, UNIMOS) provided an overall overview of the marketing standards in each of the ROSETTA food commodities, which consisted of: (a) Introduction, (b) Key challenges faced, (c) The most common specifications, (d) The most significant impacts on food waste, (e) indicative practical examples of private marketing standards per food commodity. Indicative lists of existing private marketing standards per food commodity can be found in Annex II.

In addition, key findings have been identified for each food commodity regarding private marketing standards that emerged from the analysis of the 50 interviews conducted as part of T1.2. ***The detailed methodology, analysis, and conclusions can be found in D1.2. Analysis of EU, international and national marketing standards.*** In particular, here we concentrate on: (a) the private standards that stakeholders may impose on their partners, their implementation, and control; (b) the reasons for the establishment; (c) the private marketing standards that their partners may impose and control; and (d) the specific private marketing standards requirements that lead to increased food waste.

4.1 Fruits and vegetables

Introduction

The evolution of private marketing standards in fruit and vegetable sector reflects broader shifts in European and global agricultural practices, emphasising quality, traceability, and environmental standards. Initially, marketing standards in the EU aimed to ensure quality control and consumer protection, and alongside these public standards, the rise of private standards—such as GlobalGAP and British Retail Consortium (BRC) certifications—has become significant. Driven largely by supermarkets and food retailers, these standards focus on safety and quality, covering elements like pesticide residues, microbial contamination, and traceability, imposing stricter requirements on growers. In Spain, producer organisations and cooperatives have used these private standards to enhance market competitiveness, but compliance often requires substantial investment, particularly challenging for smaller farms[134]. Over the years, private marketing standards have evolved significantly, and their focus has expanded from basic quality and safety parameters to include aspects such as sustainability, ethical production practices, and traceability[135]:

[134] Directorate General for Internal Policies, Agriculture and Rural Development (2011): The EU Fruit and Vegetables Sector: Overview and Post 2013 Cap Perspective. link

[135] Henson, S., & Reardon, T. (2005). "Private agri-food standards: Implications for food policy and the agri-food system." Food Policy, 30(3), 241-253.

- ***Technological Advancements:*** Advances in technology have played a crucial role in the evolution of these standards. Tools such as blockchain for traceability and precision agriculture techniques have enabled more stringent and verifiable standards.
- ***Consumer Demand:*** Increasing consumer awareness and demand for sustainable and ethically produced food have driven companies to adopt and promote higher standards. This trend has led to the development of certifications such as Fair Trade and Organic, which set additional criteria for production and marketing.
- ***Regulatory Changes:*** Regulatory bodies continue to update and refine standards in response to new scientific evidence and societal expectations. For example, the EU's Farm to Fork Strategy, launched in 2020, aims to make food systems fair, healthy, and environmentally-friendly, influencing marketing standards accordingly.

Challenges in the fruit and vegetables sector

The market for fruits and vegetables faces several restrictions that impact producers, traders, and consumers. *Key restrictions include*[136]*:*

1. **Trade Barriers**: Tariffs, quotas, and non-tariff barriers (NTBs) such as sanitary and phytosanitary (SPS) measures can limit access to international markets. These restrictions are intended to protect domestic agriculture and ensure food safety but can also pose significant obstacles for exporters.
2. **Regulatory Compliance**: Compliance with varying national and international regulations can be costly and complex. Producers and exporters must navigate different sets of rules regarding pesticide residues, labeling, and packaging, which can be particularly challenging for small-scale farmers.
3. **Logistical Challenges**: The perishable nature of fruits and vegetables requires efficient supply chains and cold storage facilities. Inadequate infrastructure and transportation can lead to significant post-harvest losses, reducing market access and profitability.

Influence of Marketing Standards

Marketing standards play a crucial role in shaping the market dynamics for fruits and vegetables. While they are essential for ensuring quality and safety, they also present challenges[137]:

1. **Quality and Safety Assurance**: Marketing standards such as those set by private certifications (e.g., GlobalGAP) ensure that fruits and vegetables meet specific quality and safety criteria. This builds consumer trust and facilitates international trade.
2. **Market Differentiation**: Standards enable producers to differentiate their products in the market. Certifications like organic or Fair Trade can attract premium prices, providing a competitive edge.
3. **Cost of Compliance**: Meeting stringent standards often involves significant investment in infrastructure, technology, and training. This can be a barrier for smallholders and producers in developing countries, limiting their market access.

[136] European Commission. "Marketing standards for fresh fruit and vegetables." European Commission, link

[137] Henson, S., & Humphrey, J. (2010). "Understanding the complexities of private standards in global agri-food chains as they impact developing countries." Journal of Development Studies, 46(9), 1628-1646.

4. **Impact on Smallholders**: Small-scale farmers may find it challenging to comply with the comprehensive requirements of private standards, leading to market exclusion or dependency on larger companies that can meet these standards.

Common specifications for fruit and vegetables products

Marketing standards for fruits and vegetables include various specifications such as size, quality, and packaging. These standards ensure product consistency, safety, and consumer satisfaction. Below are the most common specifications, along with examples and their importance [138,139,140]:

Size Specifications

Size specifications refer to the physical dimensions of fruits and vegetables, including weight, diameter, and length. These standards help in uniformity and ease of packaging and transportation. For example, tomatoes should have a diameter between 60–70 mm, ensuring uniformity for optimal presentation and packaging.

Quality Specifications

Quality specifications assess the overall condition of the produce, including factors like appearance, taste, and absence of defects. For instance, peppers should be firm, with glossy, bright skin (red, yellow, or green) and free from wrinkles or soft spots.

Packaging Standards

Packaging standards include requirements for materials, labelling, and packing methods to preserve the quality and safety of fruits and vegetables during transport and storage.

Freshness and Expiry Date

Freshness specifications ensure that fruits and vegetables are sold within an optimal period after harvest to maintain quality and safety. For instance, strawberries should be sold within 2–3 days of picking to maintain optimal taste and texture.

Importance of Specifications

These specifications are crucial for several reasons:

1. **Consumer Satisfaction**: Ensuring that fruits and vegetables meet certain standards in size, quality, and freshness helps maintain consumer trust and satisfaction. Consumers are more likely to purchase products that consistently meet their expectations.
2. **Market Access**: Compliance with these specifications is often important for accessing both national and international markets. Meeting these standards ensures that producers can sell their products in various regions without facing trade barriers.

[138] https://info.mercadona.es/document/es/memoria-anual-2022.pdf
[139] Herzberg, R., Trebbin, A., & Schneider, F. (2023). Product specifications and business practices as food loss drivers – A case study of a retailer's upstream fruit and vegetable supply chains. Journal of Cleaner Production, 417, 137940. https://doi.org/10.1016/j.jclepro.2023.137940
[140] https://www.globalgap.org/

3. **Fair Pricing**: Uniform standards help in the grading and sorting of produce, leading to fair pricing. Products that meet higher standards can be sold at premium prices, benefiting both producers and retailers.
4. **Reduced Waste**: Proper packaging and freshness standards help in reducing food waste by ensuring that fruits and vegetables remain in good condition for longer periods.
5. **Health and Safety**: Quality standards, especially those related to freshness and absence of defects, play a vital role in ensuring the health and safety of consumers. Products that meet these standards are less likely to harbour harmful pathogens or contaminants.

The most significant impacts of food waste on fruit and vegetables products

Food waste in fruits and vegetables is a significant issue and is influenced by various factors ranging from production practices to consumer behaviour. Understanding these factors can help in developing strategies to reduce waste and improve food security.

Below are the main factors contributing to food waste in this sector[141,142,143,144,145]:

1. **Stringent Quality Standards**

Quality standards often lead to food waste when produce that does not meet aesthetic criteria is discarded. Retailers and consumers typically prefer fruits and vegetables that are visually appealing, leading to the rejection of produce with minor blemishes or irregular shapes.

Example: In the EU, marketing standards require that apples be free from visible defects and uniform in colour and size. Produce that fails to meet these standards is often left unharvested or discarded post-harvest, contributing to significant waste.

2. **Overproduction and Market Surpluses**

Farmers often produce more than the market demands to hedge against unpredictable yields due to weather conditions or pests. When supply exceeds demand, surplus produce can go to waste.

Example: In Spain, overproduction of tomatoes can lead to a glut in the market, with excess produce being discarded due to lack of buyers or storage facilities.

3. **Supply Chain Inefficiencies**

Inefficiencies in the supply chain, such as delays in transportation, poor infrastructure, and lack of coordination between supply chain actors, contribute to food waste.

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[141] FAO. "Global food losses and food waste – Extent, causes and prevention." FAO, link.

[142] Gustavsson, J., Cederberg, C., Sonesson, U., van Otterdijk, R., & Meybeck, A. (2011). "Global food losses and food waste: Extent, causes and prevention." FAO.

[143] Ministerio de Agricultura, Pesca y Alimentación (MAPA). "Post-harvest management and marketing of fruit and vegetables." MAPA, link.

[144] Parfitt, J., Barthel, M., & Macnaughton, S. (2010). "Food waste within food supply chains: Quantification and potential for change to 2050." Philosophical Transactions of the Royal Society B: Biological Sciences, 365(1554), 3065-3081.

[145] WRAP. "Household food waste in the UK, 2015." WRAP, link

Example: Delays in transporting strawberries from farms to retail outlets can result in spoilage, as strawberries are highly perishable and require quick turnaround times.

4. **Consumer Behaviour**

Consumers contribute to food waste through over-purchasing, improper storage, and discarding edible produce based on appearance.

Example: In Europe, households are responsible for a significant portion of fruit and vegetable waste. Consumers often discard produce that has minor blemishes or that they believe has passed its peak freshness, even if it is still edible.

5. **Retail Practices**

Retail practices such as strict inventory management, promotional discounts, and the refusal to sell produce close to its expiration date can lead to waste.

Example: Supermarkets in Spain and other countries often reject fruits and vegetables that do not meet size and shape criteria, leading to waste at the retail level. Additionally, produce that is not sold before its "best before" date is often discarded.

6. **Lack of Processing Facilities**

In regions where there are no facilities to process surplus or substandard produce into value-added products like jams, juices, or dried fruits, this produce is often wasted.

Example: In many rural areas of Spain, the absence of processing facilities means that surplus peaches and apricots, which do not meet fresh market standards, are left to rot.

Insights from T1.2 Interviews

Private marketing standards imposed to partners: requirements, control and revision

Our investigation indicated that in the fruits and vegetables industry, farmers do not impose any private requirements on their partners, and **the majority of private standards are imposed by retailers and food service providers**. Respondents noted that major retailers enforce tougher marketing standards, which they sometimes struggle to achieve. On the other hand, it is revealed that most distributors "*do not have pre-defined standards. Instead, they use potential 'standard' deviations to negotiate the final price"* (Farmer Spain). An interesting note is that, despite the fact that farmers appear to impose no standards, there is a case of a farmer cooperative that sets marketing standards for all members to follow in order to ensure that the total production of the cooperation is of excellent quality, i.e. that products will not get rejected by their customers. These requirements specify rules for appearance, pesticide use, and farming methods.

Distributors in the fruit and vegetable sector enforce certain marketing standards on farmers and other suppliers. The major reasons are to ensure that the products purchased are of great quality and will remain such for many days after purchase, and that they will not contribute to food waste if not sold promptly. They also aim to ensure that the fruits and vegetables they supply are of constant quality. They employ EU marketing guidelines as a foundation for building their own standards, which are driven by consumer expectations. However, they do not always examine the standards of their competitors, as it is said that *"Everybody's standards are reasonably similar on EU standards"* (Distributor Ireland). These standard

requirements appear to fluctuate, with some distributors setting stricter requirements than others. For example, a distributor in Spain merely wants production at a specific maturity level, whereas one in Ireland is tighter, requiring specific parameters in size, quality, storage, and temperature, as well as a 0% tolerance for mistakes.

In the same vein, processors and manufacturers may also enforce their own standards. These requirements include parameters about (a) size; (b) maturity; and (c) appearance (i.e., not being sliced or split). However, marketing standards are not always formally enforced. A processor, in instance, stated that they had verbal agreements with their suppliers to produce fruits of high quality (i.e., no rotten, mouldy fruits) even though they do not have any official marketing standards.

Retailers' standards appear to be stricter than those of actors in earlier stages of the supply chain. They impose their own rules on producers and other suppliers. For example, producers may be required to meet requirements about: (a) product size: not too small or too large; (b) appearance: no odd shapes; and (c) brix degrees. Other suppliers must also meet the following requirements: (a) traceability: certification informing about the complete process from planting to delivery; (b) cultivation: free of plant protection products; (c) restrict active substance of fire to one or fewer; and (d) origin. The main reasons for the establishment of the retailers' marketing standards are to meet consumers' preferences and expectations, or to ensure that they sell their products, as *"products with extreme sizes is difficult to be marketed, and brix degree is a main driver of taste and it is really important in delivering food of great quality"* (Retailer Spain). Interestingly, when setting their marketing standards, retailers do not appear to follow either EU or their competitors' requirements, indicating that they constantly monitor their competitors, but when it comes to marketing standards, they have no clear picture of the restrictions that they impose.

Food service providers often set requirements for their suppliers. The primary reasons for doing so are to ensure quality and, in some situations, to ensure that the partners share the food service provider's values and meet consumer expectations. They do not consider EU marketing standards, but rather their competitors, and they usually aim to set standards that are on the same level, if not stricter, than their competitors. Their marketing standards do not include any specific aesthetic requirements, and they mostly address the maturity degree of fruits and vegetables. Furthermore, our data revealed some intriguing information from two food service businesses in Spain, the first of which had formally established marketing standards and the second of which had oral agreements with their suppliers. The first imposes marketing standards on their suppliers requiring: (a) sustainable and organic or pesticide-free farming practices: this ensures that all produce meets high standards of health, environmental care, and quality; (b) delivery of fresh produce following specific quality criteria (i.e., level of ripeness, texture) with short delivery times; and (c) use of eco-friendly or even re-usable packaging materials: to reduce the environmental impact; and (d) food safety and quality control: to ensure that all produce and ingredients meet service provider's high standard. This includes correct handling, storage, and transportation to ensure freshness and avoid infection. The second, through verbal agreements, requires from their suppliers: (a) quality and freshness: strict criteria are set for the flavour, texture, and appearance of all products, while produce should be harvested at peak ripeness; (b) sustainable farming and sourcing methods: sourcing organic or pesticide-free ingredients whenever possible, supporting local farmers who use environmentally friendly practices, and selecting products with a lower carbon footprint. Additionally, they encourage agricultural rotation and water conservation among their suppliers. (c) reusable packaging (when possible): suppliers who offer reusable, recyclable, or biodegradable packaging to help minimise waste are preferred. This includes using returnable containers for deliveries or choosing eco-friendly materials with a low environmental impact; and (d) on-time delivery: suppliers must deliver ingredients on time to ensure product freshness and the restaurant's efficient kitchen operation. Deliveries must be timed around the restaurant's demands, with the ability to vary quantities based on menu changes or seasonal fluctuations.

Timely deliveries help to avoid food preparation delays, eliminate spoilage risks, and keep inventory levels manageable, minimising food waste.

As a result, we can see that, in addition to retailers, ***food service providers may impose strict marketing standards on farmers and other suppliers that address not only product quality but also sustainability and food waste reduction***. The biggest difference between the requirements set by retailers and those set by food service providers is the amount of food waste produced. On the one hand, it is thought that retailers' requirements increase food waste since they discard products and return them to distributors or farmers. A store, for example, remarked that *"Retailer's standards can impact food waste, so producers need to find alternative channels for their products"* (Retailer 1 Spain). On the other hand, food service providers believe that their qualifications can reduce food waste along the supply chain because: (a) fresh ingredients ensure longer shelf-life and minimise spoilage; (b) sustainable farming reduces food waste in the production stage; (c) reusable packaging also reduces waste; and (d) on-time delivery helps to maintain product.

Another intriguing fact is that the actors in the fruits and vegetables sector do not work with third parties to ensure that their partners adhere to their marketing standards requirements, but rather have dedicated workers for this purpose. The majority of the time, they work for the food safety or quality teams. In restaurants, the head chef performs this role, and in farmer cooperation, the agronomy department does so.

Finally, it appears that most fruit and vegetable supply chain operators lack a mechanism for revising their marketing standards. However, a retailer revealed the following steps used during the updating of their standards: (1) evaluation and analysis of customer feedback; (2) development of hypotheses about potential difficulties; (3) testing of hypotheses with dedicated customer review; (4) proposing modifications to standards requirements; (5) seeking approval for changes; and (6) executing new standards. Interestingly, retailers adjust their marketing standards based on seasonal factors and consumer preferences. As indicated: "…during winter (marketing standards) are more flexible due to weather conditions" (Retailer Greece).

Private marketing standards imposed by partners: requirements and importance

Our analysis of the marketing standards imposed on various actors by their partners revealed that food service providers are exempt from any requirements, retailers must follow the requirements set by the food service providers, and distributors, processors/manufacturers, and farmers must follow the retailers' marketing standards. ***As a result, it is clear that retailers' marketing standards requirements have a greater impact on the fruits and vegetables supply chain than the ones by other supply chain participants***. Retailers, in particular, are simply required to comply with requirements relating to the maturity level of the products provided to food service providers, which they find quite easy to achieve. The chef always checks to see if the retailer satisfied the required criteria. Farmers who collaborate with traders in international markets may also be required to follow International Featured Standards (IFS) and the BRC Global Standard for Food Safety, which include: (a) origin information; (b) arrival timing; (c) packaging materials; and (d) traceability.

Farmers, processors/manufacturers, and distributors, on the other hand, must adhere to retailers' requirements that focus on a variety of criteria, including: (a) labelling; (b) quality; (c) appearance; (d) size; (e) brick degrees: ensure they have not softened; (f) shape; (g) freshness: perfect condition with guaranteed shelf life; (h) packaging: ensure it looks pristine upon arrival; and (i) sorting process. Most actors find retailers' criteria to be quite stringent and difficult to meet, and producers frequently find themselves on the verge of meeting all of the product demands required by retailers, particularly cosmetic standards. Under cosmetic standards, retailers frequently insist that fruits meet specified visual criteria, such as uniform size, shape, colour, and surface quality. For example, they may require basilicum stems to be chopped to a specified length, which parameter, however, varies among retailers. Therefore, any fruit or vegetable that does not match these

cosmetic standards, even if fully edible, may be rejected by retailers. This is why *"Specifications from retailers are 100% food waste"* (Distributor, Spain). Furthermore, employees, particularly the quality assurance team, are usually in charge of ensuring that partners meet retailers' marketing standards. Some retailers, however, use third-party checking services. In any event, if some of the deviations in each order surpass a specific parameter, the entire order is turned down, and the distributor must organise transport to collect the shipment and return it to the warehouse.

Finally, all supply chain actors in the fruits and vegetables industry stated that adhering to the standards set by their partners is critical to conducting business, maintaining healthy long-term relationships with key actors, and ensuring their continued market presence. Farmers also want to get the greatest market price and avoid financial losses due to product rejections from retailers, which could lead to food waste. The latter is also very important to distributors. Looking at the other side of this business partnership, supply chain actors stated that it is especially important for retailers to collaborate with partners who meet their standards because this allows them to maintain high product quality in the market while also meeting consumer expectations.

Food waste due to private marketing standards and actions to reduce it

As previously stated, fruit and vegetable stakeholders face unique challenges in meeting retailers' requirements. As a result, the proportion of their products that do not meet retailers' standards is repurposed or discarded. **Distributors report that approximately 15% of their shipments do not meet retailers' marketing standards, with 60% of this occurring due to cosmetic factors, particularly size**. They employ alternate methods to avoid wasting all that food, such as (a) selling it to smaller clients, (b) promoting it to all customers, or (c) donating it to a food charity. ***Processors/manufacturers report that 10% of the products provided to retailers do not fulfil their marketing standards, with around 8% attributable to aesthetic requirements***. They also reuse the products to help reduce food waste. ***Farmers report that more than 20% of their fruits and vegetables are rejected owing to retailers' requirements, with the majority of rejections (60-80%) related to aesthetic factors, such as size***. The rejected products are returned to them, and they must find alternative uses for them in order to reduce food waste. Most of the time, farmers can repurpose them in a variety of ways, such as (a) selling second-grade fruits to farmer markets, (b) processing to make sauces/jams, or (c) giving them to friends and family. However, in certain cases, they are unable to identify alternate solutions and hence are discarded. As one farmer stated, *"Any product that is rejected comes back to us and it is dumped"* (Farmer Ireland).

A significant proportion of food could be wasted throughout in the retailing stage. Retailers reported that around 10% of the products offered by their suppliers do not match their standards each year, with aesthetic criteria playing a large influence (more than 50%); nevertheless, during the summer, effective temperature control and refrigeration are also critical. When fruits and vegetables are of good quality and they are not returned to their suppliers, retailers employ different methods to repurpose them, such as: (a) selling them as imperfect foods; (b) preparing ready-to-eat meals; or (c) selling them to manufacturers for additional processing. Some retailers have also implemented technology to prevent food waste. They, for example, monitor deliveries and inventories using computer systems and ordering tools, or even applications that provide information about clients' profiles, allowing them to plan each purchase depending on their preferences and needs.

Furthermore, ***food service providers may waste a significant amount of food, with up to 30% of products delivered failing to fulfil their criteria each year***. However, they only send products back to producers in extreme circumstances, so they use alternate methods to limit food waste, such as (a) incorporating imperfect vegetables into soups and sauces; (b) adjusting menu items based on available seasonal components; and (c)

optimising portion sizes. Some food service providers have also implemented the 'Use first' label, which indicates which products arrived first.

Finally, ***at the distributor level, less than 1% of the fruits and vegetables delivered are rejected for failing to fulfil their criteria, with less than 10% due to aesthetic grounds.*** However, in this circumstance, they do not have any other options for repurposing food; they simply return the products to the producer.

4.2 Dairy products

Introduction

The evolution of private marketing standards in the Danish dairy sector has been marked by a collaborative approach, integrating stringent quality control and sustainability efforts across the supply chain. Since the 1990s, Danish dairy producers have emphasised standardised safety through initiatives like the Danish Dairy Board's sector guide, introduced in 1993. This guide supports dairy companies in developing rigorous, site-specific food safety systems, fostering compliance with evolving EU regulations. One major example is Arla Foods' "Arla Farm" program, a cooperative quality initiative focusing on milk quality, food safety, animal welfare, and environmental impact. This framework not only aligns producers with strict quality standards but also promotes continuous improvement via regular audits. Over the years, Danish dairy standards have thus evolved to ensure high-quality, traceable products that reinforce Denmark's reputation in global dairy markets[146].

Challenges in the dairy sector

To maintain high quality and meet evolving consumer expectations, Danish dairies voluntarily adopt additional private marketing standards. These standards encompass various aspects such as animal welfare, environmental sustainability, and biodiversity. Certifications like the animal welfare label[147] introduced in 2020, and other schemes from organisations such as Dyrenes Beskyttelse[148] and organic certification bodies[149], are increasingly used to communicate product attributes and enhance market differentiation.

These certifications not only affirm the product's quality but also align with consumer values, helping to maintain a competitive edge in a market that values transparency and ethical practices. As these labelling

[146] Food Nation (2019). "Food Quality & Safety World-leading innovation in the Danish food cluster". link
[147] https://foedevarestyrelsen.dk/kost-og-foedevarer/alt-om-mad/gaa-efter-maerkningen/bedre-dyrevelfaerd/det-betyder-hjerterne
[148] https://www.dyrenesbeskyttelse.dk/anbefalet-af-dyrenes-beskyttelse
[149] https://foedevarestyrelsen.dk/kost-og-foedevarer/oekologi/oekologi-for-foedevarevirksomheder/certificering-og-kontrol

schemes become more recognised among Danish consumers, they contribute to product differentiation and support the sector's commitment to high standards.[150,151]

Common specifications for dairy products

Standardisation in dairy products is a fundamental aspect of quality control in the food industry. Ensuring consistent characteristics, such as fat content, is essential to maintaining the high standards expected by consumers and is often considered a hallmark of good craftsmanship. While certain attributes like colour and taste may vary slightly due to seasonal changes, these variations are generally perceived as indicators of product authenticity and quality rather than defects. Below can be found some specifications imposed in the Dairy industry[152]:

- **Product freshness and durability:** It is crucial that dairy products have a significant portion of their total shelf life remaining when they reach the consumer. Typically, the expiry date should reflect that at least 75% of the product's total durability is intact. Freshness is highly valued by consumers globally, and this is particularly evident in markets where there is a cultural expectation, such as in Denmark, for fresh milk to be readily available.
- **Standardised packaging:** Retailers often prefer dairy products to be sold in standardised, pre-packaged weights (e.g., 200g or 300g for cheeses) rather than by variable weight per kilogram. This practice simplifies inventory management and meets consumer expectations for consistency in product size and price.
- **Temperature control and cold chain maintenance:** dairy products must adhere to strict temperature control guidelines during storage and transportation to ensure safety and quality.

The most significant impacts of food waste on dairy products

Price sensitivity is a significant driver for consumers, influencing their purchasing decisions and shopping habits. According to a Kauza analysis[153] of 10,000 households, the share of products purchased on sale in Denmark has increased by 19% since 2021, reaching an all-time high. Similarly, research by Madkultur[154] shows that a large percentage of consumers prioritise price and discounts when deciding what to buy, often leading them to shop around in search of the best deals. This behaviour contributes to a lack of loyalty to specific supermarkets, with 26% of Danish consumers shopping at more than seven different stores in the last three months, as per a 2022 study by the Retail Institute Scandinavia[155].

These conditions cater well to the Danish consumer's preference for shopping flexibility. However, they also contribute to food waste. To avoid running out of stock, shops tend to purchase slightly more than their estimated daily need. With multiple stores adopting this approach, the surplus accumulates. Intense competition has already driven prices as low as possible, leaving little room for further reductions without jeopardizing profitability. Nevertheless, supermarkets often lower prices to secure final sales, yet this practice

[150] https://www.danskerhverv.dk/siteassets/mediafolder/dokumenter/04-politik/2023/analyserapport---i-2022-var-prisen-pa-krisen-vigtigere-end-marker.pdf
[151] https://taenk.dk/forbrugerliv/mad-og-indkoeb/maerker-du-skal-kende-naar-du-koeber-ind
[152] https://foedevarestyrelsen.dk/lovstof/vejledninger/hygiejnevejledningen/26-koelekrav-for-foedevarer
[153] https://jyllands-posten.dk/indland/ECE17199057/danskerne-jagter-tilbud-som-aldrig-foer/
[154] https://www.madkulturen.dk/wp-content/uploads/2023/12/MADKULTUR-2023-web-1.pdf
[155] https://retailinstitute.dk/ny-forbrugerundersoegelse-danske-dagligvarekunder-er-blevet-mere-illoyale/

does not fully address the issue. Consumer expectations along with supermarket's strategy of purchasing of their need, often result in unsold food being discarded, contributing to food waste.[156].

The same principle applies at the dairy. To maintain credibility, professionalism, and loyalty as a supplier, it is essential to consistently meet the demands of supermarkets and wholesalers. To achieve this, daily sales are estimated with a slight buffer added. However, challenges arise due to private labelling standards concerning product durability, requiring careful consideration in making these estimates[157].

Insights from T1.2 Interviews

Private marketing standards imposed to partners: requirements, control and revision

Similar to fruits and vegetables, in the dairy industry, producers do not impose any marketing standards on their partners, and the majority of marketing standards are imposed by retailers and food service providers.

Distributors in the dairy sector enforce certain marketing standards on milk producers. The major reasons are to ensure that the products purchased are of great quality. Distributors' requirements include (a) cleanliness and hygiene standards of the production site: aging process, cutting and shrinking, proper refrigeration; (b) ratio of milk types used; and (c) sensory tests to evaluate taste. In the same vein, processors and manufacturers may also enforce their own requirements. However, they have not established any formal marketing standards. They have oral agreements with their partners regarding (a) delivery time, and (b) sourness of product.

Similar to the fruits and vegetables and meat sectors, retailers' marketing standards in the dairy industry appear to be stricter than those of actors in earlier stages of the supply chain. They impose their own rules on producers and other suppliers, with their requirements including specification about: (a) time spend between production and delivery; (b) texture; (c) appearance; (d) taste. The main reasons for the establishment of the retailers' marketing standards are to meet consumers' preferences and expectations. Interestingly, when setting their marketing standards, retailers follow their competitors' requirements, and they always try to adapt their marketing standards to theirs. Additionally, food service providers' requirements are mostly focusing on sustainability aspects, and when competitors' marketing standards are considered developed.

Similar to the fruits and vegetable, most actors in the dairy sector do not work with third parties to ensure that their partners adhere to their marketing standards requirements, but rather have dedicated workers for this purpose. The majority of the time, they work for the quality department of the company. Also, the actors in the dairy industry have no internal mechanism for the revision of their marketing standards. However, they are revised when something changes in the market or something out of the ordinary occurs.

Private marketing standards imposed by partners: requirements and importance

Our examination of the marketing standards placed on various actors by their partners shows that, like the fruits and vegetables, food service providers are exempt from all obligations. However, in the dairy industry, retailers, distributors, and processors/manufacturers must adhere to wholesaler rules, while farmers must adhere to the marketing standards' requirements of processors and manufacturers. As a result, in contrast to

[156] https://www.dst.dk/en/informationsservice/oss/spiseva

[157] Reducing food waste and losses in the fresh dairy supply chain (link)

the fruits and vegetable, processors/manufacturers' and wholesalers' marketing standards requirements have a higher impact on the dairy supply chain than those of other supply chain actors.

Producers must follow processor and/or manufacturer requirements that address a variety of criteria, including (a) milk quality and (b) animal welfare. Furthermore, wholesalers set marketing standards for processors/manufacturers and retailers. Processors and/or manufacturers adhere to delivery time standards. The products, for instance, may not be accepted if they are delivered more than 9 days after the date of production. On the other hand, retailers adhere to order quantity requirements, which sometimes find difficult to meet, especially when the requirements do not align with real-time market demand. The employees of the wholesaler are tasked to ensure that these partners adhere to their marketing standards.

Finally, all supply chain actors in the dairy industry acknowledged that conforming to the criteria established by their partners is crucial for selling more products at higher prices, maintaining solid long-term relationships with key actors, and ensuring market presence. Looking at the opposite side of this business alliance, supply chain actors claimed that wholesalers must engage with partners who satisfy their requirements in order to maintain good product quality and processors to establish a strong brand.

Food waste due to private marketing standards and actions to reduce it

In the dairy industry, the main reason of waste is due to limited shelf-life, cost of raw materials, and expiration dates. However, compared to the fruits and vegetables and meat industries, the proportion of food wasted in the dairy industry is minimal, mainly because the supply chain actors don't struggle to meet their partners marketing standards. Producers, for instance mentioned that less than 0.5% of their production does not meet the standards set by processors/manufacturers. Processors/manufacturers supported this, adding that they use different ways to reduce food waste, including: (a) using milk to produce cheese; and (b) giving soured yoghurt to food banks. They only dispose food when an accident occurs, such as mixing two different fruits when producing a fruit yoghurt.

Additionally, distributors detect a small proportion of dairy products that do not fulfil their marketing standards. However, such products can be used in a variety of ways, including: (a) donating to food banks; (b) selling at a discount; (c) selling in a different channel; and (d) selling on the web shop to all consumers. Sometimes these products are returned to the processors. Furthermore, retailers report that less than 2% of products delivered do not satisfy their standards, primarily owing to expiration dates. These products are returned to the manufacturer if they do not meet logistical or quality requirements. To decrease food waste, retailers monitor commodities in the warehouse and list those that are nearing expiration date, attempting to sell them first. They also use technology, including the app 'Why Waste' and barcodes.

4.3 Cereals

Introduction

Private marketing standards for cereals have evolved over time as consumer demand for consistent quality, sustainability, and traceability in food products has increased. Initially, the development of private standards was driven by industry groups, producers, and major corporations seeking to ensure product quality and differentiate their offerings in competitive markets. Over the years, organisations such as **SGS**[158], **Bureau Veritas**, and **The Roundtable on Responsible Soy (RTRS)**[159] have played a significant role in shaping these standards, focusing on factors like quality control, environmental impact, and ethical sourcing. [160]

A significant aspect of this evolution involves private buyers of grain, who, unlike public procurement processes that specify strict criteria, enjoy considerable flexibility in choosing the assessment criteria and standards they apply. [161] Despite this flexibility, these standards are crucial as they define food safety measures and the technological suitability of the grain for further processing. Even though they are private standards, they are designed to be uniform and comparable across the sector, ensuring consistency in product quality and safety. [162]

The rise of certification schemes, such as **Fair Trade**, **Organic**, and **Non-GMO**, in the 1990s and 2000s[163, 164,165], marked a significant shift in the private sector, where the emphasis was placed not only on product quality but also on sustainability and consumer transparency. These standards are voluntary and often set by trade associations, certification bodies, or specific companies looking to meet the expectations of environmentally and socially conscious consumers. [166]As consumer awareness of issues like environmental sustainability and ethical sourcing has grown, so to have the demands for more rigorous private standards, with traceability, carbon footprint reduction, and fair labour practices now central to many of these frameworks.

Challenges in the cereals sector

[158] https://www.sgs.com/en/service-groups/food-retail
[159] https://responsiblesoy.org/sobre-la-rtrs#mision
[160] https://certification.bureauveritas.com/certification/food-agriculture
[161] Requirements and quality standards for cereals traded on the traded on the exchange under the RTRS https://tge.pl/pub/TGE/RTRS/Standardy_jako_ciowe_dla_pszenic.pdf
[162] Quality of Polish wheat harvest 2023, https://www.ibprs.pl/wp-content/uploads/2023/11/Wheat_quality_report-_2023.pdf
[163] Kononets, Y., Konvalina, P., Bartos, P., & Smetana, P. (2023). The evolution of organic food certification. *Frontiers in Sustainable Food Systems, 7.* https://doi.org/10.3389/fsufs.2023.1167017
[164] Elena Castellari, Claudio Soregaroli, Thomas J. Venus, Justus Wesseler, Food processor and retailer non-GMO standards in the US and EU and the driving role of regulations,Food Policy,Volume 78,2018,Pages 26-37,ISSN 0306-9192, https://doi.org/10.1016/j.foodpol.2018.02.010.
[165] Marcuta, L., Popescu, A., Tindeche, C., Fintineru, A., Smedescu, D., & Marcuta, A. (2023). Study on the evolution of fair trade and its role in sustainable development. Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development, 23(2), 427. https://doi.org/10.3934/mear.2023.2.427
[166] https://www.fairtrade.net/en.html

Market dynamics and challenges in Poland's grain market

Poland's grain market, particularly cereals, is a significant component of its agricultural sector, influencing both domestic and international trade. Many small companies appeared after the market opened in 1990, causing strong demand and price competition. After a year, the market stabilised and slightly centralised to more prominent players. Several factors, including market restrictions, marketing standards, and barriers to market entry, shaped the dynamics of this market.[167]

Geographical Origin

Since different regions produce various types of cereals under different environmental conditions, and these cereals are sold across markets, it is important to ensure traceability to verify the origin of the grains.[168]

Organic Certifications

More and more consumers are concerned about the organic production of cereals. However, obtaining such certifications requires meeting strict guidelines and undergoing regular inspections, which can be costly and time-consuming for producers. Additionally, it is crucial to ensure that cheaper non-organic products are not mislabelled as organic.[169]

Gluten-Free Products

With the celiac disease, which is caused by the immune system reacting to gluten in wheat, barley, etc., more gluten-free alternatives are appearing on the market. It is critical to ensure the authenticity of products claiming to be gluten-free to avoid potential health risks.[170]

Market disruptions

In the last two years, Poland has also facilitated the export of Ukrainian grain through alternative routes due to the war in Ukraine[171]. However, a significant amount stayed in Poland, disrupting the local market with cheaper, lower-quality products.

Common specifications for cereals[172,173]

The quality of grain depends on its variety, climatic and soil conditions, and the mechanisms used during maturation and harvest. The required quality parameters vary at different stages of storage, milling, and processing, and the criteria applied differ for various grain types, primarily depending on the intended use of the grain.

The primary criteria for evaluating all grains are:

- General grain characteristics

[167] Polish Ministry of Agriculture and Rural Development. (2021). Agricultural Market in Poland (link)
[168] Cereals and cereal – based products (link)
[169] Cereals and cereal – based products (link)
[170] Cereals and cereal – based products (link)
[171] European's Commission Crops market observatory (link)
[172] Cereals statistics: https://agriculture.ec.europa.eu/data-and-analysis/markets/overviews/market-observatories/crops/cereals-statistics_en
[173] Cereals and cereal-based products (link)

- Storability, considering contamination levels, presence of pests, moisture, and food safety
- Technological suitability, i.e., potential for further processing

Wheat Quality Assessment Criteria[174]

General Grain Characteristics: Quality is assessed organoleptically, considering factors such as appearance, colour, gloss, smell, and maturity. Desired grain has a uniform colour and characteristic smell for the species, and there are no signs of disease, mould, fungi, or pests. Poor weather conditions at harvest and improper storage can significantly degrade quality, which can be mitigated by drying, ventilation, and cleaning the grain.

Storability - Key factors include:

- **Contamination Level**: Critical for food safety, distinguishing between unusable (mineral, organic, harmful to health, including weeds like ergot) and applicable contaminants (lean, undeveloped grains, sprouted grains, mouldy or decayed grains, mechanically damaged, darkened grains, grains of other cereal species). Total contamination should not exceed 6%, with a maximum of 2% unusable and no more than 0.5% harmful contaminants.
- **Moisture**: Affects both storability and technological suitability, defined for all grains at 14-15%.
- **Density**: The mass of a specific volume of grain expressed in grams or kilograms, influencing milling suitability. It depends on moisture and contamination levels, with consumer wheat density above 72 kg/hl, ideally above 76 kg/hl.
- **Falling Number**: Measures alpha-amylase activity, indicating baking suitability and the physiological state of the grain, which informs about storability (hidden grain sprouting).

Technological Suitability: Primarily determined by genetic traits of the variety and cultivation conditions, it cannot be improved post-harvest. Main quality criteria include:

- **Protein Level**: Both protein and gluten determine the baking quality of flour. The desired protein level for consumer wheat is 12%, and grain intended to enhance milling blends with lower-quality grain is at least 14%.
- **Gluten Level**: Gluten, composed of gliadin and glutenin, is assessed for both quantity and quality (spreadability) of wet gluten. Gluten content should be at least 25% (40% for blends), with spreadability between 5 and 8 mm. It is essential to check both quantity and quality, as quality may decrease with increasing amounts. Quality is lower for varieties where gluten is not genetically determined but results from excessive nitrogen fertilisation.
- **Sedimentation Index**: Indicates gluten's ability to bind water and swell. The higher this index, the better the baking quality. Grain below 20 ml is not classified as consumer-grade; the minimum criterion for flour production is 22-25 ml or more. Grain for enhancing milling blends should have an index of 40 ml.

[174] SGS International Laboratory, quality factors for wheat: https://www.sgs.com/pl-pl/aktualnosci/2022/04/laboratorium-zbozowe-sgs-polska-ocena-jakosci-pszenicy

The above parameters are private standards imposed by individual collection points and may slightly differ between them. Although these standards are voluntary, the quality parameters specified are critical for obtaining appropriate raw materials for further food production, determining industry standards with little room for deviation[175,176].

Similar standards are established for other grain types, including corn and barley[177].

Justification for Standards

- **Food Safety**: Standards ensure that grain meets quality criteria regarding contamination, pesticides, and harmful substances.
- **Technological Suitability**: Standards ensure the appropriate quality of flour and its efficiency/suitability in further food production.
- **Uniform Standard:** Grain standards provide farmers with guidelines on production standards and mechanisms, supporting market predictability.

The most significant impacts of food waste on cereals

Cereals are a major staple food, providing the majority of calories for many people worldwide. Common examples include wheat, rice, maize, and barley. Unfortunately, cereals also contribute significantly to food waste. Poor storage, improper transportation, and post-harvest losses are key factors behind this waste. More specifically, storage conditions such as temperature and humidity must be carefully controlled, and appropriate containers should be selected for transportation. Cereals are especially vulnerable to damage from insects and pests if not stored or handled correctly. Additionally, a significant amount of loss occurs during the harvesting process due to mishandling and improper packaging.[178]

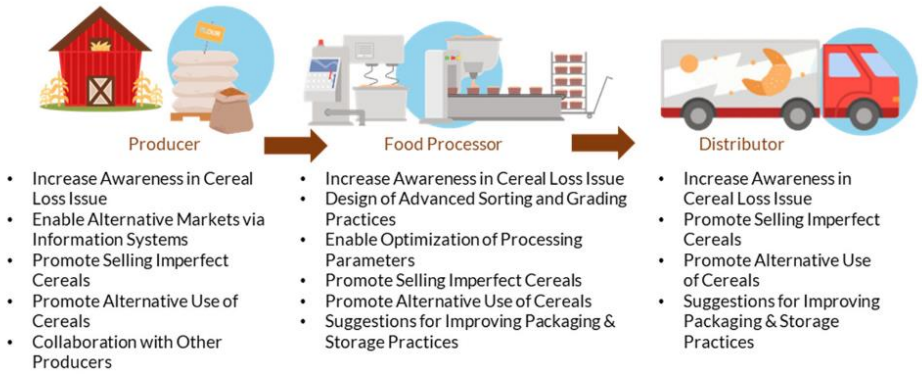


Figure 6.Actions to reduce food waste in the cereal sector

[175] Requirements and quality standards for cereals traded on the exchange under the RTRS https://tge.pl/pub/TGE/RTRS/Standardy_jako_ciowe_dla_p

[176] Quality of Polish wheat harvest 2023, https://www.ibprs.pl/wp-content/uploads/2023/11/Wheat_quality_report-_2023.pdf

[177] Requirements of Melvit S.A. is the largest producer of groats and cereals in Poland and one of the largest in Europe https://melvit.pl/skup-zboza/

[178] Kechagias, E.P.; Gayialis, S.P.; Panayiotou, N.; Papadopoulos, G.A. A Holistic Framework for Evaluating Food Loss and Waste Due to Marketing Standards across the Entire Food Supply Chain. Foods 2024,13, 3273. https://doi.org/10.3390/foods13203273

Introducing more flexible marketing standards that allow for differences in crop quality and appearance could contribute to the reduction of edible products being discarded and help cut down on food waste. [179]

Insights from T1.2 interviews

Private marketing standards imposed to partners: requirements, control and revision

Similar to the other industries in focus, in the cereals industry, farmers do not impose any marketing standards on their partners. However***, in cereals industry the majority of requirements are imposed by processors and/or manufacturers***, while retailers and food service providers seem to rather use oral agreements with their partners than formal marketing standards.

Processors and/or manufacturers in cereals industry enforce certain marketing standards on producers, including: (a) quality criteria (e.g., no pests/bugs/worms, fresh, not mixed with other substances); and (b). transportation of seeds (e.g., the material of truck). They employ EU marketing guidelines as a foundation for building their own standards, which are driven by consumer expectations.

On the other hand, retailers and food service providers prefer to rely on oral agreements and trust with their suppliers. These agreements, mainly focus on delivery time, indicating that the products supplied should have at least 2/3 of shelf-life remaining when bought. In the same direction, food service providers have oral agreements with their suppliers focusing on food quality aspects, primarily in product freshness and secondarily on appearance. They refer to those requirements as 'common sense', and their main motivation for introducing them is to maintain food quality and safety while minimising associated sanitary or reputational risks. They do not consider EU marketing standards but they are focusing on the expectations of their consumers.

Similar to the other industries under consideration, cereal industry actors do not rely on third parties to ensure that their partners meet their marketing standards requirements, but rather employ dedicated workers for this reason. Finally, cereal supply chain operators do not appear to have a system in place to revise marketing requirements. However, they frequently change their marketing standards in response to the season and harvest. For example, if the weather is bad that year, affecting production quality, their marketing standards are less stringent.

Private marketing standards imposed by partners: requirements and importance

Our analysis of the marketing standards imposed on various actors by their partners revealed that food service providers are exempt from any requirements, while retailers and producers must follow the requirements set by the food service providers. Producers adhere to requirements about (a) content parameters; (b) transportation of products; and (c) price. On the other hand, retailers should imply on requirements related to the consistency of the products, for instance, cuts on the crust of bread, size of rolls, etc.

Finally, it is mentioned that adhering to the standards set by supply chain partners is critical to conducting business, and selling their products. Looking at the other side of this business partnership, supply chain actors stated that it is especially important for processors to collaborate with partners who meet their standards

[179] Kechagias, E.P.; Gayialis, S.P.; Panayiotou, N.; Papadopoulos, G.A. A Holistic Framework for Evaluating Food Loss and Waste Due to Marketing Standards across the Entire Food Supply Chain. Foods 2024,13, 3273. https://doi.org/10.3390/foods13203273

because this allows them to maintain high product quality in the market, meaning that they increase their revenues.

Food waste due to private marketing standards and actions to reduce it

In the cereals industry, ***the amount of production that does not meet partners' requirements is minimal***. Actors treat in various ways those products that do not meet the marketing standards. The manufacturers and the retailers return the products to producers, the producers sell the products for animal feed, while the food service providers either process them or give them for free to their employees.

4.4 Meat

Introduction

The main driving forces behind the rise of private marketing standards are the globalisation of trade, progress in information technology, concentration in the food processing and retail industries, changing consumer preferences and regulatory changes in major developed markets.

Private meat marketing standards emerged as a response to growing consumer demands for specific product attributes beyond those mandated by government regulations. These standards are developed and implemented by private entities such as retailers, food service companies, or industry associations. The initial rise of private marketing standards coincided with increased consumer awareness about food safety, animal welfare, and product quality. Retailers, seeking to differentiate their offerings and build consumer trust, began introducing their own standards. For instance, some retailers started implementing stricter criteria for antibiotic use in livestock or sourcing from farms with specific welfare practices. Consumer demand for products aligned with personal values and preferences acted as a catalyst for the development of private standards.

Key milestones and influential events are outlined below[180]:

- **1990s and beyond**: Private marketing standards escalated as more retailers and food service companies adopted them. The focus broadened to include environmental sustainability, traceability, and social responsibility.
- **Globalisation and supply chain complexity**: The increasing complexity of global food supply chains necessitated the development of comprehensive standards to ensure product integrity and safety throughout the production process.
- **Tightening regulatory environment**: Food crises in the late 1990s and early 2000s prompted increased focus on food safety. These crises led to stricter government regulations holding the food industry responsible for contamination. In response, the industry implemented measures like supplier standards, traceability, and certification to protect themselves from liability. Essentially, the responsibility for food safety shifted down the supply chain.

[180] Pascal Liu, "Private standards in international trade : issues and opportunities." (2009), Trade and Markets Division, FAO (link).

- **Key players**: Retailers like Walmart, Costco, and Whole Foods in the US and TESCO and Carrefour in Europe, along with industry associations such as the **Global Food Safety Initiative (GFSI)[181],** played pivotal roles in shaping and driving the adoption of private standards. Some companies created their own private food safety and quality standards (like Carrefour's "filière qualité"), while others joined forces with competitors to develop shared standards (such as the EurepGAP standard, now GlobalGAP, created by European supermarket chains in the 1990s).

Identifying key challenges in the meat sector

The meat market is subject to a complex web of regulations, standards, and trade barriers that significantly influence market dynamics[182, 183]. These restrictions can be categorised as follows:

- **Food safety and hygiene regulations**: Stringent standards for meat processing, handling, and storage are essential for public health but can impose significant costs on producers.
- **Animal welfare regulations**: Growing consumer concern for animal welfare has led to stricter regulations on livestock treatment, impacting production methods and costs.
- **Environmental regulations**: Restrictions on land use, water pollution, and greenhouse gas emissions can limit meat production and increase costs.
- **Trade restrictions**: Tariffs, quotas, and non-tariff barriers (e.g., SPS agreement on the application of Sanitary and Phytosanitary Measures[184]) can limit market access for meat products.
- **Market volatility**: Fluctuating prices for livestock, feed, and energy can create financial instability for meat producers.
- **Economic downturns:** Reduced consumer spending on meat during economic recessions can lead to oversupply and lower prices.

The specific impact of these factors can vary significantly depending on the type of meat (beef, pork, poultry, etc.), geographic location, and target market. Additionally, technological advancements and changing consumer preferences are continually reshaping the meat market landscape.

Common specifications for meat products

Specific examples of private marketing standards for meat are difficult to find publicly due to their commercial nature. However, some general areas where retailers might implement private standards for meat include:

- **Animal welfare:** Consumers are increasingly concerned about animal welfare. Retailers may set standards for factors like breed, housing conditions, and access to outdoor space that are more stringent than minimum legal requirements.
- **Sourcing:** Private standards may address the origin of the animals, including restrictions on antibiotics or growth hormones used during rearing.

[181] Global Food Safety Initiative, Safe food for consumers, everywhere (link).
[182] Mike Jhordan, "Exploring the Modern Meat Market: Trends, Challenges, and Future Directions", Medium 2024 (link)
[183] Market Research Intellect, "Red Meat Market Analysis Report 2024", Strategic Research Hub (link)
[184] The WTO Agreement on the Application of Sanitary and Phytosanitary Measures (SPS Agreement): Quarantine and biosecurity measures implemented to safeguard human, animal, or plant life and health; They are designed to protect against risks stemming from the introduction, establishment, and spread of pests and diseases, as well as additives, toxins, and contaminants in food and feed (link)

- **Labelling:** Mainly for processed meat products, but also for packaged meat cuts as well, transparency about the origin of the meat and the ingredients in processed meat, is a growing consumer concern. Retailers may implement private standards that go beyond mandatory labelling requirements.

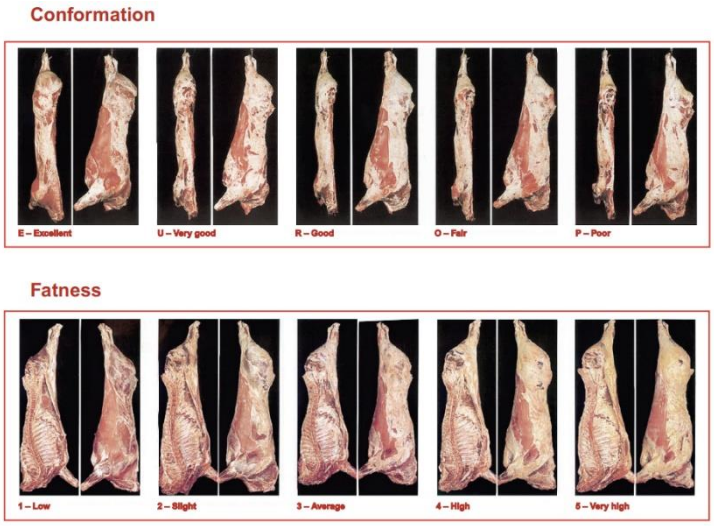
Based on the above general areas of private standards for meat, general product specification elements commonly found in red meat and poultry standards are[185, 186, 187, 188 ,189]:

- **Meat cut and trim specifications**: Detailed descriptions of meat cuts, including allowed bone content, fat content, and other physical characteristics, ensuring consistent quality and portion size from specific meat cuts and helping consumers identify and select desired cuts.
- **Specific weight and size ranges**: Retailers may have preferences for the size of the poultry they sell.
- **Meat quality parameters:** Specifications for factors like tenderness and colour may provide some level of standardisation in product quality and appearance
- **Meat safety criteria**: Microbiological limits, chemical residue levels, and allergen information, ensuring meat products are free from harmful bacteria, chemicals, and contaminants. Examples of meat safety testing are salmonella testing for poultry and antibiotic-free testing indicating that animals and birds were raised without the use of antibiotics for growth promotion or disease prevention.
- **Packaging requirements**: Material types, labelling, and storage conditions, preserving the quality, safety, and marketability of meat products.
- **Traceability information**: Detailed information about the product, such as breed, origin, production method, lot numbers, production dates, and other tracking details, demonstrating transparency and commitment to food safety, building trust with consumers.
- **Animal welfare indicators**: Specifications related to animal and bird handling, stunning, and slaughter methods, promoting sustainable farming practices and animal husbandry and building consumer confidence in the product and the industry. Examples of animal welfare indicators include grass-fed or pasture-raised cattle, free-range or pasture-raised poultry, organic certification adhering to strict guidelines for animal and bird welfare, feed, and living conditions.

As an example of visual appraisal of a beef carcase, the following beef classification method is shown, which is based on an overall visual assessment of the carcase and visual appraisal of its external fat. Carcases of bovine animals are classified by assessment of conformation and fat cover[190]:

- **Cattle conformation** is a **visual assessment** of the **overall shape and flesh coverage** of the carcase.
- The **fat class** is determined by a **visual appraisal** of **external fat** development

[185] FAO, "Guidelines for slaughtering, meat cutting and further processing", 1991 (link)
[186] Ian Jenson, John Sumner, "Performance standards and meat safety — Developments and direction", Meat Science, Volume 92, Issue 3, 2012 (link)
[187] Cecilia Carlsson, Helena Johansson, "Private standards – levelling the playing field for global competition in the food supply chain?", AgriFood Economics Centre, 2013 (link)
[188] P.P. Purslow, from New Aspects of Meat Quality, 2017 (link)
[189] Dimitrios Kafetzopoulos et al. "Managing Traceability in the Meat Processing Industry: Principles, Guidelines and Technologies", HAICTA, 2020 (link)
[190] Rural Payments Agency "Beef Carcase Classification Scheme - Guidance on dressing specifications and carcase classification", GOV.UK, 2020 (link)



These are just examples, and the actual specifications would vary significantly based on meat type, product form, target market, and specific standard requirements. They can vary widely between retailers and regions. Additionally, some retailers may combine multiple standards into a comprehensive programme.

The most significant impacts of food waste on meat products

Meat waste is a significant global issue with far-reaching environmental and economic consequences. Several practices, standards, and market demands contribute to this problem [191] ,[192]:

- **Production and processing**:
  - The emphasis on rapid growth in certain breeds (i.e. broiler chickens) may lead to worse welfare outcomes[193],that affect meat quality and shelf-life[194].
  - Inefficient slaughter and processing practices can result in meat contamination, damage, and subsequent waste.
  - Overproduction of meat may occur due to fluctuations in the market and shifts in consumer preferences, combined with inefficient forecasting and planning; if strategies like reprocessing of fresh meat surplus to products with higher shelf-life (i.e. frozen meat or other meat products) are not in place, the surplus may ultimately lead to waste.
- **Supply chain and distribution**:
  - Meat is highly perishable, requiring strict temperature controls and rapid transportation. Failures in the cold chain can lead to spoilage.

[191] Mena, Carlos & Terry, Leon & Ellram, Lisa "Causes of Waste across Multi-tier Supply Networks: Cases in the UK Food Sector", International Journal of Production Economics, 2014 (link)

[192] Karwowska, M.; Łaba, S.; Szczepański, K. "Food Loss and Waste in Meat Sector—Why the Consumption Stage Generates the Most Losses?", Sustainability 2021, 13, 6227 (link)

[193] Stephanie Torrey, Mohsen Mohammadigheisar, Midian Nascimento dos Santos, Daniel Rothschild, Lauren C. Dawson, Zhenzhen Liu, Elijah G. Kiarie, A. Michelle Edwards, Ira Mandell, Niel Karrow, Dan Tulpan, Tina M. Widowski, "In pursuit of a better broiler: growth, efficiency, and mortality of 16 strains of broiler chickens, Poultry Science", Volume 100, Issue 3, 2021, (link)

[194] Perichitala Vasudev Nethra, Kappat Valiyapeediyekkal Sunooj, Basheer Aaliya, Muhammed Navaf, Plachikkattu Parambil Akhila, Cherakkathodi Sudheesh, Shabir Ahmad Mir, Aboobacker Shijin, Johnsy George, "Critical factors affecting the shelf life of packaged fresh red meat – A review", Measurement: Food, Volume 10, 2023 (link)

  - Inconsistent consumer demand can result in overstocking or understocking, both of which contribute to waste.
  - Inadequate storage and transportation facilities can accelerate meat spoilage.
- **Marketing standards and consumer behaviour**:
  - Stringent cosmetic standards for meat appearance can lead to the rejection of perfectly edible products with minor imperfections; for example, a steak with a slight discoloration due to bruising from the packaging process might be deemed unfit for sale, even though it is perfectly safe to consume; similarly, a chicken breast with a small blemish on the skin might be rejected, even though it is perfectly healthy to eat.
  - Consumer preferences for specific meat cuts and packaging can result in the underutilisation of other parts and excess packaging waste.
  - Misjudging portion sizes at both the production and retail levels can create waste through overpreparation.
  - Confusing or overly conservative date labelling can lead to premature discarding of safe-to-consume meat. Some manufacturers may use overly conservative dates to minimise the risk of spoilage claims, leading to unnecessary food waste. Furthermore, as there is not a standardised way of date labelling, different date labels such as “sell-by” or “use-by” may be confusing to consumers, especially when not clear instructions are given about the meaning of these dates. For example, ground meat and poultry can be used for up to 1 to 2 days past their “sell-by” date if they are stored properly in the fridge. This period may be extended for a couple of more days in the case of beef cuts.

Insights from T1.2 interviews

Private marketing standards imposed to partners: requirements, control and revision

In the same line with the fruits and vegetables industry, our investigation indicated that in the meat industry, producers do not impose any private requirements on their partners, and the majority of private standards are imposed by retailers and food service providers.

Despite the fact that producers appear to impose no standards, there is a case of a producer cooperative that sets marketing standards for all members to follow in order to ensure that the total production of the cooperation is of excellent quality and meets their clients’ requirements, while considering the optimisation of corresponding cost. These requirements include specifications about (a) breeding and rearing conditions: type of feed, energy use, etc.; (b) size; and (c) weight. The producer cooperation, when setting their marketing standards, do not appear to follow either EU or their competitors’ requirements. However, they consider their customers’ expectations, ensuring that their products will not get rejected by them, reducing food waste.

Retailers impose their marketing standards on their suppliers, imposing strict requirements, including: (a) weight specifications; (b) fat content; (c) traceability; (d) origin; (e) transportation; and (f) packaging. The main reasons for the establishment of the retailers’ marketing standards are to improve product safety and fulfil their customers preferences. Similar to fruits and vegetables industry, in meat industry when retailers are setting their marketing standards, retailers do not appear to follow either EU or their competitors' requirements, indicating that they constantly monitor their competitors, but when it comes to marketing standards, they have no clear picture of the restrictions that they impose. Additionally, food service providers often set requirements for their suppliers. The primary reasons for doing so are to meet consumer expectations. Their marketing standards include strict specifications on delivery and storage of meat

Similar to the fruits and vegetable industry, the actors in the meat sector do not work with third parties to ensure that their partners adhere to their marketing standards requirements, but rather have dedicated workers for this purpose. The majority of the time, they work for the quality or the production technology teams. In restaurants, the head chef/kitchen manager performs this role.

Private marketing standards imposed by partners: requirements and importance

Similar to the fruits and vegetables industry, our analysis of the marketing standards imposed on various actors by their partners in the meat sector revealed that food service providers are exempt from any requirements, retailers must follow the requirements set by the food service providers, and distributors, processors/manufacturers, and farmers must follow the retailers' requirements. As a result, it is clear that retailers' marketing standards requirements have a big impact in the meat supply chain.

Retailers, in particular, are required to comply with strict requirements relating to (a) weight specifications of meat products; (b) food safety; and (c) traceability. The service provider's employees always check to ensure that the retailer satisfied the required criteria. On the other hand, producers and processors must adhere to retailers' requirements that focus on various specifications, including: (a) weight; (b); size; and (c) meat cuts. Employees, particularly the product manager team, are usually in charge of ensuring that partners meet retailers' marketing standards

Finally, similar to the fruits and vegetables sectors, the supply chain actors in the meat industry mentioned that adhering to the marketing standards set by their partners is crucial for maintaining long-term relationships with their partners, building trust and ensuring that they satisfy their clients who are a central part of their businesses. Looking at the other side of this business partnership, supply chain actors stated that it is especially important for retailers to collaborate with partners who meet their standards because this allows them to maintain high product quality in the market while also ensuring consumer safety.

Food waste due to private marketing standards and actions to reduce it

Similar to the fruits and vegetables industry, the proportion of their products that do not meet retailers' standards is repurposed or discarded***. Producers and processors report that approximately 10% of their products do not meet retailers' marketing standards***. They employ alternate methods to avoid food waste, such as freezing the products and selling them to alternative marketing channels, such as catering in ships.

A significant proportion of food could be wasted throughout in the retailing stage. ***Retailers reported that around 4% of the products offered by their suppliers do not match their standards each year***, mostly due to packaging and temperature issues caused during transport. When meat products are not of good quality, they are returned to their suppliers. To reduce food waste retailers, have stricter control procedures at delivery. Some retailers have also implemented technology to prevent food waste. They, for example, use digital tools which forecast their supply needs to optimise ordering and delivery and minimise cost and waste.

Furthermore, ***food service providers may waste a significant amount of food, with up to 10% of products delivered failing to fulfil their criteria each year***. When meat products are not of good quality, they are either returned to their suppliers or discarded, otherwise, they are given to retailers' employees. To reduce food waste, they do not overstock, and they use meat promotions to encourage consumption, or process meat to read to eat meals.

4.5 Examples of private marketing standards

In the framework of the project, different standards relevant to ROSETTA's food commodities were identified. Some of these, particularly those more relevant to ROSETTA's pilot cases, were further investigated. Examples of these standards are provided below:

Fruits & Vegetables

The Mercadona SPB standard is commonly applied within the Spanish fruits and vegetables sector, particularly for ensuring consistent quality and safety across Mercadona's private label products. This standard is widely used by Spanish producers due to its clear requirements and its role in maintaining consumer confidence, especially in the fresh produce category

Name of marketing standard	Mercadona SPB
Organisation or company imposing the standard	Mercadona
Food commodity (if it refers to a more specific product please note it, for example specific for apples)	Fruits and Vegetables
Documents about the standard	RETEMA SPBAnual
Scope of application	
i) Sector **ii) Geographical** **iii) Topics covered**	i) Retail + Production ii) National iii) In regards to fruits and vegetables, it focuses mainly on appearance and taste of products, as well as the use of certain chemicals for its production

Benefits from using the standard	1. Consistent Quality: The SPB standards ensure that all fruits and vegetables sold at Mercadona meet a consistent quality level, which enhances customer satisfaction and trust in the brand. 2. Affordability: By maintaining strict quality and sourcing standards, Mercadona can offer competitive prices, making fresh produce more accessible to a wider range of consumers. 3. Brand Reputation: Consistently high standards help build and maintain a strong brand reputation for quality and reliability. 4. Supply Chain Efficiency: The standardization of quality and size helps streamline the supply chain, reducing sorting and handling times and improving overall efficiency.
Restrictions from the no-use of the standard	1. Inconsistent Quality: Without the SPB standards, the quality of fruits and vegetables might vary significantly, leading to reduced customer satisfaction and potential loss of consumer trust. 2. Increased Complaints: Lack of consistent quality could lead to an increase in customer complaints and returns, which can be costly and damage the brand's reputation. 3. Market Differentiation: Without these standards, Mercadona might struggle to differentiate itself from competitors who do maintain high and consistent quality standards. 4. Operational Inefficiencies: The absence of standardised quality criteria can lead to inefficiencies in the supply chain, increasing costs and potentially leading to more waste during sorting and handling.
Examples of product specifications of project (e.g. size, appearance, how close to expiry date should optimally the product be, other cosmetic specs)	1. **Size**: - **Tomatoes**: Must be of uniform size, with a diameter between 60-70 mm for optimal presentation and packing. - **Apples**: Minimum diameter of 65 mm, ensuring they are easy to handle and visually appealing to customers. 2. **Appearance**: - **Bananas**: Must be free from blemishes, bruises, and significant curvature. The color should be a uniform yellow with minimal green at the tips. - **Peppers**: Should be firm, with a glossy skin and bright, uniform color (red, yellow, or green) with no signs of wrinkling or soft spots. 3. **Expiry Date**:

	- **Lettuce**: Should be sold within 3 days of harvest to ensure maximum freshness and crispness. - **Strawberries**: Should be sold within 2-3 days of picking to maintain optimal taste and texture. 4. **Other Cosmetic Specifications**: - **Cucumbers**: Should be straight, with a uniform dark green color and a smooth skin free from blemishes or discoloration. - **Carrots**: Must be straight, bright orange, and free from cracks or splits.
Treatment of suboptimal foods	Mercadona has implemented several strategies to handle suboptimal foods to minimise waste: 1. **Discounting**: Suboptimal foods that do not meet the stringent SPB standards but are still safe and edible are often sold at a discount. This helps reduce waste while offering customers more affordable options. 2. **Donations**: Produce that is close to its expiry date or has minor cosmetic defects is frequently donated to food banks and charitable organisations, ensuring it is consumed rather than wasted. 3. **Processing**: Suboptimal fruits and vegetables are sometimes redirected to processing facilities where they are used to make juices, sauces, or pre-cut fruit and vegetable packs. This adds value and reduces waste. 4. **Animal Feed**: Inedible produce is often repurposed as animal feed, providing a sustainable way to utilise waste products.

Dairy

Contractual obligation between dairy producer and retailer in Danish dairy sector

This contractual obligation in the Danish dairy sector is a standard requirement imposed by retailers and wholesalers when purchasing dairy products. This ensures that producers meet specific shelf-life expectations, providing the freshest possible products to end consumers.

Name of marketing standard	Contractual point – required by all wholesalers & retailers: Total durability
Organisation or company imposing the standard	The retailer that buys the food products from the producer. As well as the food wholesalers, that sell the products to restaurants etc.
Food commodity (if it refers to a more specific product please note it, for example specific for apples)	Dairy products
Documents about the standard	This standard is documented in every private contract made between retailers/wholesalers and the producers. It is a non-negotiable term required to sell your products.
Scope of application	
(i) Sector (ii) Geographical (iii) Topics covered	i) Retail and wholesale ii) National, International iii) Best before date / durability
Benefits from using the standard	Ensures the end customers receive the freshest product. Furthermore, increased and secure revenue for the retail/wholesaler, as they will have the longest possible time to sell the product within, and hopefully bring down their waste.
Restrictions from the no-use of the standard	It gives producers very limited time to sell products and impose higher risk of food waste upon the producers.
Examples of product specifications of project (e.g. size, appearance, how close to expiry date should optimally the product be, other cosmetic specs)	Milk with a shelf life of 12 days must have 9 days remaining on the morning of delivery, equating to 10 days remaining by the time it is dispatched. This restriction effectively limits the available selling period to just days 1 and 2 of the product's shelf life.

Treatment of suboptimal foods	Wholesalers often offer alternative methods for managing products that do not meet standard specifications by providing a pricing table based on the remaining shelf life. For example: • If a product is promised to have a durability of 10 days and is received with 9 days remaining, wholesalers may apply a 20% discount on the full price (10% of the shelf life shortfall multiplied by 2%). • For products with 8 days remaining, a 40% discount may be applied (20% of the shelf life shortfall multiplied by 2%). • For products with 7 days remaining, a 60% discount may be applied (30% of the shelf life shortfall multiplied by 2%). Despite these provisions, wholesalers rarely impose these discount penalties. Instead, they generally decline products with insufficient shelf life.

Cereals

The IFS Food standard is highly favoured within the grain and cereal production sector in Poland due to its widespread use among many mills, bakeries and other grains products manufacturers. This standard has earned popularity among food businesses in the country and is widely recognised for its broad and effective applicability, particularly in the context of grains.

Name of marketing standard	**IFS FOOD**
Organisation or company imposing the standard	IFS Management GmbH (a joint venture of the French retail association FCD and the German retail association HDE)
Food commodity (if it refers to a more specific product please note it, for example specific for apples)	Applicable to all food products, not specific to a particular commodity
Documents about the standard	LINK

Scope of application	
i) Sector **ii) Geographical** **iii) Topics covered**	i) Food manufacturing, processing, and handling sectors including primary production, processing, and trade ii) Global iii) - General aspects of food safety and quality management systems - Creating confidence in products and processes - Safety, quality, legality, authenticity, and compliance with specified customer requirements - On-site evaluation, documentation review, and inspection
Benefits from using the standard	1. Increased sales 2. Reduced operating costs 3. Improved efficiency 4. Continuous improvement through the scoring system 5. Ability to conduct individual risk assessments through the risk-based approach 6. Flexibility to create custom-made solutions due to its non-prescriptive nature
Restrictions from the no-use of the standard	1. Without IFS certification, companies may struggle to gain the trust of potential customers, affecting their ability to demonstrate commitment to quality and safety. 2. The lack of IFS certification could lead to higher operating costs and inefficiencies, as the certification's requirements are designed to improve processes and reduce costs related to waste, recalls, and rejected products. 3. Companies without IFS certification may find it challenging to drive continuous improvement in food safety and quality assurance, as the scoring system and audit reports provided by IFS certification play a significant role in indicating areas for progress and development. 4. The absence of IFS certification may limit a company's ability to conduct individual risk assessments and implement custom-made solutions tailored to their unique processes, potentially hindering their ability to ensure the highest standards of product safety and quality.
Examples of product specifications of project (e.g. size, appearance, how close to expiry date should optimally the product be, other cosmetic specs)	**Composition**: All grains must meet specific standards for attributes such as moisture content (typically not exceeding 14%) and protein content, which varies by grain type. **Physical, Organoleptic, Chemical, and Microbiological Characteristics**: Grains must meet defined criteria for hardness, aroma (e.g., a nutty aroma for quinoa), chemical residues (e.g., pesticide levels within permissible limits), and microbiological limits (e.g., total bacteria count should not exceed industry standards).

	Legal Requirements: Compliance with local and international regulations for contaminants, labelling, and food safety is mandatory - for instance, grains should not exceed the maximum permissible levels of mycotoxins. **Treatment Methods, Packaging, and Shelf Life**: Grains should undergo treatment to remove contaminants, be packed in moisture-proof and pest-resistant packaging, and have clear shelf life indicators on the label. The packaging must safeguard the grains from moisture and environmental factors. **Storage Conditions, Transport, and Distribution:** Grains must be stored in cool, dry, and well-ventilated conditions. Transport should be carried out in clean, dry, and pest-free vehicles. Distribution processes should avoid contamination and maintain the integrity of the product.
Treatment of suboptimal foods	The treatment of suboptimal foods should be based on the procedures outlined in the relevant quality management system. When non-conforming raw materials, semi-finished products, finished products, processing equipment, or packaging materials are identified, immediate actions should be taken to ensure that food safety and product quality requirements are complied with. This includes procedures for: o isolation/quarantine, o risk assessment, identification, o and decision-making regarding further usage, such as release, rework/reprocessing, blocking, quarantine, or rejection/disposal. It's important that all relevant employees understand and apply the procedures for managing non-conforming products, and finished products that are out of specification should not be placed on the market under the corresponding label unless a written approval of the brand owner is available.

Meat

GRMS (Global Red Meat Standard), further analysed below, provides a fully integrated quality management system, **specifically customised to the red meat industry**. Even though it has been developed in Denmark it is available for implementation globally and has achieved **GFSI recognition** for animal primary conversion and processing of perishable animal products.

Name of marketing standard	Global Red Meat Standard (GRMS)
Organisation or company imposing the standard	Danish Agriculture & Food Council, in partnership with its abattoir members and the Danish Meat Research Institute, has developed the Global Red Meat Standard (GRMS), a certification programme customised to the specific requirements applying to the red meat industry. The Standard is available for implementation by all meat producers within its scope.
Food commodity (if it refers to a more specific product please note it, for example specific for apples)	Red meat (pork, beef, lamb/sheep, goat, and horse meat)
Documents about the standard	Version 6.1 of the standard was published on 10 August 2020, valid from 10 August 2020, compulsory from 1 January 2021. In addition, Version 6.1 standard interpretation guidelines, published on 7 August 2020, are available to be downloaded from here.
Scope of application	

(iv) Sector (v) Geographical (vi) Topics covered	iv) Production. v) It has been established in Denmark but is available globally. vi) It outlines specific requirements for premises and equipment, operational systems and procedures, product specifications (i.e. characteristics, shelf life, packaging and shipping, labelling), nonconforming products, traceability, animal welfare, hygiene and sanitation, personnel, documentation and record-keeping.
Benefits from using the standard	Key benefits include: **Enhanced consumer trust**: it demonstrates commitment to animal welfare, food safety, and quality **Access to new markets**: many retailers and food service companies require or prefer GRMS-certified suppliers. **Improved operational efficiency**: Standardised processes can lead to cost savings and reduced waste. **Risk management**: Identifies and mitigates potential hazards to ensure product safety.
Restrictions from the no-use of the standard	Non-implementation of GRMS can be a significant barrier to market access for red meat sellers. It can limit access to major buyers, reduce consumer confidence, and put sellers at a competitive disadvantage.
Examples of product specifications of project (e.g. size, appearance, how close to expiry date should optimally the product be, other cosmetic specs)	GRMS provides overarching principles and guidelines rather than detailed product-specific criteria. The actual specifications (general examples of most common meat specifications are mentioned in Section 4.4 of this document). might be more granular at the level of individual meat cuts, processing methods, and target markets. **Many specific product requirements within standards like GRMS are often considered proprietary information, shared exclusively with certified organisations and their members.**
Treatment of suboptimal foods	The standard requests that appropriate product release procedures are prepared and implemented, including procedures for re-work in relation to nonconforming products.

FSSC 22000, further analysed below, contains a complete certification Scheme for Food Safety Management Systems aligned with the ISO Management System approach and the ISO Harmonised Structure. FSSC 22000 has been delivering impact on global food safety for 15 years. The Scheme provides a certification model that can be used in the food manufacturing industry and the related supply chain to ensure food safety standards and processes. FSSC 22000 is **GFSI-recognised** and follows the food chain category description as defined in ISO 22003-1:2022. **The most recent version of the Scheme introduced a new additional requirement focused on reducing food loss and waste**.

Name of marketing standard	FSSC 22000
Organisation or company imposing the standard	Foundation FSSC is the global non-profit and independent Scheme owner to provide trust and deliver impact to the consumer goods industry. Based in Europe, the Netherlands, they have regional representatives for organisations across North America, Latin America, South Asia, India, Japan, Türkiye, and the Middle East. They also have a liaison in China.
Food commodity (if it refers to a more specific product please note it, for example specific for apples)	It applies to various food commodities / food chain categories. Regarding meat and meat products, it applies to animal primary conversion and the processing of perishable animal products, including slaughtering, bulk chilling & freezing, bulk storage, cutting, deboning, and packaging of meat. It also covers the production of meat-based products such as sausages, hams, burgers etc.

Documents about the standard	In March 2023, FSSC 22000 published version 6 of its Scheme, which is mandatory since 1 April 2024, and can be downloaded from here. In addition, FSSC Guidance documents are available to assist certified organisations on how to implement certain requirements within their management system, including: Environmental Monitoring Equipment Management Food Defence Food Fraud Mitigation **Food Loss and Waste** Food Safety and Quality Culture Transport Tank Cleaning
Scope of application	
i) Sector **ii)** Geographical **iii)** Topics covered	i) Food manufacturing industry and related supply chain, including retail, catering, transport & storage, food packaging and animal feed. ii) International iii) The Scheme ensures food safety in production through a two-pronged approach: a) PRPs (Prerequisite Programmes): These set the foundation for hygiene by controlling factors like facility cleanliness, worker hygiene, and proper storage, b) HACCP (Hazard Analysis and Critical Control Points): This identifies and manages specific hazards like bacteria in meat processing. It focuses on critical control points (CCPs) like cooking temperatures to eliminate these hazards. The Scheme also covers other areas like traceability, labelling, and continuous improvement to maintain a robust food safety management system. For meat specifically, there's additional focus on controlling hazards like E. coli, managing allergens, and ensuring no chemical residue from medications used in animal rearing.

Benefits from using the standard	There are several benefits for businesses involved in meat and meat-based product production: **Enhanced food safety**: The core focus is on preventing foodborne illnesses by identifying and controlling hazards throughout the production process. This leads to safer products for consumers. **Improved brand reputation**: FSSC 22000 is a globally recognised certification, demonstrating a commitment to food safety and quality. This can enhance brand reputation and consumer trust. **Increased market access**: Many retailers and distributors require FSSC 22000 certification as a condition of doing business. Achieving certification can open doors to new markets and sales opportunities. **Streamlined operations**: The focus on preventive controls and HACCP helps identify and address potential problems before they occur, leading to improved efficiency and reduced waste. **Stronger risk management**: The systematic approach of FSSC 22000 helps businesses proactively identify and manage food safety risks, minimising the chance of product recalls and associated costs. **Alignment with other standards:** FSSC 22000 is based on ISO 22000, allowing for easier integration with existing quality management systems for a more holistic approach. Overall, implementing FSSC 22000 can bring significant benefits for meat producers, not just in terms of food safety but also in terms of brand reputation, market access, operational efficiency, and risk management.

Restrictions from the no-use of the standard	Ultimately, the decision of whether or not to implement FSSC 22000 depends on a seller's specific circumstances and market. However, the potential restrictions outlined below should be carefully considered when making this decision: **Limited market access**: Many major retailers and distributors require FSSC 22000 certification as a prerequisite for doing business. Without certification, sellers may be excluded from these important markets, limiting their sales potential. **Increased scrutiny from buyers**: Even if not strictly required, buyers may be more cautious about sourcing from non-certified companies. They may request additional audits or impose stricter quality control measures, increasing costs and complexity for the seller. **Reduced brand reputation**: Consumers are increasingly concerned about food safety. The lack of FSSC 22000 certification may raise concerns about a seller's commitment to food safety, potentially damaging brand reputation and consumer trust. **Competitive disadvantage**: In a competitive market, FSSC 22000 certification can be a significant differentiator. Sellers without certification may be at a disadvantage when competing with certified companies that can demonstrate their commitment to food safety.

Examples of product specifications of project (e.g. size, appearance, how close to expiry date should optimally the product be, other cosmetic specs)	FSSC 22000 Version 6 covers a wide range of **process requirements rather than product specifications**, to ensure food safety in meat and meat-based products. Here's a breakdown of some key areas: **PRPs (Prerequisite Programmes):** These are foundational controls that create a hygienic environment for production. They include: • **Premises and equipment:** Proper design, maintenance, and sanitation of buildings, equipment, and utensils. • **Personnel hygiene:** Training and practices to ensure worker hygiene to prevent contamination. • **Cleaning and sanitation:** Procedures for cleaning and sanitising surfaces, equipment, and transport vehicles. • **Pest control:** Strategies to prevent and manage pest infestations. • **Water control:** Management of water quality used in processing and cleaning. • **Transportation and storage:** Maintaining proper temperature controls and hygiene during transportation and storage. **HACCP (Hazard Analysis and Critical Control Points):** This identifies potential hazards specific to meat processing and establishes critical control points (CCPs) to prevent or eliminate them. Examples of CCPs in meat production could be: • Slaughtering and cutting procedures to minimise contamination • Cooking temperatures to ensure pathogen destruction • Cooling and freezing rates to prevent microbial growth **Other relevant requirements:** • **Traceability and recall:** Systems to track ingredients and finished products for efficient recall if necessary. • **Labelling:** Compliance with labelling regulations to ensure accurate information for consumers.

	• **Non-conformance management:** Processes for identifying and addressing deviations from food safety standards. • **Continual improvement:** Systematic approach to identify areas for improvement and enhance the food safety management system. **Additional considerations for meat products:** • Control of specific hazards associated with meat, such as E. coli, Salmonella, and Listeria. • Management of allergens (e.g., soy, milk) that may be present in ingredients or used during processing. • Control of chemical residues from antibiotics or veterinary medicines used in animal production. It is important to note that this is not an exhaustive list, and the specific requirements will depend on the type of meat product and the individual organisation's processes.
Treatment of suboptimal foods	FSSC 22000 version 6 introduced a new additional requirement focused on reducing food loss and waste (2.5.16 Food Loss and Waste). The standard mandates that organisations have: • Documented policy and objectives, outlining the strategy to reduce food loss and waste within the organisation and its supply chain. • Controls for managing product donations, ensuring food safety and compliance with regulations. • Management of surplus products/by-products intended as animal feed/food, maintaining food safety and regulatory compliance. The key objectives of this requirement are to: • Reduce food loss and waste by implementing effective strategies and controls. • Enhance food safety through proper management of donated products, surplus products, and by-products. • Contribute to sustainability by minimising the environmental impact of food production and consumption.

In addition to the global private marketing standards analysed above, this example presents an individual retailer's case of a collection of **private standard protocols for meat**, developed by **CHALKIADAKIS S.A.** - a leading local supermarket of the island of Crete in Greece - for the company's own use. The following analysis of this private standard, which includes a collection of protocols for meat, is based on exchange of information with expert personnel of CHALKIADAKIS S.A. that is not publicly available. Any documentation, on which this analysis is based, is **proprietary material** of CHALKIADAKIS S.A.

Name of marketing standard	**CHALKIADAKIS collection of private standard protocols for meat**
Organisation or company imposing the standard	CHALKIADAKIS S.A. is the largest supermarket chain In Crete, Greece, for over 44 years and with 41 stores all over Crete. The company and its dedicated Quality Control Department has established a collection of private marketing standard protocols, to assure the high quality of the meat offered to its customers.
Food commodity (if it refers to a more specific product please note it, for example specific for apples)	Meat (pork, beef, lamb/sheep, goat, and poultry)
Documents about the standard	Internal documentation, circulated within the company and stores, not publicly available. Approved by an external quality control advisor.
Scope of application	
i) Sector **ii) Geographical** **iii) Topics covered**	i) Retail - super market ii) Crete, Greece iii) a) **Meat producer ID**: Full Traceability System in meat; b) **Sourcing of meat**: Preference of local meat suppliers, a common practice within the purchasing/ sourcing department; c) **Crisis management due to climate change and global trend analysis: Course of actions when** sourcing meat from areas affected by climate change crises (such as floods, fires, and natural disasters) and monitoring global market quality issues, d) **Stock monitoring and analysis per store by processing date and increase of consumer awareness**:

	Reduction of food waste and increase of consumer awareness about food waste.
Benefits from using the standard	Key benefits include: **a) Meat producer ID**: **Enhanced consumer trust**: Demonstrates commitment to quality assurance, traceability, and the use of local meat sources. **Risk management**: Identifies and mitigates potential hazards to ensure product safety. **b) Sourcing of meat**: **Enhanced consumer trust:** Demonstrates commitment to local communities and economies and ensures trust in the quality of local products. **Risk management:** Reduces the risk of quality issues during meat transportation. **Food waste reduction**: Facilitates close collaboration between the Purchasing Department and producers to avoid excess supply. Producers are better informed about demand fluctuations due to seasonality and changes in customer behaviour, leading to higher flexibility. **Sustainability:** Supports local communities and reduces the logistics and transportation footprint. **c) Crisis management due to climate change and global trend analysis**: **Risk management**: Reduces the risks of quality issues caused by natural disasters in the sourcing area and by global quality issues in specific food categories/products. **Food waste reduction**: Minimises excess orders **d) Stock monitoring and analysis per store by processing date and increase of consumer awareness**: **Food waste reduction**: Minimises food waste resulting from inaccurate orders or unexpected demand fluctuations **Consumer trust**: Enhances sustainability and builds consumer confidence
Restrictions from the no-use of the standard	N.A.

Examples of product specifications of project (e.g. size, appearance, how close to expiry date should optimally the product be, other cosmetic specs)	a) **Meat producer ID:** Supplier; Lot number; Place of animal breed; Slaughter date. b) **Sourcing of meat**: Local suppliers are always preferred over domestic or foreign ones. c) **Crisis management due to climate change and global trend analysis**: Intensive lab sampling controls d) **Stock monitoring and analysis per store by processing date and increase of consumer awareness**: Maximum 5-7 days on display within the stores
Treatment of suboptimal foods	Suboptimal meat, identified through stock monitoring and analysis per store by processing date, is used to prepare and sell ready to eat meals.

5. Consumers, Food Waste and Suboptimal foods

5.1 The global challenge of food waste

The global statistics on food waste reveal that 30-50% of all food produced worldwide is lost across the entire supply chain, from production, harvest, processing and storing to distribution and consumption. In 2019 alone, over 931 million tons of food were discarded globally, with retail and household levels accounting for significant portions at 13% and 61%, respectively. [195]The impact of this waste is multidimensional. Environmentally, the toll is substantial, with 24% fresh water, 23% crop land, and 23% of fertilisers dedicated to producing food that goes to waste. [196] Economically, the impact is significant, with an annual cost of $161.6 billion attributed to wasted food in the United States alone. Furthermore, there are essential social and ethical dimensions to consider, as approximately 690 million people worldwide suffer from undernourishment.[197] When coupled with the ongoing population growth, projections indicate a need for a 50-70% increase in food supply by 2050 to meet global demand. [198] Given these challenges, understanding consumers' perceptions, knowledge, and attitudes towards food waste across the supply chain is imperative to develop tailored solutions and optimal programs aimed at reducing food waste.

5.2 Influences promoting food waste reduction among consumers

Consumer attitudes towards food waste are shaped by a complex mix of financial, moral, and environmental considerations. Many perceive wasting food as equivalent to wasting money, leading them to prioritise sustainability when it offers economic benefits. This mindset is particularly spread among individuals facing significant income or lifestyle changes, as they become aware of the financial implications of food waste. In addition to financial motives, moral principles play a significant role in shaping consumer behaviour. A notable percentage of consumers view food waste as morally wrong. Whether this is driven by the desire to set a positive example for their children or by concerns about global hunger issues, these individuals are committed to minimizing waste. Moreover, environmental concerns drive certain consumers to actively reduce food waste after recognizing the limit on natural resources and the environmental challenges associated with excessive waste, aiming to safeguard the planet for future generations.[199]

[195] Zhang, Yi & van Herpen, Erica & Van Loo, Ellen & Pandelaere, Mario & Geuens, Maggie. (2022). Save near-expired food: Does a message to avoid food waste affect food purchase and household waste prevention behaviors?. Journal of Cleaner Production. 384. 135555. 10.1016/j.jclepro.2022.135555.

[196] Kummu, M., de Moel, H., Porkka, M., Siebert, S., Varis, O., and Ward, P. J. (2012). Lost food, wasted resources: global food supply chain losses and their impacts on freshwater, cropland, and fertiliser use. Sci. Total Environ. 438, 477–489. doi: 10.1016/j.scitotenv.2012.08.092

[197] FAO, IFAD, UNICEF, WFP, and WHO. (2020). The State of Food Security and Nutrition in the World 2020: Transforming Food Systems for Affordable Healthy Diets. Rome, Italy: FAO, IFAD, UNICEF, WFP and WHO. doi: 10.4060/ca9692en Also Available in: Arabic Russian French Spanish Chinese.

[198] Ahmed S, Stewart A, Smith E, Warne T and Byker Shanks C (2021) Consumer Perceptions, Behaviors, and Knowledge of Food Waste in a Rural American State. Front. Sustain. Food Syst. 5:734785. doi: 10.3389/fsufs.2021.734785

[199] Nabi, N., Karunasena, G. G., & Pearson, D. (2021). Food waste in Australian households: Role of shopping habits and personal motivations. Journal of Consumer Behaviour. doi:10.1002/cb.1963

5.3 The problem of Suboptimal foods

A significant portion of food waste stems from consumers' reluctance to purchase and consume suboptimal foods.[200]

Suboptimal foods refer to perfectly safe-to-consume food items that deviate from standard expectations in terms of appearance, date labelling (e.g., nearing expiration date), or packaging. These foods may exhibit imperfections in cosmetic criteria such as appearance, colour, size, or may be nearing their labelled expiration date. Despite being safe and nutritious, consumers often hesitate to purchase or consume suboptimal foods due to perceptions of lower freshness or quality.

Retailers face pressure to cater to consumer preferences, leading them to enforce strict criteria and only accept flawless food items for retail. Consequently, substantial quantities of edible food are discarded within the supply chain due to not meeting these quality standards. This not only has notable economic and environmental consequences but also introduces an ethical dilemma. The unnecessary wastage of food solely for aesthetic reasons becomes particularly concerning in light of ongoing global issues surrounding food accessibility, quality, and security. [201]Given that consumer behaviours influence marketing restrictions, delving deeper into their attitudes towards sub-optimal foods is crucial. Identifying the primary barriers and understanding their responses to potential solutions and marketing strategies can facilitate a shift towards accepting suboptimal foods. Ultimately, this shift could encourage retailers to reconsider and potentially relax their stringent standards, therefore reducing the food waste in the supply chain.

Figure 7. Fruits and vegetables with suboptimal appearance

There are various factors that influence consumers' attitudes towards suboptimal foods, either positively or negatively. One of the primary influencers is the level of awareness and knowledge individuals possess regarding food waste. This encompasses their understanding of suboptimal foods, familiarity with the food production process, awareness of food waste issues, and knowledge of labelling and indicators of food quality.

[200] Zhang, Yi & van Herpen, Erica & Van Loo, Ellen & Pandelaere, Mario & Geuens, Maggie. (2022). Save near-expired food: Does a message to avoid food waste affect food purchase and household waste prevention behaviors?. Journal of Cleaner Production. 384. 135555. 10.1016/j.jclepro.2022.135555.

[201] Tsalis, G. (2019). What's the deal? Consumer price involvement and the intention to purchase suboptimal foods. A cross-national study. Food Quality and Preference, 103747. doi:10.1016/j.foodqual.2019.103747 10.1016/j.foodqual.2019.103747

Additionally, factors related to shopping habits and context, as well as dietary behaviors, play a significant role. These include frequency of supermarket visits, price sensitivity, preference for organic or meat products, and overall attitudes towards suboptimal foods. Socio-demographic factors such as household size, presence of children, and participants' pro-environmental beliefs and personality traits may also contribute to their behaviour.[202]

Figure 8. Factors affecting behaviour towards suboptimal foods and food waste

5.4 Measures of consumption patterns, consumer behaviour, and preferences

Knowledge and awareness

There is an overall discrepancy between consumers' perception of the importance of the food waste issue and their understanding of their own role in contributing to it. They believe they can easily reduce food waste but lack awareness of their significant contribution to it, underestimating household waste while overestimating waste at the retail level. Additionally, consumers feel that the media and government do not adequately address the food waste problem. [203]

Shopping Habits

Shopping habits greatly influence the amount of food waste generated by consumers and it's during the planning and shopping stages where the heaviest impact on food waste production occurs. It is evident that shopping is a routine procedure, and consumers often tend to purchase larger quantities of food to avoid frequent trips to the store throughout the week. Additionally, packages are often oversised, especially for one-person or couple households, while smaller packages tend to be more expensive. Various shopping practices, such as purchasing in bulk or taking advantage of discounts like "buy two, get one free," can indeed play a pivotal role.[204] Therefore, without careful meal planning, this can lead to food waste. In addition, the place where you purchase your food plays a pivotal role. Most people tend to buy their groceries primarily from large supermarket chains, while a smaller portion of the population shops at smaller local stores and farmers' markets. Research indicates that consumers who obtain their groceries from large supermarkets tend to

[202] Hartmann, T., Jahnke, B., & Hamm, U. (2021). Making ugly food beautiful: Consumer barriers to purchase and marketing options for Suboptimal Food at retail level – A systematic review. Food Quality and Preference, 90, 104179.
[203] Barbe, Federico & Dewitz, Philip & Gonzalez-Triay, Magdalena. (2017). Understanding Consumer Behaviour to Develop Competitive Advantage: A Case Study Exploring the Attitudes of German Consumers towards Fruits with Cosmetic Flaws. International Journal of Academic Research in Business and Social Sciences. 7. 10.6007/IJARBSS/v7-i6/3013.
[204] Aydın AE, Yildirim P, Understanding Food Waste Behavior: The Role of Morals, Habits and Knowledge, Journal of Cleaner Production, https://doi.org/10.1016/ j.jclepro.2020.124250

generate more food waste compared to those who shop at smaller establishments or participate in food production themselves.[205] This is because they are more aware of the resources and effort required for production. Similarly, studies have demonstrated that individuals who prioritise purchasing local foods are less likely to contribute to food waste, with reductions of up to 90% observed.[206],[207]. Furthermore, studies also indicate that brand recognition plays a significant role in food waste, as evidence suggests that risk aversion and brand familiarity contribute to consumers' willingness to purchase products nearing their expiration date. This stems from consumers' perceived sense of safety associated with trusted brands, particularly in higher-risk food categories like dairy products.[208]

Dietary Habits

Eating and dietary habits can also play an important role in the generation of food waste but also the acceptance of suboptimal foods. Traits such as vegetarianism and a preference for vegetables significantly impact the consumption and selection of fresh, aging products. Consumers who regularly eat fresh produce, such as vegetarians, tend to be more aware of the aging process and thus more willing to buy such products. They are also often more knowledgeable about the storage life of fresh foods.[209]

Disgust is a human emotion that protects us from eating spoiled foods and pathogens that could make us ill. While it plays an important role in keeping us safe from risky foods, it can also lead to stricter dietary habits and contribute to food waste. This emotion often explains why people avoid less-than-perfect foods. [210]Recent studies show that individuals with higher disgust sensitivity are more likely to throw away foods past their best-before date.[211]

Suboptimal foods and purchasing decisions

It's common for many individuals to hesitate when it comes to accepting suboptimal foods, often due to differences in appearance. Concerns primarily revolve around perceived lower product quality and safety issues, such as damage or spoilage. Studies have revealed that acceptance of suboptimal foods is influenced by consumers' experience with the production and farming processes, as well as the extent of deformity[212]. In the case of slight cosmetic deformations in vegetables, a significant percentage of consumers feel it's unjust that these products are not sold due to overly strict aesthetic standards imposed by the market. Interestingly,

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[205] Jorissen, J., Priefer, C., Br € autigam, K.-R., 2015. Food waste generation at household level: results of a survey among employees of two European research centers in Italy and Germany. Sustainability 7, 2695e2715.

[206] Setti, M., Falasconi, L., Vittuari, M., Andrea, S., Cusano, I., Griffith, C., Griffith, C., 2016. Italian consumers' income and food waste behavior. Br. Food J. 118.

[207] Schanes K, Dobernig K, Gözet B, Food waste matters - A systematic review of household food waste practices and their policy implications, Journal of Cleaner Production (2018), doi: 10.1016/j.jclepro.2018.02.030.

[208] Faruk Anıl Konuk, The role of risk aversion and brand-related factors in predicting consumers' willingness to buy expiration date-based priced perishable food products. Frin (2017), doi:10.1016/j.foodres.2018.06.009

[209] Christina M. Neubig, Jutta Roosen, Cornelia A. Karg, Simone Moser, It's safe and healthy! Increasing consumers' willingness to consume aging produce, Food Quality and Preference, Volume 101, 2022, 104608, ISSN 0950-3293, https://doi.org/10.1016/j.foodqual.2022.104608.

[210] Christina M. Neubig, Jutta Roosen, Cornelia A. Karg, Simone Moser, It's safe and healthy! Increasing consumers' willingness to consume aging produce, Food Quality and Preference, Volume 101, 2022, 104608, ISSN 0950-3293, https://doi.org/10.1016/j.foodqual.2022.104608.

[211] Stancu, V., & Lahteenmaki, L. (2022). Consumer-related antecedents of food provisioning behaviors that promote food waste. Food Policy, 108(3), Article 102236. https://doi. org/10.1016/j.foodpol.2022.102236

[212] Hooge, I. E. de, Oostindjer, M., Aschemann-Witzel, J., Normann, A., Loose, S. M., & Almli, V. L. (2017). This apple is too ugly for me! Food Quality and Preference, 56, 80–92. https://doi.org/10.1016/j.foodqual.2016.09.012

some people associate rougher product appearances with organic farming, as they deviate from traditional formats. The rejection of appearance-based suboptimal foods is also attributed to a lack of familiarity with such products in supermarkets, where all available items conform to stringent standards, leading to consumer hesitation in purchasing them. Concerning products close to expiration dates, most consumers tend to reject them unless they have a specific plan for immediate consumption. Safety concerns also play a role, as some individuals worry about falling ill from consuming such products. Additionally, broken packaging is viewed negatively by consumers, who fear loss of product, reduced quality, and overall mishandling.[213]

Effect of marketing strategies on food waste reduction.

Messaging marketing strategies for reducing food waste across retail and household levels.

In recent studies, it has been observed that integrating messages regarding food waste, particularly concerning products approaching their expiration date, can significantly influence consumers' purchasing decisions. Surprisingly, this effect remains even in the absence of economic incentives such as discounts. Moreover, this principle extends to suboptimal foods that may not meet aesthetic criteria.[214] Beyond purchase behaviour, the presence of such messages not only enhances consumers' willingness to buy but also boosts satisfaction levels, creating a sense of responsible consumption. Furthermore, this initiates consumers to take additional measures for proper storage and consumption at home, leading to a reduction in household food waste.[215]

Increasing the availability of suboptimal foods in retail stores

Retailers have adjusted their criteria and strategies to meet consumers' demand for flawless products. Consequently, suboptimal foods are not present in many major stores, and this is particularly important as consumers often lack experience with suboptimal foods due to their consistent exposure to perfect products, leading to reluctance to engage with imperfect items. However, research indicates that gradually introducing such foods into stores can increase consumer awareness. As a result, consumers may come to acknowledge that suboptimal foods are not inferior to regular products, particularly in terms of quality and freshness. [216]

Price reduction and discounts for food waste.

Studies have indicated that consumers often require a price reduction to consider purchasing sub-optimal foods, and reduced prices generally facilitate greater acceptance. The practice of lowering prices for products nearing their expiration date or displaying slight deviations in appearance is prevalent in stores across Europe.[217]

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[213] Stangherlin, Isadora & Ribeiro, Jose Luis & Barcellos, Marcia. (2019). Consumer behaviour towards suboptimal food products: a strategy for food waste reduction. British Food Journal. 10.1108/BFJ-12-2018-0817.

[214] van Giesen, R.I., de Hooge, I.E., 2019. Too ugly, but I love its shape: reducing food waste of suboptimal products with authenticity (and sustainability) positioning. Food Qual. Prefer. 75, 249–259. https://doi.org/10.1016/j.foodqual.2019.02.020.

[215] Zhang, Yi & van Herpen, Erica & Van Loo, Ellen & Pandelaere, Mario & Geuens, Maggie. (2022). Save near-expired food: Does a message to avoid food waste affect food purchase and household waste prevention behaviors?. Journal of Cleaner Production. 384. 135555. 10.1016/j.jclepro.2022.135555.

[216] Tsalis, G., 2020. What's the deal? Consumer price involvement and the intention to purchase suboptimal foods. A cross-national study. Food Qual. Prefer. 79 https:// doi.org/10.1016/j.foodqual.2019.103747.

[217] Aschemann-Witzel, Jessica & Giménez, Ana & Ares, Gastón. (2018). Consumer in-store choice of suboptimal food to avoid food waste: The role of food category, communication and perception of quality dimensions. Food Quality and Preference. 68. 29-39. 10.1016/j.foodqual.2018.01.020.

5.5 Consumer attitudes, pro-environmental behaviour and demographic elements

Various parameters such as gender, income, age, education, household size, and the presence of may affect consumer behaviours. For example, household size may be a key factor, especially concerning expiring food items, as there may be concerns about the ability to consume them before they spoil. The presence of children in the household or purchasing food for children may further influences the avoidance of suboptimal foods.[218]

In addition to demographic factors, personality aspects and pro- environmental behaviours can also play a crucial role in shaping consumption patterns, food waste and sustainable consumption. Consumers who are generally committed to environmental sustainability are more likely to choose environmentally friendly options. Moreover, individuals who prioritise biospheric values over egoistic aspects and have confidence in their ability to improve their environment are more inclined to make sustainable choices in their food consumption.[219]

6. EU consumer survey

6.1 Sample

After conducting comprehensive literature research and consulting with relevant partners, WR developed a questionnaire aimed at understanding stakeholders' perceptions, consumption patterns and attitudes regarding food waste due to marketing standards. The final questionnaire underwent pre-testing with a smaller group of participants.

Study's aim: The study aims to investigate consumer's attitudes towards food waste, food marketing practices, and foods that don't meet marketing standards in various European countries. By conducting an online survey with a large number of consumers, we aim to uncover what factors influence their decisions in relation to food. This research could provide valuable insights for companies and policymakers, helping them develop more effective marketing strategies and policies to reduce food waste and promote sustainable consumption habits across Europe.

[218] de Hooge, Ilona & Oostindjer, Marije & Aschemann-Witzel, Jessica & Normann, Anne & Mueller Loose, Simone & Almli, Valérie. (2016). This apple is too ugly for me: Consumer preferences for subotpimal food products in the supermarket and at home.

The survey was integrated into a crowdsourcing campaign (PROLIFIC), with the objective of securing 3,500 responses from the general public across 10 EU countries (Greece, Ireland, Spain, Poland, Denmark, Germany, France, Italy, Netherlands, Portugal). The selection of countries was guided by three key criteria: i) inclusion of the pilot areas of our project, ii) representation across diverse European regions (Central, Southern, Eastern, Northern, and Western Europe), and iii) access to a sufficient pool of participants to achieve the required sample size for analysis.

Figure 9: Ten EU countries (including our pilot regions) were chosen for the survey

Crowdsourcing was selected as the optimal method due to its efficiency in generating a large volume of responses within a constrained timeframe. Two specialised platforms were selected for the recruitment of participants:

1. ***Prolific*** stands out as a specialised platform dedicated to online subject recruitment tailored specifically for researchers. Unlike other crowdsourcing platforms that have been adapted for scientific use, Prolific emphasise high-quality recruitment standards at a reasonable cost, ensuring participants are fully informed that they are contributing to research. It has attracted thousands of researchers across disciplines such as economics, psychology, and food science. Prolific is characterised by its strict policies on participant treatment, a user-friendly interface, and nice functionality.[220]
2. **Dynata** uses extensive survey data from a global community to support in gathering meaningful consumer insights, by providing a unified platform that enables researchers to conduct targeted surveys and integrate findings across their market research (In Denmark, we observed a limited number of candidates available to respond to our questions on PROLIFIC. To ensure consistency and secure a sample size comparable to that of other countries, we decided to utilise DYNATA.)

"In addition, to mitigate the risk of not receiving enough responses from pilot countries with a more limited pool of respondents, we translated the questionnaire into the local pilot languages. These measures helped ensure that we gathered the necessary sample from all our survey countries."

Data collection occurred in multiple waves to monitor responses and maintain data quality (we utilised Prolific's functions to ensure that respondents would be unique and could not respond to our questionnaire multiple times). This chapter presents findings from descriptive and statistical analyses, focusing on consumer perceptions, preferences, attitudes, and behaviours towards food waste and marketing standards.

6.2 Questionnaire structure

Our research was designed aiming to investigate key dimensions of consumer behaviour and attitudes related to food waste and suboptimal foods at both country and cross-country levels. Below can be found some important aspects considered during the design of the survey.

[220] Stefan Palan, Christian Schitter, Prolific.ac—A subject pool for online experiments, Journal of Behavioral and Experimental Finance,Volume 17,2018,Pages 22-27,ISSN 2214-6350,https://doi.org/10.1016/j.jbef.2017.12.004.

Consumer perceptions and preferences:

- Examination of how demographic factors (e.g., age, income, education) and psychometric characteristics (e.g., personal values, personality traits) shape consumer attitudes and behaviors toward food waste and suboptimal foods.

Cultural and regional influences:

- Investigation of cultural dimensions (e.g., Hofstede's framework) and their role in explaining differences in consumer responses across our survey countries.
- Exploration of how cultural and demographic factors contribute to similarities and differences in consumer perceptions of food waste and suboptimal foods.
- Exploration of the regional variables, such as financial attitudes and ethical considerations, on consumer responses.

"Survey Variables"

#1 Food waste awareness
#2 Consumers' evaluation of the responsibility for market standards
#3 Norms, attitudes and ethical considerations,
#4Dietary habits
#5 Food disgust
#6 Avoidance due to cosmetic flaws
#7 Social media intensity
#8 Biospheric, altruistic, hedonic, and egoistic values
#9 Age
#10 Gender
#11 Education level
#12 Current net annual household income

Figure 10. Survey variables

Behavioral responses to food marketing:

- Study of consumption patterns and tolerance for suboptimal foods (e.g., fruits, vegetables, meat, dairy, cereals).
- Assessment of the impact of social media usage (e.g., Social Networking Intensity scale) on consumers.

Food waste perceptions:

- Evaluation of consumer awareness, knowledge, and ethical considerations related to food waste.
- Analysis of intentions to avoid food waste.
- Assessment of dietary habits and attitudes toward the edibility of foods (e.g., measured through the Food Disgust Scale).

Hofstede's dimensions and regional indexes were incorporated into our analysis to explore cross-country, regional, and cultural differences, as outlined in the methodology. The inclusion of these exogenous variables is a well-established practice in numerous studies published in leading academic journals[221,222,223,224,225,226]. These variables are further analysed in subchapters 6.3.3 and 6.3.4.

In addition, our use of multilevel analysis represents a state-of-the-art approach for handling heterogeneous datasets, particularly those combining exogenous and endogenous variables. This methodology is highly

[221] Songshan (Sam) Huang, John Crotts, Relationships between Hofstede's cultural dimensions and tourist satisfaction: A cross-country cross-sample examination, Tourism Management, Volume 72, 2019, Pages 232-241, ISSN 0261-5177, https://doi.org/10.1016/j.tourman.2018.12.001 .

[222] Hofstede, G., Garibaldi de Hilal, A. V., Malvezzi, S., Tanure, B., & Vinken, H. (2010). Comparing Regional Cultures Within a Country: Lessons From Brazil. Journal of Cross-Cultural Psychology, 41(3), 336-352. https://doi.org/10.1177/0022022109359696

[223] Djula Borozan, Regional-level household energy consumption determinants: The european perspective, Renewable and Sustainable Energy Reviews, Volume 90, 2018, Pages 347-355, ISSN 1364-0321, https://doi.org/10.1016/j.rser.2018.03.038

[224] Beugelsdijk, S., Kostova, T. & Roth, K. An overview of Hofstede-inspired country-level culture research in international business since 2006. J Int Bus Stud 48, 30–47 (2017). https://doi.org/10.1057/s41267-016-0038-8

[225] Strain, TessaAbdul Raheem, Raheema et al. National, regional, and global trends in insufficient physical activity among adults from 2000 to 2022: a pooled analysis of 507 population-based surveys with 5·7 million participants, The Lancet Global Health, Volume 12, Issue 8, https://doi.org/10.1016/S2214-109X(24)00150-5

[226] Charron, N., Dijkstra, L., & Lapuente, V. (2013). Regional Governance Matters: Quality of Government within European Union Member States. Regional Studies, 48(1), 68–90. https://doi.org/10.1080/00343404.2013.770141

versatile and applicable across various contexts[227]. The multi-level analysis is further elaborated on subchapter 6.3.5.

The survey's questions were clustered in 7 main sections, each of which corresponds to a series of dedicated research questions.

Theme 1: Knowledge and Awareness: This theme explores respondents' awareness and knowledge regarding food waste.
Theme 2: Perceptions and Attitude towards Food Waste: In this section, participants' attitudes and intentions towards reducing food waste were examined.
Theme 3: Shopping Habits: Shopping habits and routines were examined in this theme.
Theme 4: Dietary Habits: This theme explored respondents' dietary preferences and habits, including their attitudes towards vegetables, vegetarianism, and the criteria they used to determine food edibility.
Theme 5: Attitudes towards suboptimal foods: Attitudes towards imperfect foods were explored in this section. Participants rated their likelihood of purchasing cosmetically flawed produce and their reasons for doing so.
Theme 6: Biospheric-Altruistic-Hedonic-Egoistic Values: This theme focused on personal values related to environmental protection, humanitarianism, and personal enjoyment.
Theme 7: General Information – Demographics: This section gathered demographic data about participants, including their country of residence, age, gender, education level, and household income.

All demographic information was collected in compliance with the general data protection regulation (GDPR) of the European Union and was used solely for research and statistical reasons. No natural person can be identified through their demographic information. In addition, to take part in the survey, all research subjects had to agree to the terms and conditions set out to a dedicated consent form that was included in the online survey session. Finally, the management of datasets including such information adheres to the project's data management plan.

[227] Altsitsiadis E., Kaiser M., Tsakas A., Kyriakidis A., Stamos A. (2024). Investigating the Regional and Individual Drivers of the Support for Renewable Energy Transition: The Role of Severe Material Deprivation, https://www.jbs.cam.ac.uk/wp-content/uploads/2024/04/eprg-nts2402.pdf

6.3 Survey's Analysis

6.3.1 Descriptives

In analysing the data gathered and gaining meaningful insights regarding food waste, we adopted the following process:

- Data merging, cleaning, and preprocessing
- Data extraction combining related Questions (Qs)
- Exploratory Data Analysis (EDA), visualisations, and descriptives
- Multilevel analysis to examine which factors affect consumers' attitudes related to food waste

As already mentioned, we obtained a sample size for analysis (n=3537, at least 350 per country), in ten EU countries, that are Portugal, Italy, France, Ireland, Italy, Greece, Germany, Netherlands, Denmark, and Poland.

Concerning the respondents' sample, Figure 11 visualises the distributions of three key demographic variables; gender, education level, and current net annual household income within the surveyed population. The majority of respondents, 54%, identify as male, while 45% identify as female. A small fraction, less than 1%, identify as non-binary, prefer not to say, or belong to other gender categories. Regarding the education level, the distribution indicates a well-educated sample, with a significant portion holding higher education degrees. More precisely, the largest group, 38%, holds a Bachelor's Degree, followed by 30% who have attained a Master's Degree. A smaller proportion, 17%, completed High School or GED, while only 1% did not complete their education. A minority of respondents, 4%, have pursued advanced graduate work or a Ph.D., and 11% attended some college. Lastly, with respect to the current net annual household income, the largest segment, representing 18% of the respondents, falls within the €15,001 - €25,000 income range. Following this, 16% of respondents report incomes between €25,001 - €35,000, and 14% fall within the €5,001 - €15,000 range. Smaller segments represent higher income brackets, with 10% of respondents earning €75,001 or more. This distribution suggests a diverse economic background among the respondents, with a significant portion in the lower to middle-income brackets. Additionally, the average participant age was 33.9 years old.

Figure 12 illustrates the distribution of gender, education level, and current net annual household income across the 10 EU countries. Notably, Ireland stands out as the only country where the majority of participants identified as female, while in the other countries, male participants were the majority. In terms of education, Denmark has the highest number of participants holding a Bachelor's degree, whereas France has the highest number of participants with a Master's degree or a Ph.D. compared to the rest of the countries. Both Poland and Denmark have a considerable proportion of participants who have completed high school. Regarding annual income, Greece has a significant majority of participants earning between €5K and €15K, highlighting economic challenges. In contrast, Denmark has the largest share of participants earning €75K or more,

indicating a more affluent population. Meanwhile, in Italy, Portugal, and Poland, the majority of participants fall into the €15K to €25K income bracket.

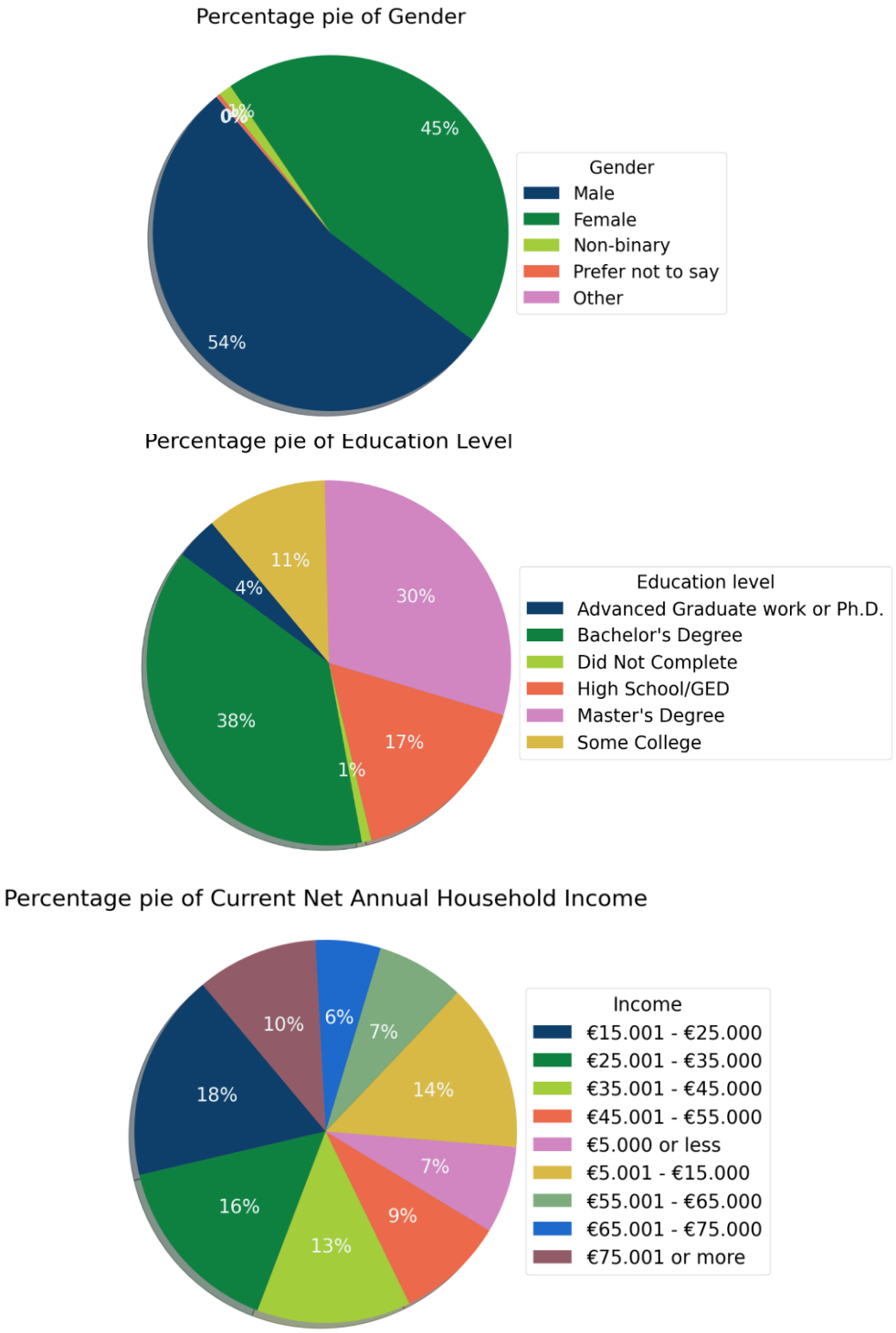

Figure 11. Gender, education level, and current net annual household income distributions.

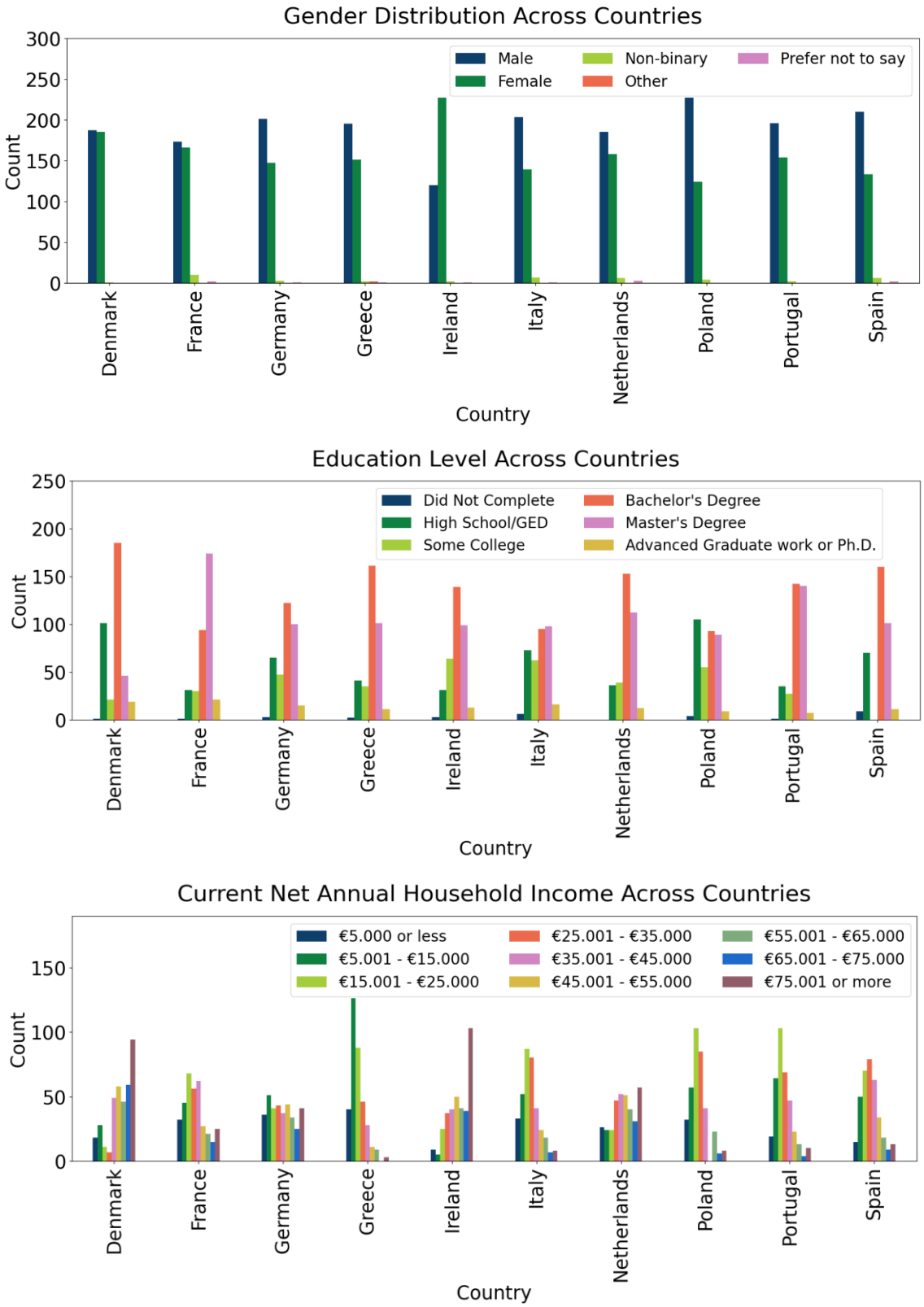

Figure 12. Gender, education level, and current net annual household income across the 10 EU countries

6.3.2Variables

This section examines the variables extracted from the survey and their utilisation to analyse the results.

6.3.2.1 Dependent Variables

In this study, the **five dependent variables** (DVs) under investigation are '**Intention to avoid food waste** (Q4)', '**Attitude toward suboptimal fruits** (Q17)', '**Attitude toward suboptimal meat** (Q22)', and '**Attitude toward suboptimal dairy products**(Q23)', and '**Attitude toward suboptimal cereals** (Q25). Across the four statements of survey Q4 (Figure 13), the majority of consumers express strong or somewhat strong agreement, reflecting a widespread and strong intention to minimise food waste in various aspects of their food-related behaviour. Moreover, the boxplot of Figure 14 illustrates consumers' willingness to consume different apples (labelled A to F) ranging from perfectly ripe to visibly suboptimal on a scale from 0 (certainly not) to 100 (absolutely). Consumers showed the highest tolerance for apples A and F, with a mean willingness score of 85.75 and 89.55 respectively. Apples C, D, and E received the lower mean scores indicating less tolerance among consumers. Interestingly, the distribution of responses shows that opinions are more varied for these apples. In general, while consumers are generally willing to consume suboptimal apples, their tolerance varies depending on the degree of visible imperfections. On the contrary, the visual quality of beef appears to have a more significant impact on consumers' willingness to consume the meat. This is evident in the lower mean scores observed in Figure 15, where consumers showed considerably less tolerance for suboptimal beef compared to the apples. The most visually unappealing beef (top sample) is largely rejected with a mean tolerance score of 13.19, while the most optimal beef (bottom sample) is generally accepted by consumers with a mean score of 77.12. Lastly, Figure 16 reveals a spectrum of beliefs about the safety of consuming dairy products after the best-before date. While the largest group (24%) somewhat agrees that there may be a risk, a significant number of respondents either disagree (17%) or somewhat disagree (17%), showing less concern. The mixed responses indicate that opinions on this issue are diverse, with varying levels of concern about potential food safety risks. Lastly, across the responses for Q25 (Figure 17), the majority of participants indicated that it is extremely unlikely (49%) or very unlikely (21%) to discard cereals with minor cosmetic flaws, such as slightly damaged packaging, even if they are still within the best-before date. This suggests a relatively high level of consumer flexibility when it comes to packaging imperfections. However, a smaller proportion (21%) remains somewhat or highly likely to discard cereals with minor cosmetic flaws in packaging.

Additionally, the different consumer attitudes across the 10 EU countries are investigated and presented in Figure 18, Table 4, and Figure 19 and Figure 20. Regarding the intention to avoid food waste, respondents from all countries exhibit a positive intention to avoid food waste. Nevertheless, some minorities in the Netherlands and Poland responded with 'Disagree' in Q4.3 and Q4.4, expressing their obsession with producing very little food waste and using all leftovers. Concerning the mean tolerance toward suboptimal food (Table 4), consumers in France have the highest tolerance for suboptimal apples, while consumers in Greece have the lowest. Interestingly, consumers located in Denmark and Ireland appear to be more tolerant toward suboptimal beef, whereas consumers in Poland are the least eager to use beef with clear visible imperfections. In Figure 19 risk perceptions of the dairy products are displayed across the 10 EU countries. In general, the largest proportion of consumers are not very concerned about utilising dairy products after the best-before date. On the other hand, it is worth mentioning that some consumers in France and Poland do not wish to use this type of dairy product. Lastly, the bar chart in Figure 18 illustrates how the likelihood of discarding cereals with minor cosmetic flaws varies across the different countries. In all countries represented, the largest group of respondents consistently selected "Extremely unlikely" to discard cereals due to minor packaging flaws. Nevertheless, consumers in Denmark and Italy show a comparatively higher tendency to choose to discard cereals due to imperfections in packaging, suggesting a slightly stricter attitude in these countries.

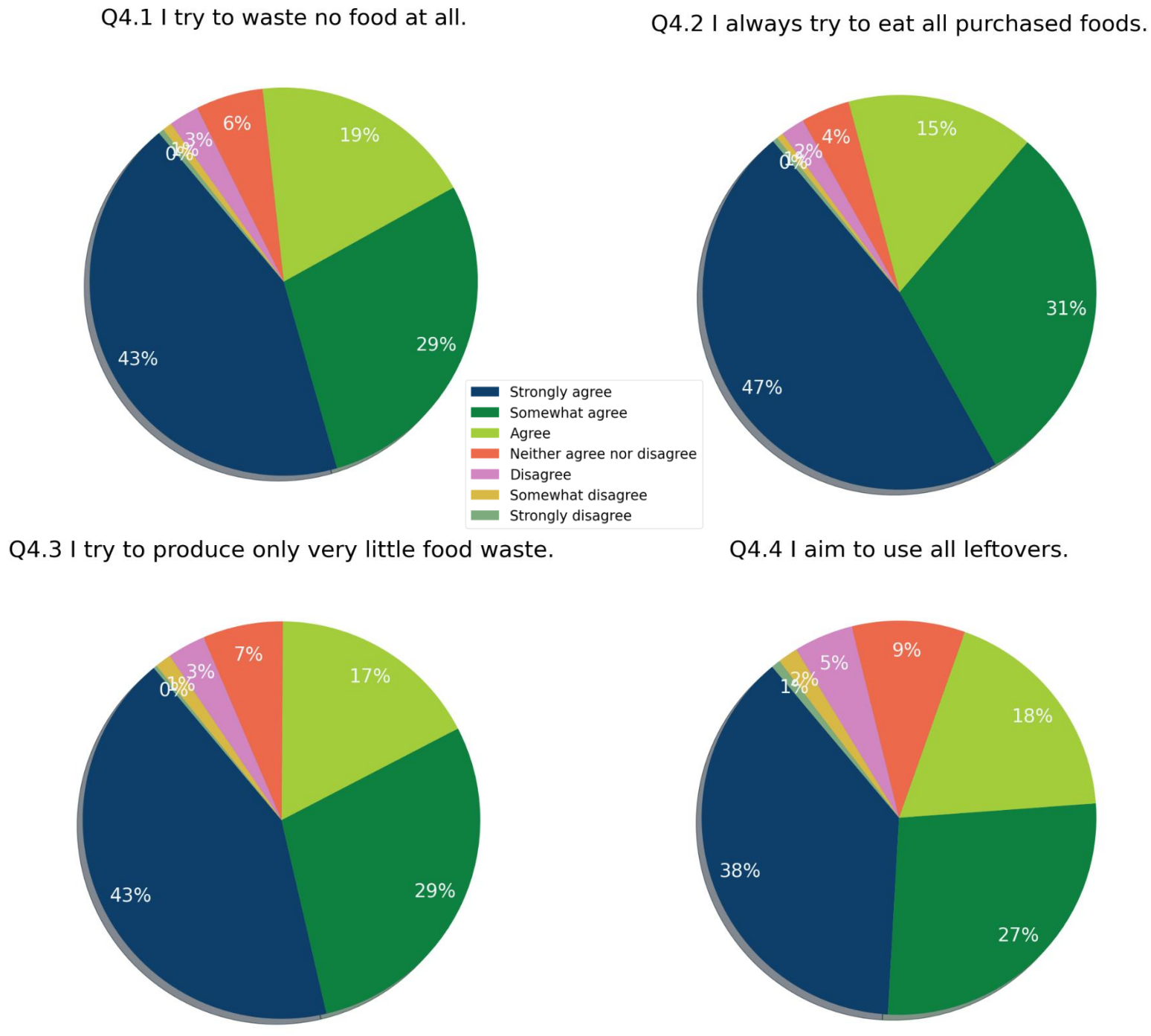

Figure 13. DV1 Intention to avoid food waste.

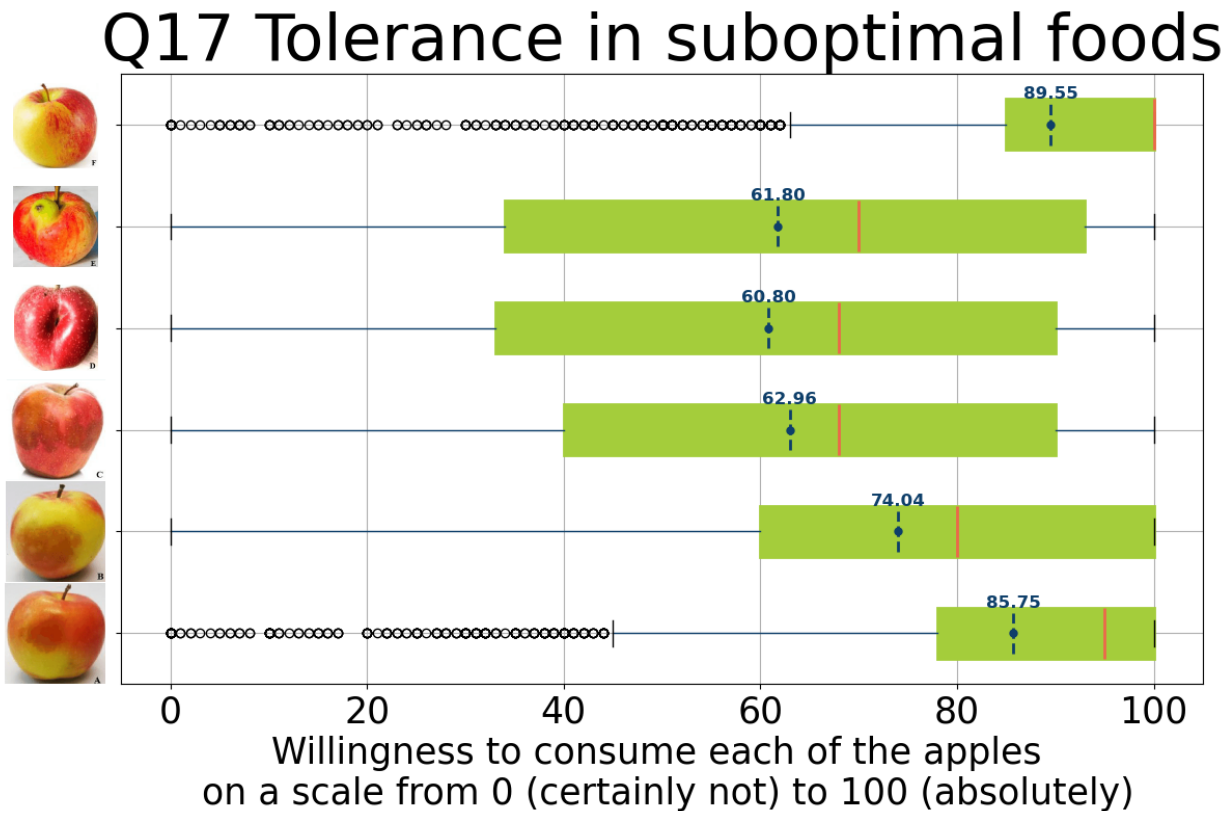

Figure 14. DV2 Attitude toward suboptimal fruits. The mean values of each response are depicted in blue.

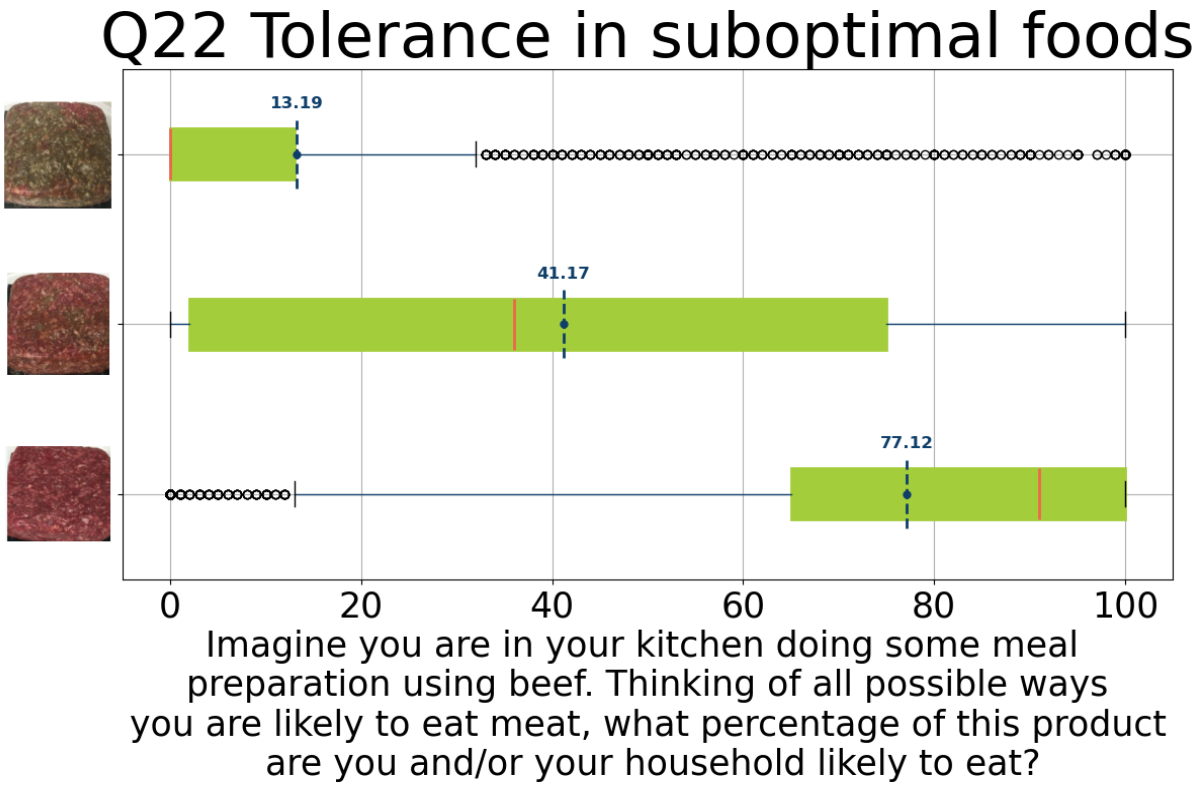

Figure 15. DV3 Attitude toward suboptimal meat. The mean values of each response are depicted in blue.

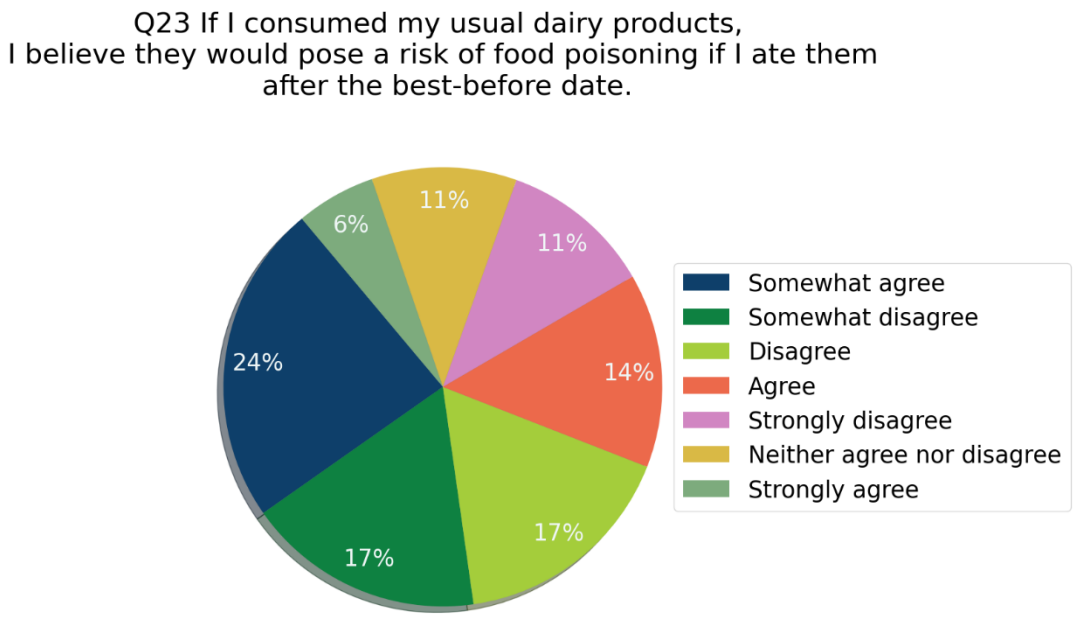

Figure 16. DV4 Attitude toward suboptimal dairy products.

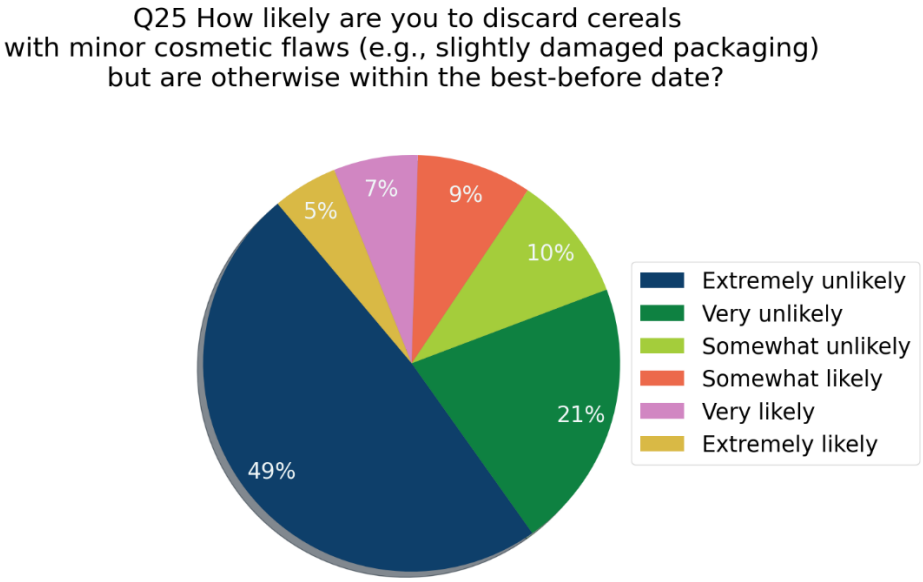

Figure 17. DV5 Attitude toward suboptimal cereals

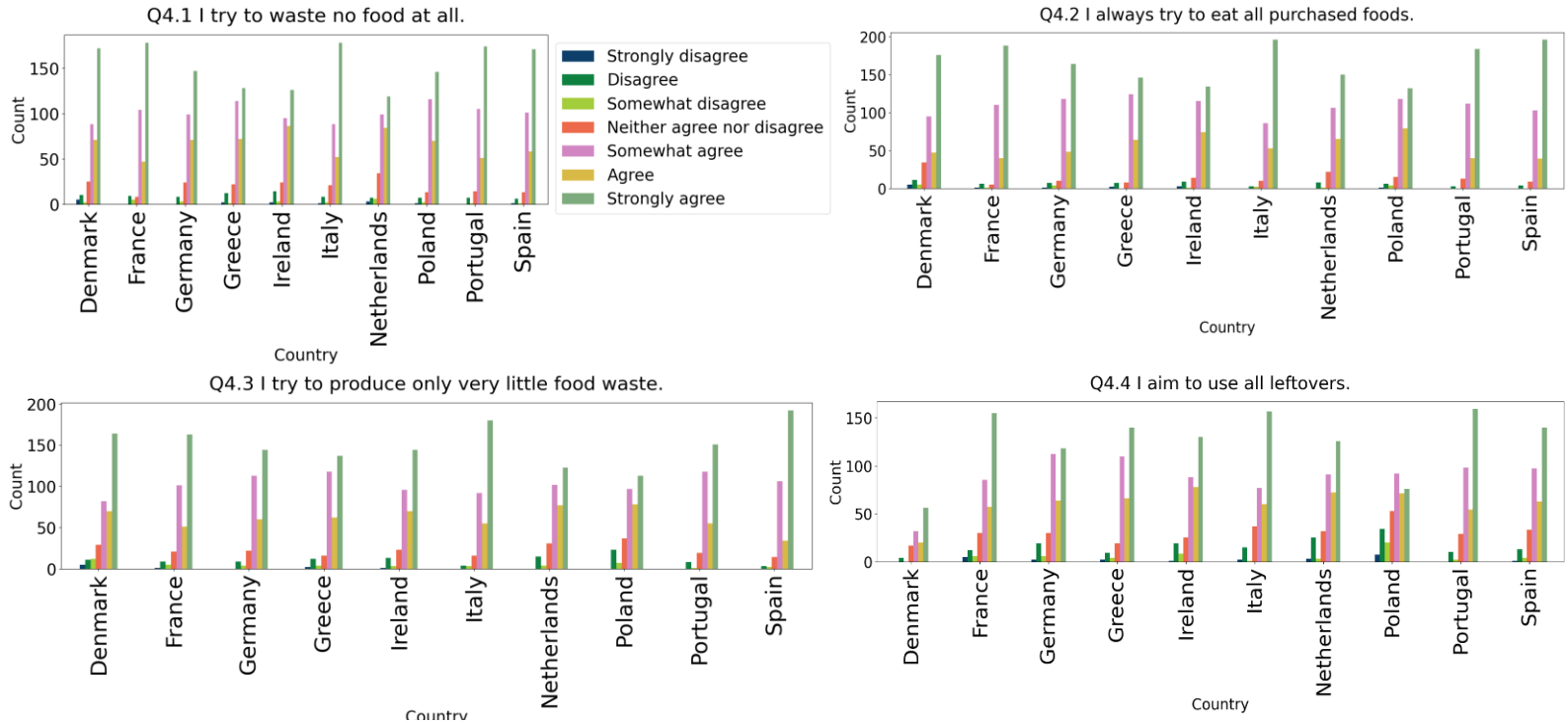

Figure 18. DV1 Intention to avoid food waste across countries.

Table 4. DV2 and DV3 Mean tolerance toward suboptimal food across countries. The maximum values per image are highlighted in green and the minimum in yellow.

									
Denmark	91.24	79.26	61.82	59.61	61.03	77.60	21.66	38.37	66.19
France	92.53	67.01	67.93	66.64	81.06	89.05	14.23	45.95	80.61
Germany	90.18	58.71	58.95	59.10	73.92	86.75	10.67	33.72	71.87
Greece	78.39	43.01	52.38	64.75	68.52	80.62	13.89	38.55	78.91
Ireland	90.44	64.61	58.86	53.67	72.88	85.80	15.83	52.63	81.25
Italy	92.44	61.03	64.15	69.64	80.26	89.94	14.13	44.95	77.15
Netherlands	88.76	60.21	58.03	60.39	73.50	84.91	12.75	42.34	73.48
Poland	92.30	63.37	62.99	66.59	76.12	87.71	7.03	29.09	78.18
Portugal	90.01	62.55	64.95	62.99	75.82	86.89	12.74	41.66	81.74
Spain	90.22	56.25	57.62	66.32	78.39	88.91	14.30	44.87	82.75

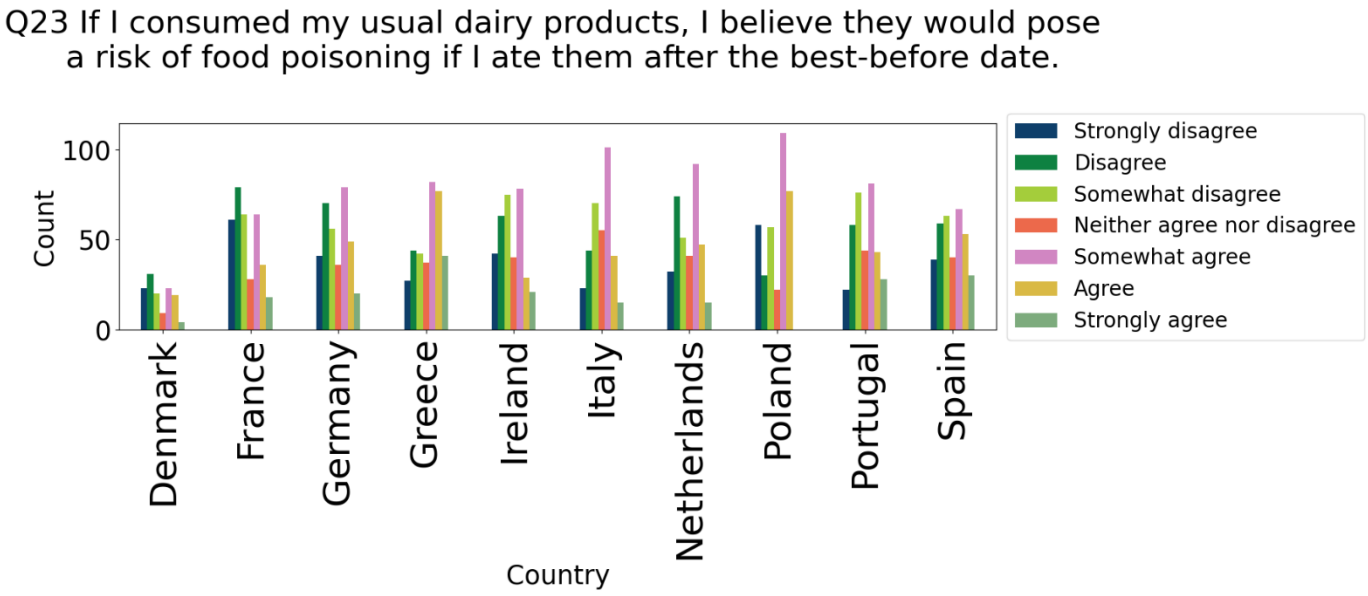

Figure 19. DV4 Attitude toward suboptimal dairy products across countries.

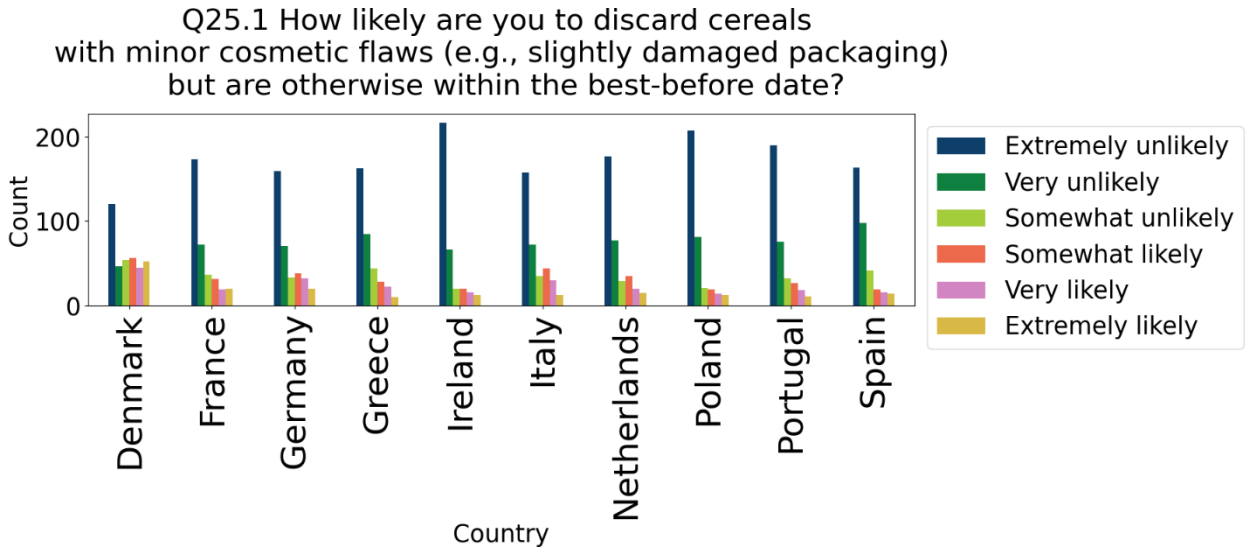

Figure 20. DV5 Attitude toward suboptimal cereals across countries

In extracting meaningful DVs from multiple Qs, we deployed a reliability analysis to evaluate if it is possible to merge specific Qs and express them in one new key variable. Thus, to ensure data consistency and reduce redundancy we calculated Cronbach's alpha (Tavakol, 2011) finding out whether or not the Qs represent related measurements. Cronbach's alpha ranges from 0 to 1, where higher values indicate higher reliability. If the alpha value is close to 1, it suggests high internal consistency, indicating that the Qs might be suitable for merging. The results suggested we can successfully merge the Qs shown in Table 5.

Table 5. Reliability analysis for DV1,2,3.

DV	Qs to merge	Cronbach's alpha
Intention to avoid food waste	Q4.1, Q4.2, Q4.3, Q4.4	0.80
Attitude toward suboptimal fruits	Q17.A, Q17.B, Q17.C, Q17.D, Q17.E, Q17.F	0.83
Attitude toward suboptimal meat	Q22A, Q22B, Q22C	0.69

6.3.3 Hofstede's Cultural Dimensions

Hofstede's Cultural Dimensions Theory[228] has been widely recognised and facilitated cross-cultural research across a range of academic disciplines[229]. To study the differences across the different participants' cultures, the following Hofstede Cultural Dimensions were utilised in our analysis:

A. **Power distance index (PDI)** refers to the power inequality between superiors and subordinates.
B. **Individualism vs. collectivism (IDV)** refers to how people value themselves and their groups/organisations.
C. **Uncertainty avoidance (UAI)** refers to people's tolerance of ambiguity.
D. **Motivation towards Achievement and Success (MAS)** defines the gender gaps and roles in groups/organisations.
E. **Long-term orientation vs. short-term orientation (LTO)** associates the connection of the past with the current and future actions/challenges.
F. **Indulgence vs. restraint (IND)** refers to the degree of freedom that societal norms give to citizens in fulfilling their human desires.

Country	Power Distance	Individualism	Motivation towards achievement	Uncertainty Avoidance	Long Term Orientation	Indulgence
Denmark	18	74	16	23	35	70
France	68	71	43	86	63	48
Germany	35	67	66	65	83	40
Greece	60	35	57	112	45	50
Ireland	28	70	68	35	24	65
Italy	50	76	70	75	61	30
Netherlands	38	80	14	53	67	68
Poland	68	60	64	93	38	29
Portugal	63	27	31	104	28	33
Spain	57	51	42	86	48	44

Figure 21. The six Hofstede cultural dimensions across the survey countries

[228] Hofstede, G. Culture's Consequences: International Differences in Work Related Values. Beverly Hills, CA: Sage. 1980
[229] Orr, L.C. A Re-Inquiry of Hofstede's Cultural Dimensions: A Call for 21st Century Cross-Cultural Research. 2008

6.3.4 Eurostat indices

We additionally incorporated the following data features from the Eurostat database[230]:

A. **Main Gross domestic product (GDP) per capita 2023** captures the economic activity within certain territories.
B. **Heating degree day (HDD)** index is a weather-based technical index designed to describe the need for the heating energy requirements of buildings.
C. **Cooling degree day (CDD)** index is a weather-based technical index designed to describe the need for the cooling (air-conditioning) requirements of buildings.
D. **Material deprivation** is an indicator that means the inability to afford some items considered by most people to be desirable or even necessary to lead an adequate life
E. **Regional innovation scoreboard (RIS)** assesses the innovation performance of European regions on a limited number of indicators.

6.3.5 Multilevel Analysis

In further analysing the survey results, a multilevel regression analysis was adopted as the analytical strategy to simultaneously examine group-level and individual-level factors influencing food waste-related behaviours. The multilevel analysis conducted provides insights into the relationships between various independent variables (IDVs), such as Hofstede Cultural Dimensions[231], Eurostat indices[232], and survey-specific behavioural and psychological variables and the five DVs. Each DV is predicted across the following four levels:

Level 1 is the baseline model including only the intercept to capture the average behaviour across the entire sample.

Level 2 includes Hofstede's cultural dimensions, which capture cultural differences across different populations.

Level 3 adds some Eurostat socio-economic indices.

Level 4 incorporates psychological and behavioural variables directly obtained from the survey, that are food waste awareness (Q1), consumers' evaluation of the responsibility for market standards (Q3), norms, attitudes and ethical considerations (Q8), dietary habits (Q15), food disgust (Q16), avoidance due to cosmetic flaws (Q20), social media intensity (Q27), biospheric, altruistic, hedonic, and egoistic values (Q31), age (Q34), gender (Q35), education level (Q36), and current net annual household income (Q37).

Table 6, Table 7, Table 8, Table 9 and Table 10 include the results of the multilevel analysis for each DV in detail. Generally, if the p-value is less than 0.05, the results are considered statistically significant, which means that the findings are unlikely to have occurred by chance alone, and there may be a real effect or difference. The statistically significant variables are highlighted in bold green in Table 6, Table 7, Table 8, Table 9 and Table 10. The estimate value (also known as the regression coefficient) represents the direction and magnitude of the relationship between each IDV and the DV.

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[230] European Commission. (n.d.). Eurostat database. European Commission. Retrieved August 22, 2024, from https://ec.europa.eu/eurostat/databrowser/explore/all/all_themes?lang=en&display=list&sort=category
[231] https://data.world/adamhelsinger/geerthofstedeculturaldimension
[232] https://ec.europa.eu/eurostat/databrowser/explore/all/all_themes?lang=en&display=list&sort=category

DV1: Intention to Avoid Food Waste

Table 6 presents the results of exploring the relationships between the IDVs and DV1. The high intercept values across all three steps indicate a strong baseline intention to avoid food waste.

Notably, the first step did not raise any statistically significant relationships between the Hofstede cultural dimensions and DV1. Adding the level of Eurostat indices, created the following statistically important variables; Power distance (0.14), Individualism (-0.11), Motivation towards achievement (0.15), Uncertainty avoidance (-0.28), Long term orientation (0.04), GDP (-0.1), HDD (-0.01), CDD (-0.02), RIS (0.31). More precisely, power distance has a positive impact on DV1, indicating that the higher the power distance the more probable is consumers to intend to avoid food waste. Individualism is negatively correlated with DV1, stating that consumers with low individualism are more likely to try to minimise food waste. Motivation towards achievement has a positive impact, indicating that consumers highly motivated to achieve are more likely to intend to avoid food waste. Uncertainty avoidance has a negative relationship with DV1, meaning that people who prefer rules are less likely to avoid food waste. Long term orientation positively affects DV1, indicating that consumers interested in future rewards are keener on trying to avoid food waste. Regarding the Eurostat region-related indices GDP, HDD, and CDD have a negative impact on DV1, underlying the fact that consumers located in regions with lower GDP, HDD, and CDD are more likely to try to minimise food waste. Lastly, people residing in regions with high RIS index, are more likely to intend to avoid food waste.

The full model, containing variables from all levels, resulted in adding Indulgence from Hofstede cultural dimensions and Material deprivation from Eurostat in statistically important estimators. Indulgence (0.24) has a positive impact on DV1. Namely, the more indulgent a consumer feels, the more probable is to avoid food waste. On the contrary material deprivation (-0.21) has a negative impact stating that the more incapable are consumers to afford and access crucial items, the less interested are in minimising food waste. Concerning the psychological and behavioural variables obtained by the survey questions, norms, attitudes, and ethical considerations (0.6) are strong positive predictors of the intention to avoid food waste. The more influenced are consumers by these considerations, the more they intend to minimise food waste. On the contrary, hedonic values (-0.1) negatively affect the DV1 prediction, the lower they feel gratification the more probable is to avoid food waste. The remaining positive factors are consumers' evaluation of the responsibility for market standards (0.6), social media intensity (0.17), and altruistic values (0.13), while dietary habits (-0.02), food disgust (-0.06), and avoidance due to cosmetic flaws (-0.05) have negative impacts on DV1.

DV2: Attitude Towards Suboptimal Fruits

The results concerning DV2 are reported in Table 7. In the first level power distance, uncertainty avoidance, and indulgence are statistically significant predictors for DV2. In the second layer, there is no statistically important variable. Finally, in the full model, the more statistically important factors derive from the survey questions. The statistically significant psychological and behavioural variables are food waste awareness, consumers' evaluation of the responsibility for market standards, dietary habits, food disgust, avoidance due to cosmetic flaws, social media intensity, biospheric, altruistic, and hedonic values, and household income. Interestingly, the Social Networking Intensity scale (SNI) plays a crucial positive role in consumers' attitudes toward suboptimal fruits. Additionally, food disgust is negatively associated with DV2.

DV3: Attitude Towards Suboptimal Meat

In predicting DV3, as shown in Table 8, Hofstede and Eurostat variables are not statistically significant in the first two layers of the regression. In the full model and last layer, Hofstede and Eurostat variables become important. Additionally, food waste awareness, norms, attitudes and ethical considerations, dietary habits,

food disgust, biospheric, altruistic, and egoistic values, education level, current net annual household income, and age are significant estimators. More specifically, indulgent consumers are more likely to have a positive attitude towards suboptimal meat, while consumers with a low tolerance for uncertainty do not seem to have a positive attitude towards suboptimal meat. It is worth mentioning that consumers who do not have access to crucial daily items are more likely to consume suboptimal meat.

DV4: Attitude toward suboptimal dairy products

The results of DV4 in Table 9 show that a wide range of Hofstede cultural dimensions, Eurostat indices, and survey variables play an important role, but with lower estimated values than in the case of the rest of the DVs. In the first layer, five out of 6 Hofstede cultural dimensions are statistically important. In the second regression step, power distance, individualism, long term orientation, material deprivation, and RIS play a crucial role. In the last step, all Hofstede and Eurostat variables become important, as well as the majority of the survey variables. This fact underlines the complex interplay between cultural norms, economic conditions, and personal beliefs in shaping risk perceptions related to dairy consumption. Notably, uncertainty avoidance is negatively correlated with dairy risk perception, meaning that the more tolerant the consumers are of uncertainty the less probable is to consume dairy products after the best-before date. Furthermore, the higher the power distance the more probable consumers to have a low-risk perception regarding dairy products. Concerning the psychological and behavioural variables acquired from the survey questions, dietary habits negatively affect dairy risk perception, while egoistic values have a positive relationship with DV4.

DV5: Attitude toward suboptimal cereals

In inferring DV5, as shown in Table 10, the survey variables play the most crucial role. In the second step, only the RIS index is statistically significant, suggesting that regional innovation has a noteworthy role in shaping consumer attitudes toward cereals. In the last step, the survey-related psychological and behavioural variables serve as statistically important contributors to DV5. More precisely, food waste awareness, norms, dietary habits, food disgust, hedonic values, income, and age have a positive relation with the attitude toward cereals, while on the other hand, biospheric and altruistic values, gender, and age correlate negatively with consumers' attitude toward cereals. The Hofstede cultural dimensions (e.g., individualism, long-term orientation) and most Eurostat variables lack significance, pointing to a stronger individual and psychological basis for cereal attitudes compared to structural or macroeconomic factors.

Table 6. Multilevel analysis for DV1 (Intention to avoid food waste). Note: Values in green are statistically significant with p<0.05. Values in parentheses are standard errors.

DV1: Intention to avoid food waste			
	Step 1	**Step 2**	**Full model**
Level 1 – Intercept	**5.96819 (0.06869)**	**5.96759 (0.01550)**	**5.96756 (0.01329)**
Level 2 – Hofstede Cultural Dimensions			
Power distance	0.01110 (0.01804)	**0.14289 (0.06550)**	**0.16469 (0.05983)**
Individualism	-0.01349 (0.01166)	**-0.11122 (0.05485)**	**-0.13255 (0.05014)**
Motivation towards achievement	0.000565 (0.00480)	**0.15002 (0.07544)**	**0.17159 (0.06870)**
Uncertainty avoidance	-0.01199 (0.01391)	**-0.27638 (0.12737)**	**-0.31550 (0.11633)**
Long term orientation	0.00678 (0.00697)	**0.03880 (0.01858)**	**0.04591 (0.01696)**
Indulgence	-0.00323 (0.00826)	0.20045 (0.10573)	**0.23688 (0.09634)**
Level 3 - Eurostat indices			
2023_main_GDP_per_capita		**-0.09733 (0.04716)**	**-0.11136 (0.04299)**
Heating degree days		**-0.00565 (0.00255)**	**-0.00606 (0.00232)**
Cooling degree days		**-0.01860 (0.00863)**	**-0.01994 (0.00785)**
Material_Deprivation		-0.15124 (0.10245)	**-0.20518 (0.09328)**
RIS		**0.31395 (0.01654)**	**0.28647 (0.01473)**
Level 4 – Survey's variables			
Food waste awareness (Q1)			-0.01562 (0.01373)
Consumers' evaluation of the responsibility for market standards (Q3)			**0.60300 (0.03026)**
Norms, attitudes and ethical considerations (Q8)			**0.10886 (0.02539)**
Dietary habits (Q15)			**-0.02387 (0.00698)**
Food disgust (Q16)			**-0.05980 (0.01602)**
Avoidance due to cosmetic flaws (Q20)			**-0.04745 (0.01110)**
Social media intensity (Q27)			**0.16700 (0.01872)**
Biospheric values (Q31)			0.02255 (0.02165)
Altruistic values (Q31)			**0.12798 (0.01764)**
Hedonic values (Q31)			**-0.10374 (0.01533)**
Egoistic values (Q31)			-0.02403 (0.02608)
Gender (Q35)			-0.02214 (0.01166)
Education level (Q36)			0.00294 (0.00601)
Current net annual household income (Q37)			0.00126 (0.00136)
Age (Q34)			0.01079 (0.02794)

DV2: Attitude towards suboptimal vegetables			
	Step 1	**Step 2**	**Full model**
Level 1 – Intercept	**72.3338 (0.3268)**	**72.3338 (0.3262)**	**72.3205 (0.3023)**
Level 2 – Hofstede Cultural Dimensions			
Power distance	**0.3777 (0.0927)**	-0.5811 (1.3815)	0.6701 (1.3607)
Individualism	-0.0128 (0.0686)	0.8653 (1.1571)	-0.2590 (1.1403)
Motivation towards achievement	-0.0295 (0.0226)	-1.0259 (1.5903)	0.3810 (1.5626)
Uncertainty avoidance	**-0.2740 (0.0814)**	1.4079 (2.6849)	-1.0681 (2.6457)
Long term orientation	0.0321 (0.0362)	-0.2811 (0.3920)	0.0942 (0.3857)
Indulgence	**-0.2017 (0.0403)**	-1.6787 (2.2291)	0.3389 (2.1910)
Level 3 - Eurostat indices			
2023_main_GDP_per_capita		0.5890 (0.9938)	-0.3190 (0.9778)
Heating degree days		0.0268 (0.0538)	-0.0177 (0.0528)
Cooling degree days		0.0856 (0.1817)	-0.0655 (0.1785)
Material_Deprivation		1.9276 (2.1644)	-0.1036 (2.1216)
RIS		0.5293 (0.6797)	0.2040 (0.3349)
Level 4 – Survey's variables			
Food waste awareness (Q1)			**-1.2177 (0.3123)**
Consumers' evaluation of the responsibility for market standards (Q3)			**1.5785 (0.6883)**
Norms, attitudes and ethical considerations (Q8)			1.0312 (0.5774)
Dietary habits (Q15)			**-1.0862 (0.1588)**
Food disgust (Q16)			**-5.0232 (0.3644)**
Avoidance due to cosmetic flaws (Q20)			**-0.7960 (0.2523)**
Social media intensity (Q27)			**2.0329 (0.4258)**
Biospheric values (Q31)			**1.5240 (0.4924)**
Altruistic values (Q31)			**0.8357 (0.4012)**
Hedonic values (Q31)			**-2.1678 (0.3487)**
Egoistic values (Q31)			-0.3454 (0.5931)
Gender (Q35)			-0.3799 (0.2651)
Education level (Q36)			0.1220 (0.1366)
Current net annual household income (Q37)			**0.1663 (0.0308)**
Age (Q34)			0.4458 (0.6354)

Table 7 Multilevel analysis for DV2 (Attitude toward suboptimal fruits). Note: Values in green are statistically significant with p<0.05. Values in parentheses are standard errors.

DV3: Attitude towards suboptimal meat			
	Step 1	**Step 2**	**Full model**
Level 1 – Intercept	**44.94711 (0.8234)**	**44.9318 (0.3969)**	**44.931 (0.3815)**
Level 2 – Hofstede Cultural Dimensions			
Power distance	0.27618 (0.2229)	1.3893 (1.6810)	**5.330 (1.7175)**
Individualism	-0.15924 (0.1535)	-0.8624 (1.4079)	**-4.186 (1.4393)**
Motivation towards achievement	0.04373 (0.0574)	1.2536 (1.9350)	**5.788 (1.9723)**
Uncertainty avoidance	-0.21912 (0.1823)	-2.4923 (3.2669)	**-10.417 (3.3395)**
Long term orientation	0.00413 (0.0866)	0.2368 (0.4770)	**1.290 (0.4868)**
Indulgence	0.13147 (0.0995)	1.6907 (2.7123)	**8.073 (2.7656)**
Level 3 - Eurostat indices			
2023_main_GDP_per_capita		-0.8164 (1.2092)	**-3.755 (1.2342)**
Heating degree days		-0.0506 (0.0655)	**-0.205 (0.0667)**
Cooling degree days		-0.1602 (0.2211)	**-0.689 (0.2253)**
Material_Deprivation		-0.6036 (2.6336)	**-6.192 (2.6779)**
RIS		1.6077 (0.8271)	**0.951 (0.4228)**
Level 4 – Survey's variables			
Food waste awareness (Q1)			**-1.179 (0.3942)**
Consumers' evaluation of the responsibility for market standards (Q3)			0.653 (0.8687)
Norms, attitudes and ethical considerations (Q8)			**-5.483 (0.7288)**
Dietary habits (Q15)			**-2.087 (0.2005)**
Food disgust (Q16)			**-1.934 (0.4600)**
Avoidance due to cosmetic flaws (Q20)			0.166 (0.3185)
Social media intensity (Q27)			-0.166 (0.5374)
Biospheric values (Q31)			0.384 (0.6215)
Altruistic values (Q31)			**2.018 (0.5064)**
Hedonic values (Q31)			-0.525 (0.4401)
Egoistic values (Q31)			**-4.472 (0.7487)**
Gender (Q35)			-0.121 (0.3346)
Education level (Q36)			**0.396 (0.1725)**
Current net annual household income (Q37)			**0.250 (0.0389)**
Age (Q34)			**1.592 (0.8020)**

Table 8. Multilevel analysis for DV3 (Attitude toward suboptimal meat). Note: Values in green are statistically significant with p<0.05. Values in parentheses are standard errors.

DV4: Attitude toward suboptimal dairy products (Q23)			
	Step 1	**Step 2**	**Full model**
Level 1 – Intercept	**4.02586 (0.05653)**	**4.01390 (0.02757)**	**4.0139 (0.02566)**
Level 2 – Hofstede Cultural Dimensions			
Power distance	**0.08513 (0.01532)**	**0.24711 (0.11665)**	**0.4957 (0.11623)**
Individualism	**-0.04875 (0.01056)**	**-0.19662 (0.09770)**	**-0.4078 (0.09739)**
Motivation towards achievement	**0.01228 (0.00395)**	0.20459 (0.13427)	**0.5003 (0.13347)**
Uncertainty avoidance	**-0.07044 (0.01254)**	-0.37332 (0.22675)	**-0.9019 (0.22618)**
Long term orientation	**0.02857 (0.00595)**	**0.08370 (0.03308)**	**0.1450 (0.03289)**
Indulgence	0.00783 (0.00684)	0.28638 (0.18821)	**0.7002 (0.18714)**
Level 3 - Eurostat indices			
2023_main_GDP_per_capita		-0.11139 (0.08393)	**-0.3114 (0.08359)**
Heating degree days		-0.00604 (0.00455)	**-0.0164 (0.00452)**
Cooling degree days		-0.01871 (0.01535)	**-0.0551 (0.01526)**
Material_Deprivation		**-0.38668 (0.18261)**	**-0.6902 (0.18070)**
RIS		**0.16262 (0.05745)**	0.0476 (0.02842)
Level 4 – Survey's variables			
Food waste awareness (Q1)			**-0.1498 (0.02650)**
Consumers' evaluation of the responsibility for market standards (Q3)			0.0922 (0.05844)
Norms, attitudes and ethical considerations (Q8)			**-0.1719 (0.04896)**
Dietary habits (Q15)			**-0.2213 (0.01401)**
Food disgust (Q16)			**-0.1929 (0.03099)**
Avoidance due to cosmetic flaws (Q20)			**-0.0615 (0.02143)**
Social media intensity (Q27)			**0.0886 (0.03629)**
Biospheric values (Q31)			**-0.1305 (0.04205)**
Altruistic values (Q31)			**0.0691 (0.03411)**
Hedonic values (Q31)			**-0.2113 (0.02961)**
Egoistic values (Q31)			**0.2422 (0.05037)**
Gender (Q35)			-0.0353 (0.02256)
Education level (Q36)			0.0132 (0.01159)
Current net annual household income (Q37)			**0.0215 (0.00262)**
Age (Q34)			**0.1588 (0.05394)**

Table 9 Multilevel analysis for DV4 (dairy risk perception). Note: Values in green are statistically significant with p<0.05. Values in parentheses are standard errors.

DV5: Attitude toward cereals (Q25)			
	Step 1	**Step 2**	**Full model**
Level 1 – Intercept	**2.06553 (0.06841)**	-7.7871 (19.0100)	**2.18880 (0.02353)**
Level 2 – Hofstede Cultural Dimensions			
Power distance	0.00607 (0.03171)	-35.9186 (45.5733)	0.29099 (0.22017)
Individualism	-0.00304 (0.01689)	30.6418 (37.6713)	-0.24109 (0.18896)
Motivation towards achievement	-0.00327 (0.00675)	-42.8253 (53.9356)	0.32278 (0.23878)
Uncertainty avoidance	-0.01127 (0.03846)	72.1345 (91.6024)	-0.55779 (0.40885)
Long term orientation	0.00812 (0.00723)	-9.6747 (12.4658)	0.09154 (0.06681)
Indulgence	-0.01222 (0.02074)	-60.2925 (75.2324)	0.44848 (0.33802)
Level 3 - Eurostat indices			
2023_main_GDP_per_capita		27.0100 (34.4892)	-0.20167 (0.14553)
Heating degree days		1.4667 (1.8753)	-0.01102 (0.00769)
Cooling degree days		5.0033 (6.3867)	-0.03654 (0.02520)
Material_Deprivation		51.0251 (67.0067)	-0.43295 (0.36756)
RIS		**0.0568 (0.0360)**	-0.00599 (0.02618)
Level 4 – Survey's variables			
Food waste awareness (Q1)			**0.04963 (0.02425)**
Consumers' evaluation of the responsibility for market standards (Q3)			0.08293 (0.05332)
Norms, attitudes and ethical considerations (Q8)			**0.10398 (0.04421)**
Dietary habits (Q15)			**0.14363 (0.01340)**
Food disgust (Q16)			**0.14299 (0.02808)**
Avoidance due to cosmetic flaws (Q20)			-0.00200 (0.01927)
Social media intensity (Q27)			0.00904 (0.03263)
Biospheric values (Q31)			**-0.16570 (0.03782)**
Altruistic values (Q31)			**-0.07862 (0.03069)**
Hedonic values (Q31)			**0.14853 (0.02680)**
Egoistic values (Q31)			-0.02040 (0.04542)
Gender (Q35)			**-0.01738 (0.02025)**
Education level (Q36)			-3.43e−4 (0.01040)
Current net annual household income (Q37)			**0.00893 (0.00238)**
Age (Q34)			**-0.09106 (0.01487)**

Table 10. Multilevel analysis for DV5 (attitude toward cereals). Note: Values in green are statistically significant with p<0.05. Values in parentheses are standard errors.

6.4 Discussion

Across the sample, the majority of consumers demonstrated a strong intention to reduce food waste. While there was generally a high tolerance for suboptimal fruits, acceptance of suboptimal meat was significantly lower, especially when it appeared visually unappealing. Opinions on the safety of dairy products varied widely, highlighting different levels of concern across regions.

In conclusion, the multilevel regression analysis offers a review of the factors influencing food waste behaviours. Psychological and behavioural factors where the most significant drivers, underlying the importance of understanding consumer motivations and perceptions when addressing food waste. These insights provide a foundation for targeted interventions and campaigns aimed at reducing waste across populations.[233]

Intention to avoid food waste: A significant portion of people surveyed across Europe expressed a strong desire to reduce food waste. This motivation could be influenced by various factors including cultural attitudes, economic conditions, and psychological aspects. For instance, in cultures that emphasise enjoying life (known as indulgence cultures), there might be a tendency to avoid wasting food. Additionally, in societies that prioritise community over individual (referred to as collectivist cultures), there might be a stronger commitment to reducing waste.

These insights could suggest that food waste reduction campaigns need to be customised to align with the cultural values of different European regions. What works in one country may not be as effective in another. For instance:

- In countries like Spain (with high PDI), where there is a big gap between hierarchical structures, marketing campaigns could utilise influential figures to pass the message. For instance, they could collaborate with respected chefs, public figures, or local celebrities who have significant influence in their communities.
- In countries like Denmark, where there is a strong emphasis on enjoyment, marketing practices could focus on the pleasure of reducing food waste by organising events where consumers can experience the joy of cooking with leftovers or suboptimal products.
- In countries such as Greece (with the lowest individualism values), where there is a strong sense of community, marketing strategies could emphasise the benefits for the entire community by highlighting stories of local initiatives focused on food waste reduction (e.g. local community kitchens, food banks etc.)
- In countries like Ireland, with a strong achievement-oriented culture, framing food waste reduction as a measurable success enhances motivation. Highlighting tangible benefits like cost savings and environmental impact appeals to efficiency and goal-driven values.
- In cases of low indulgence scores such as Poland, citizens could be influenced to avoid food waste, emphasise practical benefits like saving money and conserving resources. Additionally, it would be beneficial to frame food waste reduction as a social norm.

[233] This chapter is a discussion and reflection by the authors following the completion of the research. It does not constitute the official recommendations of the project, which will be produced in T5.1 and T5.2 and will incorporate the extensive research conducted under WP1, WP2, and WP5.

Material deprivation and economic factors: Material deprivation—reflecting economic hardship—could be a negative predictor of food waste awareness and behaviour. These findings emphasise the need for marketing strategies that address affordability. For instance:

- Marketing messages in economically disadvantaged regions could focus on the financial benefits of reducing food waste. Promoting solutions, such as buying suboptimal fruits or utilising leftovers, could be interesting for the lower-income households.
- Retailers and brands can introduce pricing strategies, such as discounts on suboptimal food items (e.g., misshaped fruits and vegetables), to make these products more attractive to consumers.
- Synergies with NGOs to distribute suboptimal food can increase brand visibility while addressing food waste in low-income regions

Consumer acceptance of suboptimal food: The survey showed varying levels of acceptance for suboptimal fruits and meat, influenced by psychological factors such as food disgust. While suboptimal fruits were generally well accepted, particularly in countries like France, suboptimal meat was less tolerated, especially in Poland. This indicates the need for marketing interventions that address consumers' concerns around food quality.

- Social media platforms could be used to promote the purchase and consumption of suboptimal food. Campaigns with influencers or celebrities who consume suboptimal products can reduce stigma.
- Brands could use storytelling marketing to build emotional connections with consumers. For example, supermarkets could create campaigns that highlight the journey of suboptimal fruits and vegetables from farm to table, emphasising reducing waste, and supporting farmers.
- Risk perception regarding dairy products after the best-before date varied across countries. Educational marketing to address concerns over food safety could help on that front. In addition, brands could introduce smart packaging solutions, such as freshness indicators, that reassure consumers about the quality of dairy products after the best-before date. Such innovations would differentiate the brand and also encourage consumers to rely on actual product freshness rather than dates.

Food disgust could correlate with negative attitudes towards food waste. Consumers who have high levels of food disgust tend to have negative attitudes toward food waste reduction. They are less likely to show concern about wasting food and are also less willing to consume suboptimal or imperfect food products, such as misshapen vegetables, bruised fruits, or items nearing expiration. Consumers may often associate suboptimal food with poor hygiene or lack of freshness. To this aim brands could create campaigns that educate consumers about the safety and nutritional value of imperfect or "ugly" produce. Another strategy is to support the consumption of suboptimal foods by promoting them as environmentally friendly choices.

Social media could have a positive effect on the acceptance and consumption of suboptimal fruits. Highlighting real people enjoying these fruits in their everyday lives can help reduce any stigma surrounding their imperfections. Brands can collaborate directly with social media platforms to promote the use and acceptance of suboptimal fruits.

Demographic factors such as gender, age, income, and education level in our survey generally do not have a significant impact on food waste-related behaviours compared to other variables.

In summary:

- **Power inequality** between superiors and subordinates significantly influences attitudes toward food waste and consumer behaviour. In regions with greater power disparity and hierarchical structures, consumers are more likely to avoid food waste and show higher tolerance for suboptimal products.
- **Material deprivation**, reflecting poverty through the lack of essential items and activities, negatively impacts intentions to reduce food waste and consume suboptimal food. In economically disadvantaged regions, residents tend to show less awareness and concern regarding food waste.
- **Social media** has a positive effect on the acceptance and consumption of suboptimal fruits.
- **Food disgust** strongly correlates with negative attitudes towards food waste. Higher levels of disgust lead to lower concern about food waste and reduced willingness to consume suboptimal products.
- **Demographic factors** such as gender, age, income, and education level generally do not have a significant impact on food waste-related behaviours.

7. Conclusions

Food waste is one of the most important challenges that the food system is facing today. In this report, we have explored the role of private marketing standards in the food industry, how these standards contribute to food waste, and the role of consumers. By examining the connection between industry and consumers, we can reveal key opportunities to reduce food waste and support the efforts towards a more sustainable food system.

The role of private marketing standards in the food industry

Private marketing standards play a critical role in the food industry. They are developed by retailers, trade associations, and private companies, and are designed to ensure the safety and quality of food products, and facilitate food trade. While they are generally voluntary, these standards can have a significant influence over production processes. However, the number of private standards continues to grow and food producers—especially small businesses—face new challenges in meeting the conflicting and complex requirements.

Many of the standards focus on securing a high-quality appearance of products, especially in the fresh produce sector. While consumers often prefer visually appealing food, the aesthetic requirements of private marketing standards contribute significantly to food waste. Private and public standards, in addition to ensuring food safety and quality, have already begun adapting—and will continue to evolve—to meet sustainability demands and changing consumer preferences.

Private marketing standards and their impact on food waste

Private marketing standards have a direct and substantial impact on food waste, particularly due to the strict aesthetic criteria applied to products such as fruits and vegetables. The most notable issue is the rejection of perfectly edible food that does not meet the required size, shape, or appearance. This waste begins at the production level, continues through processing and wholesale stages, and grows by consumer expectations. Consumers, influenced by these standards, tend to reject food that appears imperfect, even though it may still be safe to eat. In addition to cosmetic factors, logistical issues within the supply chain, such as

miscommunication between different actors and changing product specifications, contribute to waste. At the consumer level, misconceptions about food expiration dates and a general reluctance to purchase "suboptimal" foods—those that are nearing expiration or have minor imperfections—further support the cycle of waste.

The influence of marketing standards in different food sector

The impact of private marketing standards presents differences among different sectors within the food industry. In dairy, the focus of standards is more concentrated towards traceability, sustainability, and animal welfare, aiming to respond to the growing consumer demand for transparency. In the cereals sector, private standards are essential to ensure food safety and the technological suitability of grains for processing. The meat industry faces a complex landscape, balancing regulatory requirements with the need to address waste and environmental concerns. However, it is the fruits and vegetables sector that is much affected by strict aesthetic standards. Retailers' demands for visually appealing produce, together with consumer preferences, often result in significant waste. These strict standards, while aiming to maintain consumer satisfaction, can lead to the rejection of food that is perfectly safe for consumption. It could be beneficial to explore how evolving marketing standards could maintain product quality while potentially contributing to food waste reduction and addressing broader environmental concerns.

Moving forward

The results of the report underline the need for a more comprehensive approach to reducing food waste. While private marketing standards are important to ensure product quality, they could be further evolved in order to better align with the needed sustainability goals. The relation between consumer behaviour, private standards, and production of food waste underlines the need for collaboration across all levels of the food supply chain. Refining marketing standards, improving the communication between the supply chain actors, and educating consumers about the value of imperfect food and product quality are critical steps in order to reduce food waste.

8. Annexes

8.1 Annex I – Thematic analysis

This annex outlines the methodology used in the thematic analysis.

Methodology

For the Thematic Analysis, we adopted a systematic approach that integrated Latent Dirichlet Allocation (LDA) topic modelling technique with hyperparameter tuning, complemented by Large Language Model interpretation, as described below.

Data Collection and Preprocessing

Our thematic analysis focused on exploring the literature related to food marketing standards and their relation to food waste. The first step involved gathering a corpus of relevant academic papers, reports, and other literature sources. After assembling the corpus, we conducted preprocessing to ensure the data was clean and suitable for analysis. This included:

- **Tokenisation**: Breaking down the text into individual tokens (words).
- **Stop word Removal**: Eliminating common stop words (e.g., “and”, “the”, “is”) that do not contribute significant meaning.
- **Lemmatization**: Reducing words to their base forms (e.g., "wastes" to "waste") to improve consistency.

Latent Dirichlet Allocation (LDA) Topic Modelling

LDA was used to uncover the latent topics within the collected literature. The algorithm works by treating each document as a mixture of topics, with each topic being a mixture of words. To achieve the best results, we fine-tuned the model parameters through an iterative process described below.

Hyperparameter Tuning

To ensure optimal topic coherence and interpretability, we conducted a hyperparameter tuning process by systematically adjusting the following key parameters:

- **Number of Topics (K)**: The number of topics to extract was not predetermined but was instead determined through benchmarking. We tested a range of topics (e.g., from 2 to 11 topics) and evaluated each iteration based on coherence scores.
- **Alpha (Document-Topic Distribution)**: This hyperparameter controls the sparsity of the document-topic distribution. We explored different values of alpha to find the best balance between having each document focused on a few topics or being more spread out over many topics.
- **Beta (Topic-Word Distribution)**: Beta determines the sparsity of the word distribution within each topic. By adjusting beta, we could tune whether topics were characterised by a small set of prominent words or a broader distribution.

Benchmarking Coherence Scores

To evaluate the quality of the topics generated by different hyperparameter settings, we used **coherence scores** as a metric. Coherence measures how interpretable and semantically meaningful the topics are by assessing the degree of semantic similarity among the top words within each topic.

We iteratively adjusted the number of topics, alpha, and beta, benchmarking each configuration based on coherence scores. This allowed us to identify the model configuration that maximised coherence, thereby ensuring the most meaningful and distinguishable topics were generated.

Topic Interpretation

Interpreting the results of LDA topic modelling can often be subjective, as it involves identifying the key themes from a list of words associated with each topic. To mitigate the inherent subjectivity in this process and provide an objective and reliable interpretation, we integrated **GPT-4o** into our methodology.

Here's how we used GPT-4o to interpret the topics:

- **Contextualisation**: Before prompting GPT-4o, we provided the model with detailed context about the project, including the specific focus on food marketing standards and food waste. This ensured that model's responses were aligned with the research goals and remained within the relevant domain.
- **Prompt Engineering**: We carefully designed the prompts to elicit objective, accurate interpretations of the topics. An example prompt might include: *"Given the following list of high-probability words associated with a topic, explain how this topic relates to food marketing standards and food waste"*. We repeated this process for each topic generated by LDA.
- **Iterative Refinement**: After GPT-4o generated an explanation, we reviewed the outputs, ensuring that they were consistent with the overall objectives of the project and the existing literature. If the interpretation seemed off-target or unclear, we refined the prompts further to extract better interpretations.

Final Framework

The final output of the thematic analysis consists of a set of distinct topics derived from the LDA model that explain the key themes in the literature on food marketing standards and food waste.

Results

Topic	Top terms
1	0.012*"firms" + 0.010*"attributes" + 0.009*"figure" + 0.009*"persimmon" + 0.008*"benefits" + 0.007*"preferences" + 0.005*"cost" + 0.005*"commission" + 0.005*"technology" + 0.004*"agrifood"
2	0.019*"suboptimal" + 0.016*"waste" + 0.007*"cosmetic" + 0.006*"mqs" + 0.006*"specifications" + 0.005*"2015" + 0.005*"emissions" + 0.005*"2018" + 0.004*"vol" + 0.004*"2013"

3	0.058*"class" + 0.020*"cosmetic" + 0.016*"aspects" + 0.015*"waste" + 0.013*"apples" + 0.012*"defects" + 0.010*"pears" + 0.010*"tomatoes" + 0.009*"volume" + 0.008*"cultivation"
4	0.040*"waste" + 0.038*"flw" + 0.013*"2014" + 0.009*"prevention" + 0.008*"2013" + 0.007*"date" + 0.006*"2012" + 0.006*"2015" + 0.006*"losses" + 0.006*"household"
5	0.011*"certification" + 0.006*"legitimacy" + 0.005*"developing" + 0.005*"2008" + 0.005*"forest" + 0.004*"papers" + 0.004*"governance" + 0.004*"vol" + 0.004*"fairtrade" + 0.004*"coffee"
6	0.033*"waste" + 0.018*"loss" + 0.012*"losses" + 0.007*"harvest" + 0.006*"2019" + 0.005*"interviews" + 0.005*"crops" + 0.005*"2017" + 0.005*"germany" + 0.004*"pos"
7	0.015*"governance" + 0.006*"agrifood" + 0.006*"2005" + 0.006*"fairtrade" + 0.006*"coffee" + 0.006*"upgrading" + 0.005*"commodity" + 0.005*"journal" + 0.005*"developing" + 0.005*"paper"

Topic 1: ***Food Firm Strategies and Technological Innovations***

- **Top terms**: firms, attributes, figure, persimmon, benefits, preferences, cost, commission, technology, agrifood.
- **Interpretation**: This topic likely addresses how *agrifood firms* and their strategies, such as technological adoption, attributes of products (e.g., persimmons), and cost considerations, are linked to marketing standards and the potential benefits they provide. The emphasis on firms and technology suggests a focus on the role of companies and innovations in food production and marketing.

Topic 2: ***Suboptimal Food and Waste from Cosmetic Standards***

- **Top terms**: suboptimal, waste, cosmetic, MQS (market quality standards), specifications, emissions.
- **Interpretation**: This topic is centred on *cosmetic standards* and their role in food waste. The term "suboptimal" refers to food that does not meet cosmetic standards and may be rejected, thus contributing to waste. The focus here is likely on how strict specifications or standards for appearance, size, or shape of products like fruits and vegetables lead to high levels of food waste, as evidenced in the literature.

Topic 3: ***Waste from Cosmetic Defects in Specific Produce (e.g., Apples and Tomatoes)***

- **Top terms**: class, cosmetic, waste, apples, defects, pears, tomatoes, volume, cultivation.

- **Interpretation**: This topic discusses the issue of *cosmetic defects* and how they relate to waste in specific types of produce such as apples, pears, and tomatoes. It likely highlights how cosmetic standards that classify produce (e.g., “Class I”, “Class II”) contribute to significant food waste, as products with minor defects or imperfections are rejected, even though they are still edible.

Topic 4: *Food Waste Prevention and FLW (Food Loss and Waste) Reporting*

- **Top terms**: waste, FLW (food loss and waste), prevention, losses, household.
- **Interpretation**: This topic is focused on *food waste prevention strategies* and *food loss and waste (FLW) reporting*. The frequent references to years suggest a timeline or a reference to important reports or initiatives, while prevention efforts are highlighted. It could also involve discussion of consumer behaviour (e.g., household-level waste) and how various actors are addressing waste.

Topic 5: *Certification Systems and Legitimacy in Marketing Standards*

- **Top terms**: certification, legitimacy, developing, governance, fairtrade, forest, coffee.
- **Interpretation**: This topic addresses *certification systems* such as *Fairtrade*, which provide legitimacy to products and their adherence to certain standards. The focus seems to be on how certification and governance mechanisms in the food sector (possibly extending beyond just food marketing standards to sustainability or ethical certifications) are influencing food systems, potentially in *developing countries* (as seen with the mention of "forest" and "coffee").

Topic 6: *Post-Harvest Losses and Food Waste in Supply Chains*

- **Top terms**: waste, loss, losses, harvest, interviews, crops, Germany, pos (point of sale).
- **Interpretation**: This topic is about *post-harvest losses*, focusing on how food waste happens at different stages of the supply chain, including post-harvest and at the point of sale (POS). It may include insights from interviews and studies conducted in various countries (e.g., Germany), reflecting supply chain inefficiencies that lead to food waste.

Topic 7: *Governance and Upgrading in Agrifood Supply Chains*

- **Top terms**: governance, agrifood, fairtrade, coffee, upgrading, commodity.
- **Interpretation**: This topic deals with *governance in agrifood supply chains*, particularly concerning *commodity markets* like coffee. It may also touch on *upgrading* strategies for developing countries, possibly linking the governance of marketing standards with the broader issue of food security and sustainability. The focus could be on how different levels of governance influence food waste, particularly in international trade contexts.

8.2 Annex II – Indicative list of marketing standards per food commodity

In this Annex, lists of private marketing standards are presented. These standards help maintain consistency and quality in the market for ROSETTA's food commodities, ensuring that products meet consumer expectations and facilitating smoother trade. Each standard has specific criteria that producers must meet, impacting how the food commodities are grown, harvested, and marketed.

8.2.1 Fruit & Vegetables

Name of standard	Short Description	Link	Focus area	Example
GLOBALG.A.P. GlobalGAP	GlobalGAP (Global Good Agricultural Practices) is a certification program that sets voluntary standards for the certification of agricultural products around the globe. It aims to ensure safe, sustainable agriculture worldwide.	GlobalGAP	Size, appearance, food safety, sustainability	A GlobalGAP certified carrot farm must ensure that carrots are uniform in size and color, free from cracks and deformities, and meet specific size criteria for different market classes.
Tesco Nurture Standards	Tesco Nurture is a private standard developed by Tesco for its suppliers, emphasizing high quality, safety, and sustainability criteria, including specific size and appearance standards.	Tesco Nurture	Size, appearance, sustainability, food safety	Tesco Nurture standards for cucumbers require them to be straight, uniform in length (typically 30-40 cm), and free from blemishes or deformities.
Carrefour Quality Lines	Carrefour's Quality Lines standard focuses on high-quality, traceable, and sustainably produced fruits and vegetables. It aims to ensure that products meet strict criteria for taste, appearance, and environmental impact.	Carrefour Quality Lines	Quality, traceability, sustainability.	Grapes sold under Carrefour Quality Lines must meet specific criteria for sweetness, size, and appearance, while also being produced using sustainable farming practices.
Mercadona SPB	Mercadona's SPB Quality Standards focus on providing high-quality products at low prices. This includes strict criteria for the selection, handling, and presentation of fresh fruits and vegetables to ensure consistency and quality.	SPBAnual	Quality assurance, affordability, consistency.	Tomatoes sold at Mercadona must meet specific criteria for freshness, size, and appearance. They are sourced from selected suppliers who adhere to Mercadona's standards for sustainable farming and quality control.

Calidad DIA	DIA's Calidad DIA standard ensures that fruits and vegetables meet rigorous quality and safety requirements. This includes standards for freshness, taste, and appearance, as well as sustainability practices.	DIA Quality Standards	Quality control, food safety, sustainability.	Oranges sold under the Calidad DIA label must be free from blemishes and defects, have a consistent size and color, and be produced following sustainable agricultural practices. Suppliers are regularly audited to ensure compliance with these standards.

8.2.2 Dairy

Name of standard	Short Description	Link	Focus area	Example
Contract	Required contract – This focus area is included in all wholesalers and retail contracts. Compliance with these standards is a mandatory requirement for market participation.	N/A	**Total durability** Best before date / total durability The products durability (expiry date), must be no less than 75% of the total durability upon arrival.	When a milk has 12 days, it must have 9 days the morning of delivery (10 days the evening you send it off), which means you only have day 1 and 2 to sell the product.
Contract	Required contract – This focus area is included in all wholesalers and retail contracts. Compliance with these standards is a mandatory requirement for market participation.	N/A	**Weight variable** Set weight products Supermarkets only want to buy small pieces of cheese with set weight, instead of pieces sold in weight pr. Kg.	Handmade cheeses often exhibit variability in weight. This variability presents challenges in meeting National and EU standards, potentially resulting in an increased incidence of cheeses being classified as underweight.
IFS Food	Voluntary private marketing standard **International featured standard for food:** Standard for auditing product and process compliance in relation to food safety and quality, developed in 2002 as	https://www.ifs-certification.com/en/	Governance and senior management commitment; Food safety and quality management system; Resource management; Operational processes;	**Supply chain & distribution IFS requirements**: Dairy requiring strict temperature controls and rapid transportation. Failures in the cold chain can lead to spoilage.

	a joint venture of the French retail association FCD and the German retail association HDE, widely used in the European Union		Measurements, analysis, improvements.	Inadequate storage and transportation facilities can accelerate spoilage.

8.2.3 Cereals

Name of standard	Short Description	Link	Focus area	Example
IFS FOOD	The IFS Food Standard evaluates a food producer's ability to make safe, authentic, and quality products according to legal requirements and customer specifications. It supports businesses in meeting transparency and traceability demands and is assessed by independent accredited certification bodies.	IFS FOOD	Size, appearance, food safety, food authenticity, food quality, traceability	An IFS FOOD-certified cereal manufacturer must demonstrate rigorous control over the production process, including ensuring that the cereal is free from contaminants, meets quality standards for texture and taste, and complies with labelling regulations. This involves maintaining strict hygiene practices and conducting regular quality checks throughout the production process.
JAKOŚĆ TRADYCJA	"Jakość Tradycja" is a quality mark designed to distinguish agricultural products, foodstuffs, and spirits made from natural raw materials and produced using traditional methods in Poland. This certification guarantees that the products meet high-quality standards and possess a traditional character with a history of at least 50 years.	JAKOŚĆ TRADYCJA	natural raw materials, traditional composition and production methods, traceability, high quality, exclusion of GMO, traditional breeds and varieties	Cereal certified with the 'Jakość Tradycja' mark must use natural raw materials from organic or Good Agricultural Practices farms without GMOs. It must be produced using traditional methods and recipes, ensuring its traditional character and high quality. The entire production process must be traceable from raw materials to the final product.
BRCGS Food Safety	The BRCGS Food Safety standard, developed by BRCGS, specifies requirements for food safety, quality, and operational criteria. It ensures that food products are safe, legal,	LINK	Food safety, quality management, legal	A BRCGS Food Safety-certified cereal manufacturer must adhere to strict food safety protocols, manage risks related to contaminants, and comply with food safety regulations. This

	and of high quality, providing a framework for continuous improvement and compliance across the food supply chain.		compliance, and operational practices.	involves implementing rigorous hygiene practices, conducting regular audits, and maintaining comprehensive documentation to guarantee the safety and quality of the cereal produced.
ISO 22000	ISO 22000 is an international standard that outlines requirements for comprehensive food safety management systems (FSMS) to ensure safe food products. It integrates HACCP principles and provides a framework for managing food safety risks across the entire supply chain.	LINK	Food safety management, risk assessment, hazard control, and compliance with food safety regulations.	An ISO 22000-certified cereal manufacturer must implement a food safety management system. This involves identifying and controlling potential hazards, conducting regular hazard analysis, establishing critical control points, and monitoring procedures to ensure safe production and quality standards.
GMP+ (Good Manufacturing Practice)	The GMP+ standard ensures the safety, reliability, and quality of animal feed products by combining feed safety management systems with HACCP principles. It is widely recognized in the international feed industry and covers all stages of the feed supply chain.	LINK	Managing food safety, risk assessment, hazard control, and compliance with food safety regulations.	A grain processing company adheres to GMP+ standards to ensure that the cereals and grains processed into animal feed are free from contaminants such as mycotoxins, pesticides, and heavy metals. The company implements a HACCP plan to identify critical control points, and conducts regular testing, and monitoring to ensure compliance with GMP+ standards, leading to safe grain-based feed products for animal consumption and high-quality food products derived from those animals.
Dobry produkt	The "Dobry Produkt" competition aims to recognise outstanding food products in terms of quality, innovation, and traditional and regional recipes for the retail and HoReCa markets. The “Dobry Produkt” Certificate logo serves as a guide for consumers, helping them make quality	LINK	Sustainability, innovation, local product, quality, traditional and regional recipies	In order to receive the "Dobry Produkt" certificate, the bakery must meet specific criteria related to quality, innovation, tradition, sustainability, brand recognition, and compliance. For instance, the bread should be crafted using locally-sourced grains and a unique fermentation process to differentiate it in the

	choices among the various options available.			market. The recipe must respect regional baking traditions and employ environmentally friendly farming methods.
Ekogwarancja PTRE	Ekogwarancja PTRE is a certification body in Poland that provides organic certification services for agricultural and food products, ensuring compliance with the EU's organic regulations.	LINK	Organic agriculture, sustainability, environmental protection, high-quality organic food.	A farm is seeking certification from Ekogwarancja PTRE for growing organic grains like wheat, barley, and oats. To achieve this, the farm has to follow strict organic farming practices, such as using organic seeds, avoiding synthetic fertilizers and pesticides, and maintaining soil health. Ekogwarancja PTRE conducts inspections to ensure compliance with organic standards. Once certified, the farm's organic grains can be marketed with the Ekogwarancja PTRE label, ensuring high quality and adherence to organic principles.
GLOBALG.A.P IFA	GLOBALG.A.P. certification ensures robust and compliant farm assurance solutions through a network of over 185 approved certification bodies worldwide. CBs play a crucial role in conducting audits and updating certification data, offering visibility and access to new business opportunities.	LINK	Food safety, Sustainability, Traceability, Compliance, Certification, Audit integrity, Transparenc, Competency training, Stakeholder engagement, Market access	A GlobalGAP certified grain and cereal farm must comply with strict standards to ensure food safety, sustainability, and traceability. The certification process includes unannounced reward program participation, consultant use, parallel production and ownership registration, certified product purchase, combination with other standards, and harvest and product handling observation. This ensures that grains and cereals meet safety and quality standards, are free from contaminants, and are traceable from farm to market, contributing to safer and more sustainable farming practices.

FSA (Farm Sustainability Assessement)	The Farm Sustainability Assessment (FSA) evaluates and promotes sustainable agricultural practices, focusing on environmental, social, and economic aspects to improve overall farm performance and sustainability.	LINK	Environmental impact, social responsibility, economic viability, and overall farm management practices.	A cereal producer in the FSA must demonstrate sustainable farming practices, such as efficient water use, reduced chemical inputs, improved soil health, crop rotation, reduced tillage, fair labour practices, and economic viability.

8.2.4 Meat

The first five standards listed below have achieved **GFSI (Global Food Safety Initiative)**[234] recognition for certification scopes related to meat and meat products, as mentioned in the "focus area" column of the following table. They are available internationally, and their implementation can be certified by accredited third parties.

Name of standard	Short Description	Link	Focus area	Example
GRMS	**Global Red Meat Standard** for the meat industry, specifically developed for the processes of slaughtering, cutting, deboning and sales of red meat and meat products.	https://www.grms.org/grms-standard/	Red meat and red meat products. GFSI certification scopes include: Animal Primary Conversion; Processing of Perishable Animal Products.	Kouwenhoven Vlees B.V. (Netherlands) GRMS certificate for primary cutting, deboning, cutting and packaging (vacuum) of fresh and frozen beef and veal meat. All GRMS certified organisations/sites are available here.
IFS Food	**International Featured Standard for Food:** Standard for auditing product and process compliance in relation to food safety and quality, developed in 2002 as a joint venture of the French retail association FCD and the German	https://www.ifs-certification.com/images/ifs_documents/IFS_Food_v8_standard_EN_1711635033.pdf	Governance and senior management commitment; Food safety and quality management system; Resource management; Operational processes; Measurements, analysis, improvements. GFSI certification scopes include among others: Animal Primary Conversion; Processing of	ELVIDA FOODS S.A. (Greece) IFS certificate for: Cutting, mixing and standardising meat preparations and breaded meat preparations from meat, poultry and minced meat, frozen or chilled packed in plastic bags; Production of frozen meat products and frozen ready to eat meals in nylon bags and plastic trays;

[234] GFSI-Recognised Certification Programme Owners (link)

Name of standard	Short Description	Link	Focus area	Example
	retail association HDE, widely used in the European Union.		Perishable Animal Products; Processing of Perishable Animal and Plant Products (Mixed Products); Processing of Ambient Stable Animal and Plant Products (Mixed Products).	Production of chilled and frozen beef cuts packed in plastic trays in vacuum. Database of IFS certified organisations/sites is only accessible by certified organisations.
BRCGS for Food Safety BRCGS	**British Retail Consortium (BRC) Global Standard for Food Safety,** providing comprehensive, risk-based criteria addressing current and emerging global food safety issues.	https://www.brcgs.com/our-standards/food-safety/	Food safety culture; environmental monitoring; food security and defence; allergen management; labelling and packing controls. GFSI certification scopes include among others: Animal Primary Conversion; Processing of Perishable Animal Products; Processing of Perishable Animal and Plant Products (Mixed Products); Processing of Ambient Stable Animal and Plant Products (Mixed Products).	CRETA FARM FOODS S.A (Greece) BRCGS certificate for: Production of precooked cured chicken, turkey, beef and pork meat products, frozen precooked meat products and meat preparations; Packaging of sliced yellow cheese, and precooked cured chicken, turkey, beef and pork meat products, in plastic film in vacuum or MAP; HPP processing of precooked cured chicken, turkey, beef and pork meat products, including outsourced production of precooked and smoked turkey products; Packaging of frozen precooked meat products and meat preparations in plastic bags. Directory of BRCGS certified organisations/sites is available here.
SQF Food Safety SQF	The **SQF (Safe Quality Food)** Institute is a division of FMI—The Food Industry Association, established to administer the SQF Programme, a leading global food safety and quality certification and management system. The **SQF Food Safety Programme** is a rigorous and credible food safety and quality programme geared towards businesses looking to satisfy their	https://www.sqfi.com/our-program/certification-programs/food-safety-program	SQF Food Safety Codes include among others: Primary Animal Production, applied to food-sector categories for production, capture, and harvesting of livestock and game animals as well as apiculture (bee keeping); Animal Product Manufacturing, applied to food sector categories for slaughtering, boning, and butchery; manufactured meats and poultry; and seafood processing. GFSI certification scopes	Aliments Asta Inc. (Canada) SQF certificate for Slaughtering, boning and butchery; pork meat products. Directory of SQF certified organisations/sites is available here.

Name of standard	Short Description	Link	Focus area	Example
	retailers' and buyers' GFSI requirements, designed to meet industry, customer, and regulatory requirements from all sectors of the food supply chain.		include among others: Farming of Animals for Meat/ Milk / Eggs / Honey; Animal Primary Conversion; Processing of Perishable Animal Products; Processing of Perishable Animal and Plant Products (Mixed Products); Processing of Ambient Stable Animal and Plant Products (Mixed Products)	
FSSC 22000	**Foundation FSSC,** based in Netherlands, is a global non-profit and independent Scheme owner to provide trust and deliver impact to the consumer goods industry. **FSSC 22000** offers a certification Scheme for the auditing and certification of **Food Safety Management Systems**, aligned with the ISO Management System approach and the ISO Harmonised Structure, to ensure the provision of safe food, feed, and packaging to the consumer goods industry	https://www.fssc.com/schemes/fssc-22000/	Regardless of the specific product or process, FSSC 22000 Version 6 emphasises the following areas: Food safety culture; Allergen management; Environmental monitoring; Food defence and fraud prevention;. Product labelling and traceability. GFSI certification scopes include among others: Animal Primary Conversion; Processing of Perishable Animal Products; Processing of Perishable Animal and Plant Products (Mixed Products); Processing of Ambient Stable Animal and Plant Products (Mixed Products).	KTIMA VAVOURAKI (Greece) FSSC 22000 certificate for: Production and Packaging of Meat Products (Sausage, Apaki, Syglino) and Meat Preparations (Raw Sausage) in vacuum; Processing and Packaging of Raw Meat in vacuum. Public register of FSSC certified organisations/sites is available here.
CHALKIA DAKIS collection of private standard protocols for meat	A collection of specific marketing standard protocols developed by CHALKIADAKIS S.A. - a leading local supermarket of the island of Crete in Greece - for the company's own use.	Internal documentation, not publicly available	Meat (pork, beef, lamb/sheep, goat, and poultry)	a) Traceability (Meat producer ID); b) Preference of local meat suppliers; c) Crisis management due to climate change and global trend analysis; d) Stock monitoring and analysis per store by processing date and increase of consumer awareness.

8.3 Annex III – Questionnaire

Welcome note

Dear participant, welcome to our survey!

The survey lasts approximately **15 minutes**. There are no right or wrong answers, this is about your views. All data is anonymised and your privacy is guaranteed.

Thank you for helping us gather relevant information!

What is ROSETTA all about?

Rosetta is a 3-year project funded by the EU. It aims to see how marketing standards affect food waste and to find ways to use food that doesn't meet these standards but is still safe to eat. Rosetta will:

- Look at how marketing standards lead to food waste.
- Try out different ways to sell food that isn't perfect but is still good to eat and share these ideas.
- Give advice to food businesses, owners of marketing standards and policymakers

STUDY TITLE

A consumer survey on marketing practices, food waste perceptions and consumption patterns

DEFINITIONS

1)Marketing standards: Marketing standards are defined as 'a set of rules aimed to ensure that the single market is supplied with standardised quality agricultural products that meet consumer expectations

2)Suboptimal foods:Suboptimal foods refer to perfectly safe-to-consume food items that deviate from standard expectations in terms of appearance, date labeling (e.g., nearing expiration date), or packaging. These foods may exhibit imperfections in cosmetic criteria such as appearance, color, size, or may be nearing their labeled expiration date.

DESCRIPTION

The study aims to investigate consumer's attitudes towards food waste, food marketing practices, and foods that don't meet quality standards in various European countries. By conducting an online survey with a large number of consumers, we aim to uncover what factors influence their decisions in relation to food. This research could provide valuable insights for companies and policymakers, helping them develop more effective marketing strategies and policies to reduce food waste and promote sustainable consumption habits across Europe.

RISKS AND BENEFITS

There are no known risks associated with this study.

PARTICIPANT'S RIGHTS

If you have read this form and have decided to participate in this project, please understand your participation is voluntary and you have the right to discontinue participation at any time without penalty or loss of benefits to which you are otherwise entitled. You have the right to refuse to answer particular questions. Your individual privacy will be maintained in all published and written data resulting from the study.

CONTACT INFORMATION

If you have any questions concerning this privacy policy or our data collection practices you may contact us at ***info@rosetta -project.eu***. We reserve the right to change this privacy policy at any time and inform all participants about the updates.

In addition to your opinion, we are collecting some personal information such as Age, Gender, Area of residence, Educational status and Net Annual Household Income for socio-demographic purposes. The collected data will be saved and used until the end of the research period of the ROSETTA project (31/12/2026). The data will be only used for the purpose of the ROSETTA project, funded under the European Union Horizon Europe programme (Grant Agreement no. 101136427).

The lawfulness of the processing of personal data is determined pursuant to Article 6 of the EU's General Data Protection Regulation (GDPR). With respect to personal data, the processing of personal data is based on consent. White Research will be responsible for accessing and processing the data.

1. If you have read the information above and would like to participate in the study, please click "I consent."

Alternatively, if you do not want to complete the study, please click "I do not consent" and you will be redirected to the end of the study.

- ☐ I consent
- ☐ I do not consent

2. What is your Prolific unique ID?

Theme 1: Knowledge and Awareness

Q1. Please indicate your level of agreement with each of the following statements by selecting a number from 1 to 7, where 1 means "strongly disagree" and 7 means "strongly agree"?

	1	2	3	4	5	6	7
I know exactly how much food I throw away every day.	☐	☐	☐	☐	☐	☐	☐
I know exactly what kind of food I throw away.	☐	☐	☐	☐	☐	☐	☐
I am aware of how much money I pay weekly for food that gets thrown away.	☐	☐	☐	☐	☐	☐	☐
Food waste is not a problem for the environment as it is natural and biodegradable.	☐	☐	☐	☐	☐	☐	☐
The fact that I waste food does not affect the undernourished people in the world because anyway I could not give that food to them.	☐	☐	☐	☐	☐	☐	☐

Q2. What are the ways food is wasted? You can select more than one option.

- ☐ Food close or beyond the date label.
- ☐ Throwing away visibly spoiled food.
- ☐ Throwing leftovers in households.
- ☐ Fresh produce with a not-normal look.
- ☐ Leftover in the food service sector.
- ☐ Concerns over food safety.
- ☐ Waste from food manufacturing.

Q3. Who is responsible for setting market standards?

- ☐ Supermarkets set market standards to regulate the appearance of fruits and vegetables. There are no legal restriction
- ☐ Supermarkets set market standards to regulate the appearance of fruits and vegetables have to look. Apart from that, there are legal restrictions for some varieties of fruits and vegetables regarding their appearance.
- ☐ Supermarkets set market standards to regulate appearance of fruits and vegetables. Apart from that there are legal restrictions for all varieties of fruits and vegetables regarding their appearance.
- ☐ Supermarkets do not set market standards to regulate the appearance of fruits and vegetables. However, there are legal restrictions for all varieties of fruits and vegetables regarding their appearance.

Theme 2: Perceptions and attitude towards food waste

Q4. Please indicate your level of agreement with the following statements by selecting a number from 1 to 7, where 1 means "strongly disagree" and 7 means "strongly agree"

	1	*2*	*3*	*4*	*5*	*6*	*7*
I try to waste no food at all	☐	☐	☐	☐	☐	☐	☐
I always try to eat all purchased foods	☐	☐	☐	☐	☐	☐	☐
I try to produce only very little food waste	☐	☐	☐	☐	☐	☐	☐
I aim to use all leftovers	☐	☐	☐	☐	☐	☐	☐

Q5. Even if you try to avoid food waste, it still happens that certain foods end up in the trash (for example, because they are spoiled, cannot be consumed in time or do not taste good). Approximately how often do you think it happens that you throw away parts of the following foods?

	Never	*Rarely*	*Sometimes*	*Often*	*Always*	*I don't buy this*
Fruits	☐	☐	☐	☐	☐	☐
Vegetables	☐	☐	☐	☐	☐	☐
Bread and Bakery Products	☐	☐	☐	☐	☐	☐
Meat and Fish	☐	☐	☐	☐	☐	☐
Dairy Products	☐	☐	☐	☐	☐	☐

Q6. Which sector do you believe contributes the most to food waste?

- ☐ Households
- ☐ Food service sectors
- ☐ Retails
- ☐ On the farm
- ☐ During transportation
- ☐ At the manufacturers unit.

Q7. And overall, to what extent do you agree or disagree with the following statements?

		Strongly Disagree	Disagree	Neither agree nor disagree	Agree	Strongly Agree
Descriptive norms	Most people I know try to reduce the amount of food they throw away at home.	☐	☐	☐	☐	☐
Personal norm	I feel a strong obligation not to waste food in my household.	☐	☐	☐	☐	☐
	Generally speaking, I care a lot about what others might think about me in terms of how I can help the environment.	☐	☐	☐	☐	☐
Ethical considerations	I have a bad conscience when I waste food at home.	☐	☐	☐	☐	☐
	I feel guilty when I waste food because some people don't have enough to eat.	☐	☐	☐	☐	☐
Financial attitudes	I think that in general wasting food is a waste of money	☐	☐	☐	☐	☐
	I rarely think about money when I throw away food	☐	☐	☐	☐	☐

Theme 3: Shopping Habits

Q8. Whether you buy it yourself or someone else, where do you normally buy the food items for your home?

- ☐ Hypermarket
- ☐ Supermarket
- ☐ Discount stores
- ☐ Traditional shops
- ☐ Internet
- ☐ Other

Q9. How many times per week do you normally buy food items for your home, whether you buy it yourself or someone else?

- ☐ 1 time
- ☐ twice

- ☐ 3 times
- ☐ 4 or more times a week
- ☐ Less frequent that once a week

Q10. To what extent do you agree or disagree on these statements?

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
We often buy unintended food products when shopping							
We often buy food in packages that are too big for our household's needs							
We usually buy higher amounts of food when they offer good value for money							

Q11. To what extent do you agree or disagree on these statements?

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
I am very concerned about low prices, but I am equally concerned about product quality	☐	☐	☐	☐	☐	☐	☐
When grocery shopping, I compare the prices of different products to be sure I get the best value for the money.	☐	☐	☐	☐	☐	☐	☐
I always check prices at the grocery store to be sure I get the best value for the money I spend.	☐	☐	☐	☐	☐	☐	☐

Theme 4: Dietary Habits

Q12. Please indicate your level of agreement with the following statements:

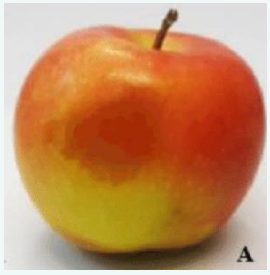
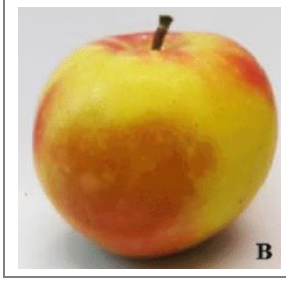
	Question	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
Vegetable liking	I often prepare vegetables							
	I like eating vegetables							
	I like eating lettuce							
Vegeterian preference	I don't eat meat or try to avoid meat.							
	I don't eat animal products or try to avoid them.							
	If I can choose between a vegetarian and a meat dish, I choose the meat dish.							
Objectification of Edibility	When it comes to judging whether a food is still safe to consume, I stick to the stated best-before date.							
	If the best-before date on a product has passed, I will no longer eat it.							
Internalization of Edibility	When it comes to judging whether a food is still safe to consume, I trust my own senses (sight, smell, taste).							
	I think of the best-before date as a non-binding recommendation.							

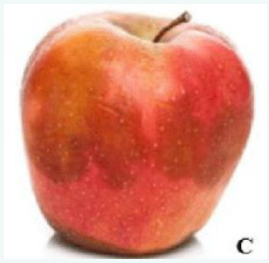
Q13. Please rate how "grossed out" you are by each item on a scale from 1 (not grossed out at all) to 6 (extremely grossed out).

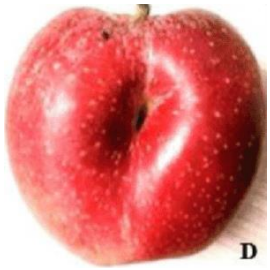
	1	2	3	4	5	6
To put animal cartilage into my mouth						
To eat with dirty silverware in a restaurant						
Food donated from a neighbor whom I barely know						
To eat hard cheese from which the mold was cut off						
To eat apple slices that turned brown when exposed to air						
The texture of some fish in the mouth						
To eat brown-colored avocado pulp						
There is a little snail in the salad that I wanted to eat						

Theme 5: Attitudes towards suboptimal foods

Q14. Rate your willingness to consume the apple on a scale from 0 (certainly not) to 100 (absolutely)





Q15. Would you buy fruits and vegetables with cosmetic flaws?

- ☐ Extremely likely
- ☐ Very likely
- ☐ More likely
- ☐ Unlikely
- ☐ Extremely unlikely

Q16. Why would you purchase misshaped fruits and vegetables? *(if likely)*

- ☐ There are no quality differences with flawless fruits and vegetables
- ☐ They can help reduce the amount of food waste
- ☐ These products look more natural
- ☐ Others

Q17. Why you would not buy fruits and vegetables with cosmetic flaws? *(if unlikely)*

- ☐ They do not look nice
- ☐ They could turn bad more quickly
- ☐ They do not taste good
- ☐ They are harder to peal
- ☐ I am not used to these kind of fruits and vegetables
- ☐ I prefer flawless fruits and vegetables

Q18. What do you believe is the reason supermarkets offer misshaped fruits and vegetables? Please select one option.

- ☐ Marketing
- ☐ To reduce food waste
- ☐ Profit
- ☐ To support the producers
- ☐ Shortage of flawless fruits and vegetables.

Q19. Imagine you are in your kitchen doing some meal preparation using beef. Thinking of all possible ways you are likely to eat meat, what percentage of this product are you and/or your household likely to eat?

	0-100 (sliding scale)
	0-100 (sliding scale)

	0-100 (sliding scale)

Q20. Please indicate your level of agreement with the following statement

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
If I consumed my usual dairy products, I believe they would pose a risk of food poisoning if I ate them: After the best-before date	□	□	□	□	□	□	□

Q21. How do various factors influence your decision-making regarding the consumption and purchase of cereals?

	1 (very unlikely)	*2*	*3*	*4*	*5*	*6 (very likely)*
How likely are you to discard cereals with minor cosmetic flaws (e.g., slightly damaged packaging) but are otherwise within the best-before date?	☐	☐	☐	☐	☐	☐
How likely are you to buy cereals that are close to or past their best-before date if they are discounted?	☐	☐	☐	☐	☐	☐
How much do you trust that the best-before dates on cereals accurately reflect their edibility?	☐	☐	☐	☐	☐	☐

Q22. Please indicate how frequently each of the following statements applies to you

	Never	Rarely	Occasionally	Sometimes	Often	Very Often	Always
Visiting social networking sites is part of my everyday activity							
I check my social networking site(s) almost every day							
I feel out of touch when I haven't logged onto my social networking site(s) for a day							
I feel I am part of the community of my social networking site							
I would be sorry if my social networking site shuts down							

Q23. How often is your shopping behavior influenced by food companies' promotions like 'buy one get one free' or 'limited time offer'?"

- ☐ Always
- ☐ Often
- ☐ Sometimes
- ☐ Rarely
- ☐ Never

Theme 6: Biospheric - Altruistic – Hedonic- Egoistic - values

Q24. Please indicate to what extent the person in the description is similar to you.

	Not like me at all	*Not like me*	*A little like me*	*Somewhat like me*	*Like me*	*Very much like me*
It is important to me to prevent environmental pollution.	☐	☐	☐	☐	☐	☐
It is important to me to protect the environment.	☐	☐	☐	☐	☐	☐
It is important to me to respect nature.	☐	☐	☐	☐	☐	☐
It is important to me to be in unity with nature.	☐	☐	☐	☐	☐	☐
It is important to me that every person has equal opportunities.	☐	☐	☐	☐	☐	☐
It is important to me to take care of those who are worse off.	☐	☐	☐	☐	☐	☐
It is important to me that every person is treated justly.	☐	☐	☐	☐	☐	☐
It is important to me that there is no war or conflict.	☐	☐	☐	☐	☐	☐
It is important to me to be helpful to others.	☐	☐	☐	☐	☐	☐
It is important to me to have fun.	☐	☐	☐	☐	☐	☐
It is important to me to enjoy the life's pleasures.	☐	☐	☐	☐	☐	☐
It is important to me to do things I enjoy.	☐	☐	☐	☐	☐	☐
It is important to me to have control over others' actions.	☐	☐	☐	☐	☐	☐
It is important to have authority over others.	☐	☐	☐	☐	☐	☐
It is important to me to be influential.	☐	☐	☐	☐	☐	☐

It is important to have money and possessions.	☐	☐	☐	☐	☐	☐
It is important to work hard and be ambitious	☐	☐	☐	☐	☐	☐

Sport Participation

Most modern theories of decision making recognize the fact that decisions do not take place in a vacuum. Individual preferences and knowledge, along with situational variables can greatly impact the decision process. In order to facilitate our research on decision making we are interested in knowing certain factors about you, the decision maker. Specifically, we are interested in whether you actually take the time to read the directions; if not, then some of our manipulations that rely on changes in the instructions will be ineffective. So, in order to demonstrate that you have read the instructions, please ignore the sport items below, as well as the continue button. Instead, simply click on the title at the top of this screen (i.e., "sports participation") to proceed to the next screen.

Thank you very much.

Which of these activities do you engage in regularly? (click on all that apply)

- ☐ Skiing
- ☐ Soccer
- ☐ Snowboarding
- ☐ Running
- ☐ Hockey
- ☐ Football
- ☐ Swimming
- ☐ Tennis
- ☐ Basketball
- ☐ Cycling

Theme 7: General information - Demographics

We would like to learn some additional information about you.

Q25. Please select the country that you are currently living in.

- ☐ Greece
- ☐ Ireland
- ☐ Spain
- ☐ Poland
- ☐ Denmark
- ☐ Germany
- ☐ France

- ☐ Italy
- ☐ Netherlands
- ☐ Portugal

Q26. Please name the city/town/village that you are currently living in.

Q27. Please indicate your age.

Q28.Please indicate your gender

- ☐ Male
- ☐ Female
- ☐ Non-binary
- ☐ Other
- ☐ Prefer not to say

Q29. Please indicate the highest level of education you have attained.

- ☐ Did not complete
- ☐ High School/GED
- ☐ Some College
- ☐ Bachelor's Degree
- ☐ Master's Degree
- ☐ Advanced Graduate work or Ph.D.

Q30. Please indicate your Net Annual Household Income (in Euros) now.

- ☐ €5.000 or less
- ☐ €5.001 - €15.000
- ☐ €15.001 - €25.000
- ☐ €25.001 - 35.000
- ☐ €35.001 - €45.000
- ☐ €45.001 - €55.000
- ☐ €55.001 - €65.000
- ☐ €65.001 - €75.000
- ☐ €75.001 or more

Q31. Please indicate your Net Annual Household Income (in Euros) when you were growing up.

- ☐ €5.000 or less
- ☐ €5.001 - €15.000
- ☐ €15.001 - €25.000

- ☐ €25.001 - 35.000
- ☐ €35.001 - €45.000
- ☐ €45.001 - €55.000
- ☐ €55.001 - €65.000
- ☐ €65.001 - €75.000
- ☐ €75.001 or more

Q32. Please indicate the number of your household members (including yourself)

- ☐ 1
- ☐ 2
- ☐ 3
- ☐ 4
- ☐ 5
- ☐ More than 5

Q33. Please indicate the number of adults in your household (including yourself)

- ☐ 1
- ☐ 2
- ☐ 3
- ☐ 4
- ☐ 5
- ☐ More than 5

Q34. Please indicate the number of children under 18 years of age in your household

- ☐ 0
- ☐ 1
- ☐ 2
- ☐ 3
- ☐ More than 3

Q35. Please indicate your residential unit

- ☐ Apartment
- ☐ House
- ☐ Other

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