

# Reduction of food waste in Finnish food production chain as part of life cycle management

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**Abstract** Reduction of avoidable food waste is one way in mitigating the environmental impacts of the entire food supply chain, and these reductions call for efforts both from food supply chain players and consumers. Based on the new Finnish research project FOODSPILL's results most of the food waste is generated due to consumer's behaviour especially in households but also in restaurants as plate leftover food. In Finland the amount of food waste at household level is studied to be around 120 000–160 000 tons per year. This estimate was based on a follow-up study concentrating on mapping the volume and composition of food waste in 380 Finnish households. Average per capita waste, 23 kilos, calculated from diary entries was significantly lower than the findings in international studies are pointing out. Food waste, both in Finnish restaurants and retail sector, were both found out to be around half of the food waste created in the household level.

**Keywords:** Food waste, leftover, household, consumer, retail, restaurant, catering, reduction, environment,

## 1 Introduction

Recently the environmental impacts of food production and consumption have been widely studied both in Finland and internationally. Food and nutrition amount to over one third of the environmental impacts of Finnish overall consumption. Further on, when we look at the GHG-emissions of consumption one quarter of the climate impacts come from nutrition [1]. Production of food that

is lost in the food supply chain causes remarkable unnecessary environmental impacts.

In order to reduce food waste the reasons and causes contributing to it have to be studied first. Finnish FOODSPILL research project was targeted households, restaurant and catering business, and food industry and retail. Preliminary results of households, restaurants and retails are presented in this paper. So far there have been no studies in Finland that would have covered the whole chain from production to consumption. Additionally, there has been only a couple of studies in the household level in Finland, but the number of households involved in the previous studies has been minimal. Thus FOODSPILL project started with broad literature review [2]. This deals with avoidable food waste, its sources, reasons and reduction options. One aim of this study was to find out what kind of methods have been used internationally to study food waste in the whole food marketing system and what are the pros and cons of different methods, especially when studying the food waste that is created in the household level. Another goal was to examine the amount of food waste and its variation between different stages of the food supply chain and different food groups.

It was noticed that comparison between food waste studies is very challenging and in some cases even impossible. Different methods (waste analysis, food diaries, questionnaires) and sample sizes can be used to quantify the amount of food waste. Additionally, the amounts of food waste can be presented in different units (kg, kcal, monetary value) or food waste can include different types of food materials (peels and bones are included in some studies and excluded in others) in different studies.

Measurement and estimation of the amounts of food waste is associated with many uncertainty factors and therefore it is recommendable to assess the results of food waste studies critically and consider them only as indicative estimates of the true amounts of food waste. The method used in most of the household studies was a wide spectrum waste analysis where organic waste was collected from waste containers in specific areas, and then screened for identifiable waste types. This method does not give a very detailed picture of specific types of food waste; and barely allows analysis of the reasons behind the waste.

The FOODSPILL project is carried out by MTT and funded by Quality Chain of the Finnish Ministry of Agriculture and Forestry and participating companies. The project was launched in January 2010 and will be completed by March 2012. The partners of the project are Arla Ingman, Atria Finland, HK Ruokatalo, Ingman Ice Cream, Finnish Glasshouse Growers' Association, Kokkikartano, Saarioinen, Valio, Palmia, Tampereen Ateria, UniCafe, Motiva, Helsinki Region Environmental Services Authority (HSY), The Finnish Solid Waste Association (FSWA) and Association of Packaging Technology and Research (PTR).

## 2 Household

According to several researches conducted in Europe [3, 4, 5, 6], USA [7, 8] and Canada [9] large amounts of food waste come from the household level. Therefore, in this study a lot of effort was put in the investigation of the food waste in the household level.

In this study the research data was collected through a food waste diary study during September 2010. In this study 380 Finnish householders recorded all the food waste generated in their households from the two week test period, including the quantity, type and reason for disposal. Participating householders also filled up a background questionnaire through which data was collected on their demographical, sociological and economical properties as well as their food shopping and preparation habits.

Only the type of food waste which could have been avoided by, for example, proper storing or better planning, was included into the study. Therefore, unavoidable food waste, such as, vegetable and fruit peels, bones or coffee grounds, was excluded. Additionally, no other drinks than milk and other potable dairy products were included.

The data was analyzed using descriptive statistics, crosstabs, and bar charts. Linear regression model was applied to find statistically significant results and dummy and dichotomous variables were formed to include qualitative information into the model. According to the results an average person produces annually 23 kg of avoidable food waste, and at the household level the average amount of avoidable food waste numbers about 50-65 kg/household/year. The range of produced food waste in the households in this study was from 0 kg/cap/year to 161 kg/cap/year or 584 kg/household/year. According to national statistics an average Finnish person purchases annually around 500 kg of food, according to the results in this study 4.5% of this food is unnecessarily discarded.

Average food waste (per capita) calculated from diary entries is significantly lower than the findings in international studies point at, but these different studies are not directly comparable due to the different methods used. However, the low amount of plate leftover in restaurants supports the fact, that Finnish citizens really cause less food waste compared to other Western countries. One explanation for this could be that present society is still affected by the history of peasant ethos, the dominant national ethics which emphasizes frugality. [10]

In this study the avoidable food waste comprised mainly products from the following food groups: vegetables (19% of avoidable food waste), homemade food (18%), dairy products (17%), bread and other grain products (13%), and fruit and berries (12%). The main reasons for food waste were: food was spoiled or moldy, best before date was expired, food was left on a plate, or too much food

was prepared. In the questionnaire, there was also a question about how to avoid food waste, and according to the householders storing food in right temperature and not opening new food packages before the old ones are entirely finished were considered to be the most concrete and efficient food waste prevention methods.

It was detected through some statistical tests that the following background factors correlated with the amount of food waste created: the size of the household, the gender of the grocery shopper, daily sorting of organic waste, the appreciation of low food prices, packaging sizes and the habitants own view of their potential to reduce food waste. More precisely, usually more food waste was generated in those households where the woman did most of the grocery shopping, the inhabitant was a single woman, organic waste was sorted out irregularly, and the respondents thought there is a good potential to remarkably reduce the amount of food waste in their households. Further on, the amount of food waste was larger in average in those households where the respondent felt that limited availability of smaller packaging sizes was at least sometimes the reason for the food wasted. Additionally, the amount of food waste was larger in those households where BOGOF (Buy One Get One Free) and discounted food products were not often bought.

### **3 Restaurant and catering business**

Around 810 million food portions are cooked in Finnish restaurants and in catering businesses every year [11], which corresponds around 360 million kilos of food. The amount of avoidable food waste was investigated in 56 different catering businesses, restaurants, and in three large restaurant business companies in three Finnish cities during autumn 2010. Restaurant workers kept diary and weighted the amount of food wasted and produced in one week period. Additionally, one-day food waste tracking was organized in 16 other restaurants in the project.

During these experiments organic waste was sorted out in two parts: i) avoidable food waste and ii) other organic waste which is not meant to be eaten (such as vegetable and fruit peels, bones or coffee grounds). In the end of the day only the food waste was weighted. It was important to divide the generation of food waste in three parts: kitchen waste (e.g. flaws in cooking, spoiled products and raw materials), serving losses (e.g. overproduction, that is not able to be reclaimed later) and plate leftovers, because through this division it was possible to better understand which stages were the main stages where the food was wasted.

The results revealed that in total around 70 000–90 000 tons of food is wasted annually in Finnish restaurant sector. This covers about one fifth of all food handled and prepared in restaurants and catering businesses. Findings also suggest that the main reason for food waste in the sector is buffet serving loss.

Most restaurant portions are taken as self-service (schools, lunch restaurants) and in these cases the main reason for food waste was buffet serving loss. 9–17% of the food meant to be eaten was turned out to be buffet serving loss - varying in the different restaurant types. Results also showed that the plate leftovers were about 4–8 % of all food meant to be eaten whereas kitchen waste was only few per cents.

Reasons for the food waste in all of these three food waste stages were thought through and identified in 3 workshops during March 2011. According to the results kitchen waste was due to e.g. flaws in cooking, insufficient communication between workers, wrong raw material cycle and misunderstood recipes. It is essential to pay attention to workers professional skills, taskmasters role as an advisor and overseer and bidirectional communication between kitchen staff to prevent kitchen waste.

Challenging prediction of daily sales is one of the biggest reasons for serving loss. It was identified that knowing customers' taste preferences, right sizes of serving bowls and successful calculation of portions sizes affect buffet serving loss. Findings suggest that an efficient way to prevent buffet serving loss is well organized and managed food production and serving in which the preparation and serving of food is divided into sections. The main point is that all food is not prepared and put on the buffet at the same time. Reasons for the plate leftovers were partly customers' fault (they took more food they were able to eat etc.) and partly due to the lower quality of the food.

Reasons for plate waste are related to customer attributes and to the quality of food. Customers' taste preferences, haste and greediness (take more food than can eat), especially in buffet eating, are reasons reflected from customers' characters. These factors are very difficult to affect or change. Moreover, unsatisfying quality of food (e.g. too much salt, too cold) increases plate waste. This can be avoided by paying attention to workers skills, carefulness and alertness.

## **4 Retail**

The results of food waste in wholesale and retail sector is based on interviews with representatives from the sector. Waste amounts, gathered through retail company interviews, were used as indicators for total food waste, and thus, retail food waste

amounts are not directly comparable with household and restaurant results. The biggest food product groups wasted were fresh fruits, vegetables, and fresh bakery products. According to the interviews the main reason for the food waste was the expired date of the product (or with the products without the date, e.g. with vegetables, the product was observed to be sale unusable e.g. rotten). Discount pricing, when "the best-before date" was getting closer, was considered to be one of the key solutions to reduce food waste, but it was pointed out that it requires skill and understanding to use it as a marketing tool.

Overall, 65 000–75 000 tons of food was estimated to be wasted per year in the retail sector (including retail and wholesale) in Finland, however the amount of food waste has been relatively decreased in the last few years. The total amount of food waste corresponds around 1–2% of food sales. Most retail companies are having clear picture about the amount of food waste, because the amount of food waste and the number of food items are registered very strictly and they are followed at country and product group level. In the retail sector, almost every abandoned item is weighed and the reason for the loss is documented. All retail chains do this registration regularly. The data of food waste is used for the planning of the logistics systems and other activities in the organization. This gathered data enables making more exact orders and assures that the food is in the right place at the right time. It's important that the food products are in the grocery stores, instead of in the warehouses, during their selling dates.

## **5 Conclusion and discussion**

Production of food that is lost in the food supply chain causes remarkable unnecessary environmental impacts. A huge amount of resources are used unnecessarily to cultivate, produce, store and distribute food that is not consumed. All these resources, e.g. fertilizers, fuel, natural resources, transportation, water, and electricity, are causing significant amounts of greenhouse gases and other environmental damages like contaminating the water.

In order to reduce food waste the reasons and causes contributing to it have to be studied first. Therefore, the Finnish FOODSPILL project has been established to investigate the amount of food waste in the Finnish food supply chain. Altogether, according to the results of the project more than 250 000 tons of food is wasted per year by consumers, retailers, restaurants and catering services. The main reasons for the food waste have been investigated in the project as well, and it seems that in the household level the main reasons were that the food was spoiled or moldy, best before date was expired, food was left on a plate, or too much food

was prepared. In the households, where according to the results the amount of food waste was largest, intervening to avoidable food waste creation could be relatively easy improvement in the food supply chain, e.g. compared to the dietary changes.

In the restaurants and catering businesses the main food loss happened in the buffets as a serving loss. In order to control food waste in restaurants this requires acknowledgement and recognition of the food waste issue. Moreover it is crucial to understand that food waste issue is manageable and it should be part of the management systems of companies.

In the retail sector the main reasons for the food waste were the expiring dates of the food products. Discount pricing was seen as one of the key solutions to reduce food waste. The registered data of food waste is used for planning of the logistic systems and other retailers' activities. This gathered data enables making more exact orders and assures that the food is in the right place at the right time.

Furthermore, good knowledge of the customer is essential in retail sector and restaurants and catering businesses for better predictions of the needs of the customers. New improved ways to predict the customers' purchases and consumption patterns, and related information systems need still further development in all stages of food life cycle.

Finally, to make the changes truly happen the food waste should be considered as a problem and more attention should be paid to minimize it in the whole supply chain. Food waste should be regarded as one of the hot spots of life cycle management in the food sector.

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