

## Article

# Jointly Reducing Food Waste—The Experiences of the German Discussion Forum for Wholesale and Retail

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**Abstract:** The global food system faces the challenge of food waste, which has significant environmental, social, and economic implications. In line with Sustainable Development Goal 12.3, the German food wholesale and retail sector has recognised the urgency of reducing food waste by 50% by 2030. However, limited scientific research exists on food waste in this sector. This study presents the implementation of a Discussion Forum as a three year project aiming to measure and reduce food waste in the German food wholesale and retail sectors. Collaboration among stakeholders played a crucial role, leading to the development of a voluntary agreement and ambitious reduction targets. The findings highlight the success of the Discussion Forum in generating high-quality data, fostering collaboration, and guiding reduction actions. Lessons learned include the practicality of data collection methods, the importance of data security and confidentiality, and the value of open discussions. The research contributes to filling the research gap in food waste studies and provides valuable insights for achieving SDG 12.3 in the wholesale and retail sectors.

**Keywords:** food waste monitoring; discussion forum; voluntary agreements



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## 1. Introduction

The global food system encompasses all sectors and actors, from primary production to final consumption, including waste. These systems account for 26–34% of global greenhouse gas emissions [1–3]. Food waste (FW) also has a major impact on social and economic sustainability. In times of rising inflation [4] and food prices [5], throwing away food is even more wasteful. By understanding the patterns of FW, we can create solutions to reduce it and ensure that our food supply is managed more sustainably.

FW has now been recognised as a problem at all policy levels. The United Nations [6] included it in Agenda 2030 as Sustainable Development Goal (SDG) 12.3, which aims to reduce FW by 2030. The target is a 50% reduction. Germany incorporated these goals into its National Sustainable Development Strategy in 2016, and the current government committed to them through its Coalition Agreement in 2022. SDG 12.3 is implemented through the National Strategy for Food Waste Reduction, which sets the framework for all actors along the food supply chain to work together to reduce FW and “achieve a change of mindset within society: greater appreciation of food and the resources needed for their production” [7]. To fulfil the goals of the National Strategy, a total of five Discussion Forums were established for primary production, processing, wholesale and retail, food services and private households, respectively. The wholesale and retail sectors are particularly important as they serve as the link between producers, processors, and consumers and have the ability to influence actors along the value chain [8,9].

Prior to the implementation of the Discussion Forum in the German food wholesale and retail sectors, research on food waste in this specific context had been limited globally. Available studies have primarily focused on monitoring food waste and on food waste

reduction measures. The food waste monitoring studies have provided insights at a single-store level or estimated national-level waste based on small samples and short periods. For instance, studies by Cicatiello et al. [10], Brancoli et al. [11], and Eriksson et al. [12] have explored the monitoring of food waste but have faced data scarcity challenges. Moreover, several countries, such as The Netherlands, Denmark, Sweden, the United Kingdom, Austria, and Norway, have published non-peer-reviewed reports presenting monitoring data for food waste in their respective retail and wholesale sectors. When it comes to food waste reduction measures, a lot of measures have been proposed and/or implemented, as listed in the Supplementary Table of Goossens et al. [13]. However, to our knowledge, no scientific papers can be found on how exactly to get these measures implemented and get all players on board.

The existing literature on food waste in the wholesale and retail sectors highlights several research gaps and limitations. Firstly, there is a scarcity of scientific research in this area, indicating an underrepresentation of studies compared to the growing public recognition and political attention given to food waste. This limitation hinders the development of effective strategies and solutions for waste reduction. Secondly, when it comes to food waste monitoring, variations in data quality and survey methods across different studies pose challenges in comparing and generalising findings. Thirdly, whereas publications referring to measures to reduce food waste in the wholesale and retail sectors can be found, no scientific literature could be found on how exactly to get the entire wholesale and retail sector to move towards implementing these measures and towards reducing and monitoring food waste.

By presenting information on our participatory approach, we aim to provide valuable guidance and a blueprint for other countries or stakeholders interested in adopting similar approaches to address food waste in their own contexts. Our intention is to contribute to the knowledge transfer and replication of successful strategies on food waste reduction in the wholesale and retail sectors and provide valuable guidance for achieving Sustainable Development Goal 12.3. This paper presents how the Discussion Forum has served as a framework to successfully measure and reduce FW within the German food wholesale and retail sectors. The framework and its main elements and achievements are described in Sections 2–4. Finally, Section 5 provides some lessons learned and an outlook on how the process within the retail and wholesale sectors can be continued in order to move towards achieving SDG 12.3.

## 2. The Discussion Forum on Wholesale and Retail

### 2.1. The Wholesale and Retail Sectors for Food in Germany

The retail sector can be divided into different types of businesses with different priorities in their product range (Figure 1): organised retail (supermarkets, discount stores, and hypermarkets) and extended food retail (drugstores, service stations, bakeries, butchers, online retailers, beverage stores, sales stands, and “other” outlets such as kiosks and specialty stores).

The wholesale sector is made up of two different kinds of organisations (Figure 1): pick-up wholesale (incl. cash and carry or self-service wholesale) and delivery wholesale (specialist markets, delivered food service grocery, and delivered retail grocery).

Regarding the sales concept of each business type, pick-up wholesale enables people from commercial businesses to come into the stores and pick up the food they need, which is very similar to the sales concept of food retail stores. The sales concept of delivery wholesale is very different, as commercial businesses order the food they need in advance, which is delivered by the wholesalers. Therefore, for the monitoring in the Discussion Forum, as well as for the presentation of the results in Section 4.1, the subsectors are categorised into expanded food retail (including organised food retail, extended food retail, and pick-up wholesale), as shown in the blue box in Figure 1, and food delivery wholesale (excluding pick-up wholesale).



**Figure 1.** Definition of scope: business types within the food retail and wholesale sectors.

## 2.2. Setting Up the Discussion Forum

The Discussion Forum on Wholesale and Retail was implemented as a three year project and ran from September 2019 to December 2022. The aim of the Discussion Forum was to work with key stakeholders (especially wholesalers and retailers) to map and reduce FW within their areas of responsibility through effective and efficient measures. Furthermore, the stakeholders agreed to prepare a voluntary agreement (VA) up to 2030. The VA not only aims to optimise further reduction within the companies' own spheres of influence, but also to provide additional impetus and incentives for joint reduction measures at important interfaces with other sectors.

Information on experiences from literature and other countries was collected to shape the Discussion Forum. Throughout 2019, information was gathered via email and phone from experts from about fifteen countries (Sweden, The Netherlands, Austria, Finland, Norway, the United Kingdom, Australia, South Africa, the USA, Canada, Denmark, Spain, Italy, France, Mexico, and the Czech Republic) that already had VAs, ran Discussion Forums, or implemented laws and regulations against FW. Monitoring was identified as a crucial starting point for FW reduction.

## 2.3. Aims and Objectives of the Discussion Forum

In support of the companies implementing their own actions to reduce food waste, the Discussion Forum had two main tasks (Figure 2), all contributing to the overarching goal of FW reduction. Firstly, it aimed at assessing the status of FW reduction. To do so, it included monitoring FW for the participating companies in the retail and wholesale sectors, allowing them to see where they stand regarding the SDG 12.3 target. Furthermore, a sustainability assessment of specific actions was provided in order to determine best practises and efficient actions. Secondly, the Discussion Forum stressed liabilities, as there is a political demand for binding reduction goals (set within the Coalition Agreements from 2018 and 2022 [14,15]). The liabilities were implemented as a VA and signed by relevant companies from the retail and wholesale sectors and the responsible ministry (the Federal Ministry of Food and Agriculture). Both tasks are described in detail in Section 3 (Measure action towards FW reduction) and Section 4 (Commit to working towards a certain target).

The Discussion Forum also committed to publicly sharing the results and experiences gained to achieve a broader distribution of the information and knowledge acquired. Additionally, it was necessary to form a space for open discussions between all involved stakeholders, including the actors at the interface with other sectors along the food chain in politics as well as food banks and other charitable organisations. In the three year project eight interactive work meetings formed the basis of the Discussion Forum. These meetings provided opportunities for input, exchange, and the development of outcomes.



**Figure 2.** Overview of tasks in the Discussion Forum.

#### 2.4. Declaration to Participate

The VAs from other countries were mostly developed together with the stakeholders so that the agreements could include their ideas and interests, increasing the likelihood that they would sign the agreement in the end. Following this good example, the Discussion Forum started with a declaration of participation as a binding contribution for the participants, after which a VA would be developed jointly with both the actors in retail and wholesale as well as the Federal Ministry in charge. The resulting declaration of participation [16] was inspired by the agreement from Austria [17], which was adapted to the German context and further defined.

In total, 23 companies (17 retail companies, including the major retailers and six wholesale companies) signed the declaration of participation (The signatories were Alnatura Produktions-und Handels GmbH, ALDI Nord Einkauf SE & Co. oHG, ALDI SÜD Dienstleistungs-GmbH & Co. oHG, BIO COMPANY GmbH, CHEFS CULINAR West GmbH & Co. KG Niederlassung Wöllstein, Edeka Zentrale AG & Co. KG, HelloFresh Deutschland SE & Co. KG, Kaufland Stiftung & Co. KG, lehmman natur GmbH, Lekkerland SE, Lidl Stiftung & Co. KG, METRO Deutschland GmbH, Naturkost Elkershausen GmbH, Netto Marken-Discount AG & Co.KG, NORMA Lebensmittelfilialbetrieb Stiftung & Co. KG, Penny-Markt GmbH, Querfeld GmbH, REWE Deutscher Supermarkt AG & Co. KGaA, SIRPLUS GmbH, tegut. . . gute Lebensmittel GmbH & Co. KG, Transgourmet Deutschland GmbH & Co. OHG, VollCorner Biomarkt GmbH and WASGAU Produktions & Handels AG; all based in Germany with stores across the country). Their signature signalled their commitment to collect data internally, thereby contributing to FW monitoring for the retail and wholesale sectors, and to participate in actions to reduce FW in the categories “interface to the suppliers”, “in the markets themselves”, and “redistribution for human consumption” of surplus food. They also committed to having 80% of their sales points [stores] cooperate with social organisations (such as food banks) to provide them with their unsold, edible food.

### 3. Approaches and Achievements for Measuring Actions towards FW Reduction

#### 3.1. Monitoring FW in the Retail and Wholesale Sectors

##### 3.1.1. Methodology

There are different methods used for monitoring FW in retail and wholesale. The Food Loss and Waste Protocol [18] gives a good overview of which steps and methods should be used to assess the amounts of FW depending on each participant’s context, needs, and resources.

The Waste and Resources Action Programme (WRAP) published an overview specifically for the food retail and wholesale sectors [19]. They divided the methods into two different practises: product-based (before disposal) and waste-based (after disposal). Within the Discussion Forum, a product-based approach is used, and FW is defined as the total of unsold groceries excluding surplus food donated to charities, food banks, etc. and redistributed for human consumption (see Figure 3). For data collection, processing, and analysis, see Supplementary Information.



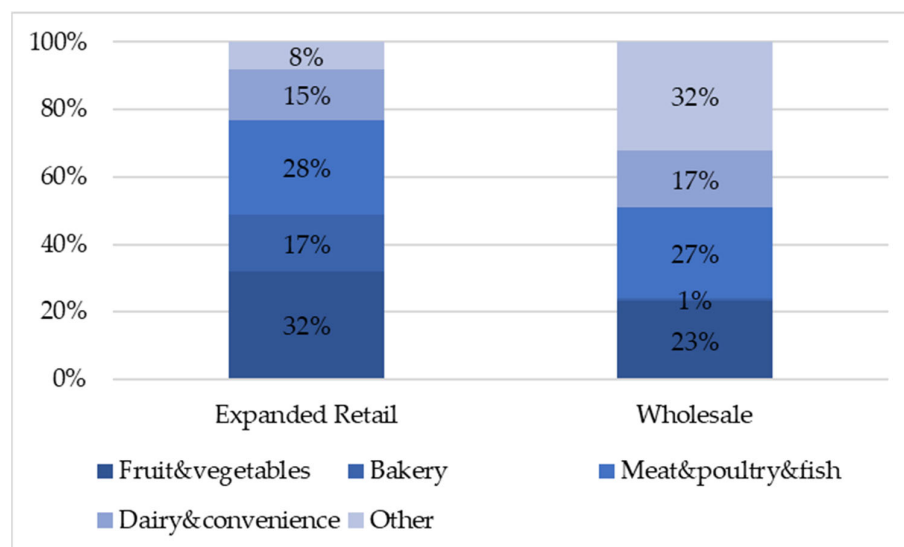
**Figure 3.** FW definition as used in the Discussion Forum.

### 3.1.2. Achievements of the German Wholesale and Retail Sectors

On average, the write-off rates of the Discussion Forum members from the expanded food retail sector have decreased from 1.7% (in 2019) to 1.5% (in 2020). The results in 2019 in these cases vary between 0.1% and 4.3%, and in 2020, they vary between 0.1% and 3.0%. For a majority of the companies (15 out of 16), the overall write-off rates reported in both 2019 and 2020 are below 3%. The average write-off rates of the food delivery wholesale sector have increased from 0.2% (in 2019) to 0.3% (in 2020). The results in 2019 vary between 0.1% and 2.6%; in 2020, they vary between 0.32% and 2.3%.

The monetary contribution of the different food categories to the total financial loss is similar for 2019 and 2020; Figure 4 shows the situation for 2020. The write-off rates vary between product groups and companies. This depends mainly on two factors: (1) the durability as well as the date marking of the products; and (2) the focus on products with different sales concepts. The product groups of bread and bakery, as well as fruit and vegetables, tend to have higher than average FW rates; this is mainly based on the short durability and the customer expectations of freshness towards these two product groups, which tend to be very high. The product group “other foods products” is mainly made up of products with high durability and less fragile products (for example, pasta, sauces, drinks, tinned products, etc.), which explains the relatively low FW rates throughout the companies. The product category specific write-off rates within the expanded retail decreased in most categories from 2019 to 2020. The highest write-off rate, as an average across all companies, is in the category of bread and bakery products, followed by the category of fruit and vegetables. The category of other food products has the lowest write-off rate. Milk and convenience products are the only categories that have increased from 2019 to 2020 (Table 1).

For the delivery wholesale sector, the write-off rates are below 1% for the majority of the product groups. The write-off rates have increased across nearly all categories from 2019 to 2020. The highest write-off rate is in the category of fruit and vegetables, followed by bread and bakery products. The category of other food products has the lowest write-off rate (Table 1).



**Figure 4.** Contribution of each food product group to the total financial losses [EUR] in 2020.

**Table 1.** Write-off rates within the expanded retail and delivery wholesale in 2019 and 2020.

		No. of Companies	Fruit and Vegetables	Bread and Bakery Products	Meat, Fish, and Poultry	Milk and Convenience Products	Other Food Products	Total
Expanded retail	2019	13	4.26%	6.18%	2.81%	1.61%	0.30%	1.76%
	2020	16	3.63%	5.72%	2.43%	1.24%	0.27%	1.54%
Delivery wholesale	2019	5	0.98%	0.60%	0.45%	0.27%	0.11%	0.23%
	2020	6	1.25%	0.17%	0.71%	0.60%	0.15%	0.35%

Table 2 shows the absolute monetary values for the turnover and the turnover losses in 2019 and 2020, as well as the absolute physical amounts of unsold groceries and FW, and this has been summarised across all participating companies. FW is calculated based on the unsold groceries subtracted from the contributions to food banks and other similar organisations. Please note that the absolute values for 2019 and 2020 are not to be compared, as the number of companies included in the data collection has grown from 2019 to 2020.

**Table 2.** Turnover and FW in retail and wholesale in 2019 and 2020.

		No. of Companies	Turnover [EUR]	Turnover Losses [EUR]	Unsold Groceries [t]	FW [t]
Expanded Retail	2019	13	71.64 bn	1.26 bn	211,683	148.178
	2020	16	97.15 bn	1.49 bn	245,916	172.141
Delivery Wholesale	2019	5	3.42 bn	7.87 bn	1110	777
	2020	6	2.74 bn	9.52 bn	1335	935

For more detailed information on the monitoring results, we refer interested readers to the two annual monitoring reports for 2019 and 2020, written in German [20,21].

### 3.1.3. Looking at Monitoring Approaches from an International Perspective

Several other countries have initiated actions to reduce and monitor FW in the retail and wholesale sectors. This section is non-exhaustive and aims to put the German approach into perspective. There may be other interesting activities taking place in other countries; nevertheless, providing a full overview was out of the scope of this paper.



In The Netherlands, action against food waste is run under the VA of “Samen Tegen Voedselverspilling” (Together against food waste). It is a VA across the three sectors manufacturing, distribution, and food service. In the retail sector, 80% of the organised retail market is covered (by five retailers), but it misses wholesale signatories. For 2020 data, the following data was reported: 1.6% is a markdown in organised retail, which is 3.6% less than in 2018. The highest markdown rates are within the category of bread and bakery products with 7.8% in 2020 (2019: 7.7%), followed by fresh meat and fresh fish as well as potatoes, vegetables, and fruit with 2.4% (2019: 2.9% and 2.7%). Dairy, eggs, and chilled convenience products have a markdown rate of 1.2% (2019: 1.4%), and the lowest markdown rate is achieved with other fresh and durable products with 0.4% (2019: 1.4%). Most signatories convert their financial data into physical data themselves. Some companies can disaggregate the edible food parts [22,23].

In Norway, the VA is called “Matvett” and it is owned by the food, drink, and service businesses themselves. The agreement aims to cover the total food chain; for wholesale, it covers up to 65–85% with seven wholesalers, and in retail, it covers the five retail chains in the country (100%). Most of the companies report financial data, but two are able to report by weight. Financial data is converted to physical data by Matvett through price-weight data for several hundred products. Their definition of food waste only includes edible foods, which are discarded. Animal feed is counted as food waste, but the signatories are supposed to achieve the best possible use of resources according to the food waste hierarchy. The eleven product categories used were: bakery products, beverages, eggs, convenience and delicatessen, fish, fruit and vegetables, frozen products, meat products, durable products, dairy products, and others [24].

Table 3 shows the results in the wholesale and retail sectors. Overall food waste, as well as economic loss and climate effects, have decreased from 2015 to 2019.

**Table 3.** Retail and wholesale losses through food waste in Norway (see [24]).

		2015	2016	2017	2018	2019
Retail	Food waste [t]	73,477	70,770	68,474	67,339	63,126
	Economic losses [bn NOK]	3.06	2.83	2.67	2.60	2.46
	Climate effect [t CO <sub>2</sub> eq]	208,394	181,582	174,414	161,667	154,577
Wholesale	Food waste [t]	6059	6324	6026	5937	4500
	Economic losses [bn NOK]	0.29	0.31	0.27	0.3	0.23
	Climate effect [t CO <sub>2</sub> eq]	9183	10,362	10,203	11,929	8974

In the UK, food waste is fought through the VA’s Courtauld Commitment 2030, which is one of the longest-running agreements. The food waste data is also contributed by financial records in retail and wholesale. Some data is also reported through counting or direct weighing. Financial data is then converted into physical data by using product weight data as well as proxies when data is not available (estimates from the Courtauld Commitment 2020 were adjusted using the Consumer Price Index and weighted by arisings). The signatories in retail cover more than 95% of the market by sales; the data are then scaled up to the total market. Food waste is not disaggregated into edible and inedible parts because there is no available data for this. The eight food categories used were: milk products, meat and fish products, fruit and vegetables, bakery products, alcoholic beverages, convenience products, wheat products, lemonade and juice, and sugar. Overall food waste as well as economic waste have decreased from 2015 to 2018. In 2018, 277 kt

of food waste were measured (2015: 261 kt), which resulted in economic losses of about 0.87 bn pounds in 2018 (2015: 0.82 bn pounds). For wholesale, there is data from four cash and carry markets ( $\frac{3}{4}$  market share) as well as interviews from four specialist markets (localised importance)—no companies for delivered food service/retail grocery and no retail street markets were in scope. The data was extrapolated by the sales area [25,26]. For an overview, see Table 4.

**Table 4.** Estimates for food surplus and food waste in 2015 in the UK (see [25]).

	Total Food Waste	Redistribution
Specialist markets	30,000–40,000	50–100
Cash and carry markets	6000–10,000	200–250
Total (mean)	43,000	300

In Austria, food waste in retail was measured within the ECR working group “waste economy”. The contributing five retailers have a market share of 83%. In 2013, 74,000 tonnes of food (9 kg per capita), resulting in EUR 255 million, were wasted. A total of 66,000 tonnes of food were redistributed for human consumption, i.e., to charities. Additionally, 35,600 tonnes of unsold bread and pastry were returned to bakeries. This resulted in a food waste rate of 1.51% (compared to the total turnover of food). There was no differentiation made between edible and inedible food parts. The nine food categories used were beverages, convenience products, sweets and snacks, frozen foods, bakery products, dairy products, meat, fish, fruit and vegetables [27].

In Sweden, the VA is called “Samarbete för Minskat Matsvinn”. The data gathered is also financial data by product type. Only edible food waste is counted; this is calculated by using proxies. Food donations are subtracted if possible; in some cases, this was not possible, and the data was not disaggregated. Overall, 99% of the market is covered and has reduced its food waste by 21% [kg per capita]. Eleven food categories were used: fish, beverage, eggs, convenience and delicatessen, durable products, fruit and vegetables, frozen products, meat products, milk products, bakery products, and others. There are also results published on the influence of the product groups on total food waste [28].

Table 5 shows the results in the retail and wholesale sectors. Overall, food waste has decreased from 2015 to 2020.

**Table 5.** Retail and wholesale food waste in Sweden (see [28]).

		2015	2016	2017	2018	2019	2020
Retail	Food waste [t]	82,350	75,850	74,440	72,950	69,100	67,400
	Food waste [per capita]	15.9	14.5	14.2	13.8	13	12.6
Wholesale	Food waste [t]	8250	7100	7700	7500	6150	6450
	Food waste [per capita]	1.6	1.6	1.5	1.4	1.2	1.2

Denmark has set up a reporting system around the VA called “Denmark Against Food Waste” which is coordinated by the organisation One/Third. The data is allowed to be gathered through direct measurement and mass balance. Depending on the presented time period, a different number of members were able to report data. The years from 2015 to 2020 include data from seven companies, and the years from 2016 to 2020 include data from ten companies. The reporting is directed towards the sectors of primary production, processing, retail, and wholesale trade, as well as the service sector. The trend that can be shown for retail and wholesale is a decrease in food waste from 2016 to 2020 of about 14.4%.



In 2020, the data-delivery companies will have a market share of about 15.2% in the retail and wholesale markets. Data on food donation is currently optional, but One /Third aim to make it obligatory in the future [29].

Table 6 provides an overview of the VAs and monitoring methods.

**Table 6.** Examples of monitoring approaches implemented in other countries.

Country	Germany	Austria	Denmark	Netherlands	Norway	Sweden	UK
VA (Name)	Zielvereinbarung Groß-und Einzelhandel zur Reduzierung von Lebensmittelabfällen	Vereinbarung 2017–2030 zur Vermeidung von Lebensmittelabfällen bei Lebensmittelunternehmen	Stop Spild Af Mad	Samen tegen Voedselverspilling	Matvett	Samarbete för Minskat Matsvinn	Courtauld Commitment
Market coverage (Retail/Wholesale)	85% organised retail and two companies from wholesale	85% retail	15.2% retail and wholesale	80% organized retail	65–85% wholesale and 100% retail	99% retail and wholesale	80% wholesale and retail
Data used	Financial data	Financial data	Direct measurement and mass balance	Financial and physical data	Financial and physical data	Financial data	Financial data
Starting Year (Data)	2019 (2 years)	2017 (3 years)	2015 (5 years)	2020 (1 year)	2015 (4 years)	2015 (5 years)	2018 (4 years)
Results reported (financial, physical, and relative)	Total FW [t] and [EUR]	Total FW [t], FW rate [%],	FW reduction rate [%]	FW rate [%]	Total FW [t] and [EUR] and climate effect	Total FW [t] (incl. per capita)	Total FW [t] and [EUR] and FW reduction rate [%]
Source	[20,21]	[17]	[29]	[22,23]	[24]	[28]	[30]

From the seven studies presented (including Germany as presented in this paper), all report quantitative information as part of a VA. Three of the presented studies started measuring FW in 2015, and four started later in 2018 (UK), 2017 (Austria), 2019 (Germany), and 2020 (The Netherlands). Two studies show data for five years (Denmark and Sweden), one for four years (Norway), two for two years (Germany and the UK), and two for one year (Austria and The Netherlands).

In general, the retail sector is well covered in these studies; for the wholesale sector, there are fewer studies, and a smaller market share is represented. All studies use scanning data/financial data, and most collect the data in Excel sheets. The product groups used to aggregate the data, or even before that for the data collection, vary slightly but are similar.

The data is mainly presented as a total of FW in tonnes and often per capita. Some of the studies report redistributed food as an extra. For Germany and Norway, the financial losses are also reported. Norway is the only country reporting the climate effects caused by the FW. For more details on the approaches taken in other countries, we refer interested readers to the German report by Orr and Schmidt [31].

#### 3.1.4. Limitations and Opportunities of the Monitoring Approach Taken

The data gathered and analysed in the Discussion Forum is the best available for Germany; however, it is still incomplete, and there are a number of limitations to the data and the approach used.

In Germany, the government commissioned a study named Baseline 2015, which aimed to quantify FW in 2015 along the value chain, including the retail and wholesale sectors [32]. However, the methodology used in Baseline 2015 differs from the one used here. The Baseline 2015 calculations for retail are based on two inputs: (1) The waste indicator of one retail company (REWE), which is calculated based on organic waste, as well as (2) a survey from 77 shops of another anonymous company, which is based on write-

offs. The Baseline 2015 projection was based on sales area [m<sup>2</sup>] in organised food retail. For the wholesale sector, similar calculations were made. However, these estimates only show FW in specialist markets, leaving out a large part of the wholesale food sector [31].

There are a few limitations to the monitoring approach taken in this paper. Firstly, due to a lack of data, all redistribution of groceries for non-human consumption is counted towards FW, even though some of these redistribution streams (such as animal feed) are not considered FW within the EU definition [33,34]. However, direct communications with the companies have shown that these streams are small and can therefore be ignored at this stage. We did not differentiate between avoidable and unavoidable FW, nor between fit for human consumption and unfit for human consumption. The effort that would have been needed to undertake this assessment considerably outweighed the perceived informative benefit that could be generated using such a differentiation.

Secondly, the representation of the entire retail and wholesale sectors was challenging. In the data collected for the food retail sector, 99% of the companies that have provided us with data represent what we describe as organised retail, as opposed to independent and individual store owners. Regarding extended retail (the remaining 1%), only companies from online retail are represented, whereas other businesses, such as bakeries and service stations, are missing. Our data for the food wholesale sector mainly refers to delivered food service, whereas specialist markets and delivered retail markets are underrepresented. Our dataset does not include any interfaces between the different stages of the supply chain (for example, between retail and wholesale or retail/wholesale and producers), so it is impossible to comment on the effects upstream and downstream. As decisions in retail and wholesale can lead to FW generation upstream or downstream, it would be important to include these effects in future research.

Thirdly, assumptions were made about the food being redistributed for human consumption. The financial loss data we used was considered to be the most effective for analysing FW in the retail and wholesale sectors. However, financial losses do not give any information on the food redistributed. Based on expert estimates, it was assumed that, on average, 30% of financial losses are redistributed for human consumption. This should be verified with more data and, if possible, supplemented with data on other forms of redistribution (such as distribution for animal feed). Pilot projects in the Discussion Forum showed a high potential for minimising food going to waste through cooperation with food banks and similar organisations. It could be shown that in the medium to long term, at least 69% of the food sorted out by the participating stores could be reintroduced for human consumption by passing it on (median for the participating branches: 89%) [35]. Future studies could investigate this aspect and try to refine the percentage we used in our calculations.

Fourthly, unsold food can be returned to the food manufacturers (for example, when it is near the expiration date, when there is broken or torn packaging, or when discolouration or other optical flaws are discovered). Such returns cannot be differentiated from the financial losses—they are partly included. This field should be explored more in the future to assess their magnitude as well as the potential for FW reduction (both at the retail/wholesale level and at other stages along the food chain).

Fifthly, the conversion from financial to physical data is not static. Our conversion is based on a total of 1400 product prices from 2019 (ten companies and their “20 products that are written off the most” for seven product groups each time). Considering that inflation rates are rising and food prices are going up, this data set needs to be updated or at least adapted regularly. It would be best if companies were able to convert the financial data to physical data themselves in order to account for the actual prices of these products immediately.

Despite these limitations, the authors conclude that financial losses offer data of high quality while requiring little effort from the companies to share the results. As such, the financial losses can be a good and solid starting point for further discussions.

Because of the expertise gained in the UK—especially because FW reduction was put high on the agenda much earlier than in most other countries—the independent company WRAP (Waste and Resources Action Programme, a climate-action NGO in the UK) was asked to evaluate the German retail and wholesale Discussion Forum and show possibilities for optimisation. In their evaluation, it is stated that “The HandelsforumRLV [read “the Discussion Forum”] was mostly following best practice among comparable countries’ VAs regarding measurement and reporting”. [36]. Nevertheless, a few opportunities for improvement were given, which have been taken into account in Section 5.

### 3.2. Sustainability Assessment of Specific Actions

The companies within the Discussion Forum have undertaken various actions to reduce FW within the retail and wholesale sectors [37]. In order to identify best practices within such actions, a thorough sustainability evaluation is needed to assess the effectiveness and efficiency of the measures. The methodology for performing such a sustainability assessment is duly described in Goossens et al. [38] and was successfully used for evaluating FW measures undertaken within the German food services sector [39,40].

The Discussion Forum foresaw the possibility of a sustainability assessment of the actions undertaken by the companies participating in the Forum. In total, two companies took up the offer to have their actions evaluated. The evaluation of these actions is beyond the scope of this paper and can be found in Lehn and Schmidt [41] and Lehn et al. [42]. The first action refers to the conversion of surplus food into high-quality end products. In cooperation with various start-ups, retail company PENNY promoted products made from food with minor defects or from overproduction that were previously not intended for human consumption with a display in one of their stores to increase awareness of the issue of FW within the value chain. In the project period of five months, 19 kg of food was saved from being wasted, and it could be shown that most of the new products created had a positive greenhouse footprint [41]. The second action was a trail of a time-temperature indicator on salmon by HelloFresh. These alternative means of displaying the durability claim were added to the packaging for the test group. The study showed that for every EUR invested in 0.1 kg of salmon, EUR 2.05 and 0.44 CO<sub>2</sub> equivalents could be reduced [42].

Such an evaluation of such initiatives is important in order to be able to derive recommendations for action by policymakers. Furthermore, for the companies in the sector, an exchange of best practices could inspire others to act and reduce FW.

## 4. Approaches and Achievements for Setting Binding Reduction Goals, Defined within a Voluntary Agreement

### 4.1. Approaches for Voluntary Agreements

To tackle FW, several policy strategies can be used. Principato [43] categorised these into five sections: market-based, information-based, regulatory, VAs, and nudging. Within the Discussion Forum, it was decided to focus on a VA. As VAs follow the strategy of the companies willing to regulate themselves, their success is mainly influenced by the parties that have committed to doing this.

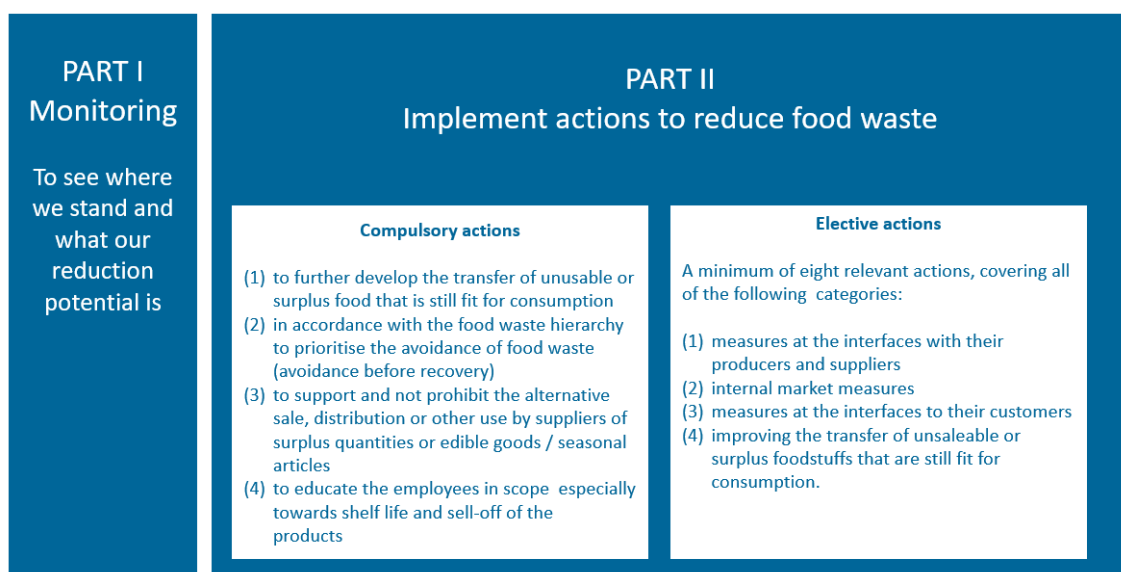
In FW reduction, there are countries with legislation, for example, France [44] and Italy [45], but also countries with VAs. Sweden, The Netherlands, Austria, the UK, Norway, and Denmark proved to be pioneers in VAs towards FW reduction. VAs make it possible to stress the liabilities, show the commitment of the stakeholders, and provide meaningful trend analysis (on the monitoring of FW).

### 4.2. A Voluntary Agreement for the German Retail and Wholesale Sector

The VA for the Discussion Forum built on its declaration of participation (see Section 2.4) and was further inspired by the VAs from Austria, Denmark, The Netherlands, Norway, Sweden, and the UK. An overview of the websites and references for the initiatives in each country can be found in Appendix A (Table A1). The German VA was jointly developed

between the members of the Discussion Forum, the Ministry of Food and Agriculture, and the project partners of the Discussion Forum (see Supplementary Information, Files S1–S3).

The VA is made up of two major parts, as described in Figure 5. Firstly, the document foresees an individual commitment towards SDG 12.3, which means achieving a 30% reduction in FW by 2025 and 50% by 2030. For this, starting with an individual base year, the companies will commit to recording, processing, and delivering their food loss rates annually. The data must be divided into at least the five commodity groups agreed upon and additionally provide sales figures for the company. Information on the volume of food given to charity must be shared for at least one year during the VA. Hereby, the already practiced data collection and trend analysis will be continued. With the two monitoring reports submitted by the Discussion Forum for the years 2019 and 2020, the retail and wholesale sectors have already underlined their willingness to contribute to gaining further knowledge about the current situation. Moreover, by doing so, they also showed their willingness to get to know the reduction potential within their sector.



**Figure 5.** Components of the German VA for retail and wholesale.

Secondly, the VA includes compulsory measures as well as elective measures to reduce FW. The compulsory reduction measures include (1) to further develop the transfer of unsaleable or surplus food that is still fit for consumption; (2) in accordance with the FW hierarchy, to prioritise the avoidance of FW (avoidance before recovery); (3) to support and not prohibit the alternative sale, distribution, or other use by suppliers of surplus quantities of edible goods/seasonal articles; and (4) to educate the employees, especially towards shelf life and, for example, reducing prices for products near expiry dates.

Regarding elective measures, a number of suggestions are made, from which the companies are free to choose depending on their respective opportunity spaces and the expected impact to be made. They must implement or continue at least eight elective measures per year, with a minimum of one measure in each of the following four categories: (1) measures at the interfaces with their producers and suppliers; (2) internal market measures; (3) measures at the interfaces with their customers; and (4) improving the transfer of unsaleable or surplus foodstuffs that are still fit for consumption.

The companies are required to report on their actions. Within the framework of the VA, an annual report shall be published containing monitoring data and information on the actions taken.

At the moment of writing, 85% of organised retailers have signed the voluntary agreement, and two of the major companies have signed for wholesalers (The signatories are: ALDI Einkauf SE & Co. oHG, ALDI SÜD Dienstleistungs-SE & Co. oHG, CHEFS

CULINAR West GmbH & Co. KG; Niederlassung Wöllstein, EDEKA ZENTRALE Stiftung & Co. KG, HelloFresh Deutschland SE & Co. KG, Kaufland Dienstleistung & Co. KG, Lidl Dienstleistung GmbH & Co. KG, METRO Deutschland GmbH, Netto Marken-Discount Stiftung & Co. KG, NORMA Lebensmittelfilialbetrieb Stiftung & Co. KG, PENNY Markt GmbH, REWE Markt GmbH, tegut. . . gute Lebensmittel GmbH & Co. KG, Transgourmet Deutschland GmbH & Co. OHG). A translated version of the VA is included in the Supplementary Information.

## 5. Lessons Learned

To define FW most suitably and to try to align the definitions in the national and international frameworks, the authors stress that the definition must also work practically for the specific requirements. Financial losses have proven to be a particularly suitable data source for the retail and wholesale sectors, as these data are available on a very detailed level and can be passed on relatively easily, resulting in high-quality data. Nevertheless, additional surveys are necessary to also record the redistributed food. Regarding returns, it would be good to gain more information on their magnitude, the extent to which these are included in the financial losses, and the extent to which these result in FW in other sectors along the food chain.

Data security and confidentiality play a major role when gaining company information; setting the terms correctly is of high significance. A major issue for the retail and wholesale sectors is the conversion of economic data into physical volumes, which requires per-kilogramme prices for a wide range of products. Depending on the scope, the conversion step could be skipped.

Regarding data collection, it becomes clear that the entire process could be made more user-friendly. This could be achieved by providing a guidance sheet through the discussion forum as an example of measuring FW during the next monitoring periods. Furthermore, it would be good to provide more value back to the participating companies, for example, by calculating the reduction potential in CO<sub>2</sub> equivalents.

The open discussions within the Forum (moderated by a neutral organisation) and getting the retail and wholesale companies involved from the start led to a high-value partnership for gaining information for monitoring. Furthermore, it allowed for the development of a joint realistic but ambitious target and process (set in a voluntary agreement), as well as the willingness of everyone involved to make the key steps towards reducing FW. Without this format, it would have been hard to imagine companies being willing to sign a VA. Additionally, a jointly set target stresses the need for high-quality monitoring that is able to show the target attainment level.

All in all, the German Discussion Forum Retail and Wholesale proved to be a successful instrument to get the stakeholders involved in monitoring FW and reduction actions. The open moderation and scientific guidance of the project partners were key to success, as this has allowed companies to share their knowledge and experience with each other and get a thorough insight into measures for reducing FW.

**Supplementary Materials:** The following supporting information can be downloaded at: <https://www.mdpi.com/article/10.3390/su151612289/s1>, Additional information on Data Collection, Data processing as well as Data analysis; Supplementing Details VA (translation of German VA).

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## Appendix A

**Table A1.** Websites and references for the initiatives and VAs in other countries.

Country	Name (in Original Language) of the Initiative or VA	Sources
Austria	Vereinbarung 2017–2030 zur Vermeidung von Lebensmittelabfällen bei Lebensmittelunternehmen	<a href="https://www.bmk.gv.at/themen/klima_umwelt/abfall/abfallvermeidung/publikationen/vereinbarung-vermeidung-lebensmittelabfaelle.html">https://www.bmk.gv.at/themen/klima_umwelt/abfall/abfallvermeidung/publikationen/vereinbarung-vermeidung-lebensmittelabfaelle.html</a> (accessed on 30 June 2023)
Denmark	Stop Spild Af Mad	<a href="https://stopwastingfoodmovement.org/">https://stopwastingfoodmovement.org/</a> (accessed on 30 June 2023)
The Netherlands	Samen tegen Voedselverspilling	<a href="https://samentegenvoedselverspilling.nl/">https://samentegenvoedselverspilling.nl/</a> (accessed on 30 June 2023)
Norway	Matvett	<a href="https://www.matvett.no/">https://www.matvett.no/</a> (accessed on 30 June 2023)
Sweden	Samarbete för Minskat	<a href="https://www.ivl.se/sams">https://www.ivl.se/sams</a> (accessed on 30 June 2023)
UK	Courtauld Commitment	<a href="https://wrap.org.uk/taking-action/food-drink/initiatives/courtauld-commitment">https://wrap.org.uk/taking-action/food-drink/initiatives/courtauld-commitment</a> (accessed on 30 June 2023)

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