

Rapport

SUSTAINABLE INNOVATION

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Food Waste in Norway 2010-2015

Final Report from the ForMat Project

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Summary

Summary of ForMat and Key Figures

This is the final report from the ForMat Project on trends in amounts and composition of edible food waste in Norway. The report covers a period of six years, from 2010 to 2015, and presents results from four stages in the value chain: food industry, wholesale, retail and households.

Fact Box 1-1 Key Figures from ForMat

ForMat: Key Figures

Food waste in Norway (industry, wholesale, retail and households)

- Edible food waste from the four stages was reduced by 12 % from 2010 to 2015 (kg per head of population)
- Measured in tons, edible food waste from the four stages was reduced by 7 %.
- Overall, 68.7 kg of food per person is discarded (2015).
- Food waste in Norway represents a financial loss of more than NOK 20 billion annually.
- Greenhouse gas emissions associated with food waste correspond to 978 000 tons of CO₂ equivalents, or about one-quarter of emissions from private cars in Norway.

Food waste in Norwegian households

- An average person throws away 42.1 kg of food per year (2015).
- An average household discards food worth NOK 5 800 annually.
- Food waste from households makes up 13 % of consumption; this means that every eighth bag of groceries ends up in the dustbin.

Key figures from the ForMat Project show a reduction in the amount of edible food waste in Norway over the last five years. After a steady increase in amounts of wet organic waste¹ in 1995-2010 (waste statistics from Statistics Norway), amounts of edible food waste have been reduced in the past five years. In other words, there has been a reversal from a rising trend in food waste before 2010 to a decrease since 2010.

Overall, for the four stages of the value chain, edible food waste has been reduced by 12 %, measured in kg per capita. There is reason to believe that this decline is due to the efforts of the ForMat Project as well as the food sector, which has supported the project activities by implementing its own waste reduction measures.

¹ Food waste is a major component of wet organic waste, but there are no separate figures for the proportion of food waste in wet organic waste prior to 2010; it can therefore only be assumed that amounts of food waste follow trends in amounts of wet organic waste.

The goal set at the start of the ForMat Project was to reduce edible food waste in Norway by 25 % by the end of 2015. Although that ambitious target was not met, we can still be pleased at the increasing awareness of edible food waste in society, commitment the food industry and retailers, the measures taken and the concrete results achieved in the short period since the commencement of the ForMat Project.

In addition to the results of its surveys, the project has yielded further positive results, which include:

- A common methodology for measuring edible food waste.
- Networks between actors in the value chain.
- Centres of expertise with a strategic focus on edible food waste.
- Numerous measures to prevent or reduce edible food waste which have proven effective.
- Increased awareness in society of edible food waste as a challenge.

Results

This year's report has several improvements with regard to data and analysis, compared with reports of previous years (see Section 3: Methodology). All these improvements have led to more accurate results for the years of the reporting period, which has involved changes in the data basis and analyses dating back to 2010. The results in this final report of the ForMat Project have been divided into three parts:

1. Results from the annual food sector survey and waste sample analyses: the percentage of food waste in economic terms from 2010 to 2015 for wholesalers and retailers, the percentage of food waste in tons for producers, and waste sample analyses of household waste (Section 4).
2. Results from consumer studies about food discard habits, reasons for discarding food, and attitudes and behaviour related to food, cooking and food waste (Section 5)
3. Key national edible food waste figures: tons of edible food waste for the four stages of the value chain from 2010 to 2015, as well as financial loss and environmental impacts linked to edible food waste (Section 6).

Annual food sector survey and waste sample analyses

Food waste from the different stages in the value chain was surveyed for six years, from 2010 to 2015.

Fact Box 1-2 Key figures from the annual food sector survey

Annual food sector survey: Key figures

Trends from 2010 to 2015

- Producers: - 4 % as a percentage of quantity produced
- Wholesalers: - 40 % as a percentage of sales
- Retailers: + 2 % from 2013 to 2015, percentage of sales²
- Waste sample analyses: - 9 % measured in kg per capita

² The data for 2010-2012 are not comparable with those for 2013-2015 due to changes in the data basis.

Food Waste in Norway 2010-2015 Final Report from the ForMat Project

At the production stage, food waste was reduced by 4% from 2010 to 2015, measured in tons of total production. Liquid dairy products, dry goods and frozen ready-made food showed the highest proportion of food waste, while eggs, solid dairy products and fresh meat had the lowest wastage. Three out of ten product groups showed an increase in the percentage of waste, while five groups showed a reduction. Reductions in waste were primarily due to the introduction of better practices in companies and active measurement and monitoring of quantities of food waste, as a result of active food waste reduction efforts.

At the wholesale stage, food waste was cut by 40% from 2010 to 2015, as a percentage of total sales. The reduction was greatest for baked goods, followed by fresh meat and frozen ready-made food. The reduced waste percentage was mainly due to increased sales and stable waste levels.

At the retail stage, food waste increased by 2.3% from 2013 to 2015 for the categories analysed, measured as a percentage of total sales (data for the percentage of sales from 2010 to 2012 are not directly comparable with those from 2013 to 2015). Despite the fact that the total proportion of food waste increased, it was reduced in eleven of fifteen categories. The categories showing an increase were potatoes, dry goods, dairy products and fresh fish. The extensive restructuring in the industry in 2015 (sale and acquisition of ICA) may be a reason for the increase over 2014, in addition to increased investment in fresh fish meals and ready-made food, but there is insufficient data to determine this.

At the consumer stage, food waste in kg per capita decreased by 9% from 2011 to 2015. Pan and plate leftovers and fruit and vegetables comprise most of the food waste and all groups except for these showed a reduction in food waste during the period. The reduction was greatest for bread, where waste was reduced by as much as 40%.

Consumer Studies

The study of consumers' food waste habits shows several positive trends. Most consumers reported discarding pan leftovers, milk/cream and fruit and vegetables, while few threw away biscuits, eggs and fresh fish products. Consumer perceptions of the most important reason for discarding food varied between the product groups, but "past its expiry date" followed by "reduced quality" were the reasons most frequently mentioned.

Consumer attitudes to food waste also show positive results; an increasing proportion reported having reduced food waste, and being more aware of their food waste as a problem. Fewer consumers state that they throw away food just because it is past its expiry date, and this applies to all age groups.

Key National Food Waste Figures

The total amount of food waste in the four stages in the value chain was 355 000 tons in 2015. Compared to 2010, food waste decreased by 25 500 tons or around 7% of the total amount.

Food waste in the four stages was the equivalent of 68.7 kg per capita, and since 2010 there has been a reduction of 10 kg per capita, or about 12%. This sharp reduction is because the total amount of food waste decreased by 25 500 tons, while the population of Norway rose by 300 000, from 2010 to 2015. The ambitious goal of a 25% reduction in food waste from 2010 to the end of 2015 has therefore been half achieved!

Most (61%) of the food waste in 2015 occurred in households; here, new figures show that about 217 500 tons were discarded. Then come producers with around 74 500 tons (21%), retailers with about 60 000 tons (17%) and finally wholesalers with approximately 3000 tons (1%) (see Figure 1-1).

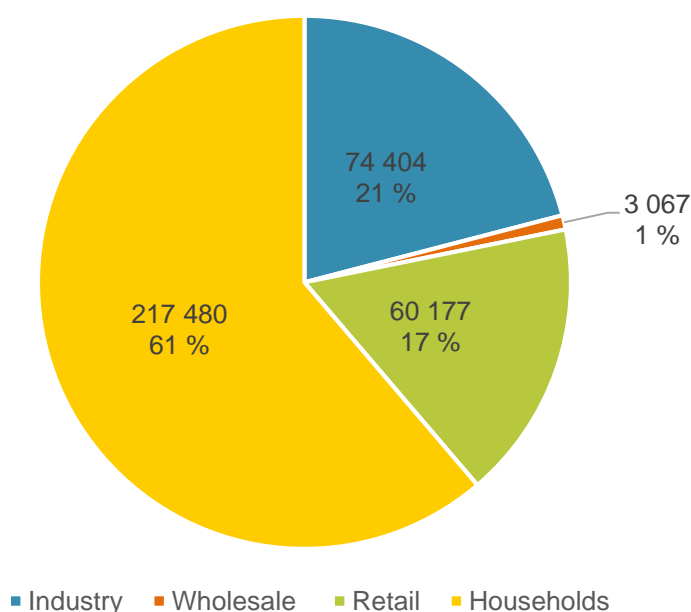


Figure 1-1 Amount (in tons) and percentage of food waste in Norway in 2015 in the four stages of the value chain

The food discarded in Norway represents a financial loss of more than NOK 20 billion per year or about NOK 4000 per capita, and leads to annual emissions corresponding to 978 000 tons of CO₂ equivalents from production, packaging and distribution of food that is discarded instead of being eaten. About NOK 13 billion of the financial loss is from households; the average household throws away food worth about NOK 5800 every year. This means that society will save on both emissions and costs by reducing food waste, making food waste reduction a very effective environmental measure.

Emissions and financial losses related to food waste have not been reduced as much as the amount of food waste, since food waste has mostly decreased for relatively inexpensive and eco-friendly products and increased for more expensive and less eco-friendly products.

Discussion of Results and Data Basis

The data collected in Norway by the ForMat Project over six years are a unique compilation of food waste statistics in a European perspective, providing valuable information about the composition and amount of food waste, where in the value chain most food is wasted and what kinds of food predominate, developments over time, and causes of food waste at the various stages of the value chain.

Several retail chains and food manufacturers have indicated that their internal procedures for recording food waste have improved during the reporting period. This represents the overall experience from the project, especially for the last three years, which have seen greatly increased commitment by the companies linked to ForMat. This means that the quality of the data has improved year by year through the reporting period. The food industry's understanding and practices regarding the concept of food waste has also changed. The first years were used to determine and communicate the difference between food refuse and food waste, and create awareness that it is profitable to implement food waste reduction measures in one's own company and in networks with other actors. The definition of food waste to be used in Norway has now been established as a result of the letter of intent on the prevention of food waste, and is similar to the definition in the ForMat Project for all the stages included in the reporting.

The ForMat Project has therefore been an important development and learning process for those involved. Although food waste statistics are the main result of the project, the methodology and reporting system developed and adapted during the project are two further important outcomes. An additional result is the knowledge of food waste and how to record it which the companies involved have acquired and developed during the project.

Experience from ForMat has also been used as a basis for the development of a common European methodology for quantifying food waste and food refuse in the EU, through the link to the FUSIONS Project. Ostfold Research has played a key role in developing the methodological basis for the mapping of food waste in Europe, and has coordinated the work of writing three methodology reports for the FUSIONS Project. Ostfold Research has also been involved in the preparation of a manual for the development of national statistics through surveys of food waste in FUSIONS. This work would not have been possible without the extensive experience acquired during the ForMat Project.

Although the data underlying these key figures are of good quality, there are still uncertainties associated with the methodology and assumptions made in the calculation of the key national food waste figures (see Section 7: Discussion).

All the results presented in this report should be seen in light of these assumptions, limitations and uncertainties.

The Way Forward

There still remains some development work in identifying food waste in Norway, since we know very little about the amounts and composition of food waste in certain sectors. The ForMat Project only covered four stages in the value chain (producers, wholesalers, retailers and consumers) and a great deal of work will be needed to study the remaining areas (the primary stage, the horeca sector, public institutions and offices). In addition, parts of the food industry have not been surveyed (such as fish processing, millers and flour manufacturers, breweries and producers of mineral water), and food waste that is discarded via drains has not been included (this applies mainly to consumers, horeca and food producers). With regard to the hotel and catering industry, a pilot project to identify the amount of food waste there has been initiated by Matvett in cooperation with Ostfold Research and the Norwegian Hospitality Association.

In light of the ongoing work to prepare a sector agreement on the prevention of food waste between the Norwegian food sector and the government, both parties appear to be willing to take steps to identify and reduce food waste in all sectors and stages in the value chain. Although the ForMat statistics are not yet complete, no other country has an equivalent overview of its own food waste, based on annual statistics. The main reason for this is Norwegian companies' openness and willingness to share data with researchers, in addition to good cooperation between actors in the various stages of the value chain.

For food waste reduction efforts to succeed throughout the value chain, broad cooperation between industry players and the government will be needed. One of the success factors of the ForMat Project has been precisely the development of such cooperation, and it is vital for future success that this cooperation continues and is enhanced through participation by more industry players.

More complete food waste statistics, more food waste prevention tools for the industry and awareness raising among consumers about the value of food will all be crucial measures in the way forward; these goals should be facilitated through collaboration between the food industry and the government.

1 Introduction

ForMat has been a collaborative project covering large parts of the value chain for the food and beverage sector in Norway. The ForMat Project was run by the company Matvett AS, and led by a steering committee with representatives from the Food and Drink section of the Confederation of Norwegian Enterprise (NHO), the Norwegian Grocery Sector's Environmental Forum (DMF), the Grocery Producers of Norway (DLF) and the Norwegian Packaging Association (NOK), while the Ministry of Agriculture and Food and the Environment Agency, on behalf of the Ministry of Climate and Environment, participated as observers. These two ministries provided funding for the project together with the Ministry of Children, Equality and Social Inclusion and the Ministry of Trade, Industry and Fisheries. In addition, the food research institute Nofima and Ostfold Research provided expert advice on food safety, the environment and communication. The aim of the ForMat Project has been to help to reduce food waste in Norway by 25% by the end of 2015, compared with 2010.

The project included three sub-projects:

- I. An annual study of food waste
- II. Communication and dissemination
- III. Networks on preventative strategies and measures

The partners in the ForMat Project were also members of the partnership of users in the EU-funded FUSIONS project, where Ostfold Research was the research partner, playing a key role in the development of methodology for the mapping and documentation of food waste in Europe (see www.eu-fusions-org). The partners in the ForMat Project were also user representatives in two of the Nordic projects on food waste: one on durability date marking and food waste and the other on redistribution of food.

This is the sixth report from the ForMat Project, and is the project's final report. Related work will be continued by Matvett and results and experiences from the project may be important elements in the sector agreement between the food sector and the Norwegian government. This report presents the results of surveys of food waste in Norway by food producers, wholesalers, retailers and consumers. The report is based on the methodology used in previous reports (Hanssen & Schakenda 2010, 2011, Hanssen & Møller 2013, Stensgård & Hanssen 2014, Stensgård & Hanssen 2015), but includes several improvements in both methodology and data that have been applied retroactively, as explained in the report. The data sources are still producers, wholesalers and retailers. Data on the frequency and causes of food discard by consumers and consumer attitudes and behaviour were collected from Norstat in the form of web panels each year from 2010 to 2015, and the report shows analyses of trends over the same six-year period, in order to study the extent to which there have been changes in food discard frequency or in behaviour, attitudes and practices related to the purchase and storage of food, the planning and execution of meals and the handling of leftovers. A new round of waste sample analyses has been conducted in Fredrikstad and Hallingdal in cooperation with the local authorities, and the results have been used in combination with national statistics in order to compare national food waste figures in 2015 with those from 2011.

The results in this final report of the ForMat Project have been divided into three parts:

1. Results of the annual food industry survey and waste sample analyses: the percentage of food waste in economic terms from 2010 to 2015 for wholesalers and retailers, the percentage of food waste in tons for producers, and waste sample analyses of household waste (Section 4).
2. Results of consumer studies of food discard habits, reasons for discarding food, and attitudes and behaviour related to waste (Section 5)
3. Key national food waste figures: tons of food waste in the four stages of the value chain from 2010 to 2015, as well as financial loss and environmental impacts linked to food waste (Section 6: Annual Food Industry Survey and Waste Sample Analyses).

The key figures in this report on amounts of food waste that occur in the four stages replace previous estimates of tons of food waste (Hanssen & Schakenda, 2011) as a result of improvements in both methodology and data sources in the ForMat Project. In addition, financial loss and environmental impact associated with food waste have been calculated for the first time.

Within the three sectors of the food industry and the consumer stage, the project has collected an extensive data base that is unique in scope and system in a European context. The data compiled through the ForMat Project represent the only complete statistics on food waste for Norwegian food producers, wholesalers, retailers and consumers.

Food waste prevention is relevant to a number of policy areas in Norway, such as:

- The government's bioeconomy strategy: <https://www.regjeringen.no/no/aktuelt/regjeringens-bioekonomistrategi/id2425964/>
- The government's efforts to prevent and treat waste: <https://www.regjeringen.no/no/dokumenter/t-1531-fra...til.../id733163/>
- The letter of intent on food waste between the government and the food sector: <https://www.regjeringen.no/no/aktuelt/pa-rett-vei-mot-mindre-matsvinn/id2458505/>

Internationally, there are also various initiatives aimed at preventing and reducing food waste. On 02.12.15, the EU launched its revised programme for a circular economy with a proposed target of halving food waste in the EU by 2030, which is in line with sustainability targets set by the UN General Assembly in September 2015. Within the framework of its circular economy package, the EU has outlined various strategies as a basis for achieving the goal of halving food waste:

- To develop and implement a common EU methodology for quantifying food waste, create a common definition of food waste and develop relevant indicators for food waste (based on experiences from the FUSIONS project)
- To create a common platform that brings together the EU nations and all relevant actors in the food chain to define measures to meet the UN sustainability goals. Matvett, Ostfold Research and Nofima have been included as one of 70 members of the expert group to assist the European Commission in developing the platform.
- To review EU legislation related to waste, food and animal feed and enhance food redistribution and the use of food for animal feed in a safe manner
- To examine how systems of date marking of food can be improved and better understood by consumers in order to reduce unnecessary food waste, with a particular focus on the "best before" date mark.

http://ec.europa.eu/growth/industry/circular-economy/index_en.htm

<http://www.fn.no/Tema/FNs-baerekraftsmaal/Dette-er-FNs-baerekraftsmaal>

2 Aims of the Survey Sub-Project

The main aim of the survey and subproject I in ForMat has been to develop the methodological basis for and gain knowledge of the amounts/values and composition of food waste in Norway. The focus has been on the entire value chain, from industrial processing and production via distribution and sales to the consumer. A further goal has been to develop methodology and IT solutions to enable the monitoring of developments in amounts of food waste over time, and enhance knowledge of the causes of food becoming waste at the various stages. This work will provide an important contribution to the establishment of a baseline for amounts of food waste in different stages of the value chain, which can form the basis for determining future reduction targets in the sector agreement.

3 Methodology and Data Basis

The following definition of food waste has formed the basis of the ForMat Project:

“Food waste includes all food that could or should have been eaten by humans, but which for some reason has not been made into human food”³.

In order to determine status and trends in food waste in Norway since 2010, 9 product groups with 21 categories (subgroups) were selected as the basis for the study throughout the value chain (see Table 3-1). The product groups selected were either those believed to generate relatively large amounts of food waste, or those which were interesting in terms of date marking. Further justification for the selection of product groups and categories is described by Hanssen (2010), who also describes the methodology used in detail. All the reports may be downloaded from www.matsvinn.no/rapporter.

Table 3-1 Product groups included in the ForMat Project divided into product categories

Product group	Product category
Frozen food	1.1 Frozen ready-made food
Fresh fruit and vegetables	2.1 Fresh fruit 2.2 Fresh vegetables 2.3 Fresh potatoes
Fresh baked goods	3.1 Fresh bread
Fresh ready-made food and delicatessen items	4.1 Fresh ready-made food 4.2 Sausages 4.3 Sliced meat and pâtés
Fresh fish and shellfish	5.1 Fresh fish
Fresh meat	6.1 Fresh meat 6.2 Minced meat
Eggs	7.1 Fresh eggs
Dairy products	8.1 Milk products 8.2 Cheese
Dry goods	9.1 Durable baked goods 9.2 Baked goods 9.3 Dressings, spiced sauces, oils 9.4 Biscuits 9.5 Sweet sandwich spreads in jars and cans 9.6 Sauces and clear soups 9.7 Snacks

The main approach chosen in the project was to quantify the composition and amount of food waste from the production, wholesale and retail stages. For the consumer stage, the chosen approach involved consumer studies with representative samples of 1000 respondents selected via the Norstat web panels; these were asked whether they had thrown away food from the 21 categories during the past week. Two comprehensive waste sample analyses of household waste were conducted in 2011 and 2015 from a sample of households in Hallingdal and Fredrikstad. These analyses formed the basis for calculating the total amount of food waste by consumers (Hanssen & Schakenda 2011, Hanssen et al. 2013).

³ The definition of food waste has been determined as part of the work on the agreement between the food sector and the government, but this mainly affects primary industry, which is not covered by this report.

3.1 The Production Stage

Amounts of food waste generated at the production stage for the 21 product categories were identified in cooperation with the companies participating in the ForMat Project. A total of 13 companies contributed data to the project, and 11 of these provided data for the entire reporting period (2010-2015). The companies cover eight of the nine main groups included in the survey (all except fresh fruit and vegetables). These 13 companies represent a wide range of production facilities and cover about a quarter of total sales in the Norwegian food industry. The selection is considered to be economically representative of a number of product groups.

The data provided by each company were used directly in the analysis, by calculating the percentage of waste in relation to the production volume. Weight was used as the basis, since most companies are unwilling to reveal the value of their production; this has no significance as long as production is relatively homogeneous in terms of product value.

In order to obtain a general idea of the annual amount of food waste from companies, two main methods of calculating waste were used, depending on the quality of company records of how much food waste occurs in the production process:

- I. If the company has complete knowledge of the amount of useable food discarded in the various stages of production (or combined), based on registration by scanning of packaged products discarded, weighing and recording of product weight, invoicing from companies receiving this type of waste for treatment, etc., this can be used as a basis for reporting.
- II. If the company only has or can obtain an overview of the total amount of waste generated, it can make a qualified estimate, in collaboration with Ostfold Research, of how much of this is food waste, which can then form a basis for reporting.

For 12 of the 13 companies, the first approach was used, providing data of relatively good quality. Companies have also had access to methodology developed in a ForMat network (2011) which ensures that they all use the same template for data collection and that the processes and types of food waste involved are clearly presented; the method also includes suggestions for key figures that can be used in both reporting and improvement work. The report "Kartlegging av matsvinn i produksjonsbedrifter - Oppsummering fra nettverksprosjekt" [A Survey of Food Waste in Food Producing Companies - A Summary from a Network Project] is available from matsvinn.no.

In this final report, the data from food producers show a significant improvement over previous reports. All companies and reporting years were quality assured and the companies' reporting of returned goods was thoroughly studied to avoid double counting. Furthermore, historical data were obtained for companies that joined the project after 2010, ensuring that the time series is as complete as possible.

Other corrections made to previous ForMat reports:

- Eggs have no waste at the production stage, as remains are reported to go directly into other food production, and this is not considered as food waste (ForMat 2014)

- Fresh fruit and vegetables have no waste at the production stage (processed fruit and vegetables are included in fresh ready-made food; waste of fresh fruit and vegetables thus occurs in the primary, wholesale or retail stages). (ForMat 2014)
- The time series for fresh ready-made food and delicatessen items has been adjusted due to significant improvements in the underlying data (ForMat 2014).
- Waste of fresh baked goods has been adjusted for double counting in the retail and production stages (returned bread) (ForMat 2015).
- Dairy products have been divided into two subgroups, solid and liquid, because the two subgroups show very different proportions of waste (ForMat 2015)
- The data for waste of fresh ready-made food in 2012-2014 have been updated and improved due to agreement on the definition of food waste (ForMat 2015)

Central to the interpretation of the results for producers is the amount (tons) of food production and food waste analysed by product group and year. The quantities included in the analysis affect the representativity of the sample of each group. Table 3-2 shows the distribution of each product group as a percentage of the total amount of food produced that is included in the analysis.

Table 3-2 Percentage distribution of amount produced, by product group included in the analysis

Percentage of total amount (in tons) included in the analysis						
Product group	2010	2011	2012	2013	2014	2015
1. Frozen ready-made food	6%	6%	5%	6%	6%	6%
2. Fruit and vegetables						
3. Fresh baked goods	17%	14%	17%	16%	15%	15%
4. Fresh ready-made food and delicatessen items	26%	27%	24%	23%	23%	23%
5. Fresh fish and shellfish	0%	0%	0%	1%	1%	1%
6. Fresh meat	18%	16%	15%	13%	13%	11%
7. Eggs						
8.1 Liquid dairy products	18%	21%	23%	22%	23%	23%
8.2 Solid dairy products	3%	3%	3%	3%	3%	3%
9. Dry goods and durable products	12%	12%	12%	16%	17%	17%

The table shows that certain groups dominate: fresh baked goods, fresh ready-made food, fresh meat, dry goods and liquid dairy products.

The division into product groups in terms of production volume has an effect on the overall food waste figures from producers. Groups with high production will affect total waste more than those with low production and variations in production and composition of the sample during the period will also affect trends in overall waste over time.

3.2 The Wholesale Stage

Estimates of food waste at the wholesale stage have been made on the basis of records of all waste at a large number of wholesale warehouses in Norway. The data mainly apply to product groups distributed through wholesale companies in Norway, and only to a minor extent those distributed directly from producer to retailer, which include:

- Fresh baked goods
- Fresh unpackaged fish sold at a fish counter
- Liquid dairy products (milk and cream)
- Beer and soft drinks

For the first three groups, i.e. those included in the ForMat Project, the figures are therefore not complete throughout the value chain.

A total of 67 product categories were recorded in food and beverages, where there is no direct overlap between the classifications used in retail and in wholesale. It has therefore not been possible to identify all product categories at the wholesale stage using the same structure as at the retail stage.

All food waste recorded was based on the net value of the product and was calculated as a percentage of the sales of the particular product group. The reason for discarding the product was also recorded, with an emphasis on two main categories:

- Not a saleable item because of too short a time to the expiry date for date-marked products
- Breakage due to the packaging or the product being damaged during handling or transport.

The method used to collect data on waste in fresh fruit and vegetables has been the same throughout the project. Therefore, developments in waste of fruit and vegetables are comparable over time, but the data collection method was established before 2009 for another purpose. This means for example that food for redistribution was not recorded, so that fruit and vegetables from wholesalers being redistributed have been included in the results for food waste in this report. The focus on redistribution has also increased during the project period. This means that waste of fruit and vegetables is probably somewhat lower than indicated by the results of this report.

As a result of reporting to the ForMat Project, the company that provided data on waste of fruit and vegetables at the wholesale stage has expressed a wish to focus on documentation of reductions in food waste and has therefore decided to change its data collection method from 2016.

3.3 The Retail Stage

The surveys of food waste from retailers were based on information on unsold amounts of food recorded from 30 stores in 2010, 29 stores in 2011, 58 stores in 2012 and 89 stores in 2013-2015. The stores are a representative cross-section of retail grocery outlets in Norway, with regard to geographical region, population density, and stores with or without fresh food sections.

Table 3-3 shows the distribution of the 89 retail outlets by type of store and region, where Eastern Norway consists of the counties of Telemark, Vestfold, Buskerud, Oppland, Hedmark, Oslo, Akershus and Østfold, Southern Norway consists of Vest-Agder and Aust-Agder, Western Norway consists of Rogaland, Hordaland, Sogn og Fjordane and Møre og Romsdal, Central Norway consists of Nord-Trøndelag and Sør-Trøndelag and Northern Norway consists of Nordland, Troms and Finnmark. Southern and Northern Norway do not include stores with a fresh food section, but this is hardly of importance for the representativity of the total sample.

Table 3-3 Geographical distribution of the retail outlets reporting in 2013-2015

Region	Fresh food section	No fresh food section
Eastern Norway	11	33
Southern Norway	0	8
Western Norway	4	15
Central Norway	2	7
Northern Norway	0	9

Food waste in stores is recorded as net value, and in the ForMat Project the sum of the net value is calculated for the major products in each of the 21 categories. Sales figures for each store were also obtained, both total sales and sales of the 21 categories analysed. The product categories included in the food waste survey represent about 56% of total sales in the 89 stores, which means that the products involved cover the main areas of food waste.

The amount of food waste was calculated as a percentage for the 21 product categories analysed. The selected categories are not representative of the entire range of products in retail outlets with regard to food waste, since several large groups with high sales and a low level of waste are not included (soft drinks, beer, and non-food products such as tobacco, detergents, etc.).

The quality assurance processes in last year's ForMat survey revealed that the return of fresh baked goods had not been included in the food waste recorded by many stores. This was especially true for 2010-2012, when few stores recorded the return of fresh baked goods.

As the data for 2010-2012 do not include the return of fresh baked goods, the percentage of return during this period has been calculated by extrapolating the return data for 2013 to 2015 using the trend line function in Excel. This means that the waste figures for retailers for fresh baked goods from 2010 to 2012 are somewhat uncertain, being based on an estimate rather than reported data. This applies to both national figures (in tons) and the annual ForMat reporting (waste as a percentage of sales value).

3.4 The Consumer Stage

3.4.1 Waste Sample Analyses

Waste sample analysis is a method for identifying the composition and quantity of waste. Samples of waste are selected, which are then weighed and sorted into predefined categories (Mepex 2015 a).

In cooperation with the research project Food Waste Prevention, funded by the Food Programme (now the Bionær Programme) of the Research Council of Norway, detailed waste sample analyses were conducted in 2011 in a sample of households in Fredrikstad and Hallingdal. In 2015, the analyses from 2011 were repeated under the ForMat Project and in cooperation with Fredrikstad Town Council and a waste removal company in Hallingdal, based on the same methodology and conditions, to enable the results to be compared and used to measure food waste trends over time. The purpose of the waste sample analyses was to document changes in the composition and amounts of household food waste (Mepex 2015 b).

Waste from about 210 randomly selected households in Fredrikstad and Hallingdal was analysed; these were from two residential areas in Fredrikstad and three areas in Hallingdal (Hanssen et al. 2013, Hanssen et al. 2016, Mepex 2015 b). Mepex had overall responsibility for the implementation, analysis and upscaling of the data and the upscaling was performed in collaboration with Statistics Norway.

The methodology and implementation of the waste sample analyses are described in detail in Hanssen et al. 2013, Mepex 2015 b and Hanssen et al. 2016.

3.4.2 Consumers

To provide an overview of food discard by consumers and developments in behaviour and attitudes related to this, systematic consumer studies were conducted throughout the survey period.

Two samples of 1000 respondents, representative of Norwegian consumers, were interviewed every year during 2010-2015. In one survey, 1000 consumers were asked whether they had thrown away various types of food in the past week and if they answered yes, they were also asked for the main reason why the food was thrown away. In the second sample, 1000 consumers were asked a number of questions about their behaviour and attitudes related to planning, purchasing, transporting and storing food, meals, packaging and date stamps, how they dealt with leftovers and whether they discarded more or less food than in previous years. The results of the consumer studies are therefore based on respondents' own statements about food discard, behaviour and attitudes, which will not always coincide with reality. True figures on food waste are only revealed by the waste sample analyses described in more detail in Section 4.4.

The surveys formed part of the Norstat Omnibus surveys, using online questionnaires (web panels) from a sample of the Norstat permanent panellists (about 50 000 people). The respondents therefore varied from year to year, although some respondents may have completed the survey several times during 2010-2015. In addition to responses to the survey on food discard, data were

also collected on age, gender, place of residence, education, social status, number of persons in the household and household income for all respondents, to enable the responses to be analysed in terms of different consumer characteristics.

The surveys were mostly conducted mostly in May or June of each year, with the exception of 2010 when there was an additional survey in September. Data collection in the two surveys took place in two consecutive weeks, and weeks were always selected that did not include or directly follow holidays. The times of data collection for the consumer studies are shown in Table 3-4.

Table 3-4 Overview of times of data collection in the consumer studies in 2010-2015

Type of question	2010	2011	2012	2013	2014	2015	Total number of respondents
Waste of specific product categories and reasons	Week 18 Week 34	Week 18 Week 34	Week 35	Week 15	Week 19	Week 17	8000
Consumer behaviour and attitudes to food waste in general	Week 24	Week 24	Week 36	Week 16	Week 20	Week 23	6000

All analyses were conducted using SPSS Statistics 23.0 and analysed for significance of differences between selections using chi-square tests.

A copy of the questionnaire used in the consumer studies is available as an appendix to the 2010 report (Hanssen & Schakenda 2010). The questions were designed by Ostfold Research in cooperation with the steering committee and Annechen Bugge of the Norwegian Institute for Consumer Research SIFO.

3.5 Methodology for the Calculation of Key National Figures

The following key national figures have been calculated for all stages of the value chain:

- Total amount of food waste generated (in tons per year and kg per capita)
- Costs associated with food waste in terms of lost revenue or additional costs of purchasing food at the consumer stage (in billion NOK)
- Greenhouse gas emissions associated with the production, packaging and distribution of food that is discarded (in tons of CO₂ equivalents)

The key figures are based on data collected in the ForMat Project (reported by producers, wholesalers and retailers, as well as from waste sample analyses), and have been scaled up to national figures based on the market share of the companies reporting and, for the consumer stage, the population of Norway.

The calculations were based on data at the product group level, and the results are shown as cumulative values (tons, financial loss and environmental impact) in each stage of the value chain. All upscaled data have been adjusted for the edible portion based on data from the food composition table at matportalen.no

3.5.1 Upscaling and Calculation of Tons of Food Waste

Producers

The data for producers are indicated in tons; it was therefore unnecessary to convert the data for this stage.

The amount of food waste that occurs in the production stage has been calculated by multiplying the production volume by the percentage of waste recorded by the ForMat companies for their particular categories. Data for the annual production volume of various kinds of food producers are taken from Statistics Norway's Table 10455 "Sold Production of Goods for Large Industrial Companies, by 8-digit PRODCOM Code" for the segment "Food, Beverages and Tobacco Industry" and include confidential data. The production statistics in terms of amounts of waste are of varying quality. To correct for missing data and sources of error in the statistics, the production statistics expressed in amounts have been combined with those expressed as sales (which are of better quality). From these two statistics, key figures for each product group and year (NOK per kg) have been calculated; these were then used to fill gaps by CPI-adjustment of the key figure from the year before/after, and sales in economic terms were then divided by the CPI-adjusted key figure. The key figures have also been used to identify errors in the reporting of tons and kilograms.

The production data have been adjusted for export, so that food waste that occurs in connection with the export of food produced is not included in the calculation of key national figures.

The waste percentage for the various product groups is based on the 11 companies that have provided data for the project for the entire period (2010-2015). As this percentage is used as a basis for upscaling, the underlying data have also been adjusted for waste associated with major events or extraordinary operations, so that abnormal fluctuations in a company's waste are evened out.

It has not been possible to calculate the amount of waste in the production of fresh fish; the reasons are the lack of data on the percentage of waste for 2010-2012, the very small number of companies producing fresh fish included in the sample and the wide variety in type and degree of processing in companies that process fresh fish. The data currently available are therefore insufficient to calculate and scale up the amount of waste that occurs in Norwegian food companies involved in the processing of fresh fish.

Fresh fish is the largest product category in the Norwegian food industry, which means that the amount of food waste calculated for food producers in this report is a moderate estimate. Waste occurring in the brewery industry and in mills and flour producers has also not been included, as no data have been collected from these sectors.

In addition, it has not been possible to identify all liquid food waste from producers, as this is often disposed of through drains and is thus difficult to detect and measure.

Wholesalers

Data from wholesalers are expressed in economic terms, so to calculate the amount of food waste in tons at the wholesale stage, the key figures in terms of NOK per kg have been used to convert from economic value to tonnage. The key figures were collected in 2010 and have been CPI-adjusted for the years 2011-2015.

Market share in the retail sector for the wholesalers reporting to the project has been used as the upscaling factor.

Retailers

As for wholesalers, the data from the retail sector are expressed in economic terms, so to calculate the amount of food waste in tons at the retail stage, the key figures in terms of NOK per kg have been used to convert from economic value to tonnage. The key figures were collected and calculated for the roughly 180 products included in the analysis in 2010 and have been CPI-adjusted for the years 2011-2015.

As a basis for scaling up food waste from retailers, data were used from 29 stores from one chain for 2010-2011, from 59 stores in two chains for 2012 and from 89 stores in three chains for 2013-2015. The 89 selected stores are representative of the retail chains. This has been quality controlled by the chains themselves.

For the upscaling in the retail stage, everything that can be eaten or drunk is included in the waste figures, which means that the selection of categories is greater than those presented in Section 3 (Table 3-1) (alcoholic beverages, confectionery and soft drinks have been included). Waste figures are therefore complete for the retail trade. This has unfortunately not been possible for consumers and producers, where food waste that goes into drains has not been identified. In the retail sector, all food waste is recorded by scanning, including liquids, while liquid food waste from producers and consumers is often disposed of via drains and is thus difficult to detect and measure.

The stores included have been scaled up to the national level on the basis of the market share of the chains for each year during the period. For market share that is not categorised ("Other"), the average amount of food waste in the stores has been used.

Consumers

The results of the two waste sample analyses (see Section 3.4.1) have been scaled up to national waste figures by the company Mepex in collaboration with Statistics Norway (Mepex 2015 b). This was done on the basis of reporting of household waste by local authorities to Kostra, the nationwide government statistics database under Statistics Norway.

Since waste sample analyses are a relatively expensive form of analysis, only two sets of analyses could be conducted during the ForMat Project period; these were in Fredrikstad and Hallingdal in 2011 and 2015. For the other years, the amount of food waste from consumers was calculated by extrapolating the data from 2011 and 2015 using the trend line function in Excel. The purpose was to illustrate developments in the total amounts of food waste at all stages for each year.

3.5.2 Calculation of Financial Loss

Financial loss associated with food waste has been calculated for each stage and for the entire value chain overall.

For wholesalers and retailers, the calculation of financial loss is relatively simple since the waste is recorded in economic terms. Calculations in these stages were therefore made by totalling the economic value of the waste and then scaling up using the same methodology as for the calculation of tonnage (wholesalers' market share in the retail sector and retailers' market share in the retail chains).

Since data from producers and consumers are measured in tons, financial loss related to food waste was calculated in terms of NOK per kg for each product group. These figures were then multiplied by the key national figures for tons of food waste calculated for producers and consumers (see the methodology for calculating tons in Section 3.5.1).

The figures used for conversion at the production and consumer stages are the same as those used to convert waste in economic terms to waste in tons at the retail and wholesale stages. These figures are net prices obtained from retail outlets, and are therefore relatively reliable for conversion at the retail and wholesale stages. For producers and consumers, these figures will be somewhat over- and underestimated, since mark-ups will add value throughout the value chain.

As the division into product groups at the production, wholesale and consumer stages is somewhat less detailed than at the retail stage (data at the level of product type), the product mix used for calculating waste by retailers (as a percentage) has also been used as the basis for calculating waste at the other stages. This is a simplification, since the composition of food waste within the various product groups is hardly the same at the different stages. But since there are no more detailed data on the composition of food waste at the non-retail stages, this is the best approach. This approach has also been used for calculating greenhouse gas emissions associated with food waste.

All values have been converted to 2015 NOK values to ensure comparability over time.

3.5.3 Calculation of Greenhouse Gas Emissions

The environmental analysis was limited to one indicator, namely greenhouse gas emissions; these were calculated using life cycle analysis methodology in accordance with ISO 14040/44 and the European Commission JRC (2010, 2011).

It is important to note that the prevention of food waste can have a positive effect on many other environmental indicators (e.g. acidification, eutrophication, photochemical oxidation and emissions of NO_x and particulates) and on resource use (such as the use of water, primary energy and phosphorus).

Greenhouse gas emissions were estimated on the basis of the amount and composition of food waste from the various stages of the value chain in Norway, and calculated by multiplying the amount of food waste in tons for the relevant product groups and stages by the corresponding emission factors.

The emission factors include all greenhouse gases related to the production, transport and packaging of food. Emissions connected to the disposal of packaging and food waste have not been included. All emissions have been converted into CO₂ equivalents.

4 Results of the Annual Food Industry Survey and Waste Sample Analyses

4.1 Producers

The results for producers show that total food waste for all product groups was reduced by 4% from 2010 to 2015. Trends in the amount of waste vary between groups; liquid dairy products, dry goods and frozen ready-made food have the highest proportion, while eggs, solid dairy products and meat have the lowest. Five out of ten groups show a reduction in food waste, while three show an increase.

Fact Box 4-1 Summary of Food Waste Figures for Producers 2010-2015

Product groups with the <i>most</i> waste as a percentage of weight were:	
1) Liquid dairy products (3.3%)	
2) Dry goods (2.7%)	
3) Frozen ready-made food (2.5%)	
Product groups with the <i>least</i> waste as a percentage of weight were:	
1) Baked goods (1.2%)	
2) Solid dairy products (1.3%)	
3) Fresh meat (1.4%)	
Product group	Change in waste 2010-2015
Frozen ready-made food	- 36 %
Fresh baked goods	+ 2 %
Fresh ready-made food and delicatessen items	+ 0,5 %
Fresh fish and shellfish	- 54 %
Fresh meat	- 18 %
Liquid dairy products	- 28 %
Solid dairy products	- 35 %
Dry goods	+ 33 %
Weighted total change	- 4 %

The data for food producers cover the same companies and are based on the same methodology for the years 2010 to 2015, except for two companies that only cover the period 2013-2015. Production volumes for the various companies naturally varied during the reporting period, which means that the composition of product groups has also varied (see Table 3-2, Section 3.1).

Figure 4-1 shows waste as a percentage of annual production in tons from 2010 to 2015 for all companies reporting to the project. The percentages marked represent the waste for the various product groups in 2015 and the broken line shows the weighted average for waste in 2015.

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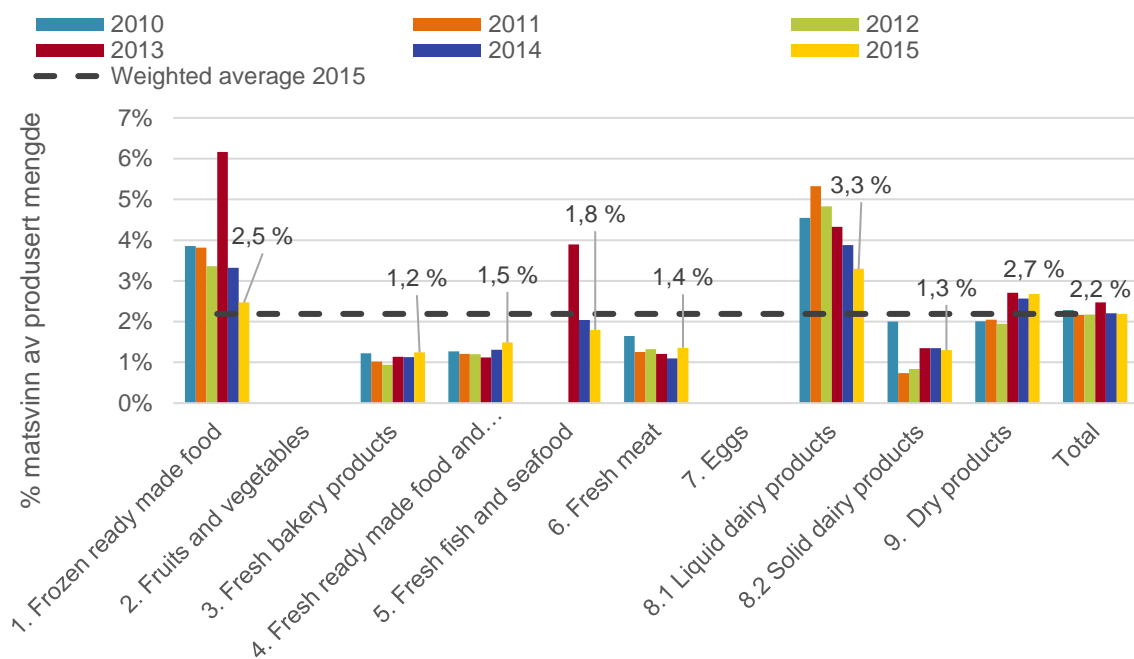


Figure 4-1 Food waste as a percentage of production (in tons) for nine product groups from 2010 to 2015

Figure 4-1 indicates that food waste overall from production for all product groups has remained relatively stable throughout the period. The total reduction for all groups from 2010 to 2015 was 4%.

As described in the methodology section (3.1) and shown in the figure, eggs have no waste in the production stage, as remains go directly into other food production, and this is not considered as food waste. Fresh fruit and vegetables also have no waste at this stage, since waste of fresh fruit and vegetables either occurs in primary production or as part of the production of ready-made food at the wholesale or retail stages.

It has not been possible to document the underlying causes of changes in food waste for every product group, but the causal relationship has been identified for some groups:

- The proportion of waste of liquid dairy products was reduced by 28% over the period, decreasing steadily from 2011 to 2015. This was due to continuous active work to prevent waste, where the company that has reported data has:
 - Implemented its own projects to survey and reduce waste
 - Focused on increasing the efficiency of processes and production lines as well as start-up and shutdown procedures
 - Introduced registration of deviations and goal management
 - Increased the focus on competence building and training
 - Changed distribution procedures, improved communication with customers, and to some extent improved ordering where necessary
 - Reduced internal transport, which has led to fewer deviations in dates on the products
- The increase in waste for dry goods was mainly due to reduced quality of raw materials and increased production complexity in the form of a larger product portfolio and range, which often leads to more frequent starts, stops and changes in production.

- The main reason for the sudden increase in waste of frozen ready-made food in 2013 was a combination of production errors and challenges related to new products.

These causal relationships indicate some of the challenges related to food waste at the production stage, where the launch of new products can lead to a considerable increase in waste for a limited period, followed by stabilisation as production is optimised. The development in waste of liquid dairy products shows that food waste reduction measures work, and also that this type of work requires the integration of many different levels and units of a company and is a result of continuous improvement work.

4.2 Wholesalers

Results for wholesalers show a 40% decrease in food waste from 2010 to 2015. Waste has been reduced for all groups except fresh fruit and vegetables. The reduction was greatest for baked goods, followed by fresh meat and frozen ready-made food. Food waste from wholesalers makes up a very small proportion of the total amount of food waste in the value chain.

Fact Box 4-2 Summary of Food Waste Figures for Wholesalers 2010-2015

Product groups with the <i>most</i> waste as a percentage of sales value were:	
1) Fresh fruit and vegetables (1.03%)	
2) Fresh fish and shellfish (0.18%)	
3) Fresh ready-made food and delicatessen items (0.16%)	
Product groups with the <i>least</i> waste as a percentage of sales value were:	
1) Eggs (0.0%)	
2) Baked goods (0.01%)	
3) Fresh meat (0.01%)	
Product group	Change in waste 2010-2015
Frozen ready-made food	- 81 %
Fresh fruit and vegetables	+ 2 %
Baked goods	- 94 %
Fresh ready-made food and delicatessen items	- 0,4 %
Fresh fish and shellfish	- 24 %
Fresh meat	- 91 %
Dairy products	- 62 %
Dry goods	- 80 %
Weighted total change	- 40 %

Data from the wholesale stage were obtained from regional and national wholesalers in Norway. Only waste defined as food thrown away and not eaten is included in the analysis for all groups except fruit and vegetables. For fruit and vegetables, the data collection method is outdated (see Section 3.2), and although the figures are comparable over time, it is highly probable that the data include food for redistribution, which means the waste of fruit and vegetables is probably considerably lower than the results suggest. As mentioned in the methodology section, the company reporting waste of fruits and vegetables at the wholesale stage has decided to introduce new methodology for recording waste.

Figure 4-2 shows food waste as a percentage of sales for wholesalers from 2010 to 2015. As in the producer stage, there is no waste from eggs at the wholesale stage.

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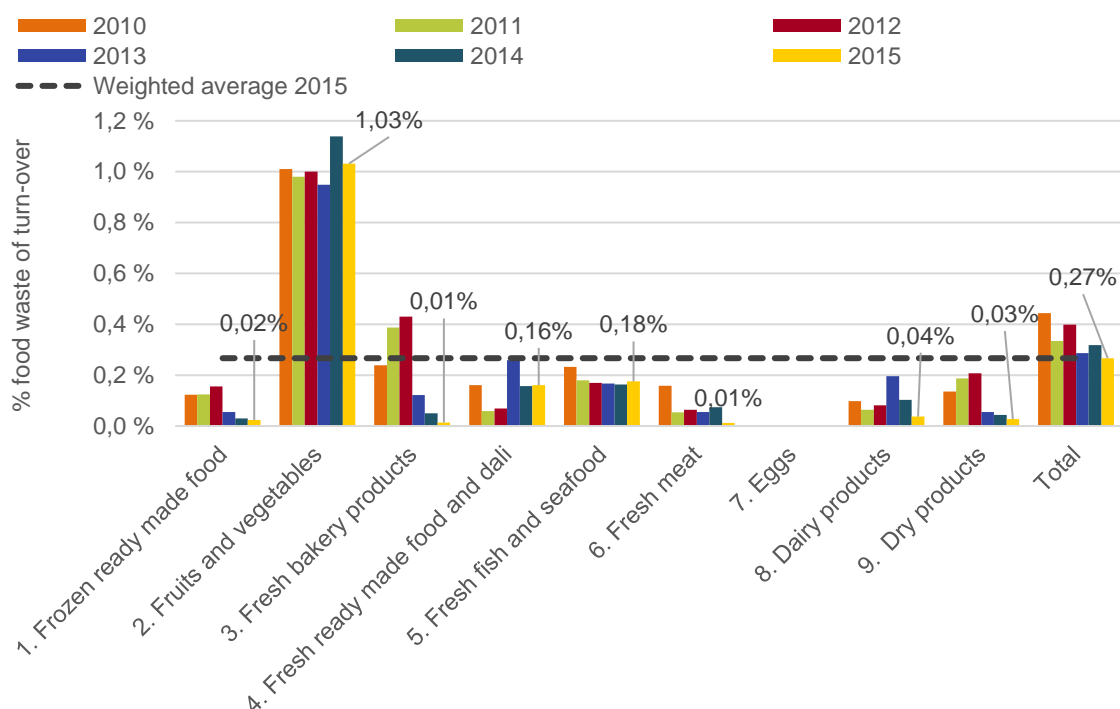


Figure 4-2 Food waste as a percentage of sales for nine product groups from 2010 to 2015

At the wholesale stage, the percentage of waste has declined as a result of increased sales, while the total amount of waste is unchanged. Thus, the percentage of waste has been gradually reduced, as the denominator of the fraction has increased while the numerator has remained stable.

At the wholesale level, several product groups had waste below 0,10%, and overall waste in 2015 was only 0,27%. Fruit and vegetables are the group with the highest proportion of waste; however, as mentioned above, there are some sources of error in the data for fruit and vegetables at the wholesale stage, and waste for this group is probably somewhat lower than indicated in the chart (see Section 3.2). For the value chain as a whole, food waste by wholesalers is very low compared to e.g. producers (Figure 4-1) and retailers (Figure 4-3) (see the y-axis values).

4.3 Retailers

The results for retailers show that food waste increased by 2.3% for the product groups analysed in 2013-2015. Although the total proportion of food waste increased, food waste was reduced in eleven of fifteen product categories. The categories showing increased waste were potatoes, dry goods, dairy products and fresh fish.

Fact Box 4-3 Summary of Food Waste Figures for Retailers in 2013-2015

Product groups with the <i>most</i> waste as a percentage of sales value were:	
1) Fresh baked goods (9.4%)	
2) Fresh fish (6.5%)	
3) Fresh meat (5.0%)	
Product groups with the <i>least</i> waste as a percentage of sales value were:	
1) Frozen ready-made food (0.3%)	
2) Eggs (0.7%)	
3) Dry goods (0.9%)	
Product category	Change in waste 2013-2015
Frozen ready-made food	-4.9%
Fresh fruit	-5.6%
Fresh vegetables	-5.7%
Fresh potatoes	+1.2%
Fresh baked goods	-1.2%
Fresh ready-made food	-2.7%
Sausages	-6.4%
Sliced meat and pâtés	-6.3%
Fresh fish	+9.8%
Fresh meat	-4.4%
Minced meat	-18.3%
Fresh eggs	-9.4%
Milk products	+28.5%
Cheese	-4.8%
Dry goods	+4.7%
Weighted total change	+2.3%

Food waste data from retailers has been collected from stores for five years, and the sample has increased from 29 stores in 2010 (one retail chain) to 58 stores in 2012 (two retail chains), and 89 stores in 2013 (three retail chains).

As the number and type of stores in the analysis has varied during the study, there is a certain risk that changes in the underlying data could affect results and trends. The results for 2013 are therefore not comparable with previous years, and we have chosen to show only the results for the

period 2013-2015. However, the data for 2010 to 2012 have been used as a basis for scaling up the total amount of food waste in the retail stage for the years in question in Section 6.

Figure 4-3 shows how food waste measured as a percentage of sales value was distributed among the selected product categories in 2013-2015. The percentages marked represent the waste in terms of sales value in 2015 and the broken line shows the weighted average for 2015.

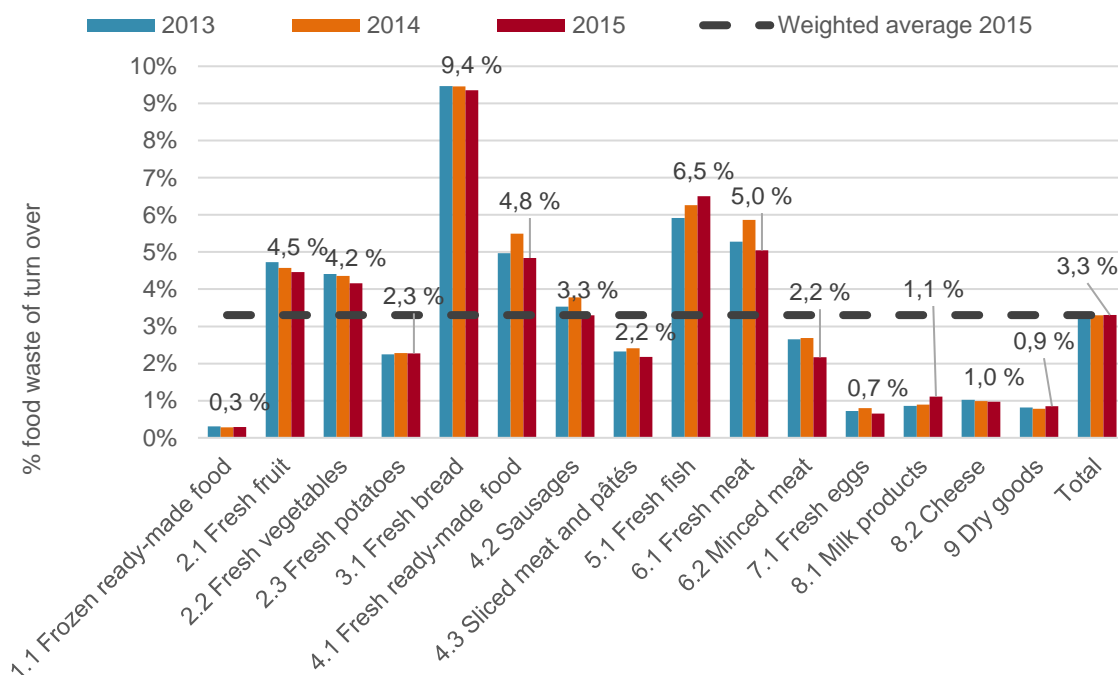


Figure 4-3 Food waste by product category as a percentage of sales value in 89 retail outlets from 2013 to 2015.

This figure shows that food waste was greatest for fresh baked goods and relatively high for fresh fish and fresh meat, while waste was relatively low for frozen ready-made food, eggs, cheese, milk products and dry goods.

The overall percentage of waste for all categories in 2015 was 3.3%. This figure represents only the product categories in the ForMat project, which have higher figures for waste than the general amount of waste from retailers in Norway.

Increased waste of fresh fish is because several chains have introduced new products in this category over the past few years. Such new product lines often lead to increased waste in a limited start-up phase, especially for goods with a short shelf life (such as fresh fish, fresh ready-made food and pre-cut salads/vegetable mixes).

The reduction in waste of minced meat may be due to efforts to improve packaging and packaging gases, resulting in extended shelf life for this product, a longer sales period and thus the potential for reduced waste.

4.4 Household Waste Sample Analyses in 2011 and 2015

The results of waste sample analyses show that food waste at the consumer stage was reduced by 9% in kg per capita from 2011 to 2015, at 46.3 and 42.1 kg per capita respectively. Amounts varied between groups: pan and plate leftovers and fruit and vegetables accounted for most of the waste, while dairy products and “other baked goods” had the least waste. Of the seven groups, only pan and plate leftovers showed an increase in waste.

Fact Box 4-4 Summary of Food Waste Figures for Consumers 2011-2015

Product groups with the *most* waste as a percentage of total waste at the consumer stage were:

- 4) Pan and plate leftovers (31%)
- 5) Fruit and vegetables (27%)
- 6) Bread (13%)

Product groups with the *least* waste as a percentage of total waste at the consumer stage were:

- 4) Dairy products (6%)
- 5) Other baked goods (6%)
- 6) Meat and fish (7%)

Product group	Change in waste 2011-2015
Bread	-40%
Other baked goods	-29%
Fruit and vegetables	-0%
Meat and fish	-14%
Dairy products	-4%
Pan and plate leftovers	+27%
Other	-28%
Weighted total change	-9%

Figure 4-4 shows results from the two waste sample analyses by product category.

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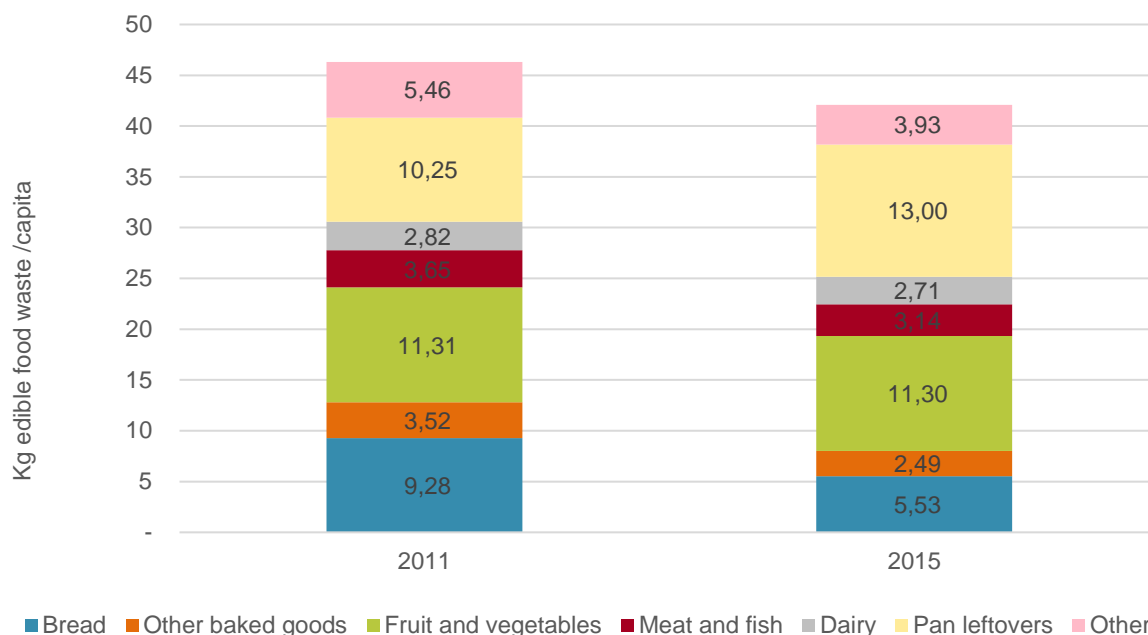


Figure 4-4 Kilograms of food waste per capita at the consumer stage, 2011 and 2015, by product category

This figure shows that food waste at the consumer stage declined from 2011 to 2015, and also that the composition of food discarded has changed. Overall, consumer food waste decreased from 46.3 kg per capita in 2011 to 42.1 kg in 2015, a reduction of 4 kg per head of population or -9%.

The figure also shows that people in Norway throw away less of all categories, except for pan and plate leftovers, which have increased. The reduction is greatest for bread, where waste has been reduced by as much as 40%.

Developments at the consumer stage have thus been positive and suggest that the communication efforts by the Format project, the food industry, retailers and the government (“throw away less food” campaigns and more consumer-friendly pack sizes, etc.) have led consumers to reduce their waste.

5 Results of Consumer Studies

5.1 Which types of food are most often discarded by consumers?

The results of six years of studies of consumer behaviour related to food discard show several interesting patterns, both in the proportion of consumers who report having thrown away different types of food and in changes in results and trends over time, as shown in Figure 5-1 below. It is important to bear in mind that the results do not reveal how much food consumers actually threw away, but only the proportion of consumers who claimed to have thrown away different kinds of food in the past week.

The types of food reported to have been discarded the most often throughout the study period are leftovers from the fridge and directly from cooking. Then follow milk and cream, fresh vegetables and fresh fruit. The last four categories show consistently high values in other parts of the value chain.

It is rather surprising that relatively large numbers of consumers also report having thrown away yoghurt, sour cream and snacks, all of which have a long shelf life.

When the surveys began in 2010, it was believed that the responses to questions about food discard might vary somewhat from year to year, but this turned out not to be the case.

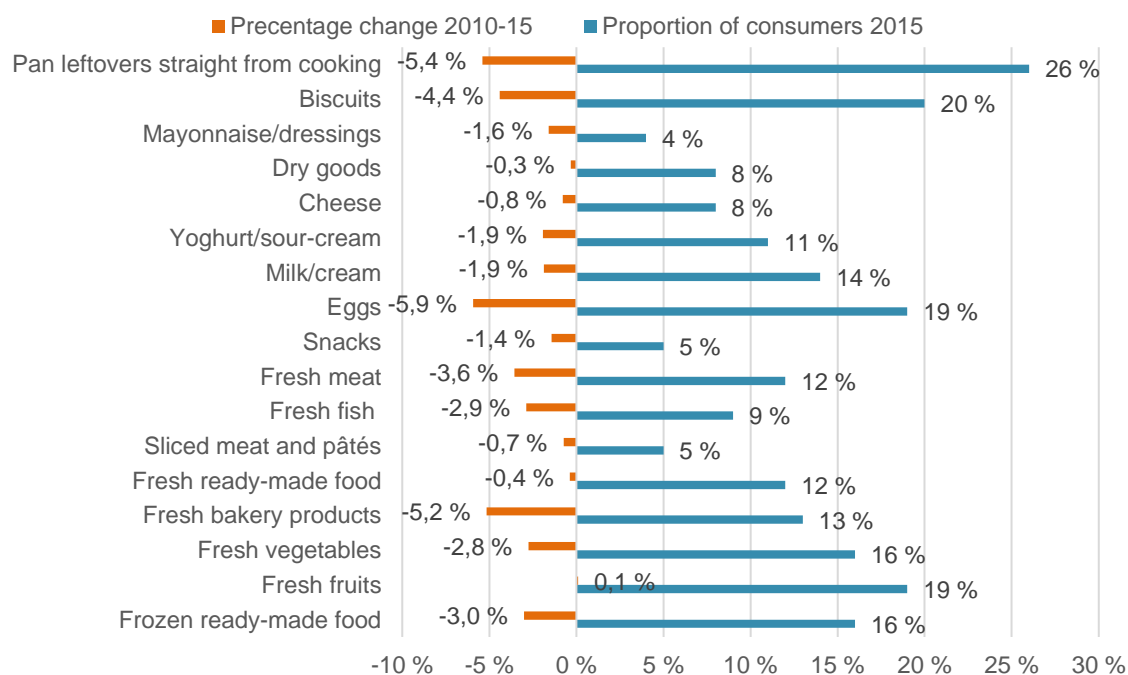


Figure 5-1 Proportion of consumers reporting having thrown away various categories of food in the past week in 2015 (blue bars) and percentage change 2010-2015 (orange bars)

Although there is little variation in the responses in the survey, Figure 5-1 shows a clear pattern of a reduction in the proportion of consumers who stated that they had thrown away different types of food (orange bars). With the exception of fresh vegetables, the results show a reduction in the percentage of all categories. The greatest decrease in percentage points from 2010 to 2015 is seen

in milk and cream (5.9 percentage points), pan leftovers from the fridge (5.4 percentage points) and fresh ready-made food (5.2 percentage points).

The results of the surveys showed little variation from year to year. This indicates that the methodology is sound and provides results that are comparable over time, although there may be systematic errors, since people cannot always remember what they threw away last week and may provide more positive responses than the reality.

5.2 Reasons for Discarding Different Kinds of Food in 2010-2015

For a selection of the types of food reported as having been thrown away, consumers were also asked what they thought was the main reason why the food had to be discarded instead of being eaten. Respondents could choose between a fixed number of possible reasons, as indicated in the figures below, and could only choose one reason for each type of food.

The results are shown in Figure 5-2 and Figure 5-3 below. For fresh fruit and vegetables, the main reason for discard was that parts of the product were damaged or inedible (37%), followed by poor quality in general (26%) and that the product was past its expiry date (25%). Since fruit and vegetables generally do not have a date stamp, the last answer probably also indicates poor quality. Few consumers reported poor storage at home or during transport home as an important reason (8%) or too much of the product in the package (4%) or poor packaging (2%). Consumers are therefore more focused on “symptomatic causes” of discarding fruit and vegetables than typical root causes related to storage and packaging (Figure 5-2).

When considering the differences between the values for 2015 and the average for the whole period, we see that there is generally little variation between the two bars, indicating little change over time in perceived important reasons for discarding food.



Figure 5-2 The main reason why consumers threw away fresh baked goods and fresh fruit and vegetables from 2010 to 2015

In the case of fresh baked goods, the single most important reason given was that the product was past its expiry date (38%), followed by poor quality (25%) and that parts were damaged or inedible (16%). These responses also indicate that consumers confuse date labelling and poor quality, since there is usually no date stamp on fresh baked goods. Too much of the product in the package was given as a reason by 9% of consumers, 11% gave poor storage as an important reason, while only 2% said poor packaging was the main reason (Figure 5-3). Here too, the responses show that

consumers are more oriented towards symptomatic causes than actual root causes in what they perceive to be the main reason why they throw away fresh baked goods. The proportion reporting date labelling or poor quality as the main cause increased slightly during the period, since the results for 2015 are somewhat higher than the average for the period.

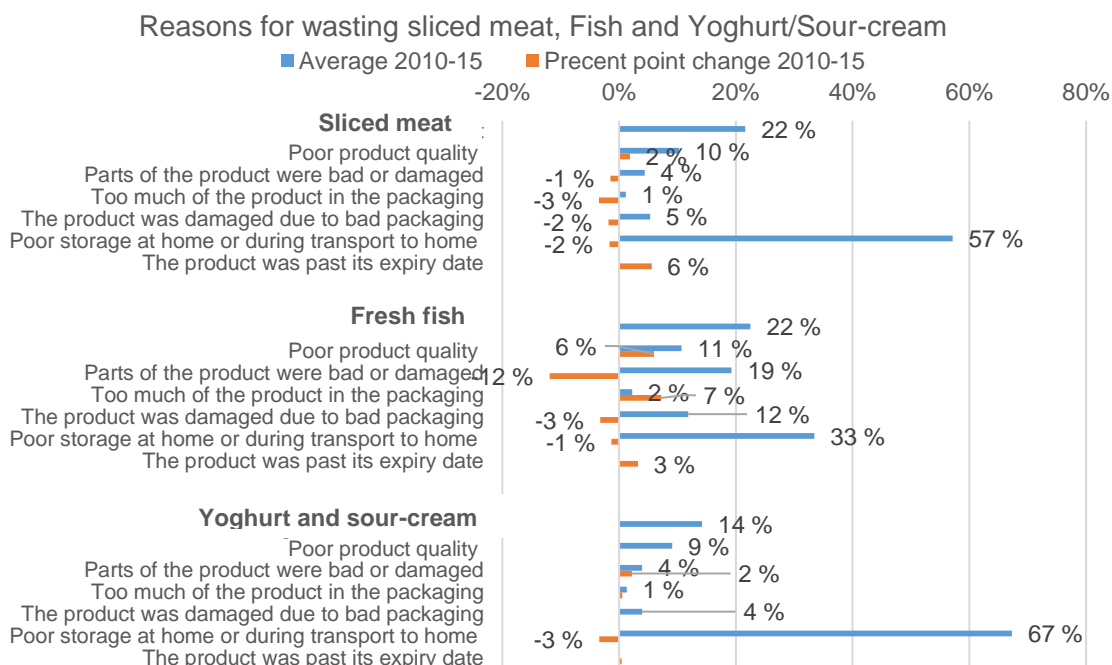


Figure 5-3 The main reason why consumers threw away fresh meat, fresh fish and yoghurt/sour cream from 2010 to 2015

Regarding fresh meat, 58% of consumers stated that “past its expiry date” was the main reason why the food was thrown away, while about 22% indicated poor quality. Packaging-related causes were of little significance; only about 4% gave “too much of the product in the package” and about 2% gave “poor packaging” as reasons (Figure 5-3). There was little change over time in perceived important reasons, as the 2015 results were almost identical to the average.

Fresh fish products show a more complex picture than meat, although “past its expiry date” (33%) and “poor quality” (22%) were again the most frequently stated reasons. However, too much of the product in the package was given as the main reason for discard by 19% of consumers, which is considerably higher than for any other product group. The fact that parts of the product were damaged or inedible (about 11%) may be linked to too much of the product in the package, while poor storage was given as the main reason by 12% of consumers. Fresh fish products also showed more change over time, since the results from 2015 showed significantly higher figures for both “past its expiry date”, “poor quality” and “too much of the product in the package” than the average for the period. On the other hand, far fewer consumers reported that parts of the product were damaged or inedible in 2015 than the average for the period (Figure 5-3).

For yoghurt and sour cream, the results show that consumers are still very concerned about date labelling on such products, even though this has been changed from “use by” to “best before”. Over 75% of consumers reported this as the main reason, and the percentage was actually higher in 2015 than the average for the whole period (Figure 5-3). Poor quality was mentioned by about 15%

of consumers, while packaging-related causes were again of very little importance, with 5% reporting too much of the product in the package and 2% reporting bad packaging. Here, there was little change during the period for all the product categories.

5.3 Changes in Behaviour Related to Purchasing, Meals and Food Discard from 2010 to 2015

The second part of the consumer study consisted of questions on how consumers plan and execute purchases and meals, on storage and transport of food and on attitudes and behaviour related to food discard. The results are seen in Figure 5-4 and Figure 5-5. With regard to the planning of purchases, an average of 85% of consumers said they knew how much food to buy when they went shopping, and as many as 64% said they used a shopping list. Only 24% reported that they are often tempted to buy more food than necessary, while 26% reported buying too much of each product. A positive trend in the results is that the percentage who reported planning purchases with a shopping list and knowing how much food to buy increased slightly over the period (1.6-2 percentage points), while the proportion who bought too much of each product or more food than necessary declined somewhat (by 3.7 and 3.2 percentage points).

Responses on the planning and execution of meals show that 48% said that they often take smaller helpings to avoid throwing away food, while 33% often make too much food and throw away all the leftovers. 29% say they often eat a little more to avoid discarding food, while 20% take too big helpings and throw away what remains. The differences here are largely age-related; younger people report making and taking too large portions, while older consumers are more aware of how much food to make and how big portions to take. Trends over time show positive results in that fewer consumers reported making too much food or taking too large helpings in 2015 than in 2010 (5.4 and 3.9 percentage point reductions).

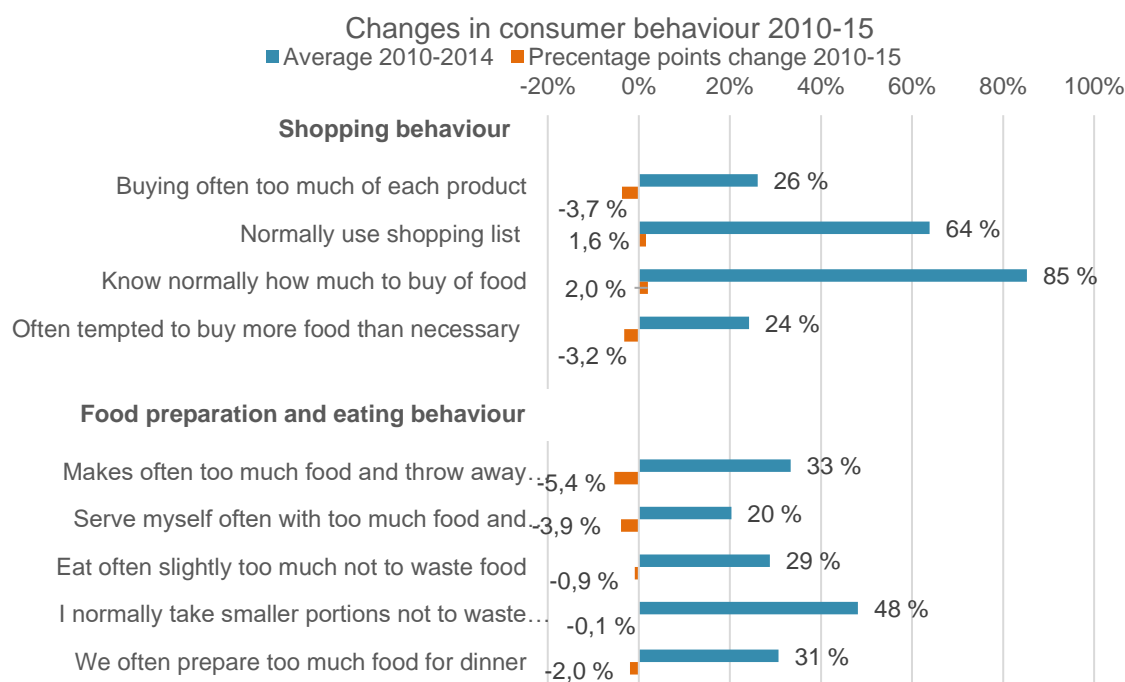


Figure 5-4 Changes in consumer behaviour related to purchasing and cooking from 2010 to 2015 (in percentages and percentage points)

With regard to transport and storage, the results again show that a large majority of consumers believe they store food properly at home (87%) and ensure the right temperature when transporting food home from the store (48%). Only 9% said that food often goes bad on the way home from the store, or that it is badly stored at home (14%). 49% of consumers reported not using the original packaging to store food at home, but their own containers. The changes are on the whole very small throughout the period, except that the percentage who reported food going bad during transport home has decreased considerably (by 4 percentage points from 2010 to 2015).

As many as 78% of consumers reported that they were familiar with and understood the difference between the two systems of date labelling, while 30% reported always discarding food that had passed its expiry date. 32% stated that there was too much of the product in the package, while 24% said that food often goes bad due to bad packaging. The most interesting points here are that the proportion reporting always throwing away food that is past its expiry date dropped by 8.7 percentage points from 2010 to 2015, while those stating that the packaging was poor decreased by 4.2 percentage points (Figure 5-5).

About half of consumers said they had become more aware of food discard as a problem in the past year (50%), while around 36% thought they had reduced their own food discard in the past year. This percentage has increased somewhat during the period (a 3.6 percentage point increase from 2010 to 2015), while the proportion who have become more aware of food discard as a problem has remained stable (Figure 5-5).

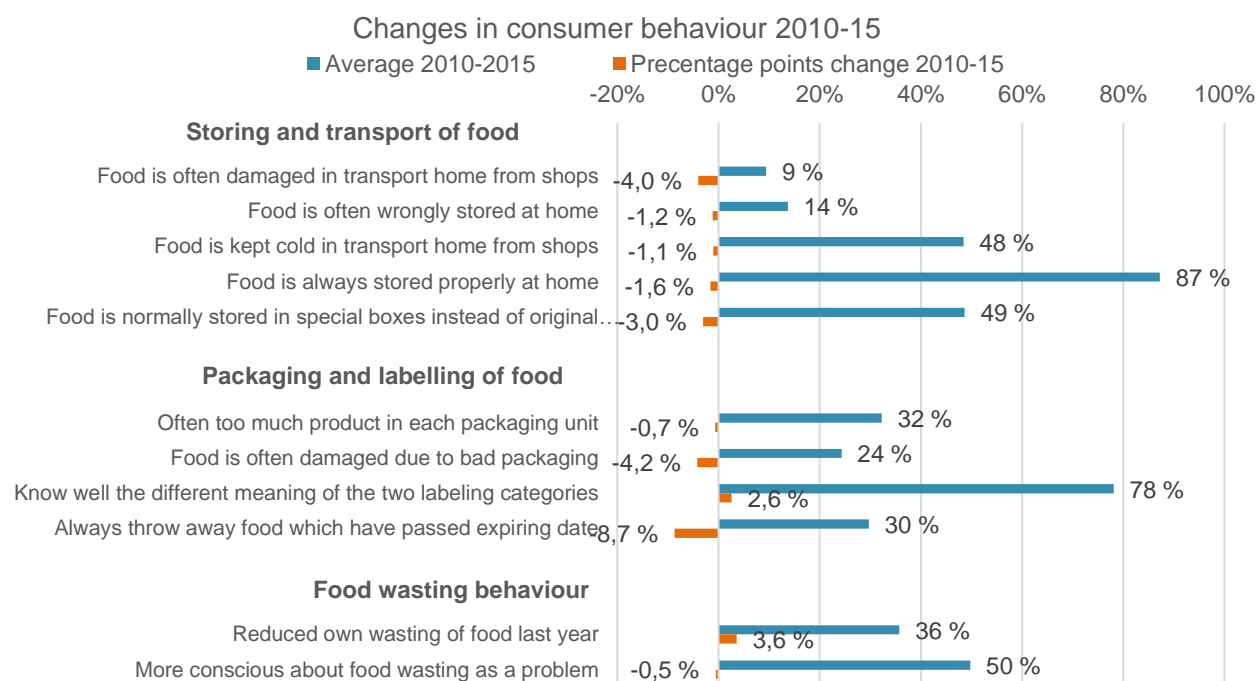


Figure 5-5 Changes in consumer behaviour related to the storage and transport of food and food discard and the importance of packaging from 2010 to 2015 (in percentages and percentage points)

6 Results: Key National Food Waste Figures

6.1 Total Amounts of Food Waste at each Stage in the Value Chain

6.1.1 Food Producers

Figure 6-1 shows developments in the amount of food waste (in tons) from food producers from 2010 to 2015.

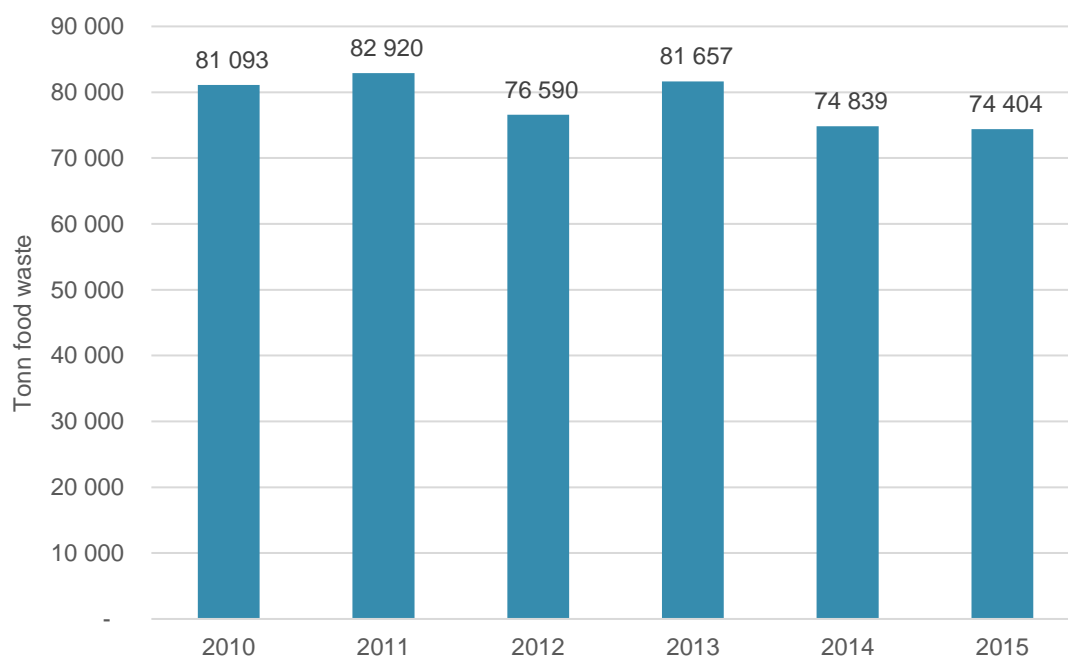


Figure 6-1 Tons of food waste from food producers from 2010 to 2015

The figure shows that the amount of food waste from food producers has remained relatively stable throughout the period, with a slight decrease in the last two years. From 2010 to 2015, food waste from producers was reduced from about 81 000 tons to about 74 400 tons, which corresponds to a reduction of 8%.

Considering the fact that sales by food producers have increased during the same period (Statistics Norway), the figure indicates that despite increased production, the amount of waste has been reduced, which is consistent with the trend in waste as a percentage of production (Section 4.1).

The amount of food waste by producers varies from year to year, while the results for producers in the sector survey section (Figure 4-1) show a relatively stable trend in the percentage of waste. The reason why the national tonnage figures vary so much is fluctuations in production volumes, which form the basis for upscaling of the food waste figures. The fluctuations are due to uncertainties and gaps in the statistics; an attempt has been made to eliminate these (see Section 3.5.1). The annual variations in the amount of food waste shown in Figure 6-1 are therefore smaller than the figure suggests.

As mentioned in the section on upscaling under methodology (3.5), waste from fresh fish, the brewery sector, mills and flour manufacturers and food waste that is discarded in drains are not included in the calculations for producers; this means that the total amount of food waste from producers is considerably more than 74 400 tons per year.

6.1.2 Wholesalers

Figure 6-2 shows developments in the amount of food waste (in tons) from wholesalers from 2010 to 2015.

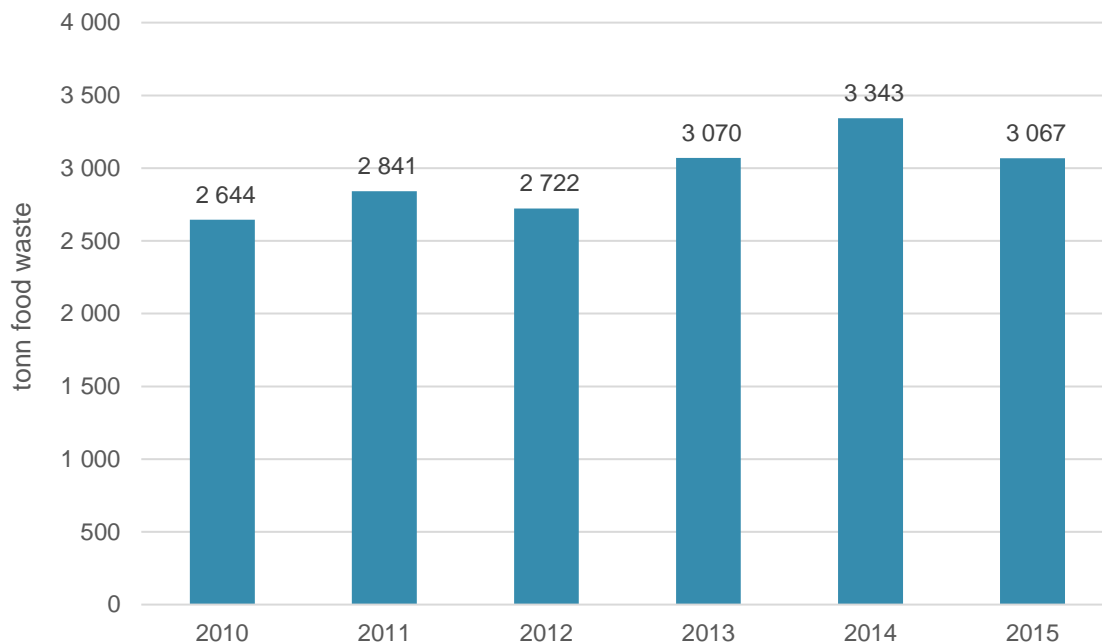


Figure 6-2 Tons of food waste from wholesalers from 2010 to 2015

The figure shows that the amount of food waste at the wholesale stage increased from about 2600 tons in 2010 to about 3100 tons in 2015, representing an increase of 16%. Section 4.2 showed a declining trend in the proportion of food waste by wholesalers (-40% from 2010 to 2015). The reason why the amount of food waste has still increased is that sales at the wholesale stage have increased sharply over the period, while waste has shown a smaller increase. Thus, the proportion of food waste has declined, while the total amount of food waste has increased.

6.1.3 Retailers

Figure 6-3 shows developments in the amount of food waste (in tons) from retailers from 2010 to 2015.

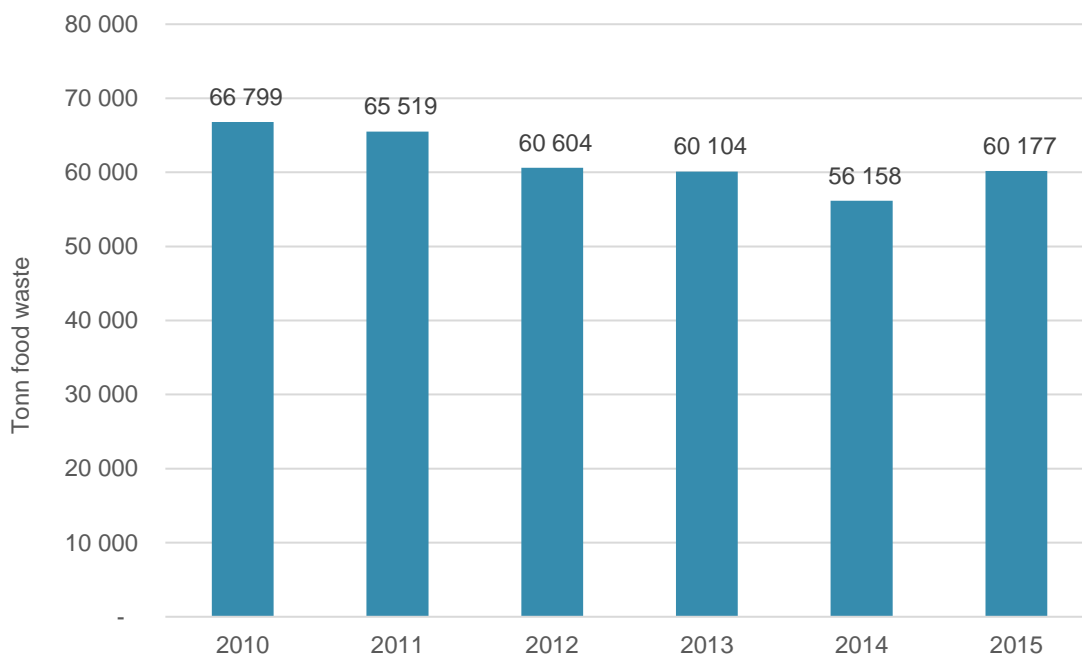


Figure 6-3 Tons of food waste from retailers from 2010 to 2015

The figure shows that the amount of food waste from retailers decreased from about 66 800 tons in 2010 to about 60 200 tons in 2015; this was a reduction of 6600 tons, or 10%. Food waste was initially reduced every year from 2010 to 2014, but then increased slightly from 2014 to 2015.

The product groups that contributed the most to the decrease from 2010 to 2015 were fresh baked goods, dry goods, dairy products and eggs. Fresh baked goods are the group with most waste in the retail sector but also contributed most to reducing food waste during the period.

The product groups that contributed most to the increase from 2014 to 2015 were fresh fruit, fresh vegetables, fresh fish, fresh ready-made food and fresh baked goods. Sales of pre-cut salads and vegetable mixes rose sharply in 2015, and since these types of product have a high percentage of waste, this also contributed to the increased waste in 2015. In addition, there was increased production of fresh industrial packaged fish and fresh meat-based ready-made meals in 2015, which probably also led to increased waste, as new lines often result in a temporary increase in waste.

As mentioned in Section 3.5.1, the tonnage calculations for retail waste includes all types of goods and products - including liquid goods. The waste figures for the retail sector are therefore complete, but this has not been possible for the other stages.

6.1.4 Consumers

Figure 6-4 shows developments in the amount of food waste (in tons) from households from 2010 to 2015.

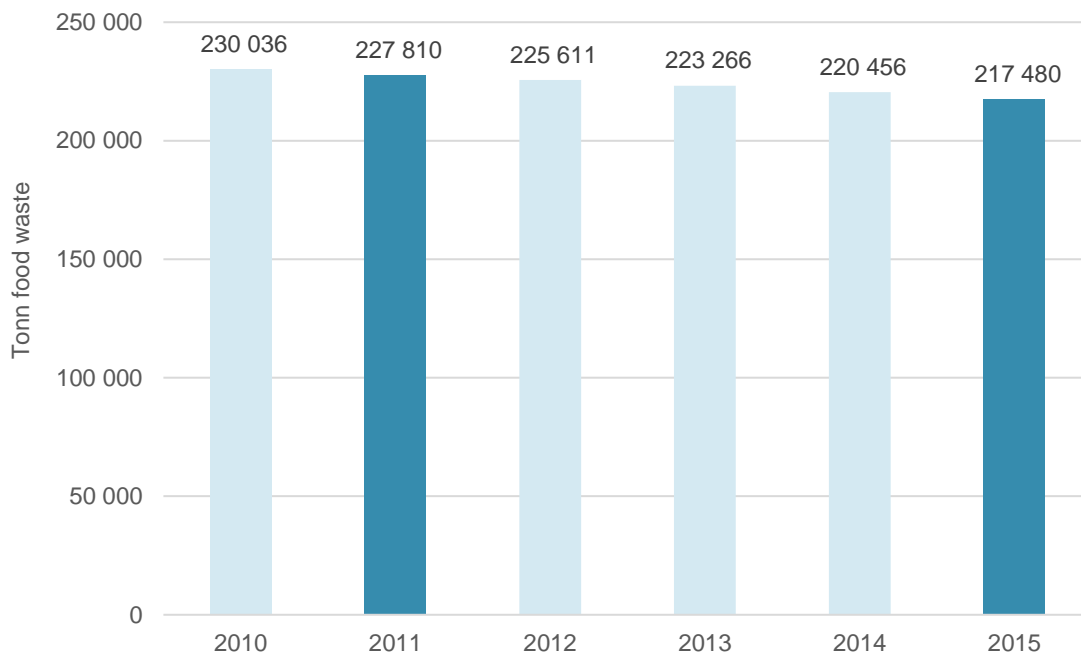


Figure 6-4 Tons of food waste from households from 2010 to 2015 (dark blue columns are recorded data and light blue columns are extrapolated values).

As mentioned in the methodology section, calculations of food waste from households (Section 3.5) were based on two waste sample analyses conducted in 2011 and 2015, while the amount of food waste for the other years has been calculated by extrapolating the values from 2011 and 2015 using the trend line function in Excel. The two analysis years are in dark blue and the amount of waste is indicated at the top of each column.

The figure shows that food waste from households was reduced by 12 500 tons from 2010 to 2015, which corresponds to a 5% decrease.

6.1.5 Total amounts of edible food waste in the value chain

Figure 6-5 and Table 6-1 show developments in amounts of edible food waste (in tons) in the different stages of the value chain from 2010 to 2015.

Table 6-1 Tons of edible food waste by stage in the value chain from 2010 to 2015 (grey boxes are extrapolated values).

Tons of edible food waste						
Year	2010	2011	2012	2013	2014	2015
Industry	81 093	82 920	76 590	81 657	74 839	74 404
Wholesale	2 644	2 841	2 722	3 070	3 343	3 067
Retail	66 799	65 519	60 604	60 104	56 158	60 177
Households	230 036	227 810	225 611	223 266	220 456	217 480
TOTAL	380 573	379 091	365 527	368 097	354 796	355 128

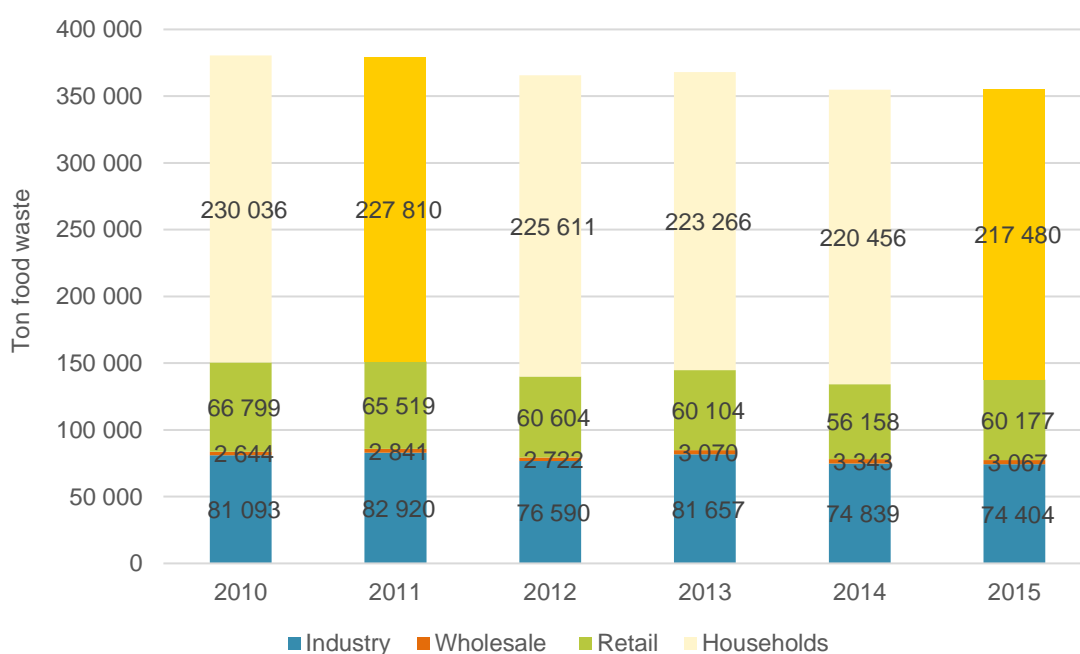


Figure 6-5 Tons of edible food waste in the different stages of the value chain from 2010 to 2015 (dark yellow columns are recorded data and light yellow columns are extrapolated values).

The chart and table show that edible food waste was reduced during the period from about 380 500 tons in 2010 to about 355 000 tons in 2015, which represents a decrease of 7 % or about 25 500 tons. The greatest amount of edible food waste in 2015 occurred in households, at about 217 500 tons (61%), followed by the industry with about 74 500 tons (21%), retailers with roughly 60 000 tons (17%) and finally wholesalers with around 3000 tons (1%).

The 355 000 tons of edible food waste comprises a large part of the food discarded annually in Norway, but there is further wastage in the primary stage and in the horeca sector. How much food is wasted in these sectors is currently unknown. Edible food waste from the fishing industry and food waste disposed of via drains have also not been quantified (see Section 3.5). These factors mean that edible food waste from industry and households is somewhat underestimated.

Figure 6-6 and Table 6-2 show developments in amounts of edible food waste in kg per capita in the different stages of the value chain from 2010 to 2015.

Table 6-2 Kg of food waste per capita by stage in the value chain from 2010 to 2015 (grey boxes are extrapolated values).

Kg of edible food waste per capita						
Year	2010	2011	2012	2013	2014	2015
Industry	16.69	16.85	15.36	16.17	14.65	14.40
Wholesale	0.54	0.58	0.55	0.61	0.65	0.59
Retailers	13.75	13.32	12.16	11.90	10.99	11.65
Households	47.35	46.30	45.25	44.2	43.15	42.1
TOTAL	78.34	77.05	73.31	72.87	69.44	68.75

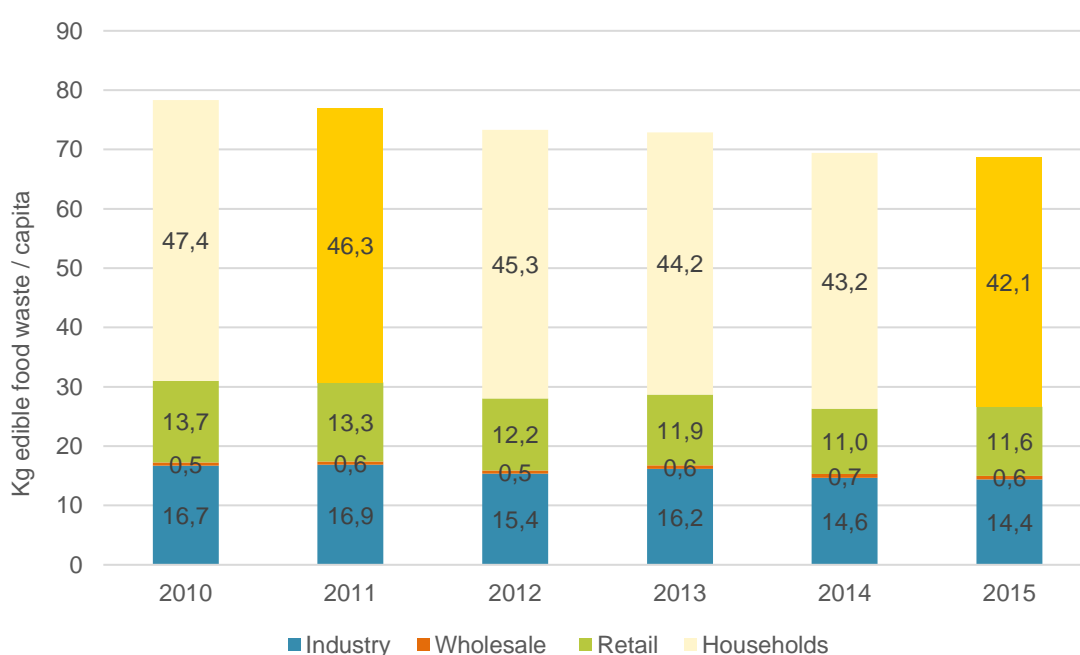


Figure 6-6 Kg of edible food waste per capita in the different stages of the value chain from 2010 to 2015 (dark yellow columns are recorded data and light yellow columns are extrapolated values).

The chart and table show that the amount of edible food waste per capita for the entire value chain was reduced from 78.5 kg in 2010 to 68.7 kg in 2015, which represents a 12% decrease.

The total amount of edible food waste shows a reduction of about 7 % from 2010 to 2015 (Figure 6-5 and Table 6-1), while edible food waste per person has declined by 12 % (Figure 6-6 and Table 6-2). The difference between the two percentages illustrates the importance of using key figures showing the amount of edible food waste related to the number of inhabitants or sales/production volume. Measuring relative trends (waste per capita or sales in NOK/volume in tons) will reveal the efficiency of the value chain, which is an important complement to the calculations of total amounts.

6.2 Financial loss related to edible food waste

Financial losses related to edible food waste have been calculated for all stages of the value chain every year in the period under study, and all values have been converted to 2015 NOK values to ensure comparability over the period.

Figure 6-7 and Table 6-3 show financial losses related to edible food waste by stage in the value chain from 2010 to 2015.

Table 6-3 Financial losses related to edible food waste by stage in the value chain from 2010 to 2015 (grey boxes are extrapolated values).

Billion NOK per Year (2015 NOK Values)						
Year	2010	2011	2012	2013	2014	2015
Industry	4.38	3.84	3.76	4.28	4.01	4.13
Wholesale	0.15	0.16	0.16	0.18	0.20	0.17
Retail	3.07	2.91	2.91	3.09	3.09	3.21
Households	12.67	12.45	12.87	13.01	13.00	13.06
TOTAL	20.28	19.36	19.70	20.55	20.29	20.58

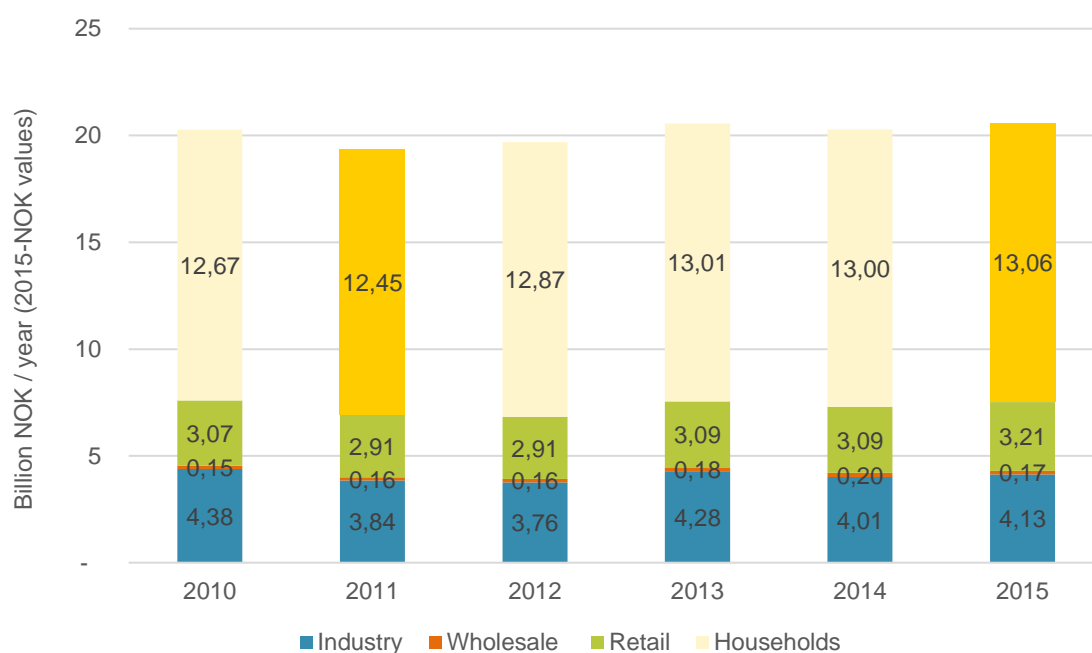


Figure 6-7 Financial losses related to edible food waste in 2015 NOK values in the different stages of the value chain from 2010 to 2015 (dark yellow columns are recorded data and light yellow columns are extrapolated values).

The chart and table show that financial loss associated with edible food waste increased from NOK 20.28 billion in 2010 to NOK 20.58 billion in 2015, which is an increase of NOK 0.3 billion or 1.5%. In spite of a reduction in the amount of waste during the period, the financial loss involved has increased. This is mainly because waste increased for relatively expensive products (berries, meat, fish and fresh food), while it decreased for relatively inexpensive products (bread and vegetables), which is particularly evident at the consumer stage.

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The greatest loss in value occurred at the consumer stage, equal to about NOK 2500 per person per year for an average resident of Norway. This corresponds to roughly NOK 5800 per year for an average household of 2.3 people.

6.3 Greenhouse gas emissions related to edible food waste

Greenhouse gas emissions related to edible food waste have been calculated for all stages of the value chain and for each year of the period under study.

Figure 6-8 and Table 6-4 show environmental impacts in the form of greenhouse gas emissions (tons of CO₂ equivalents) related to edible food waste in the different stages of the value chain from 2010 to 2015.

Table 6-4 Greenhouse gas emissions (tons of CO₂ equivalents) related to edible food waste in the different stages of the value chain from 2010 to 2015 (grey boxes are extrapolated values).

Tons of CO ₂ equivalents per year						
Year	2010	2011	2012	2013	2014	2015
Industry	305 042	276 972	263 350	274 707	256 631	248 267
Wholesale	4 962	5 051	4 925	7 159	6 910	4 610
Retail	152 431	157 249	150 918	159 151	160 766	156 183
Households	541 050	529 605	553 381	580 219	585 574	569 154
TOTAL	1 003 485	968 878	972 573	1 021 236	1 009 881	978 213

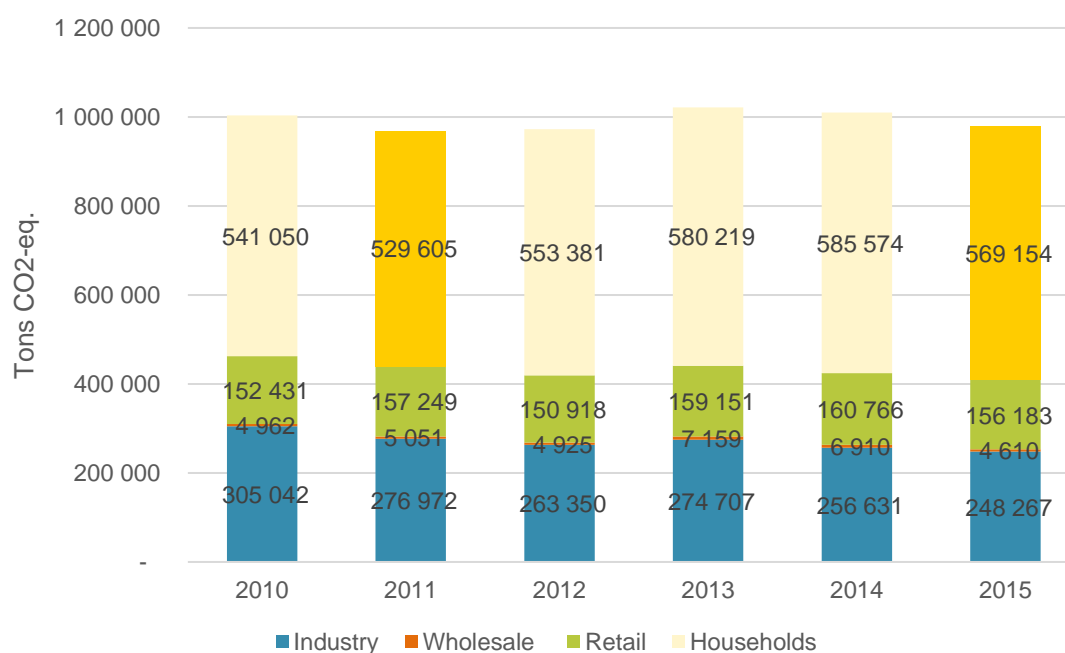


Figure 6-8 Greenhouse gas emissions (tons of CO₂ equivalents) related to edible food waste in the different stages of the value chain from 2010 to 2015 (dark yellow columns are recorded data and light yellow columns are extrapolated values).

The chart and table show that greenhouse gas emissions related to edible food waste in Norway declined from about 1 003 000 tons of CO₂ equivalents in 2010 to 978 000 tons of CO₂ equivalents in 2015, which corresponds to a reduction of about 25 000 tons of CO₂ equivalents or 3 %.

The environmental impact of edible food waste thus remained relatively stable throughout the period, and did not decrease as much as the amount of edible food waste measured in tons. This is

because edible food waste increased for products with a high impact and declined for more eco-friendly products. We see for example that emissions related to edible food waste at the consumer stage increased by about 28 000 tons of CO₂ equivalents from 2011 to 2015, while edible food waste decreased by about 10 000 tons in the same period (see Section 6.1.4). This can be explained by the fact that edible food waste increased for meat-based products like leftovers, but decreased for bread products (see Section 4.4).

7 Discussion

7.1 Discussion of Results and Trends

7.1.1 The Annual Food Industry Survey

The ForMat Project has studied edible food waste from the various stages in the value chain over a six year period from 2010 to 2015, in order to follow trends in edible food waste in Norway and evaluate the impact of the measures implemented against the objective of a 25% reduction.

The food industry survey provides valuable information on the proportion of edible food waste at each stage of the value chain, right down to the level of product group and category, and developments over time.

The results of the annual surveys show that edible food waste as a proportion of production and sales decreased at both the production and wholesale stages in 2010-2015, but increased at the retail stage from 2013 to 2015, which is the period for which data is available from all three major retail chains. Edible food waste as a proportion of production or sales and changes in amounts of edible food waste varied significantly between product categories and between the stages in the value chain. Categories such as fresh fruit and vegetables, fresh baked goods and liquid dairy products generally had a high percentage of waste in most parts of the value chain, while other categories had relatively little waste and contribute less to reducing the amount of waste measured in tons. If the product value is high or if the category leads to high greenhouse gas emissions per kg, it can be of great importance to implement waste reduction measures.

In the surveys, edible food waste is expressed as a percentage of production or sales, and products with low sales often have a very high percentage of waste. Since sales are low, such product categories provide relatively low amounts of edible food waste, measured in tons, despite their high proportion of waste. On the other hand, categories with medium-high or high sales, but with a lower percentage of waste in terms of sales or production, may comprise a relatively large proportion of the total amount of edible food waste in a company. It is also important to focus on categories with a high price or a relatively high environmental impact per kg, in order to reduce the economic and environmental effects of edible food waste.

Work on further development of the food industry survey should be considered in light of experiences from the surveys conducted by the ForMat Project (Stensgård & Hanssen 2015; Stensgård & Hanssen 2014). These surveys showed that many companies had made efforts to identify their waste internally and were keen to reduce it. It would therefore be beneficial to increase the number of companies that provide annual data on waste. If simpler web-based solutions for recording waste are developed, the number of companies supplying data could be substantially higher. It is especially important to include more fish processing companies in future surveys.

7.1.2 Consumer Studies and Waste Sample Analyses

Waste sample analysis is a methodology that provides relatively accurate data and knowledge of quantities and composition of waste from households, and is a necessary basis for recording local and national waste. Another method that can be used to keep track of amounts and composition of

edible food waste is to keep a log of what is discarded, where households themselves record how much and what they throw away. Compared with a waste sample analysis, a food waste log will avoid weight loss through evaporation, etc., it will include waste disposed of in drains and it will be easier to identify different foods. On the other hand, the use of a food waste log entails the risk that households will change their normal discard habits, since the log will increase their awareness of food waste, and their real habits will thus not be captured. The biggest drawback of both waste sample analyses and logs is that they are costly to implement and therefore must often be limited to a small number of households, making the survey potentially less representative than desirable. By following guidelines and descriptions of methods for selecting representative areas in each local authority, good data may be obtained if a number of local authorities are considered together.

Mepex, the company which organised and implemented the two waste sample analyses in 2011 and 2015, made sure that both years involved the same people, the same methodology, the same residential areas and thus as similar a basis for upscaling as possible. There is therefore a good basis for comparison between the two analyses and it is safe to assume that developments in the composition and amounts of edible food waste in the two areas presented in Section 4.4 represent real changes. Upscaling to national data for food refuse is based on a large number (about 50) of waste sample analyses conducted in Norway in 2011 and 2015; these are thus more representative than other food waste data. They are also based on the latest updated figures from Statistics Norway, which are based on nationwide local government statistics (Kostra). The waste sample analysis methodology developed and used in the ForMat Project has formed the basis for the guidelines for organic waste sample analysis drawn up by the waste management organisation Avfall Norge. There is a need for waste sample analyses by many more local authorities, using the guidelines, which not only record total amounts of edible food waste but also analyse the waste in detail by product group.

As mentioned in the methodology section (3.4.2), the results of the consumer studies must be seen in light of the fact that they are based on respondents' own statements about food discard, behaviour and attitudes, which may not always coincide with what or how much the consumers actually throw away. Despite differences in methodology and data basis, it is interesting that there are many similarities between the results from the consumer surveys and those from the waste sample analyses.

Consumers reported most often discarding food from the following categories: fridge, pan and plate leftovers, milk and cream, fresh fruit, fresh baked goods and fresh vegetables. The 2015 waste sample analysis shows that consumers mostly throw away pan and plate leftovers, fruit and vegetables and bread. The categories reported by consumers in the surveys therefore correspond relatively well with the waste sampling results, except that consumers mention discarding dairy products (milk and cream) quite often, while the waste sample analysis shows that dairy products make up a relatively small percentage of edible food waste from households (6.4%). This can be explained by the fact that waste sample analyses only capture food disposed of through waste containers in the home, and therefore show a low figure for dairy products, as milk and cream is probably mainly discarded via drains.

There are also some similarities in changes in consumer food waste habits and waste sample results between 2011 and 2015. The results of the consumer surveys show a reduction in the proportion discarded for all categories except for fresh vegetables; this corresponds with the waste sample analyses which show a reduction in edible food waste for most categories and overall.

However, the trend over time does not show such good correspondence for some individual categories; waste sampling showed an increase in pan and plate leftovers and a significant reduction in bread, while consumers reported a strong reduction in pan leftovers and a moderate reduction in fresh baked goods. The waste sample analyses conducted in 2011 revealed that the proportion of households that had thrown away fresh bread or baked goods was over 80%, which is significantly higher than the proportion who reported having discarded bread in the past week in the consumer survey, which was about 20% (Hanssen et al. 2016).

The fact that the results from the two methods still show a fair degree of correlation indicates that consumer studies may be an effective supplement to waste sample analyses since they are far less expensive to implement as annual surveys, and because they can be linked to personal data such as age, gender, education, place of residence, income, family situation, etc., which is considerably more difficult in waste sample analysis. Consumer surveys can also better capture edible food waste via drains (e.g. liquid dairy products). It is therefore recommended that both types of analysis are also included in future systematic mapping of edible food waste and associated behaviour.

7.1.3 Key national edible food waste figures

The key national figures for edible food waste show a reduction of 12% in kg per capita and 7% in tons. This is a very positive development and suggests that prevention efforts have borne fruit both in the food industry and among consumers. It is particularly important that the trend of increased food refuse, and thus greater waste from households, has reversed since 2010, after having risen steadily since 1995.

The largest proportion (about two-thirds) of edible food waste is generated in households (see Figure 7-1), while the food industry accounts for approximately one-third.

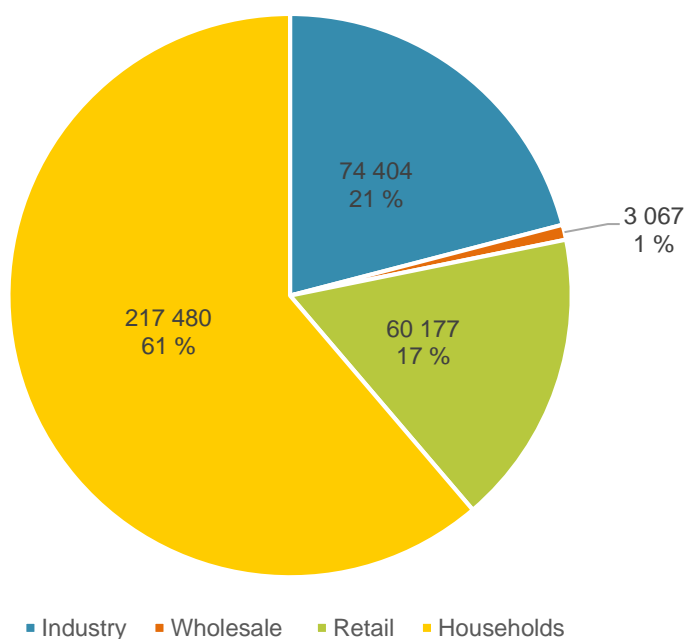


Figure 7-1 Amounts (in tons) and percentages of edible food waste in Norway in 2015, by stage in the value chain.

Based on Statistics Norway's food consumption statistics, edible food waste in households makes up 12 % of consumption. This means that about every eighth bag of groceries bought in Norway in 2015 ended up in the dustbin instead of being eaten⁴. Overall, for the entire food chain, about 20 % of food consumed, or every fifth bag of groceries, ends up in the dustbin. An average household throws away food worth NOK 5 800 every year; this is a considerable amount of money, which has not decreased during the period to the same extent as the amount of edible food waste.

Norwegians discard less food overall, but relatively more of expensive food (e.g. leftovers from meals) and food with a high environmental impact, and this is especially true of the consumer stage where both financial loss and the environmental impact related to edible food waste have increased during the period. Much of this food waste could have been avoided through simple measures which cost nothing, such as better planning of shopping, proper storage of food and better use of leftovers.

The consumer studies show that people have become more aware of edible food waste as a problem; furthermore, the environmental impact of various foods has had increased media coverage over the past two years. It is therefore puzzling that edible food waste has increased for more expensive and more environmentally harmful products. This suggests a need for even greater awareness of the costs and environmental impacts of food waste. In addition, very many people need more basic knowledge about cooking and handling of food, especially the younger generation.

The ForMat Project has succeeded in raising awareness about how much and what kinds of food people waste and which parts of the value chain waste the most. The national figures for financial loss and environmental impact may make consumers, the food industry and the government realise that prevention efforts work, but we must also focus on the types of food that cost society the most.

⁴ Previous estimates of the number of bags of groceries discarded have now been revised, and new figures showing that every eighth bag is discarded are based on more accurate calculations.

7.2 Data and Calculation Methods

7.2.1 Data

The data collected by the ForMat Project is a unique compilation of edible food waste statistics that provides valuable information on the composition of edible food waste, amounts of edible food waste, where in the value chain most food is discarded and what kinds of food, trends in amounts and composition, as well as the causes of food waste in the various stages of the value chain.

To ensure optimal quality of data and analysis, the project developed a system to provide feedback to the participating companies of their results. This raised the companies' awareness of their data, and through dialogue with the researchers, misunderstandings and reporting errors were identified and corrected. Several retail chains and producers have also indicated that procedures for recording waste in stores and factories have improved considerably during the reporting period. This is a general experience from the project, especially for the last three years which have seen a marked increase in the commitment of the ForMat companies, while data quality has gradually improved year by year.

Improvement in the data over time could imply that the results of recent years are not directly comparable with those of earlier years. For this final report, therefore, a great effort has been made to correct data for the entire period studied. This has involved quality assurance of the data for the first years, resulting in correction and improvement of certain data. The time factor and changes in the responsibility for reporting in some companies have made it difficult to check all the data from the first few years, and a somewhat uncertain data basis from the first years must therefore unfortunately be accepted.

There will therefore be some discrepancies in the results between this final report and previous reports as a consequence of this quality improvement, in terms of waste percentages for different product groups and stages in the value chain. This also applies to estimates of the total amount of edible food waste from the different stages in the value chain, compared with the 2011 report (Hanssen & Schakenda 2011). This report therefore gives a more accurate picture of trends in edible food waste throughout the period, which implies that data and results from previous reports should no longer be used as a basis for food waste statistics.

The food industry's understanding and practice regarding the concept of edible food waste has also changed. The first years were used to determine and communicate the difference between food refuse and edible food waste. The definition of edible food waste has now been established as a result of the letter of intent between the food industry and the government, and is similar to the definition in the ForMat-Project for all the stages included in the reporting.

The ForMat Project has therefore been an important learning process for all involved, and although edible food waste statistics are the main result of the project, the methodology and reporting system developed and adapted during the project are two further important outcomes. An additional result is the knowledge of edible food waste and how to record it which the companies involved have acquired and developed during the project.

Experience from the project has also been used as a basis for the development of a common European methodology for surveying food waste and food refuse in the EU, through the link to the FUSIONS Project. Ostfold Research has played a key role in developing the methodological basis for mapping of food waste in Europe, and has coordinated the work of writing three methodology reports for the FUSIONS Project (Hanssen et al. 2013, Mills et al. 2014, 2015). Ostfold Research has also been involved in the preparation of a manual for the development of national statistics through surveys of food waste in FUSIONS. This work would not have been possible without the extensive experience acquired during the ForMat Project.

7.2.2 Calculation Methods

Although the data underlying the calculation of key national edible food waste figures are of good quality, there are still uncertainties associated with the methodology and assumptions made in the calculation of the figures, yet there is less uncertainty than in many other similar surveys in other countries:

1. The key figures used as conversion factors are net prices obtained in 2009 from retailers in terms of NOK per kg of the product. These are used to calculate tons of waste in the retail and wholesale stages and to calculate financial loss in the industry and consumer stages. There are uncertainties associated with these key figures as net prices were not collected annually, but adjusted each year according to the consumer price index (CPI). The key figures also involve sources of error, since price increases are greater at later stages of the value chain, resulting in an overestimation of the financial loss at the production stage and an underestimation at the consumer stage.
2. In order to correct for gaps in production statistics (see Section 3.5), and ensure the quality of the tonnage figures, production statistics in tons have been combined with production statistics in thousands of NOK (production statistics in economic terms are of better quality). The correction was performed by calculating the annual figures for each product group (NOK per kg produced), and where there are gaps in the tonnage figures, the figure for the previous or following year was CPI adjusted. The key figures were also used to correct any sources of error in tonnage reporting, where extreme variations in NOK per kg produced have been eliminated. This method means that upscaling of the figures for the industry has a somewhat uncertain basis, being partly based on calculated values.
3. As mentioned in Section 3.1, thirteen food producers reported data to the ForMat Project, which covers about 25% of sales of the Norwegian food industry. Although the sample of companies covers many different product groups and a large market share, there is such great variation among the Norwegian food producers that it is difficult to state categorically that the sample is representative of the entire industry. However, it has been necessary to assume that the sample of companies in the ForMat Project is representative, which makes the calculation of tons of waste by the industry somewhat uncertain.
4. Since edible food waste at the retail stage is recorded by scanning products, this stage has provided the greatest level of detail in the data. Since such detail is not found in the other stages, the products studied for edible food waste by retailers were used as a basis for calculating financial loss and greenhouse gas emissions associated with edible food waste in

the other stages of the value chain. This has been necessary as the key figures for both financial loss and emission factors are product-based, while the waste data for these stages is by product group. This approach means that there is some uncertainty associated with the results for financial loss and greenhouse gas emissions for the consumer, wholesaler and industry.

Despite some uncertainty, however, the results in the present ForMat report represent the best estimate available of how much edible food waste there is in Norway, as well as the associated financial losses and greenhouse gas emissions.

7.3 Key food waste figures - International comparisons

Experience shows that it is often difficult to make comparisons between waste statistics in different countries, because of wide variations in definitions, classification of different types of waste and the methodological basis for collecting waste data (Hanssen et al. 2013). Especially for the production sector, the type of food production in the country is an important factor, as is the proportion of production that is export-oriented. Norway, for example, has a fishing industry that exports a large part of its production, while Denmark produces and exports pork and the Netherlands exports cheese. Total amounts of food waste and food waste per capita are therefore affected by both import and export figures. However, it is still interesting to see the figures for edible food waste in Norway compared with similar figures from other countries, where at least the figures for retailers, wholesalers and households are comparable in terms of kg per capita.

Table 7-1 compares the Norwegian edible food waste figures with the corresponding figures for some EU countries. As it can be seen, Norway, at 68.7 kg per capita, has much less edible food waste than Denmark and the UK, but trails Finland (56 kg) and Sweden (53 kg). Norway has a relatively high amount of food waste from households, even with the decrease since 2011, but is still below Denmark and the very high figures in the UK. Norway, Sweden and Finland all have low figures for the industry and retailers, but it should be borne in mind that the fisheries sector is not included in the Norwegian data. How much edible food waste actually occurs in this sector is unclear, however, as data for fish landings show very low waste percentages (Hanssen 2016, in prep.) and much fish is exported directly as dressed or perhaps filleted fish, probably with very low waste in Norway. The waste most likely occurs in the importing country when the fish is processed for sale, packed and distributed.

Table 7-1 Overview of food waste in the stages of the value chain in the Nordic countries and the UK.

Stage in the value chain	Norway ⁵	Sweden ⁶	Finland ⁷	Denmark ⁸	UK ⁹
Industry	14.4 kg	18 kg*	20 kg	23.8 kg	61.8 kg***
Wholesale	0.6 kg	-			
Retail	11.6 kg	7 kg**	13 kg**	29.1 kg**	
Households	42.1 kg	28 kg	23 kg	46.6 kg	69.0 kg
Total	68.7 kg	53 kg	56 kg	99.5 kg	129.8 kg

In order to compare the amount of edible food waste in the different countries, it is important to make common and comparable studies based on the same definition of edible food waste, the same methodology for data collection and analysis and the same demarcation between the stages of the value chain. Key figures should be compared as total numbers, per ton of produced goods or per million NOK in sales, and in kg per capita. Only then will it be possible to gain an idea of the effectiveness of the food sector and consumers in each country with regard to edible food waste and how different attitudes, consumption, food culture and practices affect food waste. More

⁵ This report

⁶ The Swedish Environmental Protection Agency (Statens Naturvårdsverk) 2014

⁷ Katajajuuri et al. 2014

⁸ Based on data from the Danish Agriculture and Food Council (Landbrug & Fødevarer) (2015) and population data from Statistics Denmark (www.statistikbanken.dk/FOLK1A).

⁹ Based on WRAP (Waste and Resources Action Programme) (2014) and UK population data (<http://worldpopulationreview.com/countries/united-kingdom-population/#united-kingdom-population-history>).

systematic research is therefore needed to provide good comparable results that indicate real differences in edible food waste between countries, the causes of different degrees of edible food waste and differences that may be due to different methodology and definitions of edible food waste.

7.4 The way forward

The ForMat Project has yielded several benefits in addition to the survey, and the main results of the project can be summarised in five points:

- A common methodology for measuring edible food waste
- Networks between actors in the value chain
- Centres of expertise with a strategic focus on edible food waste
- New measures to prevent and reduce edible food waste
- Increased awareness in society about edible food waste as a problem

The ForMat Project has not only identified and measured changes in edible food waste, but has also made a significant contribution to putting food waste on the agenda in Norway. The project has also helped to develop a sound methodological basis for identifying edible food waste and enhanced knowledge of the causes of edible food waste, both in Norway and in the European context.

Although the ForMat-statistics are comprehensive and of good quality, there are still some gaps and limitations in the underlying data that should be borne in mind:

- Regarding the industry and households, liquid edible food waste disposed of via drains has not been included (except for a small number of companies).
- With regard to industry, waste data for fresh fish are of varying quality, and not representative of the entire fish processing industry. There is also a lack of data for breweries and mineral water producers and milling and grain/flour production.
- Data on edible food waste in offices, public buildings such as hospitals and schools and the horeca sector have not been quantified sufficiently to create upscaled values. A pilot project is underway in collaboration with the Norwegian Hospitality Association, Matvett and Ostfold Research to create a methodological basis, data and analyses for selected pilot cases.
- Data from the primary sector is almost entirely lacking, both from the seafood sector (fisheries and aquaculture) and the agricultural sector (grain, fruit, vegetables, potatoes, meat, milk and eggs). Data sources for the primary stage have been reviewed and described as part of a Nordic project on edible food waste in the primary sector (Franke et al. 2013, 2016) and in a report to the Norwegian Environment Agency in connection with the letter of intent for edible food waste in Norway (Hanssen 2016, in prep.). There is a need for research on data collection methodology in light of the definition stated in the letter of intent, and also on the basis for statistical analysis, due to the presumed large variations between activities in the food sector in terms of geography and product lines and over time. There is further a need for more systematic analysis of the causes of edible food waste and loss of resources in different types of food production, and preventative measures that can reduce edible food waste.

In other words, there is still development work to be done on the mapping of edible food waste in Norway. In some sectors, we know very little about the amounts and composition of edible food waste and much work is needed to quantify 100% of edible food waste in Norway. The ongoing work on the establishment of a hopefully permanent sector agreement on edible food waste prevention suggests willingness on the part of both the government and the industry to identify and reduce edible food waste in all sectors and parts of the value chain.

Although the ForMat statistics are incomplete, no other country has a similar overview of its edible food waste, collected through annual statistics. The main reason for this is that Norwegian companies have shown openness and willingness to share data with researchers, in addition to good cooperation between actors in the various stages of the value chain. This openness and trust was not a matter of course, but the result of many years of work. The ForMat project has resulted in a considerable improvement in data, methodology and especially awareness and focus on edible food waste as a problem.

In light of the ongoing work on the letter of intent for the prevention of edible food waste, both the government and the food sector appear to be willing to identify and reduce edible food waste in all parts of the value chain.

In order to succeed in reducing edible food waste throughout the value chain, extensive cooperation between industry players and the Norwegian government is needed. One of the success factors of the ForMat Project has been precisely the development of such cooperation, and it is vital for future success that this cooperation continues and is enhanced through participation by more industry players.

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