

Report

SUSTAINABLE INNOVATION

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Mapping method for food loss in the food processing industry

Summary report

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Summary

In the network "Mapping method for food loss in the food processing industry" the goal was to develop a method for mapping of food loss, with joint definitions and demarcations.

The term 'food loss' was used instead of 'food waste', since 'waste' has unfortunate connotations when used in connection with food. 'Food loss' was defined as "Food that is not suitable for sale at the full price, but is required instead to be sent to various kinds of waste management".

There are many reasons for food loss in the manufacture and processing of food. The 'use by' date allocated to the manufacturer may have been exceeded; the product may have been damaged in the warehouse; it may have been wrongly packaged or labelled; there may have been errors in the production process or the product may not meet the required standard.

In order to be able to register the resources that are not being utilised in a process, it may be useful to classify food loss into 2 categories: edible food loss and potentially edible food loss.

- Edible food loss can be defined as process waste or products where the intention has been to manufacture an article of food, but where the product ends up as food loss. There could be several reasons for this. The sell- by date may have been exceeded for full price sale, but the use by date may still be valid. There could also be errors in the packaging or labelling of products or damage to the product in the storehouse.
- Potentially edible food loss refers to ingredients or products that are unsuitable for full price sale because of production errors, or where the product is not within the specified quality range. An example of this would be a product produced during line change-over.

In addition to this there is a third category: Non-edible food loss. This category comprises ingredients or products which are not suitable for consumption according to today's food standards. Examples of this would be peel, skin and bones. Ingredients or products within this category are not to be registered as food loss.

Work within the network has succeeded in developing a mapping method for food loss in the food processing industry, which can be used across product groups with set definitions, system boundaries and terminology. The method is in accordance with mapping in different areas of a value chain, and can be used as a guide. The network has contributed to a collective perception of mapping for food loss and has led to comprehensive mapping and other measures within the participant businesses. These participants recommend that the methodology developed for mapping of food loss should be used by other food manufacturers.

1 Introduction

The goal and scope of the network project "Mapping method of food waste and food losses in food processing" has been to develop a collective method for all food manufacturers, with joint definitions and demarcations. The background for this project is that there are differing methods and definitions used for mapping food waste and food losses within the production process. The different practices used, make it difficult to estimate the amount of food loss generated by food manufacturers, and to develop strategies and methods to prevent food loss. A joint method could be used by manufacturers to raise awareness of the problem and to find satisfactory solutions. The network project is financed by Innovation Norway and by a participant fee.

The results from this project will increase the quality of data with regard to the amount of food loss generated. They will also provide a better foundation for thinking within the individual company in relation to food loss, and a common methodology in order to achieve this end.

The network project has connections with the ForMat¹ project. This latter is a four year business project where the participants all along the value chain collaborate in the mapping and limiting of usable food loss in Norway.

1.1 Goal and scope

This mapping method will give an overview of the amount of food loss generated in the production phase and this will be used as a foundation to:

- compare the production phase with the other phases in the value chain for every product group
- document the development over time and internal documentation within each company generate ideas which will reduce the amount of food loss.

This will be achieved by:

- developing a method for mapping of food loss across sectors/ product groups
- defining terms and demarcations
- determining what should be included in the mapping
- describing how mapping could be carried out within companies
- developing key data which will visualise the results

Goal and scope:

To map the total amount of food loss generated in food manufacturing processes and form a better platform for utilising the recourses.

¹ ForMat is collaboration between the business sector, Ostfold Research and Nofima. The project receives financial support from the Ministry of Agriculture and Food and the Ministry of Environment. ForMat aims to reduce the amount of usable food waste in Norway by 25 %.

2 Definitions and demarcation

The term 'food loss' is used here instead of food waste; this is because the word 'waste' has negative connotations in relation to food.

Food loss may be generated in food manufacture and processing for the following reasons:

- The products have exceeded the best before² date/ sell by date³, which manufacturers are obliged to adhere to in accordance with STAND 001
- The products can be damaged in storage
- Errors in packaging or labelling, or other technical errors which can arise in the production process
- Errors in the production process
- The products do not meet the specific level of quality set for the product category

Food loss is food that is not suitable for sale at the full price, but is required instead to be sent to various kinds of waste management

Food loss is here defined as "food that is not suitable for full price sale, and that must therefore be sent to various types of waste management"

The handling of food loss can be carried out in different ways, shown here in order of environmental preference. It may be:

- sold at a reduced price
- donated or used as an ingredient or co- product
- used as animal feed or as a component in animal feed
- used in the production of biogas
- incinerated (with energy utilisation) or composted

It should be noted that the preferred order may vary with different kinds of production and types of raw ingredient. When deciding whether incineration or composting are the best options one must look at the composition of the food loss. If it is high in dry matter, incineration might be the best option, whereas if there is a high water content, composting might be best.

In order to register resources which are not being utilised in a process, it can be useful to divide the food loss into 2 categories: edible food loss and potentially edible food loss.

Potentially edible food loss are ingredients or products that are not suitable for full price sale, due to errors in production, or that the product does not meet the quality specifications.

² Best before date: Food products labelled with best before date are usually safe to consume after the given date has passed, but there might be deterioration in flavour, texture, appearance or nutrition. These dates are only advisory and in reference to quality, not food safety.

³ Sell by date: Food products labelled with a sell by date should not be eaten after the given date. These are often products with a short shelf life.

Edible food loss: Process waste or other products where the intention has been to produce an item of food, but where the product for various different reasons has become food loss. This could be, for example, that the allocated time limit supplied to the manufacturer/ retailer has been exceeded for full price sale, but the use by date is still valid. This group can also include products which have errors in packaging or labelling or which have been damaged in storage.

Potentially edible food loss: This category comprises ingredients or products that are not suitable for ordinary sale due to errors in production or the product's failure to meet the quality specifications. These could be, for example, products produced during line change-over, where there is a process change at the manufacturing stage. They could also be products from a test production, where the products are still edible, although the intention was not to sell them.

In some cases it can be difficult to define the food loss as edible or potentially edible. Two categories of food loss which can occur in this middle- bracket are products affected by errors in production or those that do not meet the norm. An example of this could be the wrong size of a sausage; this would still be edible but not suited for full price sale and could then be classified as edible food loss.

Inedible food loss: This could refer to ingredients which are not suited for consumption in accordance with today's food standards. These could be, for example, peel, skin or bones, which would not to be registered as food loss.

Figure 2-1 outlines the different kinds of food loss previously described.

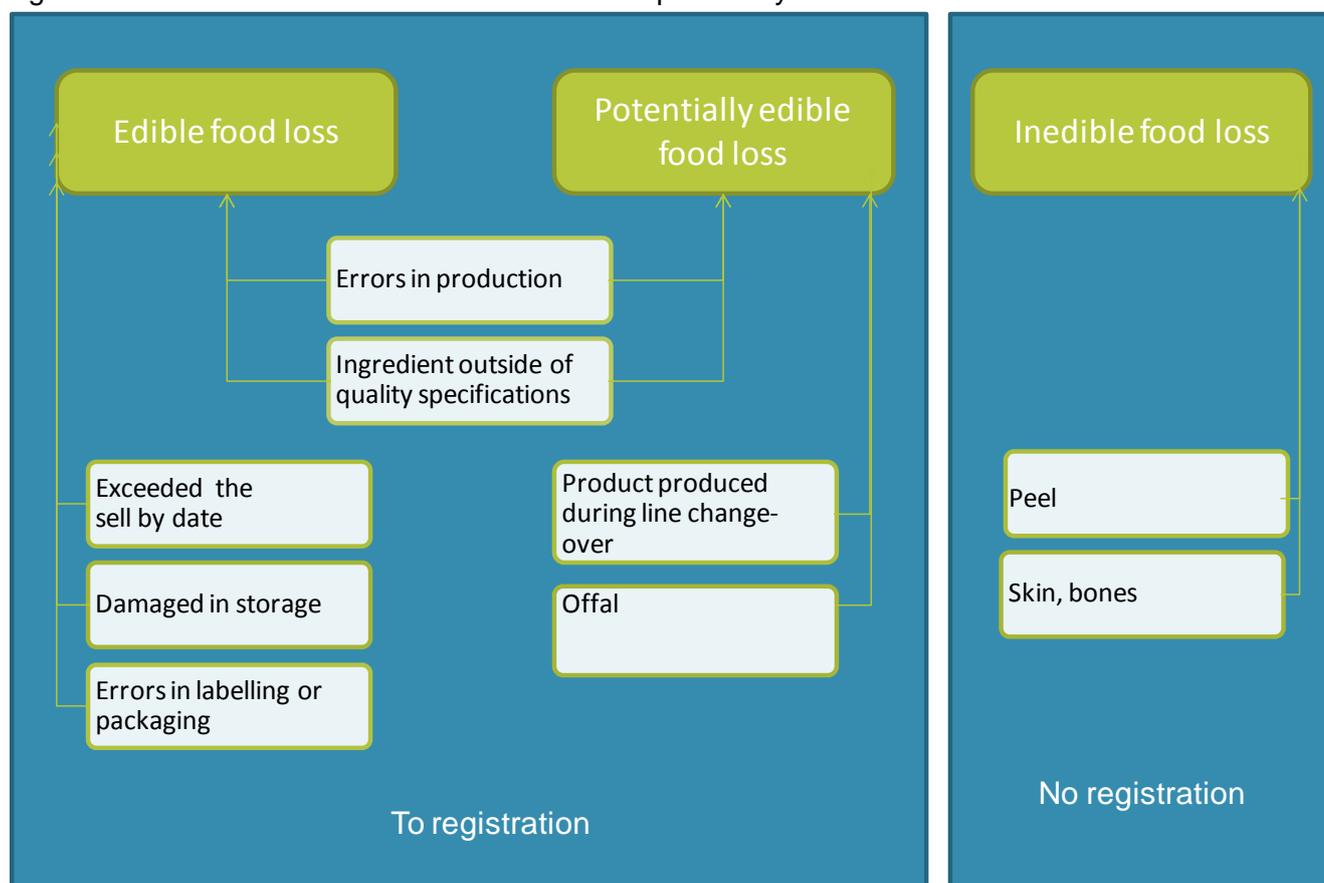


Figure 2-1 Categories of food loss and other kinds of waste

Written-down value; There can be several reasons for a product being sold at a reduced price or 'written down value'. One could be that the allocated time limit supplied to the manufacturer or retailer has been exceeded with regard to general sale. This would mean that it could no longer be sold in stores as an ordinary sales item at full price

Inclusion of water: Everything which goes in to the process as an ingredient, including any water which is added in accordance with a recipe, is to be included in the mapping of food loss. If, however, food loss is diluted with water as a part of the cleaning process, that water should not be included in the mapping. The amount of food loss generated should be adjusted either by measuring how much water is added, by calculation or by the application of empirical evidence.

The following processing phases are included in the mapping and analysis of food loss:

- Ingredient storage
- Processing
- Packaging
- Warehousing/ retailing
- Distribution if the producer is responsible for the transportation of products to the wholesaler or retailer.

These last four sections are especially important in gaining an overview. This would establish whether there is a need for the prioritising of resources both with regard to the collection of data and to calculations in relation to food loss. If the food loss is included as a component in the production of another food, it is to be registered in Table 3.6. Food which is donated to charities is to be registered in Table 3.7.

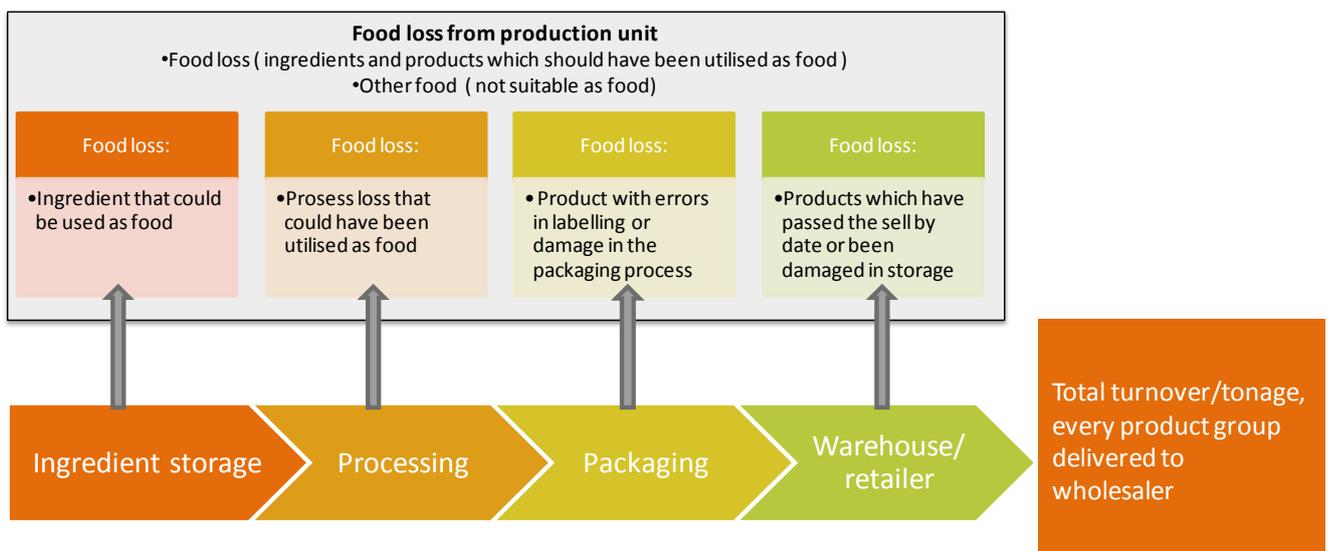


Figure 2-2 Food loss in the production process

3 Methodology for mapping of food loss

A questionnaire has been developed to map food loss in the manufacture and processing of food. The reporting of food losses from food manufacturers represents part of the total food loss in the value chain, and is used to show the amount of total food loss generated in Norway and Europe.

In this context it is desirable that the product groups used are in accordance with the product groups used for mapping of food loss in other parts of the value chain. It is therefore important that Table 3-1 is used as a starting point for product grouping. If relevant product groups are not included in Table 3-1, these should be added as new rows in the questionnaire.

Where specific data is being registered for several production units, each unit must be reported in its own questionnaire, which is then identified by noting the name of the unit on the form. The form may be copied and additional rows inserted if necessary.

Table 3-1 Main groups, product groups and products that are to be registered in the questionnaires (examples of categorisation)

No	Main groups	Product groups	Examples of products
1	Frozen food	1.1 Frozen food	Frozen ready-made meals, frozen fish, frozen fruits and vegetables, ice cream
2	Fresh fruits and vegetables	2.1 Fresh fruit	Apples, bananas, stone fruits, citrus fruits, grapes, melons, berries, pineapple, exotic fruits
		2.2 Fresh vegetables	Tomatoes, carrots, salad, root vegetables, fresh herbs, cucumber, paprika, mushrooms, exotic vegetables, avocado, onions
		2.3 Fresh potatoes	Potatoes
3	Fresh bakery goods	3.1 Fresh bread	Bread (industrial product, bakes at store or half-done), hamburger bun, sausage bun, wheat bun (industrial product, bakes at store or half-done), Danish pastry (industrial product, bakes at store or half-done),
4	Fresh convenience food and delicacies	4.1 Fresh convenience food	Industrial packed convenience food
		4.2 Sausage	Meat sausage
		4.3 Meat cold cuts and patty	Meat cold cuts, patty and cured meat
5	Fresh fish and shell fish	5.1 Fresh fish	Fish pudding, fish cakes, fresh fish
6	Fresh meat	6.1 Fresh meat	Fresh poultry, pork, beef and lamb
		6.2 Fresh minced meat	Fresh minced meat and sausage meat
7	Eggs	7.1 Fresh eggs	White eggs packed, brown eggs packed, ecological eggs, free range eggs
8	Dairy products	8.1 Milk products	Cream, milk, sour cream, yoghurt
		8.2 Cheese	White cheese, melted cheese, blue cheese
9	Dry goods	9.1 Long life bakery products	Long life bread, dried bread
		9.2 Bakery ingredient	Baking mix, flour, grain
		9.3 Dressing, spicy sauces and oils	Mayonnaise, oils, ketchup
		9.4 Biscuits	Biscuits (savoury, sweet, children')
		9.5 Sweet sandwich fillings and hermetic	Jam, hermetic patties and fish, sweet sandwich fillings
		9.6 Sauce and bullion	Dried soups, sauces and stock cubes/powders
		9.7 Snacks	Potato crisps, corn chips, cheese snacks, bacon snacks, popcorn

The questionnaire comprises 5 different tables:

- Table 3-2: Product groups and production volume
- Table 3-3: Method for calculation of food loss from a production unit
- Table 3-4:Registration of the amount of food loss
- Table 3-5:Waste codes- Registration of cause
- Table 3-6 and 3-7:Utilisation of food loss as a resource

The various different tables are described separately in the following sections.

3.1 Product groups and production volume

The total amount of food loss in a production process is, in itself, of interest, but it is also important to look at this amount when compared with the total production, measured in tons and/or turnover for each production group.

Table 3-2 shows the questionnaire for registration of the total production for each product group.

Table 3-2 Registration of production volume for the different product groups

Product groups	Production (measured in tons per year)	Production measured in turnover per year
Product group		
Product group.....		
Other product groups, total		
<i>Total amount</i>		

3.2 Method for calculation of food loss from a production unit

Table 3-3 is a registration of how the figures have been reached Are the data a result of measuring/ registration, theoretical calculations or estimated value/ expert assessment? If there are parts of the process that are not included in the mapping, they must be indicated by marking in the row titled “not included in the mapping”. Support and advice for implementing the mapping process can be found in appendix 1.

Table 3-3 Questionnaire for registration of the measuring method employed

Methodology for mapping (tick of for the used method)	Measuring/ registration	Calculations/ estimate	Not included in the mapping
Ingredient storage			
Processing			
Packaging			
Storage			
Distribution			

3.3 Registration of amount of food loss

The occurrence of food loss is to be registered in table 3-4. The amount of food loss should be divided into edible food loss and potentially edible food loss, as defined in chapter 2. It is important to note that the total amount of food loss is made up of both edible food loss and potentially edible food loss.

Table 3-4 Registration of amount of food loss

Product groups	Edible food loss (ton)	Potentially edible food loss (ton)	Total food loss (ton)
Product group			
Product group			
Product group			
Other product groups, total			
<i>Total amount</i>			

3.4 Registration of cause

Registrations of the causes of food loss are important. Knowledge of the cause creates a better foundation for the implementation of improvements and for the development of strategies for the prevention of food loss in the future. Table 3-5 shows the cause of the food loss which is to be registered:

- The sell-by date, the allocated time supplied to the manufacturer, has been exceeded
- Errors in packaging and labelling
- Errors in quality and production
- Breakage, damage at the warehousing stage
- Products which cannot be sold for reasons of bad stock rotation, exceeded sell -by date or overproduction.
- Single events leading to whole batches of food waste within a product group; for example a faulty cooling system in a truck or an accident in production.
- Other causes. Where food loss is a result of other factors, this must be noted under 'other causes'.

Table 3-5 Registration of the causes of food loss using general waste codes

Product groups	Waste code (ton food loss)							Total food loss (ton)
	Sell by date exceeded	Errors in packaging and labelling	Quality or production errors	Breakage, damage at the warehousing stage	Cannot be sold	Single events	Other causes	
Product group								
Product group								
Product group								
Other product groups, total								
<i>Total amount</i>								

Support and advice on how best to utilise the resources are found in appendix 2.

The existence of data produced as a result of the mapping of food loss creates the potential for the prevention of future food loss and thus, increased earnings. Individual businesses can establish a selection of key data. These can be used to track development through any particular year. Supporting information regarding key data can be found in appendix 3.

3.5 Utilisation of food loss as a resource

Edible food loss can often become a resource in another industry. It can also be donated to charity or sold to employees at a reduced price. To get an overview of how much food loss is utilised thus, see table 3-6 and table 3-7.

Table 3-6 Treatment of edible food loss as input in another type of industrial production

Product groups	Recipient and types of industrial production	Amount (ton product transmitted)	Value, in % of ordinary sales value
Product group ...			
Product group ...			
Product group ...			
Other product groups, total			
<i>Total amount</i>			

Table 3-7 Donation of food to voluntary organisations / employees or sale at reduced prices

Product groups	Recipient	Amount (ton product)	Value, in % of ordinary sales value.
Product group ...			
Product group ...			
Product group ...			
Other product groups, total			
<i>Total amount</i>			

4 Experience from the network

The network has achieved its goal of developing a mapping methodology that can be implemented across a broad range of sectors or product groups, with clear definitions, system boundaries and terminology. The method of mapping of food loss during food processing and manufacturer is in accordance with mapping in other phases of the value chain and may be used as a guideline. The network participants recommend the method for use by other food manufacturers.

The network has also made a contribution towards the establishment of a joint perception of the way in which food loss should be mapped. As a result some of the participant businesses have begun extensive mapping of food loss in their production.

The experiences drawn from this participation have varied for each participant. Each company has had a different approach during work on the project, and, when the project began, even the starting points differed. Some of the experiences are shown here as statements from the companies. Although the statements are not relevant for all, they give some indication of the input and experiences of those who were involved in the process.

- It is important to have a common guide for mapping of food loss in the food processing industry
- The discussions within the network have been meaningful and have contributed toward systematising the work done within the companies. Although the mapping method has not yet been used to map food loss, it has been useful in helping to create a system.
- The mapping method must have the ability to adapt to the needs of the user.
- The definition of food loss should, from an economic perspective, include both food loss and products sold at a reduced price (written down value) for reasons of poor quality or other errors.
- The division of food loss into edible food loss and potentially edible food loss may be applicable in some types of process. Potentially edible food loss shows a potential for the reduction of food loss occurring during line change-over, by using the right kind of equipment and technology.
- Key data may be used to illustrate the problem and as a motivator. It is important to record relevant information and not to use too many key data at the same time. Key data should be adapted to the context in which they are being used.

5 References

The Confederation of Norwegian Enterprise (NHO): "Handbook for cleaner production" (Næringslivets Hovedorganisasjon (NHO): Håndbok for innføring av "renere produksjon".) ISBN 82-7511-015-7.

<http://www.nhomatogdrikke.no/format/>

STAND 001, 2006. Common guidelines for labeling and distribution of shelf life (Felles retningslinjer for merking og fordeling av holdbarhetstid). <http://www.stand.no/>

Appendix 1 Proposed methodology for mapping of food loss

Data collection of food loss can be carried out due to the following plan:

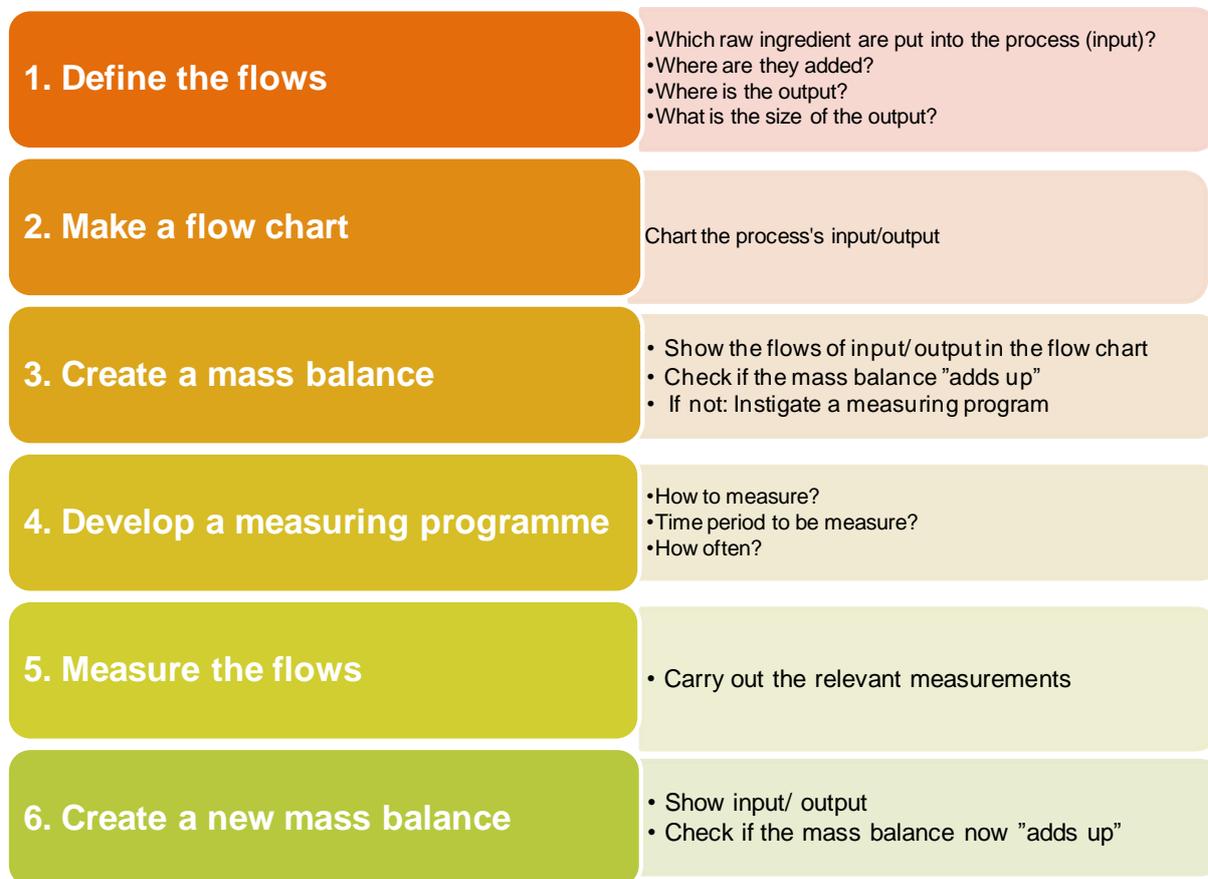


Figure V 1 Mapping and measuring

It is often helpful to create a flow chart for the process. Mark every step of the process on the chart and define the input/ output for each one.

The next step is to gain an overview of the amount of raw ingredients going into/ out of every stage of the value chain. Input of raw ingredients can often be found in the company's control system, on the invoice bill for purchased raw ingredients or by measuring and scaling. Output can often be identified in the registration by scanning the packaged product to be discarded, as well as scaling and registration of the product weight. Invoices from companies taking this kind of waste for waste treatment, can also give the relevant information, as can measuring and scaling.

It is recommended that the charted input and output are used to create a mass balance, in order to ensure that all input and output has been accounted for. For some processes where, for example, water is added or evaporated, the mass balance will not "add up". But creating a mass balance will reveal this.

If the mass balance “adds up” and the food loss is registered so that it can be divided in to edible food loss and potentially edible food loss, the data can be noted in the questionnaire for food loss.

There may be a discrepancy in the registration (the mass balance does not add up) or the food loss is registered collectively and can therefore not be split into edible food loss or potentially edible food loss. In this event it is recommended that one starts to take measurements. Use the mass balance and flow chart from the overall mapping as a starting point. Then evaluate how to split input and output in order that the data is recorded in a form which makes it possible to split the food loss into edible food loss and potentially edible food loss. Thereafter evaluate how input and output may be divided into the various different food loss categories, as well as the cause of its becoming food loss and not a product for full price sale. Find a set period of time to carry out the mapping and measuring. This could for example be done by putting out containers and sorting through the food loss manually. When the measurements are carried out, make a new mass balance to check that every input and output is now accounted for. Check again if it now adds up and it is then possible to insert the data in the questionnaire for food loss.

Appendix 2 Reduction of food loss through preventative measures

If reduction of food loss is to be implemented in the company preventative strategy, the project should be integrated part of the organisation. This should be carried out at management level and involving the employees. It may be advisable to use the process described in figure V 2, which is taken from the handbook “Cleaner production” (NHO, 1991).

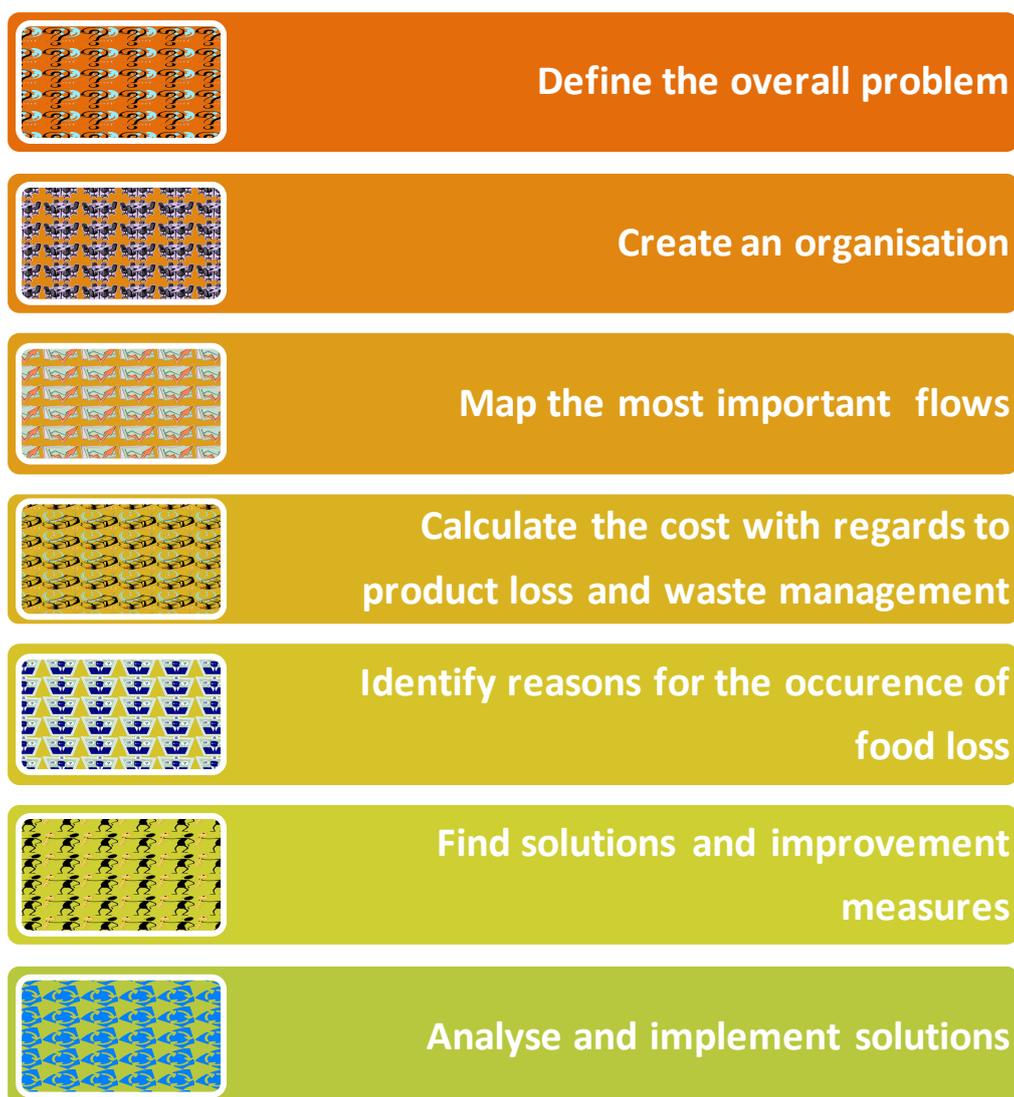


Figure V 2 Process for mapping and improving

1. Define the overall problem

This is important so that all the involved parties have a similar perception of the problem

2. Create an organisation

In order to integrate the project in the company, it is important that the management shows involvement and, for example, implements mapping and the reduction of food loss as an environmental strategy for the company. The employees from all the linked processing units should be organised in a working group, which is then responsible for the execution of the mapping. This group would also be responsible for calculating the costs in connection with food loss, identifying the reasons for its occurrence and finding a solution to the problem.

3. Map the important flows

It may be advisable to begin with a mass balance and a flow chart of the process. From there it is possible to estimate where in the process the most important flows of input and output occur. One can then create a measuring program to separate the different flows. It can then become possible to divide the different kinds of food loss and to identify the reasons for its no longer being a saleable product. The time scale for the measuring may then be determined.

4. Calculate the cost with regard to product loss and waste management

To visualise the overall cost of the food loss, it is important to show all the costs connected with product loss (written down value) and with waste management. There is often little focus on the food loss occurring in the day to day running of a process. Food loss that occurs by accident is more visible, whether due to faults in production or other technical errors. In order to reveal the real cost of food loss occurring in the day to day running, all food loss registered should be divided into two categories: accidental and day to day running.

5. Identify the reason for the occurrence of food loss

Map the waste codes used for food loss. Do the waste codes give the desired overview of the point at which food loss occurs? A clear definition of each waste code is important as this will ensure that the staffs registering the food loss understand what each waste code refers to.

6. Find solutions and methods for improvement

When the mapping of amounts, costs and the causes of food loss has been carried out, create an overview of the recommendations for its reduction.

7. Analyse and implement solutions

Analyse the recommendations for the reduction of food loss. Divide them according to the required action: Where in the process can the recommendation be slotted into to the organisation and/or routines? Perhaps its nature is more technical? Which suggestions require investment and how great is the potential for improvement? After this process has been carried out, make a list of initiatives to be implemented.

Appendix 3 Key data for food loss

An important part of the overall goal of the project is to develop good key data showing the results of work connected with the reduction of internal and external food waste. These key data should be related to both amount and costs.

Table v 1 Key data to measure the development in food loss.

Amount	Cost
Kg edible food loss/ kg turnover	Cost connected to written down value/ turnover
Kg potentially edible food loss/ kg turnover	Cost connected to loss of product / turnover
Kg donated / kg turnover Kg donated/ kg total food loss	Cost connected to waste management / turnover
Kg co-product/ kg turnover Kg co-product/ kg total food loss	
Kg animal feed/ kg turnover Kg animal feed/ kg total food loss	
Kg waste to biogas/ kg turnover	
Kg waste to incineration/ kg turnover	
Kg waste to land fill/ kg turnover	
Kg residual waste/ kg turnover	
Kg total waste/ kg turnover	

