# RESEARCH

# **Open Access**

# Understanding the phenomenon of food waste valorisation from the perspective of supply chain actors engaged in it



Madhura Rao<sup>1\*</sup>, Aalt Bast<sup>2,3</sup> and Alie de Boer<sup>1</sup>

\*Correspondence: m.rao@maastrichtuniversity.nl

## Abstract

 Food Claims Centre Venlo, Faculty of Science and Engineering, Maastricht University, Campus Venlo, 5900 AA Venlo, The Netherlands
<sup>2</sup> University College Venlo, Maastricht University, Campus Venlo, 5900 AA Venlo, The Netherlands
<sup>3</sup> Department of Pharmacology and Toxicology, Faculty of Health,

Medicine and Life Sciences, Maastricht University, 6229 ER Maastricht, The Netherlands The repurposing of surplus food and food processing by-products is a key aspect of the shift towards a circular bioeconomy. In the Netherlands, food supply chain actors are already working towards making better use of agri-food surpluses to improve food security and resource efficiency. By analysing the experiences of these actors, this study aims to identify the current state of the sector and highlight barriers and enablers of successful food waste valorisation. Based on a phenomenological analysis of 16 in-depth unstructured interviews with participants from the Netherlands, we empirically demonstrate that supply chain actors involved in food waste valorisation consider local embedding, societal perception, and food safety to be important aspects of their work. They often grapple with legislative and logistical uncertainties and face various ethical dilemmas such as having to pay for products that were once considered waste. Building on these findings, we propose that experienced professionals with a penchant for sustainability can play the role of 'transition brokers' as the food system moves towards a circular way of operating. We also posit that private standards and voluntary agreements could be a way for the sector to better manage the various bottlenecks that are characteristic of food waste valorisation endeavours.

**Keywords:** VASP, Circular economy, Food waste, Private governance, Phenomenological analysis

## Introduction

A sizeable portion of food produced for human consumption ends up in landfills every year. Through technological and policy innovation, it is possible to upcycle at least a part of this waste by developing new pathways for its use or transforming it into new raw materials and products. The most environmentally and socially beneficial way to do this is to utilise food surplus and by-products to meet the nutritional and food security needs of the growing population (Papargyropoulou et al. 2014; Wunder et al. 2018). This is already happening in several parts of the world through a broad range of practices such as donating surplus food to charities (Bilska et al. 2016; Caplan 2017; Lambie-Mumford 2017; Midgley 2014; Schneider 2013), connecting consumers with surpluses through digital platforms (Bernardi et al. 2021; de Almeida Oroski 2020; Mullick et al.



© The Author(s) 2023. **Open Access** This article is licensed under a Creative Commons Attribution 4.0 International License, which permits use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons licence, and indicate if changes were made. The images or other third party material in this article are included in the article's Creative Commons licence, unless indicated otherwise in a credit line to the material. If material is not included in the article's Creative Commons licence and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder. To view a copy of this licence, visit http:// creativeCommons.org/licenses/by/4.0/.

2021; Sedlmeier et al. 2019), creating a market for misshapen produce (Cooremans and Geuens 2019; Makhal et al. 2021; Mookerjee et al. 2021; Qi et al. 2022; Tu et al. 2018), and extracting valuable biological compounds through processing (Cecilia et al. 2019; Dimou et al. 2019; Galanakis 2020; Jiménez-Moreno et al. 2020; Rao et al. 2021a). Several sustainability focussed entrepreneurs have created products from surplus foods and ingredients that would have otherwise ended up as waste. Following the example of Bhatt et al. (2018), we refer to these food products as value-added surplus products (VASP). All endeavours to retain food that would have otherwise ended up as waste in the food supply chain are considered to be food waste valorisation in this study.

Given that food waste is a complex problem involving several stakeholders, valorisation endeavours are frequently met with legislative, logistical, and economic challenges. The fields of public policy and management recognise food waste as a wicked problem. It can be characterised as such because of its unstructured, cross-cutting, and relentless nature (Närvänen et al. 2020; Weber and Khademian 2008). Food waste is an unstructured problem because of the co-existence of several official definitions and measurement methods (Närvänen et al. 2020). The involvement of multiple stakeholders dotting the expanse of the food system makes it cross-cutting (Närvänen et al. 2020; Parfitt et al. 2010). Given the lack of an all-encompassing solution that can end the problem once and for all, the issue of food waste is also relentless (Närvänen et al. 2020). As is the case with all wicked problems, there is no straightforward or unilateral way to address this problem. Instead, a collaborative and multidimensional approach involving various stakeholders must be undertaken (Roberts 2000; Weber and Khademian 2008). To accelerate this kind of collaboration among stakeholders, understanding the problem through their perspectives is critical.

In recent years, researchers and policymakers have been working towards gathering empirical evidence that can help further our understanding of stakeholders' experiences of dealing with food waste and its prevention. Currently, much of this knowledge comes from research that is focused on consumer behaviour and food waste at the household level (Xue et al. 2017). Results from such studies have helped in designing interventions that aim to reduce the amount of food that is wasted in the household setting (Hebrok and Boks 2017; Kim et al. 2019; Reynolds et al. 2019; Zamri et al. 2020). While more than half of all food waste is estimated to occur at the household level, several million tonnes of food are wasted before it reaches the consumer (Parfitt et al. 2010; Xue et al. 2017). Actors in the food supply chain, including producers, manufacturers, distributors, and retailers, can play a role in reducing and better utilising food surplus and waste. Current literature focusing on pre-consumer food waste largely concerns establishing food waste quantities (Bellemare et al. 2017; Corrado et al. 2019; Parfitt et al. 2010; Spang et al. 2019; Xue et al. 2017), underscoring technological innovation (Arancon et al. 2013; Lin et al. 2013; Nayak and Bhushan 2019), mapping business and supply chain issues (Aschemann-Witzel et al. 2017; Diaz-Ruiz et al. 2019; Göbel et al. 2015; Huang et al. 2021; Yetkin Özbük and Coşkun 2020), and identifying legislative and policy barriers (Broeze and Luyckx 2019; Eriksson et al. 2020; Garske et al. 2020; Vittuari et al. 2015). Similar to the broader scholarship on the circular economy (Närvänen et al. 2021), material flows and technological aspects of food waste valorisation are better understood in comparison with the social, institutional, and organisational aspects. We address this gap in the literature by presenting a qualitative investigation into the experiences of supply chain actors engaged in food waste valorisation in the Netherlands. Our study focuses on nonconsumer actors such as farmers, entrepreneurs, retail executives, and food aid workers who are involved in food waste valorisation in different capacities. Considering that valorisation for the purpose of human consumption is regarded as the most socially effective and environmentally sound option for the management of food waste and surpluses (Papargyropoulou et al. 2014), this study focuses exclusively on actors involved in such undertakings. By analysing their experiences of participating in, organising, and leading these operations, we aim to shed light on the current state of the food waste valorisation sector from the perspective of those engaged in it.

## Food waste valorisation in the Netherlands

As a Member State of the European Union, the Netherlands aspires to realise the United Nations' Sustainable Development Goal (SDG) 12.3 by halving per capita food waste by 2030. This ambition is reflected in the government's 'A Circular Economy in the Netherlands by 2050' agenda. In 2016, the cabinet outlined steps to ensure that raw materials, products, and services are used in a sustainable manner in the years to come. The report 'Execution Programme Circular Economy 2019–2023' (Ministerie van Infrastructuur en Waterstaat 2019) indicates that sustainable and circular biomass is a priority for the Netherlands and reducing food waste is an important means to achieve this. The Samen Tegen Voedselverspilling (Together Against Food Waste) foundation is at the forefront of the food waste reduction movement in the country. Together with over 100 stake-holders from the public and private sectors, the foundation manages consumer campaigns, voluntary agreements among food supply chain actors, and liaises with industry stakeholders and government bodies. Between 2018 and 2021, the Dutch government made resources worth EUR 8 million available to small- and medium-sized enterprises focused on sustainable food (Rijksoverheid 2019).

Publicly available information on food waste reduction in the Netherlands focuses largely on preventing food from turning into waste at the household level. Efforts to redistribute surplus or valorise unavoidable food waste are not widely reported. However, some non-consumer-focussed initiatives have gained popularity in the country. Voedselbank Nederland is a network of over 170 charities that procure surplus food products from retailers and distributors to redistribute them among food insecure individuals (Voedselbanken Nederland 2020). Several other independent charities are also engaged in similar activities. Digital platforms such as Too Good To Go and OLIO connect consumers with discounted surplus food products in their neighbourhoods. Either through such platforms or independently, supermarkets such as Lidl offer close-to-expiration products at reduced costs. Businesses like Kromkommer, Krush, VeggiHap, and Verspillingsfabriek transform surpluses or by-products into VASP such as soups, breakfast cereal, and pasta. Nijsen, an animal feed producer, specialises in converting former foodstuff into sustainable pig feed.

Overall, the Netherlands offers a conducive ecosystem for supply chain actors who seek to incorporate food waste prevention and valorisation into their operations. Sharing knowledge, resources, and technical know-how are promoted as ways of achieving the goal of 'Circular Netherlands 2050'. However, most food waste reduction efforts remain voluntary in nature and in the absence of non-compliance sanctions, businesses are not held accountable for lack of effort towards the cause (Piras et al. 2018). Against this background of the Dutch laissez-faire approach to food waste valorisation, we examine the motivation and experiences of actors who choose to engage in it.

## Methods

Considering that the lived experiences of food waste valorisation professionals were central to our research, the phenomenological approach was found to be suitable for conducting this study. Phenomenology, as a qualitative research method, seeks to distil the common meaning of several individuals' lived experiences of a certain phenomenon (Creswell and Poth 2016). The purpose of this approach is not to generate a new theory but to further the understanding of the phenomenon in question by studying a richly detailed and contextual account of study participants' lived experiences (Sorrell and Redmond 1995). In his pioneering work on the subject, Van Manen (1997) posits that the point of phenomenological research is to 'borrow' other people's experiences and their reflections of it so as to come to a better understanding of a certain aspect of human experience. Although phenomenology is not a widely employed research method in the field of food (social) sciences, we chose to work with it because both food waste valorisation as a phenomenon and participants' experiences of it were crucial to our research.

Tesch (1984) suggests allowing the nature of the phenomenon to decide the number of participants to be recruited for the study. While 10 to 15 participants are recommended, sample sizes often vary between six and 25 (Tesch 1984). In this study, 16 participants involved in food waste valorisation in various capacities were interviewed. Participants were recruited through a purposive sampling strategy wherein they were chosen on the basis of the specific qualities, knowledge, and experience they possessed (Etikan et al. 2016). The sample was designed to have equal number of participants working for for-and non-profit organisations in order to allow a comparison of their experiences. Table 1 presents an overview of participants and a brief description of their professional or volunteer experience.

Conducting interviews is the most practiced data collection method for phenomenological studies (Creswell and Poth 2016). Although other methods such as observations or written accounts can be used as well, interviewing is preferred because it is less intrusive and is sensitive to the nature of the enquiry (Creswell and Poth 2016). Participants may be provided with an introductory text detailing the aim and the scope of the study so they can come prepared with meaningful narratives (Sorrell and Redmond 1995). For this study, participants were contacted by the first author via email with information about the study and the nature of the interview. They were informed about the purpose of the study a second time by the researchers prior to the interviews. In-depth, unstructured interviews were conducted between September 2020 and November 2021 and lasted between 60 and 75 min each. Interview questions were customised to match the expertise and background of each participant but broadly focused on similar topics and followed the interview protocol developed by the research team. As suggested by Sorrell and Redmond (1995), interviews were not only 'conducted' but were also shaped and participated in by the interviewers to

Participant	Description					
P1	Founder and director of a logistics organisation transporting surplus food to charities across the country					
P2	Food safety expert advising food charities about food safety and quality on a probono basis					
Р3	Independent food packaging professional offering <i>pro bono</i> consultancy services to charitable organisations that redistribute surplus food					
P4	Quality management and regulatory affairs professional offering <i>pro bono</i> consultancy services to charitable organisations that redistribute surplus food					
Р5	Founder of a social start-up that connects retail surplus with charities that run soup kitchens and social restaurants					
P6	Hospitality professional volunteering with a charity that prepares meals from retail surplus and offers them to those in need, free of cost					
Р7	Procurement professional offering <i>pro bono</i> consultancy services to charitable organisations that redistribute surplus food					
P8	Employee of a charitable shop that runs a community refrigerator					
Р9	Fresh produce grower and the founder of a start-up valorising fresh produce waste and surplus into VASP					
P10	Co-founder of a catering company that connects the hospitality industry with surplus produce					
P11	Head of business development for a start-up that valorises fruit peels into VASP such as food addi- tives and functional ingredients					
P12	Research and development manager for a start-up that valorises fruit peels into VASP such as food additives and functional ingredients					
P13	Quality manager for a business that creates VASP such as soups and sauces from catering leftovers					
P14	Sustainability manager for a retail chain that donates a portion of its surplus food products to chari- ties					
P15	Co-founder of a start-up that valorises vegetable processing by-products into VASP such as pasta					
P16	Sales executive for a digital platform connecting consumers with close to expiration food products in supermarket and other food retail outlets					

Table 1	Descri	ption of	<sup>-</sup> partici	pants'	profession	ial backgro	ounds
		1			1		

enable the participants to provide a detailed and focused account of their experiences. All interviews were conducted in English and transcribed *verbatim*. Participants were requested to review interview transcripts for inaccuracies.

Transcripts were analysed using the three steps described by Streubert and Carpenter (2011), supplemented by the explanation by Creswell and Poth (2016). In the first step, known as naïve reading, we read all the interview transcripts to become familiar with the text as a whole and the underlying meanings. Next, we performed structural analysis wherein the text was read once again, but this time with the intention to identify patterns and make connections. At this stage, all authors met frequently to discuss and compare their understanding of the text. Sections of the text that were perceived as significant were highlighted and were assigned codes to indicate their relevance. This was followed by coded pieces of text being grouped into broader units of description to create clusters. Interconnected clusters were grouped together into themes. Finally, in the third round of interpretation, all authors collectively reflected on the data analysis process to ensure a comprehensive understanding of the findings. Atlas.ti was used to manage and code the data. Wherever necessary, excerpts, quoted verbatim, unless modified to improve readability or ensure anonymity, have been used to underpin the findings. Figure 1 presents a schematic overview of the data collection and analysis process. The study was conducted in line with the requirements of the Helsinki protocol and received ethical approval from the Ethics Review



Fig. 1 Data collection and analysis process

Committee Inner City Faculties of Maastricht University under reference number ERCIC\_196\_10\_06\_2020.

#### Findings

Our analysis resulted in the construction of five overarching themes that collate the experiences shared by the study participants. Figure 2 illustrates the themes and subthemes in a schematic format. The subsections that follow illustrate the themes in further detail.

#### Local embeddedness

Improving food access for underserved communities, reducing the amount of food wasted by local businesses, and establishing sustainable, localised, and short supply chains were important motivating factors for participants when choosing to work in the field of food waste valorisation. Altruistic motivations were higher among participants working with food charities or non-profit organisations. Most of these participants were strongly driven by the wish to 'give back to the community'. They spoke at length on topics such as food insecurity, access to nutritious food, and desire to help fellow community members. In comparison, participants working with for-profit organisations focused on the issues of inefficient resource use and environmental damage at local and regional levels.

Several participants exhibited a strong preference for working with businesses that were local to the area or were managed by residents of the area. For instance, P1 narrated their observation regarding franchise owners of supermarkets being more willing to donate surplus food products to their own communities as opposed to managers of retail chains who did not have any connections with the residents of the area. P1 explained this through the example of the Dutch co-operative supermarket chain Plus: "With companies like Plus, where they work with the franchise model, we



Fig. 2 Themes and sub-themes

see that owners are really keen on sending surplus to the local community. But with non-franchise supermarkets, that is often not the case."

Preference for localised and short supply chains was also a prominent theme when discussing the possibilities of expanding a profitable valorisation business. When asked about the possibility of scaling up operations, participants expressed concerns regarding environmental and logistical barriers. For instance, P11 believed that procuring fruit peel from farther away than they currently do would diminish the sustainable aspect of the business: "I don't think scaling up this kind of an operation is valuable. What we do is, we make a radius of around 250 kms around this city and collect peels from supermarkets within that radius. If you go further, then the pollution caused by getting the peels here will be too big. And if there is a region with a lot of peel waste, then they could set up a similar concept there." Furthermore, P11 expressed willingness to share their knowledge and technology with other entrepreneurs with a similar vision. P15 shared that the vegetable waste they worked with varied in volume and composition on a daily basis. This would make it logistically challenging to set up a single factory that supplies several markets. Instead, they supported the idea of 'clustered' production wherein small-scale factories, tailored to the surplus available in the region, could be set up in different parts of the world.

Lack of social cohesion came up as a barrier to successful valorisation endeavours. Several participants shared that reducing food waste through redistribution or creating new products was feasible only if various actors in the supply chain cooperated with one another. P9, when asked about what kind of relationship they envision among food chain actors to allow food waste to be valorised, narrated their experience as follows: "Nowadays there is no trust in the food chain. Everybody is there for their own selves. I want to be able to look inside the factory of the processor. I am happy to allow other processors to look in my factory as well. We need to be able to trust each other and learn from each other's mistakes". Similarly, other participants hoped that the years to come would see improved commitment towards the cause from their communities and relevant stakeholders.

The small scale of food waste valorisation activities often means that organisations engaged in them cannot access resources at the national level. This is especially true for smaller, independent charities. P14 explained that stores from their retail chain only worked with a national charity network because of its reputation: "They are a really large organisation, they cover the whole country. They make food available for people in need and have a thorough system of helping and selecting their customers. It's very much an organisation that our consumers really appreciate us working with". Despite this nationalised charity's branches working independently and serving communities that are local to where their operations are, centralised administration helps them maintain a good reputation and publicise their work well.

Given that the interviews were conducted when the COVID-19 crisis was ongoing in the Netherlands, participants reflected on their experiences of dealing with lockdown measures and their impact. Particularly, participants working for charitable organisations felt the moral obligation to continue their work despite the restrictions that made it challenging to do so. The pandemic and its negative impact on food security appears to have bolstered these individuals' commitment to the cause of food waste valorisation.

#### Obligation to ensure food safety

Food safety was an important theme during most interviews. Participants reported that safety concerns regarding the valorisation of food processing by-products often arise due to supply chain inefficiencies and uncertainties regarding the legal status of the by-products. Regarding surplus food that is redistributed to consumers through charities or alternative supply chains, reduced quality, allergens, and spoilage were the main concerns. Food safety was a sensitive subject for several participants, and they felt personally responsible for ensuring that food produced or redistributed by their organisation was safe and of good quality.

In the case of charitable organisations, some participants expressed concerns regarding the level of hygiene that volunteers could maintain: "Nobody likes to talk or think about food safety in social restaurants. They never look into it because they are afraid of what they might see". They expressed confidence regarding volunteers' benevolent intentions but felt that they needed additional training to ensure food safety: "The challenge with food banks is that they are usually run by volunteers. They want to give as much support to those in need as they can. But the challenge lies in the fact that they have to recognise when it is safe to accept and redistribute this food. And this is not only with microbiological spoilage but also allergens, storage history, etc." For some participants working with food charities, 'providing food' was more important than 'providing good food'. They believed recipients could decide for themselves whether they wished to consume a certain product.

Participants working with small-scale charities shared that most did not have comprehensive hygiene rules, recall procedures, or offer regular food safety training to their volunteers. P6 explained that such matters were dealt with on an ad hoc basis: "Ideally, you would want a protocol for food safety crises before they happen. But when running a volunteer-led organisation, you have so many things to do. We just try to keep our head above the water and things like these get attention only when really needed". P1 attributes the lack of formal hygiene rules to the Dutch social norm of displaying trust in fellow citizens' good intentions: "We have a lot of regulations in the Netherlands, but we are not very good at living according to regulations. So, despite having regulations, we don't check them. Not because we don't want to, but we don't believe in 'checking'. If manuals are introduced in charitable organisations, they will ask 'why do we need to have a manual? Why does somebody who would like to cook for charity need a manual and do all kinds of checks?". Participants working with small-scale charities mentioned that the competent authority rarely ever audited such organisations. Therefore, volunteers did not consider it important to prepare for inspections or audits which are regularly conducted at larger, nationalised charities.

For those engaged in for-profit valorisation operations, such as the production of VASP, food safety was non-negotiable. Participants shared that being certified for food safety was important for them because it would allow their products retail access. However, considering that their operations and procurement deviated from regular food processing businesses, some participants found working with existing standards to be a challenge. P16, who at the time of the interview, was working together with a certification bureau to get their operations certified for food safety, shared that existing certification schemes were unable to accommodate certain aspects of their production. They were of the opinion that if certification schemes made measured exceptions regarding these aspects or introduced addendums, it would make it easier for entrepreneurs to create a market for VASP. Additionally, the usefulness of certification schemes designed specifically for such products was discussed. While some participants thought this to be beneficial, others disagreed. For instance, some believed such certification could hamper innovation and existing certification schemes should simply adapt to the needs of sustainable businesses instead of creating new schemes. One interviewee, despite considering food safety to be important, did not feel that their organisation needed to be certified or have a detailed safety manual. This was due to the fact that their organisation was only a facilitator and not ultimately responsible for the products being valorised. P11 believed that certification tailored to the special processing needs of VASP could be beneficial if it conveyed the sustainable quality of the final product to the consumer. Regarding such certification, they shared: "From a commercial perspective, it's very interesting to understand this trend. Creating ingredients out of by-products or waste has a certain mark up in the cost chain towards customers. So, we are looking for ways to make it clear to the consumer that the ingredients that you buy from us are coming from by-products".

## Ethics of food surplus valorisation

The participants of the study recounted various ethical dilemmas that they faced due to their professional or volunteer activities. Regarding the redistribution of surplus food products, participants working for charities and non-profit organisations described increasing competition from start-ups that connect consumers with surplus. They believed it was unethical for organisations to profit from selling food that would have otherwise been donated to food insecure individuals. When one participant who works for such a start-up was requested for their opinion on this competition, they shared that private organisations having to provide food aid in a wealthy welfare state such as the Netherlands in itself was unethical. Some others shared that it was possible for both kinds of valorisation activities to coexist without competing for surplus food since there was enough to go around. Most participants considered it reasonable to allow consumers who wished to purchase groceries at discounted prices or contribute towards reducing food waste to purchase such products to do so. However, they also showed a strong interest in cooperating with charities and non-profits to redistribute surplus food in a fair way. Participants shared that competition existed between charities as well. Those working with small-scale charities believed bigger charities received a majority of all surplus food in the country because of their reputation and public relations prowess.

Competition from non-food industries was also discussed. Some participants, especially those working with non-profit organisations, described that they worked hard to convince stakeholders that keeping surplus food and by-products within the food supply chain was more sustainable than sending it to animal feed or turning it into biofuel. Others questioned whether that truly was the case. P14 described their dilemma as follows: "So many initiatives are thinking of ways to keep surplus in the food supply chain. You can turn anything into a smoothie or into a soup or a quiche. But would that still make sense? Or am I then making a quiche that has a carbon footprint of a piece of beef?".

Some participants deliberated whether valorisation of food surplus and by-products truly contributed to the reduction of food waste. Considering that surpluses were required by these organisations to continue with their operations, participants wondered whether they were creating a demand for food waste. P7 expressed their views on this as follows: "We are in favour of reducing food waste but that also makes us 'thieves out of our own pocket' because every product that is not stamped as surplus stock or leftover, we won't get. So, you see that we are cutting our own supply line if we are working on reducing food waste".

When food surplus was not valorised for charitable purposes, participants were conflicted about whether the buyer who wishes to valorise them into new products should have to pay for it. Expecting primary producers to give away their surplus for free so someone else could profit from it was thought of as unethical by some participants. They thought it to be particularly unfair when the processor sold VASP at a premium price due to its sustainability credentials. P9 shared their experience with such buyers: "They come here saying they want my surplus or lower quality produce for free but that's not going to happen. I know that in the end, they will earn a lot of money with it because I see existing products which are based on this thought. They pick up the produce for free, process it into a product where you cannot see any more that it's from food waste and then ask for a higher price than regular products". They further shared that processors and catering businesses often tried to label misshapen but otherwise good quality produce as waste to take it off producers' hands for free or for lower prices thus further inflating the cosmetic standards for fresh produce. Others argued that by taking in such produce without transaction costs, processors were helping producers not to pay to dispose of their waste.

#### Societal perception

Participants spoke at length about their ideas regarding how society perceives food waste valorisation. Those engaged in for-profit valorisation activities thought it important to understand consumer perception in order to improve their product's branding. Some believed that through raising awareness about food waste and the benefit of valorising surplus or by-products as new foods, it was possible to create a market for VASP products. They shared that they prefer to stay away from the word 'waste' while communicating their brand's story, so consumers do not feel like they are paying to purchase waste. P15 shared that they preferred using terms such as 'upcycled' which help circumvent the need for mentioning waste or surplus. They believed that persuading consumers to purchase VASP to reduce food waste was not an effective marketing strategy. They shared the example of an unsuccessful VASP business from the Netherlands: "It was a very popular brand. People loved the 'end food waste' story at first. But that story could only take it so far because at some point, people just get tired of feeling guilty about whatever they're doing. Like, hey, you need to save the planet, so you buy this instead of that. Our approach is 'it's good for you' and in addition to that, it's also reducing food waste because we use surplus".

Some other participants shared this sentiment and were of the opinion that VASP or misshapen produce should not warrant a higher price simply because of food waste reduction reasons. Other participants believed that establishing such supply chains was currently more expensive and therefore expecting consumers to pay a premium price was justified. However, this may not be the case in the future if food waste valorisation were to become the norm. One participant offered the example of plant-based meat replacement products: "In the future, if more than half the food production is coming from waste, then it's not a unique selling point anymore. Look at plant-based meat replacement for example. People are currently willing to pay a premium for these products. But they are not a novelty anymore. It's becoming increasingly normal to consume these products instead of meat and eventually, people will be less willing to pay a plus for it". They believed that while this could be the case for VASP in the future, currently, the trend is at a nascent stage and therefore, premium retail prices were justified. Some others shared that consumers should adjust their expectations when purchasing VASP: "For the circular economy to work, we have to be open to new foods and food concepts. If you keep trying to replicate an existing product while aiming for circularity, it's going to be impossible".

Participants engaged in charitable redistribution also believed societal perception to be an important motivating factor for retailers to donate their surplus food. P7 was of the opinion that it was customer goodwill (*'gunfactor'* in Dutch) that motivated retailers to donate their surplus. They explained that supermarket brands wish to be viewed as organisations that fulfil their social responsibility. P5 shared that they had to often resort

to appealing to the moral sensibilities of retail executives to convince them to donate their surplus. However, they shared that convincing them is getting especially challenging in the face of initiatives looking to sell close-to-expiry or surplus products to consumers at reduced prices. According to P5: "Many initiatives try to sell leftover products for 25 cents per piece. This way, supermarkets sell their wares, but they are not making any profit. If they donated this food instead, they could tell their neighbourhood that they donate. This gives the supermarket a good name. We have seen customers choosing to buy at such supermarkets because of the goodwill it creates". However, several participants shared that despite being aware of this goodwill factor attached to donation, supermarkets were hesitant to donate because they did not wish to be responsible for food-borne illnesses that could be caused if the donated products were mishandled.

#### Coping with uncertainty

Supply chains for food waste valorisation operations in the Netherlands are not as well established as regular food supply chains. Participants engaged in both, profitable as well as charitable valorisation experienced uncertainties regarding supply. Given that it is impossible to estimate the exact quantities and composition of incoming surplus food, participants shared that they have to undertake various strategic measures to ensure that their operations can continue despite the precarity. P10 shared that they dealt with the highly erratic supply by allocating additional resources to planning and logistics: "How can you plan your operations if you don't know what to expect today? We always collect products within 24 h. So that means if somebody calls and says, 'We have 8000 kilos of paprika, we need to schedule it today. And then we need to pick it up today. This costs extra money because we cannot schedule anybody in advance". Others working with similarly diverse and fluctuating raw materials also shared that they employed strategies such as developing adaptable recipes and cooperating with other food banks in the region to arrange barters. Interestingly, P12 shared that their organisation did not have to deal with uncertainty of this nature because they worked with peels from only one kind of fruit.

Several participants shared that legal uncertainty was among their biggest obstacles when valorising by-products or surplus. For instance, food processing by-products not falling under the ambit of the EU General Food Law<sup>1</sup> (GFL) created bottlenecks for participants working with VASP. Since safety requirements for by-products such as peels, trimmings, pits, and other parts are excluded from the GFL, participants found it challenging to ensure that their products were legally safe for human consumption. P15 explained that this made it a challenge to find suppliers because they were uncertain about selling their 'waste' to a VASP producer: "In the Netherlands, we have quite a large number of vegetable processing companies, but they just wouldn't sell their by-products to us! Unless the company is built specifically for handling this type of raw materials, they are unable to tick boxes and say 'Hey, this is a by-product from this vegetable'. Because they have no space for it, they don't touch it". Another participant working with

<sup>&</sup>lt;sup>1</sup> Regulation (EC) No 178/2002 of the European Parliament and of the Council of 28 January 2002 laying down the general principles and requirements of food law, establishing the European Food Safety Authority and laying down procedures in matters of food safety.

VASP shared that their organisation had the legal status of the by-product they work with changed from waste to food material in order to be able to legally use the by-product as a raw material.

Additionally, participants shared that they faced legal uncertainty in the process of innovation. For instance, P12 described that developing new products such as functional foods and additives was challenging because they did not fit existing categories under the GFL: "We are working on developing new types of products. Let's say, functional fibre. The issue with such a product is that it doesn't currently exist in the market. The process is new because it's our own invention. Now the question is, what exactly is this product according to legislation? Is it an additive? What is its E number? For us as a small company, that is very difficult to figure out".

Participants engaged in charitable redistribution experienced legal ambiguity as well. Adherence to use-by dates, handling of frozen foods, labelling errors, and liability were some issues of concern for these participants. Those working with larger, better-organised charities shared that they were able to manage these issues through special accommodations from the Dutch competent authority responsible for food safety. In turn, these charities assured authorities of their capability by implementing a hygiene guide styled as per the national food retail standard. Those working with small-scale charities shared that volunteers often flouted rules that caused inconvenience because the competent authority rarely audits such organisations.

Lastly, several participants shared that they were unable to keep abreast with policy development on topics such as sustainability and circular economy. They shared that despite these issues being discussed extensively by politicians and legislators, they were unable to grasp what the policy changes meant for their work. Some speculated that sharing this information in an accessible way would ensure that small businesses and charitable organisations valorising food waste can benefit from the developments in the field. One participant shared: "You cannot expect everyone to speak the same level of English, French or whatever language these documents are written in. The people sitting in Brussels never visit the field where the farmer works to check whether their lawsuits the farmer's requirements".

## Discussion

Existing literature rarely examines the role of non-consumer stakeholders in mitigating or managing food waste. The aim of this study was to explore the phenomenon of food waste and surplus valorisation by drawing on the experiences of supply chain actors engaged in it to better inform policy and legislative actions surrounding food waste management. Based on a phenomenological analysis of 16 in-depth unstructured interviews, our findings offer novel insights into food waste valorisation activities in the Netherlands. In this section, we dissect the aspects of our results that invite further deliberation and delve into their relevance to the field of food waste management.

## Differences in perspectives of for-profit and non-profit professionals

Our sample for this study was composed of an equal number of participants working with for-profit and non-profit organisations. Given that both kinds of organisations are active in the food waste valorisation sector, we thought it to be important to include

Theme	Motive			
	Non-profit personnel	For-profit personnel		
Reducing food waste	Improving food security	Improving resource efficiency		
Working on a local scale	Helping lower socio-economic status communities	Establishing short food supply chains		
Concerns regarding food safety	Donor relations	Market requirements		
Ethical dilemmas	Competition for surplus food	Paying for surplus food		
Societal perception	Donor relations	Brand reputation		

	Table 2	Differences in	motivation of f	or-profit and	l non-profit work	ers
--	---------	----------------	-----------------	---------------	-------------------	-----

both perspectives. While participants engaged with either kind of organisations spoke about similar topics, their reasons for focusing on a certain theme were often diverging. It was evident during data analysis that organisational goals and visions had an impact on participants' personal views of food waste valorisation. For instance, all participants were keen on working at a local scale. However, those working with charitable or nonprofit organisations focused on communities, neighbourhoods, and people. In comparison, professionals working with for-profit organisations were motivated by the prospect of establishing local food supply chains and collaborating with entrepreneurs from the region. Similarly, while non-profit workers were keen on addressing food insecurity through their involvement with food waste valorisation, participants from the other group were inspired by the possibility of improving resource efficiency. Table 2 summarises the differences in motivation that were observed.

Against the background of food waste being a wicked problem, these diverging motivations to address it are not a surprising finding. However, it is interesting to note that the two groups did not have conflicting motives. In fact, many motives were complementary to one another. Awareness regarding which factors are important to which stakeholder can help in developing effective policy measures and governance tools. As suggested by Dentoni et al. (2018), wicked problems can be governed by harnessing their 'wickedness', i.e. by taking into account and responding to the different dimensions of the problem and thereby enabling networked action to achieve small wins.

## The food waste prevention paradox

Study participants appeared to be markedly aware of the fact that they relied on the continued supply of food surplus or waste for their valorisation endeavours. This led them to question whether they were creating a market demand for food waste instead of aiding in its sustainable management. Some even reflected on whether they were disregarding the food waste hierarchy, which suggests prevention as the topmost priority (Papargyropoulou et al. 2014). Although they were clearly motivated to reduce food waste, the widely accepted food waste hierarchy approach made them think of their actions as paradoxical.

Messner et al. (2020) recognise this as a challenge and propose that different strategies should be used when tackling the problems of over production and overconsumption of food as opposed to the management of food that has already been or is likely to be classified as waste. The former can be addressed through prevention and the later through valorisation. They argue, based on the findings of Zorpas and Lasaridi (2013), that prevention has a different ontological quality compared to the physical management or transformation of tangible waste. In the same way as it not being possible to 'fix a flat tyre by reminding someone to avoid nails, they posit that prevention has no role to play in managing food waste (Bloom 2011; Messner et al. 2020). Our results indicate that the inclusion of 'prevention' as a food waste management strategy creates confusion and scepticism among stakeholders. Therefore, this study empirically corroborates the proposition of Messner et al. (2020), regarding prevention not being a substantive method of waste management and in turn, its inclusion in the waste management hierarchy being problematic. However, another aspect of Messner and colleagues' work warrants discussion here. The authors suggest that the proliferation of businesses created to valorise food waste may cause a surge in the demand for waste, thus normalising unsustainable production and consumption. As discussed above, our participants reflected on this aspect of their work and expressed concern regarding the demand they were creating for food waste. This brings us back to the role of 'prevention' which, as established previously, does not prove effective as a food waste management strategy. Waste prevention, minimisation, and reduction must, in fact, precede the management options and businesses that rely on food waste must take this into account when setting up shop.

The work of Närvänen et al. (2021) on food waste-focused start-ups in the circular economy touches upon this paradox as well. Their findings indicate that businesses that reuse food waste become reliant on its continued supply and that their income is often positively correlated with waste volumes they are able to acquire. As a result, circular food businesses may support or even actively maintain market mechanisms that create surpluses. It is important for policymakers to carefully consider this trade-off when developing policies that guide the circular economy's development and to ensure that end goals of such policies are aligned with broader sustainability objectives.

## Food waste valorisation professionals as transition brokers

Experiences shared by study participants showcase their commitment towards addressing the problem of food waste despite being faced with several obstacles such as food safety concerns, regulatory and supply chain uncertainties, and societal scepticism regarding food surplus redistribution and VASP products. Most participants expressed eagerness to cooperate and share knowledge with other professionals working with food waste and surplus. Several characteristics exhibited by these individuals such as enthusiasm to inspire others, entrepreneurial spirit, ability to think from a system perspective, acting in collective interest, and having broad knowledge of circular innovations in the field of food waste management match the competencies thought of as essential for transition brokers (Cramer 2020). 'Transition brokers' in the context of the circular economy are described by Cramer (2020) as intermediate actors who enhance the process of change, build alliances, mediate between stakeholders, and help scale up and mainstream circular initiatives. Based on this, we posit that professionals engaged in food waste valorisation could be suitable candidates for brokering the transition to a circular food system.

Supply chain actors with an ambition to create a conducive ecosystem for food waste valorisation activities can employ their experience to identify market conditions required to realise the government's circularity ambitions. With private actors taking on this responsibility, local governments can better fulfil their conventional roles as regulators, facilitators, financers, and protectors of human wellbeing and common goods (Cramer 2020).

## The role of private standards and voluntary agreements

Results presented in this paper suggest that private actors, such as the participants interviewed for this study, are keen on regulating various aspects of food waste valorisation to better cope with the uncertainty that comes with rapid innovation. Developing hygiene guides, getting certified against private standards, and joining formal or informal agreements for cooperation were some ways in which these individuals and their organisations have dealt with the challenges of working in the nascent sector that food waste valorisation is.

Some concerns raised by study participants are reflected in existing literature as well. For instance, regarding legal opacity surrounding food processing by-products, it is known from literature that such products (as raw material) do not find a place in any lists or annexes of the EU legislation outlining food safety criteria (Rao et al. 2021a). The adoption of private food safety standards that accommodate the specific requirements of food processing by-products has been suggested as way to bridge this gap in public legislation (Rao et al. 2021a, 2021b). Additionally, circular food supply chains pose new food safety risks (James et al. 2022). Public regulators are often unable to act swiftly while addressing these new risks due to procedural requirements and bureaucracy in law-making (Fagotto 2014). In comparison, private standards can be negotiated relatively quickly and can provide a rapid solution to new risks (Fagotto 2014).

In some cases, such as charitable redistribution of food, voluntary agreements could be used as a form of private governance as opposed to private standards, which are often expensive to implement. Voluntary agreements are contracts between private actors regarding a certain goal and the means to achieve it. These agreements are popular in the context of environmental policy governance as demonstrated through cases involving forest management, water use, and energy efficiency (Cornelis 2019; Hernández-Sancho et al. 2015; Miljand et al. 2021) and have the potential to strengthen private actors' position in the food waste valorisation sector. Private actors commit themselves to such agreements to gain regulatory reliefs, customer loyalty, and higher product prices.

## Conclusion

This study explores the phenomenon of food waste valorisation by analysing the experiences of supply chain actors who are engaged in it. We empirically demonstrate that supply chain actors involved in food waste valorisation find local embeddedness to be an important aspect of their work. They often take on the responsibility to ensure food safety as a personal duty and face various ethical dilemmas related to repurposing surplus or waste food as food fit for human consumption. Additionally, they are faced with concerns regarding how society perceives food waste valorisation and often grapple with the uncertainties that come with the job.

Our findings reveal the divergent perspectives of for-profit and non-profit professionals, highlighting the importance of recognising and addressing their distinct motivations in developing effective policies for food waste management. By embracing the complexity of the food waste valorisation phenomenon and harnessing the complementary motives of these stakeholders, policymakers can foster collaborative initiatives that promote sustainable practices and resource efficiency.

The paradox of food waste prevention within the context of valorisation emerged as a critical concern among participants. We recommend policymakers to reconsider the role of "prevention" in waste management hierarchies and advocate for tailored strategies that prioritise waste reduction alongside valorisation efforts. Additionally, recognising the crucial role of food waste valorisation professionals as transition brokers provides an opportunity for public institutions to support these individuals as catalysts for a circular food system. By empowering and facilitating their endeavours, public and private sectors can synergistically work together towards a more sustainable and resilient food supply chain. Lastly, our study highlights the significance of private standards and voluntary agreements as governance tools in the circular food economy. In addition to their involvement in the development of such standards, public authorities should consider providing clarity and guidance regarding the safety of valorising food processing by-products. This could potentially enable the adoption of standardised food safety protocols, fortifying the overall position of the food waste valorisation sector.

Looking ahead, future research on this subject could explore the viewpoints of donors or sellers of by-products and surplus food, including retailers, farmers, and food processors. Understanding their perspectives and the obstacles they face in food waste valorisation will provide valuable insights for all involved stakeholders and potentially shed light on the dynamics of surplus redistribution, factors influencing participation in valorisation initiatives, and barriers that need attention to enhance the scale and effectiveness of these efforts.

#### Abbreviations

- VASP Value-added surplus product(s)
- SDG Sustainable development goal
- GFL EU general food law

#### Acknowledgements

We would like to thank all interviewees for their participation in the study. This research has been made possible with the support of the Dutch Province of Limburg.

#### Author contributions

Conceptualization: M.R.; Analysis: A.B., A.d.B., M.R.; Supervision: A.B., A.d.B.; Writing: M.R.; Reviewing and editing: A.B., A.d.B., M.R.

#### Funding

Research reported in this publication was partially supported by Interreg V A programme Deutschland-Nederland, project number 204259 SUN—Sustainable and natural side streams.

#### Availability of data and materials

The corresponding author can be contacted to request a copy of the code book.

#### Declarations

#### Ethics approval and consent to participate

This study received approval from the Ethics Review Committee Inner City faculties of Maastricht University under reference number ERCIC\_196\_10\_06\_2020. Participants involved in this study consented to their involvement by signing a declaration of informed consent.

#### **Competing interests**

The authors declare that there are no conflicts of interest.

Received: 12 January 2023 Revised: 3 August 2023 Accepted: 7 September 2023 Published online: 22 September 2023

#### References

- Arancon RAD, Lin CSK, Chan KM, Kwan TH, Luque R (2013) Advances on waste valorization: new horizons for a more sustainable society. Energy Sci Eng 1(2):53–71. https://doi.org/10.1002/ese3.9
- Aschemann-Witzel J, de Hooge IE, Rohm H, Normann A, Bossle MB, Grønhøj A, Oostindjer M (2017) Key characteristics and success factors of supply chain initiatives tackling consumer-related food waste – a multiple case study. J Clean Prod 155:33–45. https://doi.org/10.1016/j.jclepro.2016.11.173
- Bellemare MF, Çakir M, Peterson HH, Novak L, Rudi J (2017) On the measurement of food waste. Am J Agr Econ 99(5):1148–1158. https://doi.org/10.1093/ajae/aax034
- Bernardi PD, Bertello A, Forliano C (2021) Digital platforms for circular business model innovation: a case-study to tackle food waste. Routledge, In Business Model Innovation
- Bhatt S, Lee J, Deutsch J, Ayaz H, Fulton B, Suri R (2018) From food waste to value-added surplus products (VASP): Con-
- sumer acceptance of a novel food product category. J Consum Behav 17(1):57–63. https://doi.org/10.1002/cb.1689 Bilska B, Wrzosek M, Kołożyn-Krajewska D, Krajewski K (2016) Risk of food losses and potential of food recovery for social purposes. Waste Manage 52:269–277. https://doi.org/10.1016/j.wasman.2016.03.035
- Bloom J (2011) American Wasteland: How America throws away nearly half of its food (and what we can do about it). Hachette, UK.
- Broeze J, Luyckx K (2019) REFRESH deliverable D6.11—Identification of food waste conversion barriers. https://www.eurefresh.org/sites/default/files/D6.11%20Identification%20of%20food%20waste%20conversion%20barriers Final.pdf
- Caplan P (2017) Win-win?: food poverty, food aid and food surplus in the UK today. Anthropol Today 33(3):17–22. https://doi.org/10.1111/1467-8322.12350
- Cecilia JA, García-Sancho C, Maireles-Torres PJ, Luque R (2019) Industrial food waste valorization: a general overview. In: Bastidas-Oyanedel J-R, Schmidt JE (eds) Biorefinery: integrated sustainable processes for biomass conversion to biomaterials, biofuels, and fertilizers, Springer International Publishing, pp 253–277. https://doi.org/10.1007/978-3-030-10961-5\_11
- Cooremans K, Geuens M (2019) Same but different: using anthropomorphism in the battle against food waste. J Public Policy Mark 38(2):232–245. https://doi.org/10.1177/0743915619827941
- Cornelis E (2019) History and prospect of voluntary agreements on industrial energy efficiency in Europe. Energy Policy 132:567–582. https://doi.org/10.1016/j.enpol.2019.06.003
- Corrado S, Caldeira C, Eriksson M, Hanssen OJ, Hauser H-E, van Holsteijn F, Liu G, Östergren K, Parry A, Secondi L, Stenmarck Å, Sala S (2019) Food waste accounting methodologies: Challenges, opportunities, and further advancements. Glob Food Sec 20:93–100. https://doi.org/10.1016/j.gfs.2019.01.002
- Cramer JM (2020) The function of transition brokers in the regional governance of implementing circular economy—a comparative case study of six Dutch regions. Sustainability. https://doi.org/10.3390/su12125015
- Creswell JW, Poth CN (2016) Qualitative inquiry and research design: choosing among five approaches. Sage, Cambridge de Almeida Oroski F (2020) Exploring food waste reducing apps—a business model lens. In: Närvänen E, Mesiranta N,
- Mattila M, Heikkinen A (eds) Food waste management: solving the wicked problem, Springer International Publishing, pp. 367–387. https://doi.org/10.1007/978-3-030-20561-4\_14
- Dentoni D, Bitzer V, Schouten G (2018) Harnessing wicked problems in multi-stakeholder partnerships. J Bus Ethics 150(2):333–356. https://doi.org/10.1007/s10551-018-3858-6
- Diaz-Ruiz R, Costa-Font M, López-i-Gelats F, Gil JM (2019) Food waste prevention along the food supply chain: a multiactor approach to identify effective solutions. Resour Conserv Recycl 149:249–260. https://doi.org/10.1016/j.resco nrec.2019.05.031
- Dimou C, Karantonis HC, Skalkos D, Koutelidakis AE (2019) Valorization of fruits by-products to unconventional sources of additives, oil, biomolecules and innovative functional foods. Curr Pharm Biotechnol 20(10):776–786. https://doi.org/ 10.2174/1389201020666190405181537
- Eriksson M, Giovannini S, Ghosh RK (2020) Is there a need for greater integration and shift in policy to tackle food waste? Insights from a review of European Union legislations. SN Appl Sci 2(8):1347. https://doi.org/10.1007/ s42452-020-3147-8
- Etikan I, Musa SA, Alkassim RS (2016) Comparison of convenience sampling and purposive sampling. Am J Theoret Appl Stat 5(1):1
- Fagotto E (2014) Private roles in food safety provision: The law and economics of private food safety. Eur J Law Econ 37(1):83–109. https://doi.org/10.1007/s10657-013-9414-z
- Galanakis CM (2020) Food waste recovery: processing technologies, industrial techniques, and applications. Academic Press
- Garske B, Heyl K, Ekardt F, Weber LM, Gradzka W (2020) Challenges of food waste governance: an assessment of European legislation on food waste and recommendations for improvement by economic instruments. Land. https://doi.org/ 10.3390/land9070231
- Göbel C, Langen N, Blumenthal A, Teitscheid P, Ritter G (2015) Cutting food waste through cooperation along the food supply chain. Sustainability. https://doi.org/10.3390/su7021429
- Hebrok M, Boks C (2017) Household food waste: Drivers and potential intervention points for design an extensive review. J Clean Prod 151:380–392. https://doi.org/10.1016/j.jclepro.2017.03.069
- Hernández-Sancho F, Molinos-Senante M, Sala-Garrido R (2015) Voluntary agreements to promote the use of reclaimed water at Tordera river basin. In: Lago M, Mysiak J, Gómez CM, Delacámara G, Maziotis A (eds) Use of economic instruments in water policy: insights from international experience. Springer International Publishing, Berlin, pp 379–392

- Huang IY, Manning L, James KL, Grigoriadis V, Millington A, Wood V, Ward S (2021) Food waste management: a review of retailers' business practices and their implications for sustainable value. J Clean Prod 285:125484. https://doi.org/10. 1016/j.jclepro.2020.125484
- James K, Millington A, Randall N (2022) Food and feed safety vulnerabilities in the circular economy. EFSA Support Publ 19(3):7226E. https://doi.org/10.2903/sp.efsa.2022.EN-7226
- Jiménez-Moreno N, Esparza I, Bimbela F, Gandía LM, Ancín-Azpilicueta C (2020) Valorization of selected fruit and vegetable wastes as bioactive compounds: opportunities and challenges. Crit Rev Environ Sci Technol 50(20):2061–2108. https://doi.org/10.1080/10643389.2019.1694819
- Kim J, Rundle-Thiele S, Knox K (2019) Systematic literature review of best practice in food waste reduction programs. J Soc Mark 9(4):447–466. https://doi.org/10.1108/JSOCM-05-2019-0074
- Lambie-Mumford H (2017) Hungry Britain: the rise of food charity. Policy Press, Cambridge
- Lin CSK, Pfaltzgraff LA, Herrero-Davila L, Mubofu EB, Abderrahim S, Clark JH, Koutinas AA, Kopsahelis N, Stamatelatou K, Dickson F, Thankappan S, Mohamed Z, Brocklesby R, Luque R (2013) Food waste as a valuable resource for the production of chemicals, materials and fuels. Current situation and global perspective. Energy Environ Sci 6(2):426. https://doi.org/10.1039/c2ee23440h
- Makhal A, Robertson K, Thyne M, Mirosa M (2021) Normalising the "ugly" to reduce food waste: exploring the socialisations that form appearance preferences for fresh fruits and vegetables. J Consum Behav 20(5):1025–1039. https:// doi.org/10.1002/cb.1908
- Messner R, Richards C, Johnson H (2020) The "Prevention Paradox": food waste prevention and the quandary of systemic surplus production. Agric Hum Values 37(3):805–817. https://doi.org/10.1007/s10460-019-10014-7
- Midgley JL (2014) The logics of surplus food redistribution. J Environ Planning Manage 57(12):1872–1892. https://doi.org/ 10.1080/09640568.2013.848192
- Miljand M, Bjärstig T, Eckerberg K, Primmer E, Sandström C (2021) Voluntary agreements to protect private forests a realist review. Forest Policy Econ 128:102457. https://doi.org/10.1016/j.forpol.2021.102457
- Ministerie van Infrastructuur en Waterstaat (2019) Uitvoeringsprogramma Circulaire Economie 2021–2023. Planbureau voor de Leefomgeving. https://open.overheid.nl/repository/ronl-669a180a-7f09-4336-890c-633cf2c3b852/1/pdf/uitvoeringsprogramma-circulaire-economie.pdf
- Mookerjee S, Cornil Y, Hoegg J (2021) From waste to taste: how "Ugly" labels can increase purchase of unattractive produce. J Mark 85(3):62–77. https://doi.org/10.1177/0022242920988656
- Mullick S, Raassens N, Haans H, Nijssen EJ (2021) Reducing food waste through digital platforms: a quantification of crossside network effects. Ind Mark Manage 93:533–544. https://doi.org/10.1016/j.indmarman.2020.09.021
- Närvänen E, Mattila M, Mesiranta N (2021) Institutional work in food waste reduction: start-ups' role in moving towards a circular economy. Ind Mark Manage 93:605–616. https://doi.org/10.1016/j.indmarman.2020.08.009
- Närvänen E, Mesiranta N, Mattila M, Heikkinen A (2020) Introduction: a framework for managing food waste. In: Närvänen E, Mesiranta N, Mattila M, Heikkinen A (eds) Food waste management: solving the wicked problem. Springer International Publishing, Berlin, pp 1–24
- Nayak A, Bhushan B (2019) An overview of the recent trends on the waste valorization techniques for food wastes. J Environ Manage 233:352–370. https://doi.org/10.1016/j.jenvman.2018.12.041
- Papargyropoulou E, Lozano RK, Steinberger J, Wright N, Ujang ZB (2014) The food waste hierarchy as a framework for the management of food surplus and food waste. J Clean Prod 76:106–115. https://doi.org/10.1016/j.jclepro.2014.04.020
- Parfitt J, Barthel M, Macnaughton S (2010) Food waste within food supply chains: quantification and potential for change to 2050. Philos Trans R Soc B Biol Sci 365(1554):3065–3081. https://doi.org/10.1098/rstb.2010.0126
- Piras S, García Herrero L, Burgos S, Colin F, Gheoldus M, Ledoux C, Parfitt J, Jarosz D, Vittuari M (2018) Unfair trading practice regulation and voluntary agreements targeting food waste
- Qi D, Penn J, Li R, Roe BE (2022) Winning ugly: profit maximizing marketing strategies for ugly foods. J Retail Consumer Serv 64:102834. https://doi.org/10.1016/j.jretconser.2021.102834
- Rao M, Bast A, de Boer A (2021) European private food safety standards in global agri-food supply chains: a systematic review. Int Food Agribus Manag Rev 24(5):1–16
- Rao M, Bast A, de Boer A (2021) Valorized food processing by-products in the EU: finding the balance between safety, nutrition, and sustainability. Sustainability. https://doi.org/10.3390/su13084428
- Reynolds C, Goucher L, Quested T, Bromley S, Gillick S, Wells VK, Evans D, Koh L, Carlsson Kanyama A, Katzeff C, Svenfelt Å, Jackson P (2019) Review: consumption-stage food waste reduction interventions – what works and how to design better interventions. Food Policy 83:7–27. https://doi.org/10.1016/j.foodpol.2019.01.009
- Rijksoverheid (2019) Uitvoeringsprogramma Circulaire Economie 2019–2023. https://open.overheid.nl/repository/ronl-13a37442-cbd9-45e5-8e97-8fa81d657cff/1/pdf/uitvoeringsprogramma-2019-2023.pdf
- Roberts N (2000) Wicked problems and network approaches to resolution. Int Public Manag Rev 1(1):1 Schneider F (2013) The evolution of food donation with respect to waste prevention. Waste Manage 33(3):755–763. https://doi.org/10.1016/i.wasman.2012.10.025
- SedImeier R, Rombach M, Bitsch V (2019) Making food rescue your business: case studies in Germany. Sustainability. https://doi.org/10.3390/su11185101
- Sorrell JM, Redmond GM (1995) Interviews in qualitative nursing research: differing approaches for ethnographic and phenomenological studies. J Adv Nurs 21(6):1117–1122. https://doi.org/10.1046/j.1365-2648.1995.21061117.x
- Spang ES, Moreno LC, Pace SA, Achmon Y, Donis-Gonzalez I, Gosliner WA, Jablonski-Sheffield MP, Momin MA, Quested TE, Winans KS, Tomich TP (2019) Food loss and waste: measurement, drivers, and solutions. Annu Rev Environ Resour 44(1):117–156. https://doi.org/10.1146/annurev-environ-101718-033228
- Streubert HJ, Carpenter DR (2011) Qualitative research in nursing: advancing the humanistic imperative. Lippincott Williams & Wilkins, Philadelphia
- Tesch R (1984) Phenomenological studies: a critical analysis of their nature and procedures.
- Tu J-C, Lee Y-L, Wei M-Y (2018) Analysis and research on the key success factors of marketing ugly fruits and vegetables. Sustainability. https://doi.org/10.3390/su10082783

- van Manen M (1997) Researching lived experience: human science for an action sensitive pedagogy, 2nd edn. Routledge, New York
- Vittuari M, Politano A, Gaiani S, Canali M, Elander M, Aramyan L, Gheoldus M, Easteal S, Timmermans T, Bos-Brouwers H (2015) Review of EU legislation and policies with implications on food waste: Final report. https://edepot.wur.nl/ 549086
- Voedselbanken Nederland (2020) Feiten en Cijfers Voedselbanken Nederland 2020. https://voedselbankennederland.nl/ wp-content/uploads/2021/03/DEF\_Feiten\_en\_Cijfers\_per\_31-12-2020.pdf
- Weber EP, Khademian AM (2008) Wicked problems, knowledge challenges, and collaborative capacity builders in network settings. Public Adm Rev 68(2):334–349. https://doi.org/10.1111/j.1540-6210.2007.00866.x
- Wunder S, McFarland K, Hirschnitz-Garbers M, Parfitt J, Luyckx K (2018) Food waste prevention and valorisation, relevant EU policy areas. Review of EU policy areas with relevant impact on food waste prevention and valorisation. EU ReFersh. https://eu-refresh.org/sites/default/files/REFRESH\_D3.3\_EU%20policy%20screening\_18052018\_25072018. pdf
- Xue L, Liu G, Parfitt J, Liu X, Van Herpen E, Stenmarck Å, O'Connor C, Östergren K, Cheng S (2017) Missing food, missing data? A critical review of global food losses and food waste data. Environ Sci Technol 51(12):6618–6633. https://doi. org/10.1021/acs.est.7b00401
- YetkinÖzbük RM, Coşkun A (2020) Factors affecting food waste at the downstream entities of the supply chain: a critical review. J Clean Prod 244:118628. https://doi.org/10.1016/j.jclepro.2019.118628
- Zamri GB, Azizal NKA, Nakamura S, Okada K, Nordin NH, Othman N, Akhir FN, Sobian A, Kaida N, Hara H (2020) Delivery, impact and approach of household food waste reduction campaigns. J Cleaner Prod 246:118969. https://doi.org/10. 1016/j.jclepro.2019.118969
- Zorpas AA, Lasaridi K (2013) Measuring waste prevention. Waste Manage 33(5):1047–1056. https://doi.org/10.1016/j. wasman.2012.12.017

#### **Publisher's Note**

Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

# Submit your manuscript to a SpringerOpen<sup>™</sup> journal and benefit from:

- Convenient online submission
- Rigorous peer review
- Open access: articles freely available online
- ► High visibility within the field
- Retaining the copyright to your article

Submit your next manuscript at > springeropen.com