

FOOD WASTE VOLUME AND COMPOSITION IN THE FINNISH SUPPLY CHAIN: SPECIAL FOCUS ON FOOD SERVICE SECTOR

K. SILVENNOINEN*, J. M. KATAJAJUURI*, H. HARTIKAINEN*,
L. JALKANEN**, H.K. KOIVUPURO* AND A. REINIKAINEN*

* *MTT Agrifood Research Finland, Biotechnology and Food Research, Sustainable Bio-economy. Latokartanonkaari 9, FI-00790 Helsinki, Finland*

***MTT Agrifood Research Finland, Economic Research Latokartanonkaari 9, FI-00790 Helsinki, Finland*

SUMMARY: During 2010-2012 we carried out project *Foodspill*, concentrating on mapping the volume and composition of food waste in the Finnish foodchain. 380 households weighed their avoidable food waste each day when they disposed of food during a two-week research period. The average annual food waste was 23 kg per person, and for households 120–160 kg per annum. For the food service sector the amount, type and origin of avoidable food waste was investigated in 72 restaurants. Restaurant workers kept a diary and weighed the food produced and wasted in a one week period. According to the results around 75–85 million kg of food was wasted annually in the Finnish food service sector. This covers about 20% of all food handled and prepared in restaurants and catering businesses. The findings also suggest that the main reason for food waste in the sector is buffet serving loss. At the end of the project we estimated that every year consumers, the food service sector, the retail sector and the food industry together waste 335-460 million kg of food in Finland; 62–85 kg per Finnish citizen.

1. INTRODUCTION

The environmental effects of food production and consumption have been widely studied recently both in Finland and internationally. Food amounts to over a third of the environmental impact of overall Finnish consumption (Seppälä et al. 2009). When examining the impact on climate alone, we established that food (food industry, wholesale and retail, restaurants and household use) amounts to about one quarter of the climate impact of consumption, whereas the impact on the water system is even more pronounced due to over-fertilization.

Roughly one third of food produced is lost or wasted globally, which amounts to about 1.3 billion tons per annum (Gustavsson et al. 2011). It is both ecologically and economically unsustainable to waste edible food rather than consume it because the environmental impacts of producing the raw materials and processing them into food are rendered pointless. In order to reduce food waste, we have to first study the reasons and causes that contribute to it.

Before project Foodspill there had been no studies in Finland that would have covered the entire chain, from production to consumption. The number of households or food services included in previous studies was minimal (Tarvainen 2009, Kujala 2009, YTV 2009). Food waste has been studied in Europe, e.g. in Great Britain (WRAP 2008, 2009, 2011, The School Trust 2009), Sweden (KFS 2009, Engstrom and Carlsson-Kanyama 2004), and in America in USA (Jones 2005) and Canada (Gooch et al. 2010).

The aim of project *Foodspill* was to determine the volume of avoidable food waste, and its distribution among all parties involved in the Finnish food supply chain from the food industry to consumers. We specifically targeted households and food services, but also the retail and food industries were considered.

In this paper we focus particularly on the food service sector, the results for which have not been previously published. Articles that were published before from this project are Koivupuro et al. 2012: *Influence Of Socio-Demographical, Behavioural And Attitudinal Factors On The Amount Of Avoidable Food Waste Generated In Finnish Households*. International Journal Of Consumer Studies 36 (2): 183 - 191 and Silvennoinen (in review process) *Food Waste Volume and Composition, Case Study Finnish Households*.

2. MATERIAL AND METHODS

2.1 Households

During September 2010 we carried out a follow-up study concentrating on mapping the volume and composition of food waste in Finnish households. In addition, we charted the respondents' demographic background, such as age, education, current life stage, etc. Furthermore, we collected additional background information, such as eating, food preparation, grocery shopping and waste sorting habits, opinions about food packaging, and also evaluated the influence of these factors on food waste.

The respondents were chosen from an Internet panel, and the market research company responsible for selecting the respondents also carried out the practical aspects of the study. A total of 420 households participated in the study, and of these 380 households (1054 people) finished the study acceptably. Prior to the study, the participants completed and returned a background information form, and they were equipped with electronic kitchen scales, as well as detailed instructions on how to weigh and record their food waste.

The households weighed their food waste daily, every time they disposed of food. The study period was two weeks, and the results were recorded in a diary. In this study we concentrated on avoidable food waste, i.e. all wasted food and raw material that could have been consumed had it been stored or prepared differently. Other bio-waste, such as coffee grounds and bones, were not measured.

The data was analysed 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. More details and statistical methods see Koivupuro et al 2012.

2.2 Food services and catering

As partners in the study we had two communal food services (Helsinki and Tampere) and the company responsible for catering for the restaurants of Helsinki University. The three companies had a total of 55 outlets participating in this study, providing meals for various daycare centres, schools, hospitals, elderly service centres, and workplace and student restaurants and canteens.

The study time for food services was one week (Table 1).

Other restaurants and catering businesses, such as diners, licensed restaurants, hotels, cafes, petrol stations and similar establishments serving meals, participated over a shorter, one-day research period. In total the study covered 17 of these and overall there were 72 participating restaurants and 292 days were spent on research (Table 1).

Table 1. Outlets participating in the study, number of research days and number of outlets in Finland 2008 (The Nielsen Company 2008).

<i>Outlet</i>	<i>Quantity</i>	<i>Study time days/outlet</i>	<i>Outlet total days</i>	<i>Days with leftover analysis</i>	<i>Number of outlets in Finland</i>
Schools	30	5	150	8	2249
Daycare centres	14	5	70	2	992
Workplace restaurants and canteens	5	5	25	5	1508
Hospitals, elderly service centres	6	5	30	4	1578
Restaurants, diners, hotels	9	1	9	10	5041
Cafes, petrol stations, fast food restaurants	8	1	8	4	5763
Total	72		292	33	17131

The food waste in restaurants and diners was measured by establishing the amount of food served and weighing waste generated during cooking and serving, and customer leftovers.

In communal food services the study was generally carried out at lunchtime, with the exception of elderly service centres and hospitals where dinner was also monitored. In cafes, petrol stations, diners and restaurants the monitoring usually covered the whole day. After the restaurants closed, either the restaurant personnel or the researchers weighed the sorted waste. In addition, the personnel filled in forms for daily amounts of food prepared, and amounts of food waste from cooking, serving and leftovers. Furthermore, the researchers studied the contents of leftovers over 33 days in various outlets, establishing the composition and quantity of leftovers.

Along with the amount of food waste, reasons and solutions for food waste in food services and restaurants were studied. To achieve these goals three participatory workshops were organized altogether 34 participants. In workshops participants were divided into groups (6-9 persons per group) and they represented either kitchen staff or company management.

2.2.1 Preparations in the food service sector

Prior to the study period, the researchers briefed a member of the personnel, instructing them on weighing and giving them directions on how to define food waste and sort leftovers. The restaurants were provided with necessary forms, containers for various food waste, boards with guidelines for sorting food waste, and several scales for weighing the produced food and the

food waste. The representative of the personnel arranged for the necessary briefing for the rest of the staff prior to the study period, and placed the containers and scales in appropriate places.

The food waste was divided into two categories so that the edible waste was separated from inedible waste, such as vegetable peels, napkins and coffee grounds. Of the liquid foodstuff, we included milk and sour milk used in the kitchen and served to the customers, but from leftovers we separated only milk.

For weighing and sorting, the food waste was divided into three categories in accordance with its origins: kitchen waste, service waste, and leftovers.

2.2.2. Measuring cooked food

As the amount of waste food was compared with the amount of food cooked, all cooked food was weighed during the study period. The communal food services and workplace restaurants and canteens participating in the week-long study filled in forms on a daily basis, where they indicated the amount of food cooked and served (kg). The forms included information on various components of the meals, e.g. main courses, salads, breads, drinks, and special diets. If the food was catered from a central kitchen, they were asked to calculate the amount of food dispatched. Subsequently, the staff serving the food marked the number of portions served. This information was verified by counting the main course plates returned to dishwashing centres.

In cafes, licensed restaurants, diners, fast food restaurants and petrol stations participating in the one-day study, the number of servings was counted from a journal tape, which showed the portions bought over the study date. The weight of each portion was quantified by weighing dishes before serving to the customers. If the restaurant served a buffet lunch, we weighed the serving dishes prior to service, and collected the amount of sold portions from the journal tape.

2.2.3 Measuring waste

In restaurants food waste was divided between three main sources: kitchen, serving, and leftovers. Kitchen staff and waitresses sorted organic waste into two containers, based on whether the waste had been edible to begin with. At the end of the working day, the containers were weighed and the results entered into forms.

Service waste was food that was set out for consumption, but did not end up with a customer. There was a separate entry for food served that was saved for later use. In communal food services, workplace restaurants and canteens, student restaurants, and some licensed restaurants the lunch was served as a self-service buffet. In licensed restaurants, outside of lunchtime, the portions were usually selected from the menu, so there was no service waste if a part of the meal, for example salad, was not served at a self-service desk.

All restaurants participating in the study sorted and weighed leftovers. We carried out a more thorough analysis of leftovers in 33 restaurants. For weighing the leftovers, the restaurants arranged a station close to dish return lines, where the customers or researchers separated food waste and napkins. The sorting area had guidance for customers, and when necessary the restaurant personnel helped them in sorting their waste. In addition, some restaurants had a researcher present to make a more comprehensive analysis of the composition of leftovers (Picture 1,2).



Picture 1: The sorting station at a licensed dining restaurant.



Picture 2: The sorting station at a highschool canteen.

2.3 Other parts of the food chain: retail sector and food industry

The aim of the study of retail sector was to determine the amount of and reasons behind food waste in the retail and wholesale trade in Finland. A further objective was to find ways for reducing waste in grocery stores and markets. The project was carried out by interviewing various parties in retail chains, waste management and other associated actors. We interviewed representatives from four retail chains (covering 90% of Finnish food markets), one waste management and one trade association. The research did not include any weighing to determine the actual amount of waste, and consequently there were no statistical data available.

The generation of food waste in the Finnish food industry was studied by collecting information on the amounts of food waste from companies taking part in the *Foodspill* research project. In addition, information on the generation of food waste was collected from some other companies in the Finnish food industry, corporate responsibility reports of food companies, and other literature. In addition to industrial food processing, the amount of food waste from the production of vegetables in greenhouses was included in the study. The manufacture of other drinks except potable dairy products and prepared animal feeds were excluded. The percentage of food on average wasted in each sector of the Finnish food industry was estimated based on the

collected food waste data. The sector-specific food waste percentages were compared with statistical data on the production volume of each sector in order to get an estimate on the total amount of food waste. Unfortunately in the cases of some sectors of the food industry insufficient corporate-specific information on food waste was available and therefore only a coarse estimate of the total amount of wastage of edible food in the entire Finnish food industry is presented. However, clearly the largest sectors of the Finnish food industry, meat and dairy industries were well represented in the project and corporate-specific data was obtained from the largest companies of these sectors.

3. RESULTS

3.1 Household results

The amount of food waste in participating households varied considerably from 0 to 160 kg per person per annum. The average annual food waste was 23 kg per person and 60–70 kg per household (average household size 2.8 people).

Most discarded food was fresh and perishable, or leftovers from cooking and dining. Discarded food was diverse: the main discarded foodstuffs were vegetables 19%, home-cooked food 18%, milk produce 17%, bread 13%, and fruits and berries 13%. For meat, fish and eggs the value was 7% and for convenience food, 6%. Home-cooked food included various foodstuffs prepared at home, such as casseroles, stews, sauces and gravies, porridges, and soups. Convenience food included ready-made casseroles and other meals, but also hamburgers, pizzas and baby food, including infant formula. The waste of tinned goods and other non-perishable foodstuff such as snacks was relatively low, only 2.5%.

The main reasons for disposing of foodstuff were spoilage, e.g. moulded 29%, past best-before date, 19%, leftovers from dining 14%, and preparing food in excess of needs, 13%.

One aim of the study was to use statistical analysis to distinguish possible demographic factors (income, place of residence, etc.) that might explain the generation of household food waste. We found that the size of the household was directly correlated with waste produced – the more people there were in a household, the more waste was produced. When examining waste per person, we found that singles, in general, produced more waste than others, and single women in particular produced the most food waste.

Alltogether the background factors that were found to correlate with the amount of food waste were:

- Size of household
- Type of household
- Gender of person mainly responsible for grocery shopping
- Respondent's opinion of potential to reduce food waste in one's household
- Appreciation of low food prices
- Respondent's opinion of the effect of purchasing the most appropriate package size

Other demographic factors did not explain food waste in a clear and consistent way. For example, area of residence, educational level of the adults in the family, type of residence (owner occupied/rental), purchasing food daily, distance between home and grocery store, and frequency of home cooking were not connected with the amount of food waste. (Koivupuro et al. 2012).

3.2 Results: food services and catering

In communal food services and restaurants the amount of food waste in relation to prepared food varied depending on the outlet type. Relatively, most food was wasted in communal food

services catering for day-care centres, elderly service centres and hospitals. The least food was wasted in fast food restaurants. Workplace restaurants and canteens, schools, cafes, restaurants, and diners fell between the two (Fig 1).

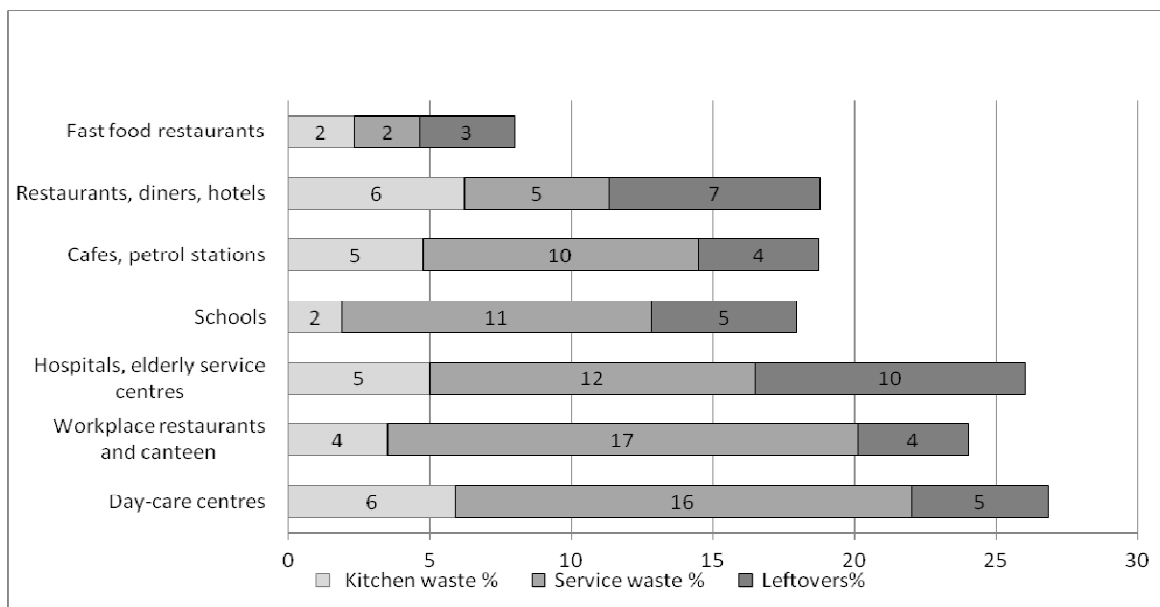


Figure 1. Estimates of food waste in restaurant food services and the sources of avoidable food waste. Results of the measurements done in the study were extrapolated in order to reflect the whole Finnish restaurant sector (share of the food produced).

Food waste in restaurants was influenced by restaurant type, and there was a clear difference between à la carte restaurants and buffet type restaurants. With self-service buffets the main cause for food waste was service waste; cooking too much food. This results from, for example, the difficulty in estimating consumption. Also, the management of kitchen processes, commitment of staff and legislation, which sets strict rules on how food served from heaters may be further processed, has an impact on the amount of food waste. In Finland the majority of restaurants serving lunch (e.g. workplace restaurants and canteens, school diners, etc.) use self-service buffets.

In the catering business 25% of all food is served through licensed restaurants, hotels and catering services. During the study we found that the restaurants representing this sector discarded 19% of all produced and served food. Of that 6% was kitchen waste, 5% service waste, and 7% leftovers. From these results we can deduce that in Finland food waste in licensed restaurants totals about 18–20 million kg per annum (Fig. 2).

Workplace restaurants and canteens serve 14% of all food in the Finnish restaurant sector. In these establishments 24% of food became waste, divided as follows: kitchen waste 3%, service waste 17%, and leftovers 4%. These results indicate that workplace restaurants and canteens produce 13–16 million kg of food waste annually.

In the fast food sector food waste was only 7% of all handled food, 2% of this was kitchen waste and 3% leftovers, and 2% service waste. The results translate to nationwide annual food waste of roughly 3–4 million kg (Fig. 2).

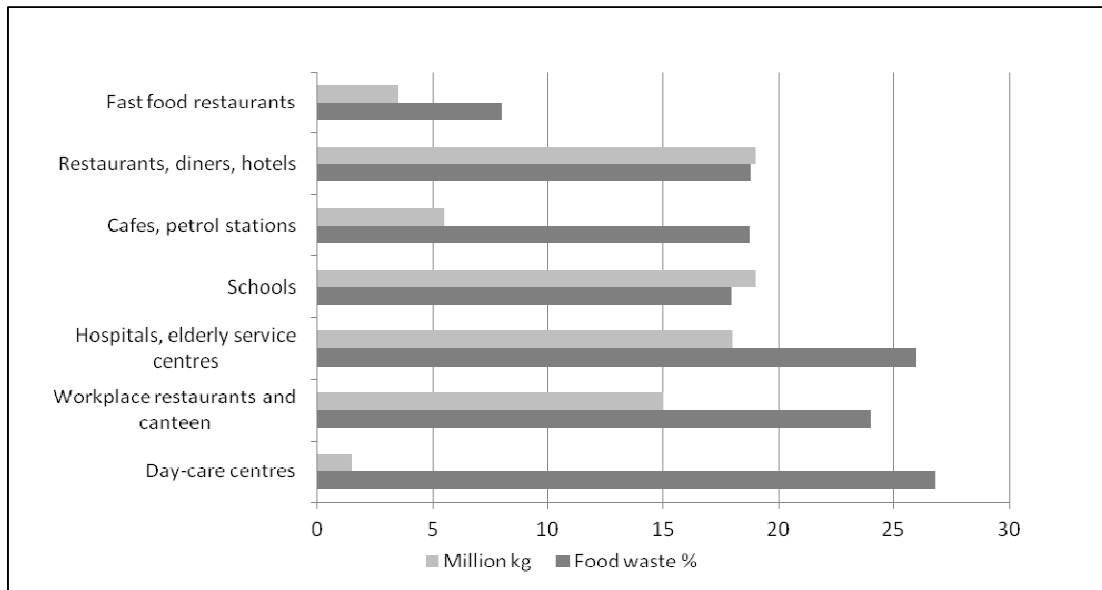


Figure 2. The amount of food waste in the restaurants covered in the study, extrapolated to describe annual food waste for the whole catering sector.

When examining all restaurants, service waste generally formed the main part of food waste. The main difference between self-service restaurants and restaurants where food was prepared to order was that in the latter the main form of food waste was leftovers. However, the amount and type of leftovers varied noticeably from one restaurant to another, depending on the restaurant's business model and type, which in turn determined the portion sizes and the menu (Fig. 3, 4).

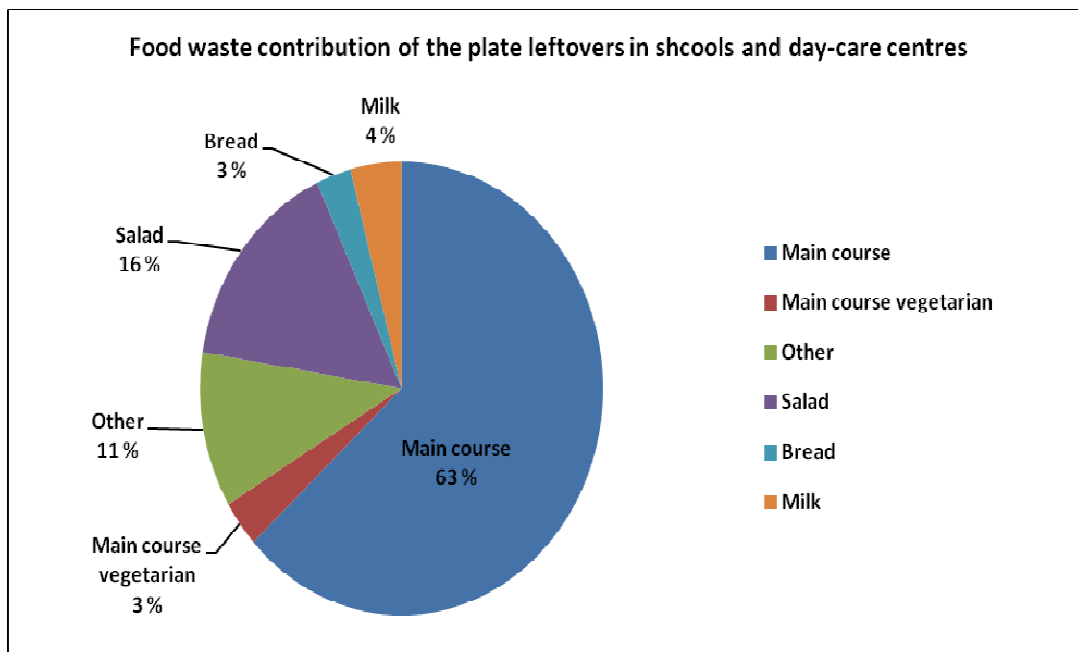


Figure 3. Food waste contribution of the plate leftovers in schools and daycare centres.

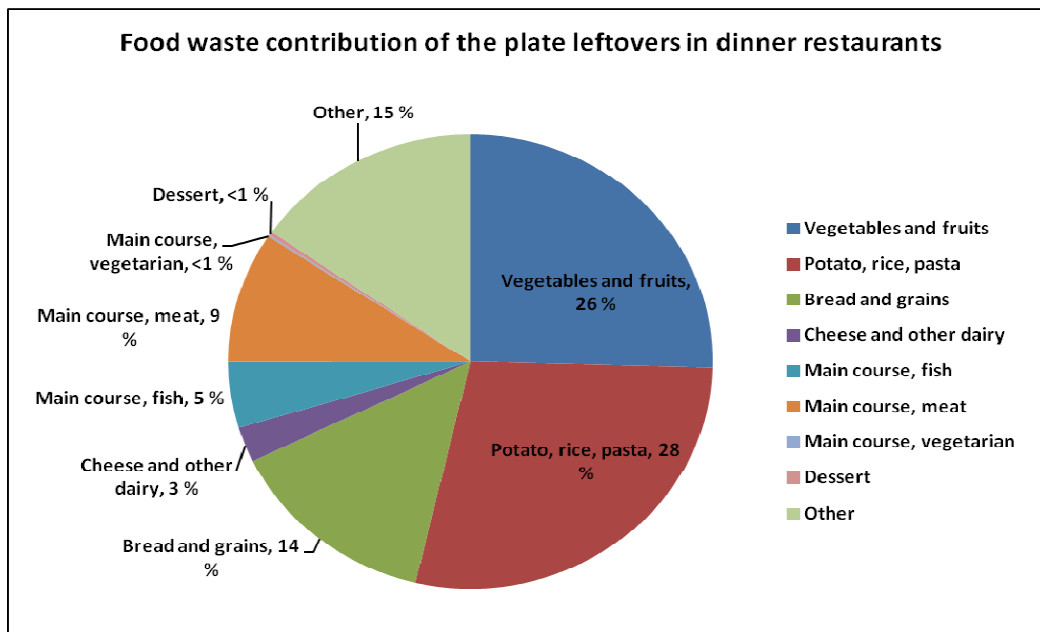


Figure 4: Food waste contribution of the plate leftovers in dinner restaurants.

3.3 Results: food waste in retail stores and food industry

According to interviews, we estimated the total food waste of the Finnish wholesale and retail business to be 65 – 75 million kg annually; 12–14 kg per Finnish citizen. The main product groups contributing to food waste in stores were fruits, vegetables and bread. Other products resulting in waste were dairy products, fresh meat and fish and convenience food. Pursuant to Finnish Law, perishable products may not be sold after ‘best before’ or ‘use before’ dates, when they are to be removed from the shelves. The least food waste was found for tinned goods, dried or frozen food and other non-perishable goods. These product groups were identical in all Nordic Countries (Stenmark et al. 2010).

Based on the calculations made in this study, 75–140 million kg of edible food is wasted annually in the Finnish food industry. This corresponds on average to roughly 3% of the total production volume of industry sectors included in the study. Not all of the edible food wasted in the sectors included in the study is included in the estimate because the share of edible material in some side-streams could not be evaluated based on the data obtained for the study. The types of side-streams which were excluded from the calculations were those from the sorting and peeling of vegetable and fruit, hull and bran material from cereal milling, and side-streams from slaughtering (blood, intestinal organs, skins etc.). In order to get more accurate results there is need for further research. Research should be targeted particularly at the sectors for which a lot of food waste may be generated but from which no corporate-specific data were obtained for this study (cereal milling, vegetable and fruit processing, slaughtering).

The results of the project suggest that every year consumers, food services, retailers and the food industry produce a combined waste of 250-320 million kg in Finland, 62–86 kg for each Finnish citizen.

4. DISCUSSION

Finnish households buy on average 500–600 kg of food per person annually (Tike 2010, Viinisalo et al. 2008). When comparing amount of purchased food to food waste (23 kg/person),

we get an average waste value of ca. 4–5%. According to the results of this study the food waste of Finnish households totals 120–160 million kg per annum. This is about double the amount of food waste in the retail (65–75 million kg) and food service sector (75–85 million kg).

4.1 Environmental and economic consequences of household food waste

In our study we also made a rough estimation of the climate impacts of household food waste by food type categories using numerous data sources to estimate the climate impact for different food product categories (Katajajuuri 2009, Pulkkinen et al. 2011, Usva et al. 2009, Williams et al. 2006).

In general, animal products, such as meat, dairy, and cheese, represent a relatively large carbon footprint when compared per kilogram of product. We noticed that even if pork and beef products amounted to only 4% of all discarded food, the carbon footprint of waste was one of the highest for all food categories. For example, discarded cheese amounted to less than 2% of total food waste, and yet it represents a relatively large carbon footprint, almost equalling that of discarded vegetables. These issues are important to bear in mind when planning waste prevention initiatives. According to the estimate made in this study the climate impacts of the food annually discarded from Finnish households is roughly equal to the annual carbon dioxide emissions of 100,000 cars.

Examining the economic perspective of food waste, we find every year that the average household uses €4,300 for purchasing food, of which the value of discarded food is €220. Thus, annually the total value of food waste from Finnish households is estimated to be roughly €550 million (OFS 2011, Viinisalo et al. 2008).

When studying the contribution of different categories, the result is quite similar to the carbon footprint: the biggest economic value categories were home-cooked food, pork, beef, vegetables and bread.

4.2 Food waste in food services

Communal food services are an integral part of Finnish food culture as they provide up to half of the meals consumed outside the home. One third of the population uses communal food services daily, and all Finnish schools serve their pupils free lunch. School meals do not have only a nutritional value, but also serve a pedagogical purpose: children and young adults learn to eat a varied, balanced diet. This may result in additional food waste, but it also offers an opportunity to learn behavioural models and get acquainted with various cuisines. Finnish schools also teach all pupils home economics, where they learn about sustainable use of resources and reducing food waste.

We established that the distribution of waste in communal food services depended on how catering was organized. In general, food waste in cooking was relatively low, as were leftovers, especially when catering was provided for municipal employees or in workplace restaurants and canteens. In restaurants, diners and fast food restaurants the amount of leftovers was larger. Leftovers discarded by customers varied from 4% to 8%, which is less than recorded in international studies (Engstrom and Carlsson-Kanyama 2004, The School Food Trust 2009). Overall, the majority of food waste was generated by cooking too much food, which could not be stored or served as a different dish later (Fig.1).

Swedish studies of food waste in the food service sector have had two kinds of result, depending on whether most food waste consists of leftovers or originates from cooking and serving (Karlson 2001, Naturvårdsverket 2009). In our study we found that in general most waste was generated in serving, notwithstanding licensed establishments, fast food restaurants and hospitals, where leftovers formed the main part of food waste. In the first two, this is due to

ordering the food instead of using self-service, whereas in the hospitals it resulted from difficulties in estimating portion sizes and food consumption.

From our study we can deduce that one of the main challenges in reducing food waste will be minimizing service waste. Based on the workshops among restaurant company representatives, this could be achieved by having a good estimate of the number of diners and careful menu planning. One solution to these problems would be getting to know the clientele and interacting with them, as well as cooking in stages. The latter could be difficult to organize, due to the limited workforce, and would require motivation and commitment from the personnel. Also careful planning of the menu and identifying correct portion sizes would help reduce waste.

Ultimately, reducing food waste boils down to simple measures: careful planning, good management, and documenting food waste data, which helps to identify the restaurant's food waste sources and forms a basis for finding solutions. Regular weighing allows for observing the changes in food waste, and identifying the most vulnerable areas in each restaurant. This cannot be substituted by personal estimates of food waste, as those reflect poorly the actual amounts. A recent study revealed that personnel in communal food services estimated their biowaste amounts to be significantly lower than the results of this study point at – evaluating it as usually to be only 0–5%, though the variation in estimates was marked (Risku-Norja et al. 2010).

4.3 Retail stores and waste management

Based on the retail representative interviews, consumers expect shops to offer an extensive selection of goods throughout their business hours, so for example fresh bread must be on offer even when the store is about to close. This makes estimating sales difficult, and sometimes retailers may even aim at only controlling their wastage instead of greatly reducing it. The challenge in minimizing food waste lies in estimating sales, and the unpredictability of the consumers - even changes in weather or events close by the store can affect the sales. In order to match supply and demand, the stores use various predictive and logistic systems for handling their orders. In this a key factor is seasoned and professional personnel. The range of goods in the store has to be properly planned for the needs of the customers living in the area. For example, there are great differences in consumer habits between northern and southern Finland.

The retail sector aims at maximizing sales and profits, yet it is not always possible to add waste reduction to this equation. Naturally, stores try to minimize their waste whenever possible to achieve cost efficiency. However, the retailers value more serving the customer and managing overall wastage. In recent years waste from Finnish retail stores has been decreasing, and electronic ordering and efficient logistics may continue to reduce the amount further.

Increasing sales requires balancing consumer wishes against minimizing waste. Indeed, the reasons behind waste lie mainly in consumer behaviour and store sales promotion, which includes, among other things, offering an extensive selection.

In the study the interviewees were asked what measures could be taken to reduce food waste in retail stores.

- Products close to due date could be sold at discount more often, so that the consumers would buy products that would otherwise end up as waste. This practice could be implemented in most of the retail chains. However, the discount system is not viable if the store or retail chain business model is based on emphasizing quality and freshness.
- Donating still edible but unsold goods to the needy should be made easier, and food that has passed 'best before' date should be used more efficiently, for example bakery products and vegetables as animal food. This would prevent food being wasted.
- Packaging and package size matters: a well-designed package made from an appropriate material preserves the food optimally, while protecting it during transportation. Correct package size helps the consumer buy a suitable amount of food for their household.

The interviewees saw that a good way of reducing waste would be to influence the attitudes of the consumers, making them more aware of the importance of the issue. The consumers could give shops feedback to let them know that they value reducing waste, and that they want to patronize business chains that take this matter seriously.

5. CONCLUSIONS

To sum up, the results of the project show that approximately 335 - 460 millions kg and about 60–90 kg/capita/year of food are wasted in Finland every year by consumers, restaurants and food services, retailers, and food industry (Table 2).

FAO has stated that roughly one-third of edible food parts get wasted in the food chain, altogether even 300 kg/capita/year (Gustavsson 2011) and according to the study ordered by the European commission (2010) food waste in the entire chain is about 180 kg/cap/year. In our study we found the values significantly lower than findings in other countries (eg Jones 2005, Knudsen 2009, KFS 2009). Further more, when we studied food waste amounts in restaurants, and workplace restaurants and canteens, the results were about same, lower than other countries. (Engstrom 2004, The School Food Trust 2009). In addition also a recent Finnish biowaste analysis study had similar, moderate low food waste amounts (HSY 2011). In order to paint a more reliable and comprehensive picture of the volume and composition of food waste in different sectors of food supply chain we still need more information and complementary studies.

After all, the final goal of avoiding food waste is to increase sustainability in the food supply chain. Improving the efficiency in food production and consumption, as well as a change in general diet in the western countries is vital to ensuring the future food supply for up to 9 milliard people in the future.

Table 2: Food waste in the Finnish supply chain.

<i>Sector</i>	<i>Households</i>	<i>Food services</i>	<i>Retail sector</i>	<i>Food industry</i>	<i>Total</i>
Total m kg/year	120–160	75–85	65–75	75–140	335–460
<i>Sector</i>	<i>Households</i>	<i>Food services</i>	<i>Retail sector</i>	<i>Food industry</i>	<i>Total</i>
Per person kg /year	22–30	14–16	12–14	14–26	62–86

REFERENCES

- Engstrom, R. and Annika Carlsson-Kanyama, A. (2004). Food losses in food service institutions: Examples from Sweden. *Food Policy*, vol. 29, n. 3, 203-294.
- Gooch, M., Felfel, A. and Marenick, N., (2010), *Food waste in Canada Value Chain Management Centre*; George Morris Centre.
- Gustavsson, J., Cederberg, C., Sonesson, U., Otterdijk, R. and Meybeck, A. (2011). *Global Food Losses and Food Waste*. FAO Rome, Italy. 2011
- Initiatives on Prevention of Food Waste in the Retail and Wholesale Trades. Report. Swedish Environmental Research Institute. Juni 2011.
- Jones, T. (2005). *Using Contemporary Archaeology and Applied Anthropology to Understand Food Loss in the American Food System*, Bureau of Applied Research in Anthropology,

University of Arizona, Tucson.

Karlsson, R. (2001). Svinn i storhushåll. Stockholms universitet.

Katajajuuri, J.-M. (2009). In Government Foresight Report on Long-term Climate and Energy Policy: Towards a Low-carbon Finland.

KFS Konsument Föreningen Stockholm, (2009), Rapport från en slaskhink.

Knudsen, M. L. C. (2009) Affaldsforebyggelse i husholdninger – muligheder og barrierer for Danmark. Roskilde University, Specialreport, December.

Koivupuro, H., Hartikainen, H., Katajajuuri, J.-M., Silvennoinen, K., Heikintalo, N. Reinikainen, A., and Jalkanen, L. (2011). Influence of socio-demographical, behavioural and attitudinal factors on the amount of avoidable food waste generated in Finnish households. *International J Consumer Studies*, vol. 36, n. 2, 183 - 191.

Kujala, H. 2009. Biojäte Tampereen yliopistollisen sairaalan keskussairaalan poti-lasruokailussa. Opinnäytetyö. Pirkanmaan ammattikorkeakoulu.

Natursårdsverket (2009). Minskat svinn av livsmedel I skolkök. Rapport 5979. Naturvårdsverket 2009.

OFS Official Statistics of Finland (2011): Annual national accounts [e-publication]. Helsinki: Statistics Finland. Available at: http://www.stat.fi/til/vtp/index_en.html.

Pulkkinen, H., Hartikainen, H., Katajajuuri, J.M. (2011). Elintarvikkeiden hiilijalanjälkien las-kenta ja viestintä. MTT raportti 2011.

Risku-Norja, H., Kurppa, S., Silvennoinen, K., Nuoranne A., Skinnari, J. (2010): Public catering and Food Education: Towards Sustainable Food Provisioning via Everyday Practices. MTT kasvu 10.

Seppälä, J., Mäenpää, I., Koskela, S., Mattila, T., Nissinen, A., Katajajuuri, J.-M., Härmä, T., Korhonen, M.-R., Saarinen, M., Virtanen, Y. (2009) Environmental impacts of material flows caused by the Finnish economy. *Suomen ympäristö 20/2009*, 134 s. (SYKE).

Silvennoinen, K., Katajajuuri, J., Hartikainen, H., Jalkanen, L., Koivupuro, H., Reinikainen, A. Food Waste Volume and Composition, Case Study Finnish Households.

Stenmark, Å., Hanssen, O., Silvennoinen, K., Katajajuuri, JM. & Werge, M. (2011).

Tarvainen, M. (2009). Rokka rikassa – Pääkaupunkiseudun lapsiperheiden ruokajätteet. The Food wastage surveys and food wastes generated by families with children in the metropolitan area. YTV 25/2009. Helsinki 2009.

The Nielsen Company (2008). Horeca rekisteri 2008.

The School Food Trust (2009). The Primary School Food Survey. Research Report. Available ta: <http://www.schoolfoodtrust.org.uk/school-cooks-caterers/reports/primary-school-food-survey-2009>

Tike (2010). Balance Sheet for Food Commodities 2008 and 2009 (preliminary). Available at: <http://www.maataloustilastot.fi>

Usva, K., Saarinen, M., Katajajuuri, J.-M. & Kurppa, S. (2009). Supply chain integrated LCA approach to assess environmental impacts of food production in Finland. *Agricultural and Food Science* 18, 3-4: 460-476.

Viinisalo, M., Nikkilä, M. & Varjonen J. (2008). Elintarvikkeiden kulutusmuutokset kotitalouksissa vuosina 1966–2006 . Abstract: Changes in the consumption of foods in households during the years 1966–2006. National Consumer Research Centre, publications 7 2008

Williams, A.G., Audsley, E. & Sandars, D.L. (2006). Determining the environmental burdens

and resource use in the production of agricultural and horticultural commodities. Main Report. Defra Research Project IS0205. Bedford: Cranfield University and Defra.

WRAP (2008). The food we waste. Waste and Research Action Programme. Banbury, UK. 2008. 236 p

WRAP (2009). Household Food and Drink waste in the UK. Final report. 94 p. Available at: <http://www.wrap.org.uk/>

WRAP (2011). The Composition of Waste Disposed of by the UK Hospitality Industry. Final report. 129 p.

YTV (2006), Factors affecting the household waste amounts in the Helsinki metropolitan area. YTV Helsinki Metropolitan Area Council.