



AALBORG UNIVERSITET

Reducing Food Waste in Denmark

Flemming Heidemann Pedersen
Jimmy Kjærgaard Jensen
Sebastian Raaberg Baasch
Sebastian William Kousgaard Gram
Thomas Gwynfryn McCollin
Thuan Duc Nguyen

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1. Introduction

This report will explore the problems surrounding food waste in private homes and attempt to find fitting solutions to these problems using information technology in the home. Once we have found and sufficiently defined a problem, we will attempt to solve this problem with software of our own design. In order to find a problem within the topic, we decided to investigate the problems existing in the specific problem area: the private home. First we will attempt to outline the large problem area, food waste and then explain our initial problem and how we arrived at it.

1.1 Introduction to Food Waste

In this section we will explore food waste in general and attempt to gain an overview of the complex problem area and the problems within. In the modern world we live in, oranges are flown from Argentina to Denmark to be sold in convenience and grocery stores across the country and pork is flown from Denmark to countless destinations across the globe. In such an industry large amounts of food is subject to transport and waiting time before arriving in stores. Therefore the food items have been given an estimated expiration date. Customers are therefore able to determine if a food item is going to last long enough for them to use it. This leads to potentially edible foods being wasted due to passing the expiration date. This kind of food waste is administered by the distributors and has in recent years been subject to reforms in order to reduce food waste [1]. However food waste among the distributors is not the largest source of food waste, the private homes are. Food waste is divided into four sectors that we will investigate in the following subsections.

1.1.1 Terminology

Firstly we will define terms used to describe the problem, with an understanding of these terms we will continue into the dissection of statistics from the four previously discussed sectors.

Waste

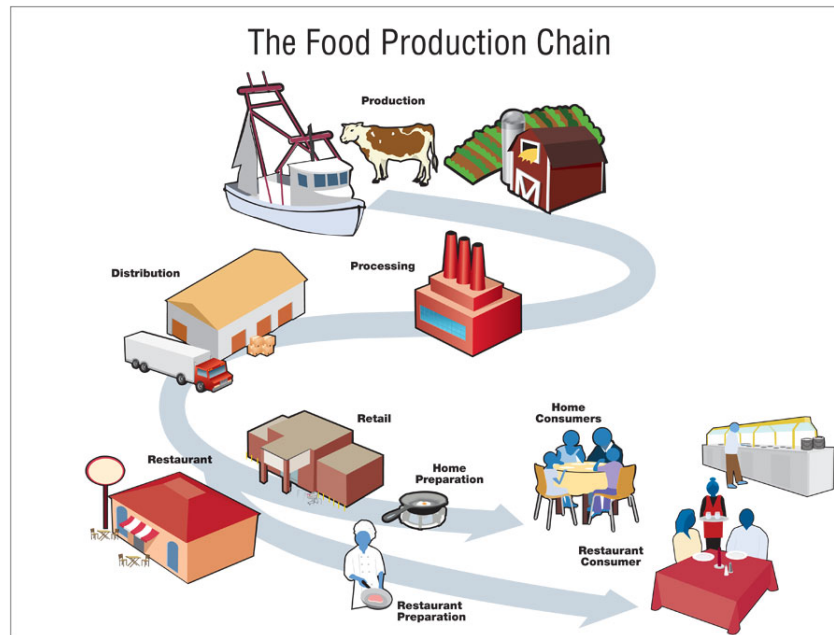
Food waste is the core of the problem, it is usable or edible foods that are disposed of for convenience or by accident. Consumers might buy too much of a certain ingredient and end up not using the entire batch. This means that the food could be used by others or that consumers could be affected to maximise use of food, before disposing of it.

Trash

Trash is the food items and related items that are not intended for eating, such as egg shells and banana peels. Several food trash items can be used in some dishes, but are generally used as an ingredient (such as orange peels) or not all (such as eggshells).

1.1.2 Food production

By producing foods we have a production chain. This production chain is almost the same all over the world, but we will define the production chain as showed on the **picture ??**. This production will cost the environment because it is production, and be producing foods we make CO_2 .



By the end of this chain the food is ending in the hands of the consumer, either coming from a supermarket or coming from a restaurant. Here we see the first place where food waste take place. The supermarket and the restaurant have food waste because they sell food. By selling foods, the problem becomes when they have food the can't be sold. The reasons for the food not being sold is that is either too expensive or people not wanting to buy it. This lead to expired food and the will mean that the supermarket or the restaurant can't sell it. This will lead to the food being throw out and that courses food waste. There is food waste in the homes of the consumer. The consumer is the one buying food in the supermarket or the restaurant to eat. In the supermar-

ket case the consumer will buy something to make at home and will take the products acquired in the supermarket and take with them home. Here we also have a food waste resource. Some of the product the consumer have acquired at the supermarket will not be used before it will expire. That will course to food waster and the consumer will lose the worth of the product leading to a waste of money.

1.1.3 Foodwaste statistics

For limiting the area more, we are going to take a look at four sectors which all have an effect on how much food is wasted in Denmark, these four sectors are, the private homes, the service, retail Sector, and production sectors.

Private Homes

This is the sector that covers the private homes and consumers, this is the everyday person. This sector is covered in depth later in the report at ??

Retail Sector

The retail sector are all the places from which the consumer buys the food, this is any type of supermarket or local store, this does however not cover restaurants or similar. This sector is some times referred to as the distributors.

Production Sector

This is where all our food is produced, before it is sent to the retail stores to be sold to the consumer. This is both primary and secondary production, which covers different types of farms, fishing boats as the primaries and packaging plants, and export companies as secondaries.

Service sector

This covers everything that is part of the service sector, which means schools, hospitals, other institutions such as homes for disabled homes for elderly as well as restaurants.

Sector	Food Waste per year in ton	Society Costs(?) in mio. kr	CO ₂ Emission in kg.
Private Homes	260.000	4500	157,14
Retail	163.000	700	37,14
Production	233.000	1430	42,85
Service	64.000	N/A	N/A

[4]

As it can be seen on the table above, the two sectors with the most waste is the private homes and the production of the food. Because that a reduction in the amount of food bought by the consumers would reduce the amount of food produced by the production sector, it is possible to actually reduce the two most wasteful sectors by targeting the private homes sector and thereby the consumers.

And not only are these two sectors the ones with the most waste, but as it is shown, they also have the biggest economic impact on our society and they are the two main reasons for CO₂ emission due to food waste.

Size of Household	Food Waste per person
1 Person	98,8 kg
2 Persons	65,0 kg
3 Persons	67,7 kg
4 Persons	57,2 kg
5 Persons	46,8 kg
6+ Persons	52,0 kg

[8]

As seen on the table above the amount of waste is much worse in homes with only a single inhabitant, when compared to homes with increasing numbers. We are taking a focus on homes with 1 or 2 inhabitants, because those are among the worst when it comes to foodwaste per person.

1.2 Initial Problem Definition

This section we will document our definition of the initial problem. The initial problem is a tool we use to approach the problem area with a problem based mindset. It is also the focus point of our problem analysis.

IT in homes

The problem area of our own choice for this project is IT in homes. Therefore it is natural to explain the problem limitation or exploration process from this initial point. In order to gain a general understanding and an overview of the problem area we decided to explore problems within the home.

Homes

From this standpoint we chose to focus on waste, as we had an interest in the problem. We mean waste as in general physical waste, therefore we did not delve long upon power consumption and economic saving.

Waste

We found a common problem among our selves, within the problem. Students and other young adults, who had recently moved out for the first time, had one common problem, Food. It was a common problem to come home from shopping and realise a much more efficient use of leftovers could have been deployed. Thus we limited the problem to food waste.

Food waste

We mean food waste as in the inefficient or uninformed use of food products that generate leftovers in excessive amounts, beyond the consumption ability of the consumer.

1.3 Initial Problem

In order to approach the problem area, and the problems within, we have formulated an initial problem. The problem serves as a vessel which we use to analyse and formulate a new problem that we will attempt to solve in the solution section of this report. The process of limiting and formulating the problem is described in the previous section. The problem is as follows:

Private Danish homes waste food.

The following are supplementary questions which are used to describe and expand upon the initial problem.

What is the extent of the food waste?

The extent of food waste and the distribution of waste sources is extremely relevant to the validity of our problem. If the main food waste sources is different from the sources we can affect, we might need to limit our problem further or move into other adjacent problems.

What is the cost?

The economic consequences of food waste, on a national and international scale, determines the relevance of our problem to society. It also affects the prospects of an actual deployment of our potential solution.

What are the potential savings?

How much can we save, in economic and environmental terms?

2. Problem Analysis

2.1 Users

This section will explore our user base and establish our target users. In our approach to the users we have divided them into different categories that are defined by their economic standpoint and potential food waste.

Food waste is an extensive problem in Denmark, it is a great waste of resources. For these users this project seeks to reduce food waste and improve the way that these users think, use and buy food.

2.1.1 Economy

Over 700.000 tons of food are thrown out every year in Denmark. The private homes represents 260.000 tons of the thrown out food, this is about 53% of all the food, excluding the industrial food waste that comes from food production.

Annual food waste per person in relation to the size of the household, shows that a larger household tends to throw out less food per person, but when the size of the household exceeds 6 persons, the amount of food thrown out is increased, this may be because the type of housing could be institutes such as hospitals, retire homes etc.

Size of Household	Food Waste per person
1 Person	98,8 kg
2 Persons	65,0 kg
3 Persons	67,7 kg
4 Persons	57,2 kg
5 Persons	46,8 kg
6+ Persons	52 kg

In terms of the economy, about 20% of the money that a household use on food ends up being thrown out. Households food waste cost 11,6 billion (DKK) per year, this is including the VAT and taxes. An average family with two adults and children waste food for 7.200 (DKK) per year.

All numbers used above is defined by following definition of food waste:

Food waste is trash that originally was food. This statment can be split up in two categories, the first category is food waste and the other one is food trash. Food waste is food that was edible, but was thrown out; an example could be bread, fruits or vegetables. Food trash is parts of food that was not meant to be eaten; this could be eggshells, cheese rinds and coffee dregs. [8]

2.1.2 Students

Students are a very specific user group, it can be interpreted as anyone with a low income and a tight budget. This could of course also relate to some families, but when narrowing it down it contains people living alone or small groups of students, where their economy are not exclusively joined.

As a student you often throw out food because of being lazy, to be more specific students tend to skip meals. As a result food spoils in the refrigerator and you would end up with spoiled food. Sometimes students even forget about their food and it ends up being situated in the refrigerator forever, or until it is in need of some good cleaning. Being a busy bee, as students can be, you often buy food in the canteen rather than bringing food yourself - resulting in more spoiled food.

2.1.3 Families

To families a large economy is an important part in their daily lives. Food waste for a family of three (mother, father and child) costs them around 7.200(DKK) per year.[8] This number out of context is not significant, but in context it is. House insurance, for a house build in 1990, 100 m², two toilets, hard roof and a basement, would would cost 4.892(DKK) annually, which is just over half of what they waste on thrown out food.[3]

2.2 Causes

Food waste in private homes is the food that is thrown out of the kitchen whether it is cooked or not (see 1.1.1). This goes for the food that did not get eaten or the ingredients we did not use. [2]

Uncooked Foods

There is a lot of reasons as to why we waste as much food as we do. Reasons for throwing out uncooked food are often based on certain factors such as: The type of food, packaging, quantities, shelf life, storage and sorting.

Throwing out uncooked meat is usually a lack of repackaging surplus meat when only using a portion of the product, this often results in the meat getting bad. Another reason could be an exceeded expiration date which makes the user unsure about the meat being fresh. Or simply that there is no more room in the freezer. Some might even throw out meat based on the amount

of fat or tendons present.

The cause when getting rid of fruits and vegetables is usually the result of buying too much of it, leaving it to expire and go bad before use. Other reasons could be poor quality and unappetizing appearance, such as bruising or discolouring.

Reasons for throwing out dairy products are very similar to the way we discard fruits and vegetables. This especially goes for products such as milk, yoghurt, cheese and eggs. The thing that differentiates is that the users are usually in doubt about the products being edible.

Canned goods are usually thrown out if the product have been opened and not entirely used. Some people might question the amount of time the product have been open.[5, p. 17]

Cooked Foods

Cooked food in large quantities generally gets thrown out whenever there is leftovers. Sometimes the amount that is left is considered too small to save for even a single person. Other reasons would be that the food have been stored for too long in the refrigerator and it has gone bad. Or that the food has been reheated too many times, making it unhygienic.[5, p. 17]

Food Amount

Food amount is meant by the amount of food that can be bought in a package, this could be 500 grams of meat. The amount of food that can be bought is necessarily not the same amount that can be eaten, before it turns bad. Students is a user that has a limited budget, and will definitely be interested in buying food to a lower price, and when the supermarket have discount on food by selling two packages for the price of one, this student will buy two for the price of one. This way of shopping food, could lead to food waste, when the student is not able to store the leftovers, or prepare the food before the expiration date.

For students or people who live alone, this is often the cause of food waste, actually the students waste about 40% more food than people who lives together. As mentioned this cause is different for families, because the amount of food available at the store, often fits the number of family members.[7]

Table 2.1: What happens to food before it is cooked [5, p. 17]

	Meat	Pasta, Rice and Potatoes	Fruit and Vegetables	Dairy Products	Canned Goods
Amounts		Bought in great amounts, so much that it goes bad before use.	Bought in great amounts, so much that it goes bad before use.	Bought in great amounts, so much that it goes bad before use.	Opened canned goods can not be repackaged or used for later.
Shelf life (packaging, quality)	Can not be resealed, so it does not keep fresh.	Potatoes turns green, black, soft, wrinkled or starts to sprout - and can not be resealed.	It turns soft, dry, wrinkled or starts to rot. It gets stored places it will not keep fresh.		Cans can usually not be resealed after opening.
Shelf life (expiration date, doubt)	Expiration date exceeded, raises doubts about whether it is inedible or unhygienic			Expiration date is close or exceeded. A lot of people is very cautious about dairy products.	Doubt about how long it has been opened.
Storage and cleaning	There is no more room in the freezer. People seem to think that the meat loses taste, when frozen for too long.	There is no more space in drawers and on shelves.			
Disposal while cooking	Thrown out if there is too much fat or tendons in the meat.	Potatoes are usually thrown out based on their appearance and quality. (bruising, sprouting).	Thrown out based on appearance and quality. (sloppy, dark, soft etc.).		

Table 2.2: What happens to food while or after it is cooked [5, p. 17]

	Meat	Pasta, rice, potatoes	Fruit and vegetables
Cooking and amounts	Too much of it was cooked.	Too much of it was cooked.	Too much of it was cooked.
Meal leftovers and amounts	Considered too small a portion to be saved, e.g. Not enough for one person.	Not important enough to be considered a leftover, or not enough for one person.	Not important enough to be considered a leftover, or not enough for one person.
Refrigerated leftovers	Have been sitting in the refrigerator for too long. Usually 4 days is considered too long.	Have been sitting in the refrigerator for too long. Usually 4 days is considered too long.	Have been sitting in the refrigerator for too long. Usually 4 days is considered too long.
Shelf life (quality, doubt)	Have been reheated before, therefore not considered unhygienic to reheat and eat it.	Have been reheated before, therefore not considered unhygienic to reheat and eat it.	
Storage and cleaning	Not enough room in the freezer.		

2.3 Existing Solutions

This section will investigate and explore existing solutions for food waste, that are already being deployed. We will attempt to understand the solutions in order to find a niche or an aspect of the problem that is not already solved or where the solution can be improved or expanded upon.

2.3.1 Campaigns

Various organisations and political groups, such as [6], have information campaigns that inform people of the ecological and economical consequences of food waste, and through this information attempts to influence the cooking and consumption habits of the people. The campaign strives to affect the purchasing behaviour of the people, to encourage them to purchase only the required amount of food. The campaign offers advice on how to change habits and lifestyles to prevent as much food waste as possible.

Lifestyle

In order to minimize the amount of wasted food in an average household, one could change their lifestyle to suit the purpose of saving food, this can be done by making a food schedule of the coming week, where you in advance decide what you want to make in terms of food, and whether or not you want to make a big enough portion to last several days.

Advice

Only buy the amount of food you require, or if you buy more than you need right away.

Freeze the leftovers for later, instead of cooking too much. Remember to label the container with important information such as the date it was frozen, portion size and the planed date of consumption.

When cooking, take a mental note of how much your household eats, and try to mimic that amount while cooking in the future, and if you do make too much food, cool it down using your fridge or freezer for later consumption, either to supplement another dish. or as an easy lunch or snack.

When buying groceries. if you know you're going to be using that food on the same day. try and find the food that expires soonest, this increases the chances that the items with a shorter expiration date will be sold before they are thrown away by the store.

2.3.2 Leftover Ingredients

Several cooking websites [9] allows users to search for recipes based on ingredients. This allows users who have ingredients leftover to find new dishes where the leftover ingredients can be used.

2.4 Survey

In this section we take a closer look on the survey we have made and spread throughout our social circles. The survey contains questions about our subject food waste. We conducted this survey in order to define our problem and to extend our knowledge of our chosen user group, in regards of food usage and waste. We did not have source material regarding this subject - based solely on our chosen user group. Therefore we made the questions in this survey meet our needs, focusing on students and families exclusively.

2.4.1 Survey Design

The type of the survey used is a quantitative survey, and it means that we are looking at a larger crowd, trying to get as many people to answer the questions we set up, to gain a further understanding of how food waste happens. These questions have a correlation with occupation, income and a few other factors. It is different to the qualitative survey where a smaller amount of people are asked a greater amount of questions with much more depth.

We chose to do the quantitative survey because it will give a better overview of the different causes for food waste, as well as an idea how to combat food waste. Also a quantitative survey gives us statistical data, numbers in general. These numbers can help us to create some generalizations about food waste in private homes.

As mentioned it was made sure that basic information like age, occupation, income, zip code and which type of living arrangements people had would be available. This information will help determine some demographics and statistics about the different groups of people that took the survey. The survey also contained questions that would help us determine how frequent a person would buy food and how often they would throw out certain types of food. Some of the questions regarding this were derived from our info tables (see 2.1 , 2.2) that were based on gathered source material(see [5]).

At the end of the survey, there was an option to leave a comment on how to reduce food waste. These comments were of course qualitative and will only be applicable to early stage development of a software solution, meaning there is a possibility some of the good advice would accumulate to a programmable feature.

2.4.2 Survey Quality

Overall, the survey were meant to give us some raw data that could help define some generalizations about students and families. These generalizations will become the foundation of a solution. There is of course some leniency regarding any presumption based on this survey, because the amount of people who answered the survey is not enough to constitute a valid sample size.

2.5 Data Analysis

This section covers the analysis of the data we received from our survey.

3. Problem Statement

This chapter summarises the previous chapter and formulates a problem that we will attempt to solve in later chapters. First we will review our findings in the previous chapter and re-evaluate our initial problem in order to formulate our problem.

Through our preliminary research we discovered that the major source of food waste is the private home (see 1.1.3). We expanded upon our preliminary research to further our understanding of the problem. The private home contains many user groups that we decided to investigate (see 2.1). The studies we had read in our research categorised home owners into categories based upon the number of residents, we however decided to focus on two categories, families and students, in an attempt to include a financial aspect in our groups, however the focus primarily resides upon the students, the families is a secondary group based on the assumption that the everyday life of small families and students is largely similar. Our problem had to be solvable and we therefore looked into the most common reasons that consumers waste food (see 2.2). Lastly we reviewed current solutions for food waste (see 2.3).

This lead us to the following statement:

Danish students waste food, because they do not know what to do with leftovers.

Our research has lead us to believe that Danish students do not know how to properly utilize all the food they buy, which leads to more food waste. The food waste could potentially be further reduced by supplying tools to aid them in efficiently purchasing, storing and preparing food. There is also a potential for saving money for the students.

3.1 Problem Limitation

We will focus on aiding the students with preventing food waste. We will attempt this using technology in possession of the users and software of our own design. Our focus is primarily on the students user group. This allows us to create a solution the solves the specific problem related to the users situation. The following chapters will cover the design and implementation of a solution to food waste, or reduction thereof, for students.

4. Design

5. Implementation

6. Conclusion

7. Perspective

8. References

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9. Appendix
