

Food Waste Minimization in the Cam- pusravta Restaurant

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Bachelor's thesis
May 2014
Environmental Engineering

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ABSTRACT

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This thesis work was done as part of the European Week for Waste Reduction (EWWR) initiative to reduce the food waste amounts in the Campusravita restaurant. The Campusravita restaurant is the student and staff restaurant in Tampere University of Applied Sciences. The aim of this work was to measure the amounts of biowaste produced by the customers of the restaurant, and then try to decrease this amount. An information campaign throughout the dining hall was launched to raise the awareness of the customers and reduce the amounts of biowaste produced. Finally, the overall amounts of biowaste were compared with the amounts found for a study done in 2009, to see the long-term trend in biowaste quantities.

In the theory part of this thesis, the restaurant itself and EWWR are introduced to the reader. The amounts of food waste worldwide and in Finland are discussed, in order for the reader to appreciate the importance of its reduction. Most of these data were gathered from similar studies done earlier. The environmental effects of food production and wastage are also discussed in brief.

The results of the study show that each customer of the Campusravita restaurant produces about 22-29 grams of biowaste per meal. This amount includes tissue paper napkins, the weight of which is hard to determine exactly. Altogether the measurements were done for 4 weeks, over which period the total amount of biowaste produced varied between 200 and 300 kg per week. This amount largely depended on the number of customers that ate at the restaurant in the particular week. Furthermore, the results showed a considerable decrease in total biowaste produced in the restaurant compared with the data from 2009. However, this comparison is not exact since the measuring methods varied considerably. Overall, the impacts of EWWR can be considered successful since the amounts decreased over the four-week period of the study. However, here too further study would be necessary to confirm the data. To further reduce the amounts of biowaste produced by the customers, permanent initiatives are suggested in this thesis. These include rearranging the layout of the lines where food is taken, and placing permanent signs to raise customer awareness.

Key words: biowaste, Campusravita, EWWR, waste reduction

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GLOSSARY

TAMK	Tampere University of Applied Sciences
EWWR	European Week for Waste Reduction
GHG	Greenhouse gases
TAMKO	Tampere University of Applied Sciences Students' Union

1 INTRODUCTION

With the growing world population and increasing prosperity food production and related human activities are some of the most pressing issues regarding environment today. Food waste constitutes large part of the overall waste produced, which means that the resources used for production of this food are used in vain. European Week for Waste Reduction is an annual initiative, which promote sustainable resource and waste management. Tampere University of Applied Sciences takes part in this initiative and this year attempted to minimize the food waste produced on campus restaurant- Camusravta. The amounts of biowaste were measured before launching an informative campaign to raise customer awareness about food waste. The food streams and food waste management systems in general were examined to paint a more detailed picture of the issues and possible improvements that can be done in the on-campus restaurant.

2 THEORY

This part will give the necessary background information to fully understand the importance of food waste and its reduction. What is biowaste and exactly how much of it is produced worldwide will be discussed below. The Campusravita restaurant and European Week for Waste reduction will be introduced to the reader.

2.1 Biowaste

Biowaste is organic, compostable and solid material that may contain food leftovers, spoiled food, fruit and vegetable peels, eggshells, coffee filters, coffee grinds, tea bags, paper towels, flowers and leaves (Pirkanmaan-Jatehuolto). For further reference avoidable biowaste such as spoiled food and food leftovers will be referred to as food waste, while the mix of food waste with other compostable materials will be referred to as biowaste. Food waste then can be further divided into waste occurring early in the supply chain during agricultural production, harvesting and processing and waste produced during final preparation and consumption (Gustavsson et al. 2011). Majority of biowaste collected in Finland is locally composted and is diverted from landfills. The manner in which biowaste must be treated in Finland is regulated by the Waste Act.

In Pirkanmaa region, where Campusravita is located, nearly all biowaste that is source separated is brought to Tarastejärvi composting site. In the composting plant the biowaste is mixed with coarse wood chips before being crushed into fine, homogenous material. The fine mass is then placed in tunnel composting units, where the initial biodegradation process begins. Sufficient amount of oxygen and moisture is provided to ensure suitable environment for the microbes and bacteria that help the composting process. Biowaste remains in these tunnel units for three weeks and can reach temperatures of up to 70 degrees Celsius. After the initial three weeks the compost is transferred to outdoors composting piles where it undergoes further biodegradation for about 2 years. The ready compost is screened before sand and moraine soil is added to it. The ready product can then be used as landscaping mulch. (Pirkanmaan-Jatehuolto)

2.2 Food waste amounts

Food waste is a huge contributor to the overall municipal waste stream, globally about 1.3 billion tons of food are wasted each year, which is approximately one third of all food produced. This food waste is produced throughout the supply chain and accumulates from initial agricultural production to the food wasted by the final consumers. Depending on the income levels within, the country the stage where the food is wasted changes from early in the supply chain in low-income countries to late in the chain in high-income countries. In medium-income and high-income countries the main reason for the food loss and waste is related to consumer behaviour and poor coordination within the supply chain of food. Careless attitude towards food waste in high-income countries due to affordability of food largely attributes to the high waste amounts. This waste contains mostly food suitable for human consumption and therefore can be reduced by raising awareness about food waste and changing consumer behaviour. It is estimated that in Europe and North America consumers waste some 95-115 kg of food per-capita annually. (Gustavsson et al. 2011, p.5-6)

The current practices are unsustainable both from economical and environmental point of view. To account for the ever-increasing population of our planet more and more food will need to be produced, putting greater strain on our limited resources such as land, water, energy and fertilizer. Reduction in food loss and food waste can provide some relief for this strain and therefore should be a priority in food security. (Silvennoinen et al. 2012, p.6-7)

A study done by MTT Agrifood Research Finland looked into 380 households and 72 restaurants to determine food waste volumes and composition in Finland. It concluded that on average each person in Finland wastes 23 kg of food annually while the whole food service sector wastes around 75-85 million kg of food annually. According to the study: *“This covers about 20% of all food handled and prepared in restaurants and catering business. The finding also suggests that the main reason for the food waste in the sector is buffet serving loss”* (Silvennoinen et al. 2012, p.1). Based on these estimations the study concludes that the whole food sector wastes up to 460 million kg of food annually. The amounts of food waste produced in restaurants changed depending on the type of restaurant indicating clear difference between a la carte restaurants and buffet type restaurants. In Finland buffet type restaurants are most common in workplaces,

schools and universities accounting for about 14% of all food served in food sector. The study found that these types of restaurants waste about 17-24% of all food handled from which 4% can be accounted to customer leftovers. (Silvennoinen et al. 2012, p.7)

2.3 Environmental impacts of food production and food waste

Environmental impact and sustainability is a major concern related to food production. Nitrous oxide, methane and carbon dioxide are the biggest contributors to global warming and are all related to food production in various ways. In addition to global warming food production contributes to eutrophication of water by the runoff water from farms lowering the dissolved oxygen concentration in the water disturbing the natural aquatic ecosystems. Furthermore the production of food requires large areas of land leading to deforestation and causing even further detrimental effects on the environment. All these factors make food production and consumption a large element in overall environmental impact from human activities. In Europe meat and dairy product consumption alone contribute for 14-35% of environmental impact in categories like acidification, eutrophication, global warming and land occupation. (Baldwin 2012, chapter 5) In North America food production accounts to 50% of land use, 80% of freshwater use and 17% of fossil fuel use from the total use in the country (Pimentel, 2003). If one third of all food produced is wasted then one third of the land, freshwater, fossil fuel and fertilizer used to produce this food is lost, rendering the negative environmental impacts even more senseless. In addition to wasted resources this food then becomes waste and has further negative impacts when disposed of. According to some estimates avoidable food waste from consumption accounts for 2-3% of all GHG emissions in UK and Sweden (Silvennoinen et al. 2012, p.6-7). In many parts of the world the food waste ends up in landfills and undergoes anaerobic decomposition releasing methane, which is a harmful greenhouse gas 23 times more potent than carbon dioxide. (Unep)

In Finland, as well as in EU in general, food, along with transportation and housing accounts for up to 70% of climate impact from consumption of goods. Food and beverages account for 35% of all climate impact from consumption, while restaurants and bars alone account for 9% of all climate impact from consumption. (Seppälä et al. 2009, p.70-71) From overall impact on environment from consumption of goods, food constitutes one third. In addition to burden from food production on environment, transporta-

tion of the goods have considerable environmental effects too. In Finland the volume of imported food has doubled in the last decade and amounted to 2.3 million tons in 2011 (Statistics Finland 2011). Even though the biowaste in Finland is disposed using sound methods the overall impact on environment from food waste is considerable.

2.4 Campusravita restaurant

Campusravita is the student and staff restaurant at Tampere University of Applied Sciences main campus at Kuntokatu 3. Each day there is a variety of alternatives to choose from, including vegetarian, soup and salad options. There are 6 different lines offering different options at different times of the day. The lunchtime is from 10:30 – 14:30, Monday through Friday there is also afternoon food available between 15:30 – 17:30. The meal consists of main course, beverage, bread and spread and salad buffet. Throughout the day warm sandwiches and baked goods are available. (Campusravita)

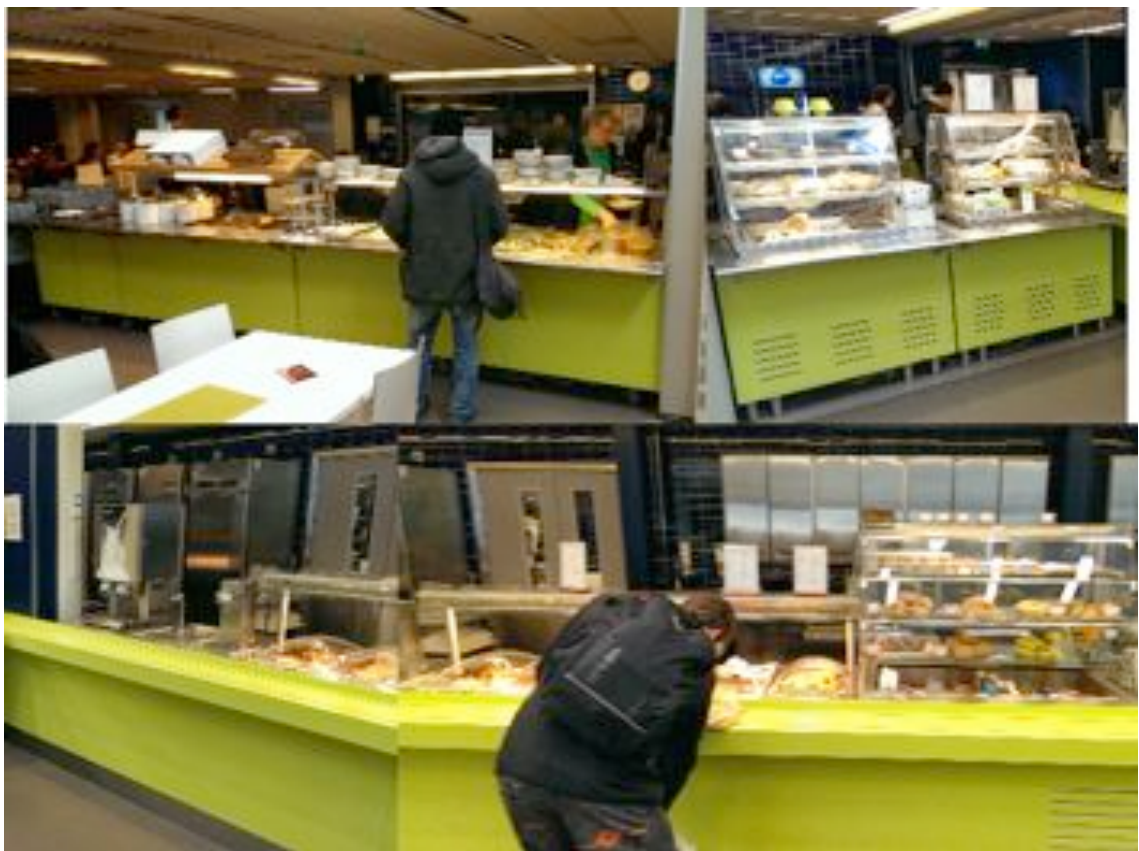


Figure 1. One of the main lunch lines at Campusravita restaurant

The restaurant is mainly buffet type, self-service and the amount of side dish, bread and salad are unlimited, while the main dish usually has limitations such as number of pieces per meal. One of the main lunch lines can be seen above in figure 1. Customers take a tray and utensils at the beginning of the line and proceed to the checkout and take their choice of food as they move along as seen in figure 1. After the meal customers return their dirty dishes as well as any waste to one of the three return points on the campus indicated in figure 5. Each of the return points have two separate waste bins, one for biowaste and one for mixed waste. Customers are encouraged to put paper tissues in the biowaste along with the food leftovers. One of these points can be seen in figure 2 below.



Figure 2. Return point for dirty dishes and waste

The biowaste collection in Campusravita is based on a vacuum conveying technology, where the waste is sucked from multiple inlets within the kitchen area to one single waste container. There are 4 cyclone shaped inlets, one behind each of the return points and one in the kitchen. Customers use regular bins to discard biowaste, which is then transferred to the vacuum system by kitchen staff. The vacuum system conveys the biowaste to an extraction station, where the excess liquid from the biowaste is removed before storing it in the storage container. This system is both more hygienic and effective as well as cost efficient. The large container can store more waste for longer period of time saving money on collection costs. In addition there are no waste bins in the kitchen, which mean better ergonomics for the employees. (Ecosir)

2.5 European Week for Waste Reduction

European Week for Waste Reduction (EWWR) is a project co-financed by European Commission aimed at raising awareness about sustainable resource and waste management during a single week. The EWWR promotes various audiences such as public authorities, private companies, civil society and citizens generally to take part in actions and events to raise awareness about and reduce waste. During the week in November the participating parties implement countless events throughout Europe and elsewhere to raise awareness about waste reduction, product reuse and materials recycling. (EWWR) Figure 3 below illustrates the three R's: reduce, reuse and recycle, principles that are the three pivotal messages of EWWR in a hierarchical manner based on their importance.



Figure 3. Hierarchical aims of EWWR (EWWR)

Tampere University of Applied Sciences (TAMK) participated in the EWWR 2014 taking place 22 – 30 of November. Informative campaign aiming at reducing customer created food waste in Campusravita restaurants was among the initiatives done by TAMK. The aim of this campaign was to raise awareness of the customers about the amounts of the food wasted, promote reduction of the food wasted and improve the signs indicating which waste should be discarded in which bin to ensure maximum recyclability.

3 METHODS

3.1 Weighing of the biowaste

Biowaste produced by the customers in Campusravita restaurant was weighed for 4 weeks altogether. First the biowaste was weighed for three consecutive weeks from 11th until 29th of November 2013 and then for another week from 3rd until 7th of March 2014. In the first phase the biowaste was weighed for one week to gain a reference value of a regular week in the restaurant, followed by the European Week for Waste Reduction (EWWR) during which an informative campaign was launched in the restaurant to promote food waste reduction. The biowaste was further weighed for another week after EWWR to observe the results of the informative campaign. During the first week customer behaviour and habits were observed to note any issues in the procedure how the dishes and waste are collected. In the second phase the biowaste created by customers of Campusravita was weighed for a week to verify the previous results and observe any long-term effects of the informative campaign conducted during the EWWR.

There are three different locations within Campusravita restaurant where customers can return dirty dishes and discard their waste. In figure 5 you can see the layout of one of these points from the view of employee of Campusravita. Customers discard the biowaste into biowaste bins and when the bins are full employees of Campusravita empty them into the vacuum conveying system seen in figure 5. During the weighing process no extra work was required by the customers or employees. The contents of the biowaste bins were simply weighed before being disposed of in the vacuum system. Metos scale with precision of 50 g and range 1-150kg was used to do the measurements.



Figure 4. Scale used for experiment, vacuum shoot and biowaste bin from employees point of view.

Weight of the biowaste was measured and the waste discarded twice a day in each of the return points indicated in figure 5 by the red and orange circles. In one of the locations indicated by the orange circle in figure 5 the biowaste was measured three times a day since that part of the restaurant is open later in the evenings. The content of the waste was observed for any patterns or abnormalities. The waste amounts then were compared to the amount of people dining each day in the restaurant to illustrate the data in the most representative way. The data was then compared to other studies done earlier.

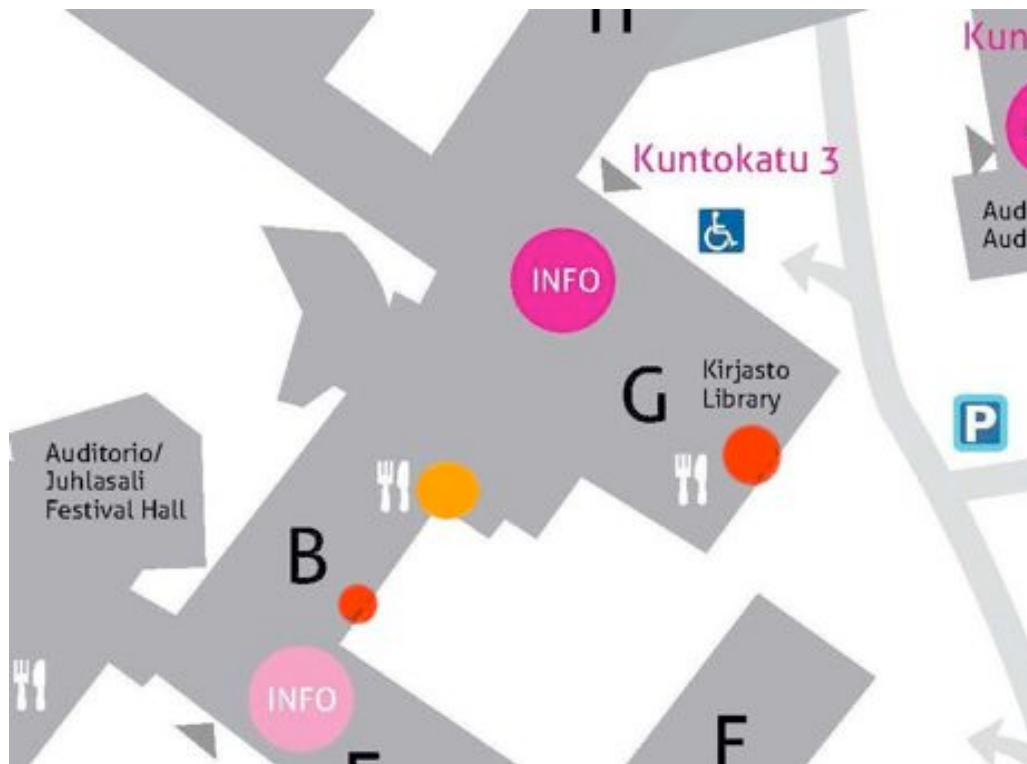


Figure 5. Layout of the dirty dish return points indicated in red and orange ()

The kitchen biowaste was measured for one week from 3rd until 7th of March 2014 to obtain a general picture of total amount of biowaste produced in Campusravita restaurants. Most unavoidable waste such as coffee ground, bones and peels was not taken into account in these measurements. When measuring the kitchen waste only leftovers and waste produced during food preparation were taken into account. Waste from dirty kitchenware was omitted too. Bins were placed next to the vacuum system shoots to collect the kitchen biowaste. The kitchen staff discarded all biowaste from the kitchen in the bins instead of the vacuum shoots.

3.2 Informative campaign

During the informative campaign a poster was designed to raise awareness about food waste and promote its reduction. During EWWR the poster was placed around the Campusravita restaurants dining halls. The poster was placed in well visible places where people line before taking food. During lunch customers are lining and waiting idle for the line to move, giving them a chance to read the poster before taking the food. In addition posters displaying the amount of biowaste produced in previous days or weeks were posted at the points where dirty dishes are returned and biowaste discarded

indicated in figure 5. These posters were placed so that they are visible while people are discarding their biowaste or lining to do so.

3.2.1 Main poster

In figure 6 below you can see the poster that was displayed near where people line before taking food. In our modern society people are overwhelmed with information and tend to focus on one thing for very short time therefore the poster had short texts in large font to catch customer attention. The three suggestions to customers were: don't take more food than you can eat, finish your plate and discard the leftovers in the appropriate waste bin. Below these three rules were some facts about the total amount of waste created at Campusravita restaurant annually and warning that food waste has negative effects on environment.

The aim of this poster was to raise awareness of the customers and hopefully initiate a more responsible way of thinking. Most people are aware that food wasting has negative impact on environment, however they tend to not think about it on a daily basis. There is a class of people who simply won't care but those who do will pay more attention to their behaviour, both on campus and in their private lives, if they are occasionally reminded of the negative impacts of food wasting. It is possible that some of the customers want to be more responsible but simply has never thought that the bits of food they throw out has such an impact.



Figure 6. Main poster for EWWR displayed in Campusravita restaurant

3.2.2 Poster displaying the amounts of biowaste created by customers

The poster displayed at the dirty dish return points above the biowaste bins can be seen in figure 7. Since the biowaste was weighed every day, the poster was updated each day and the new poster displayed in all three locations where the dirty dishes are returned and biowaste discarded. Similarly to the main poster this poster portrayed the information in a way that can be absorbed within seconds. A simple bar chart with kilograms per day of biowaste created caught the attention of many people discarding the bio-

waste. The poster in figure 7 is the final poster displayed after the first three weeks of measuring the biowaste created by customers of Campusravita.

The poster is a continuation of the theme present in the main poster. This poster shows that even the small bits and pieces that people discard in the biowaste amounts to considerable quantity of food wasted. The customers of Campusravita will be reminded about the food waste both when they take the food and when they discard it, showing them that they are part of this problem.

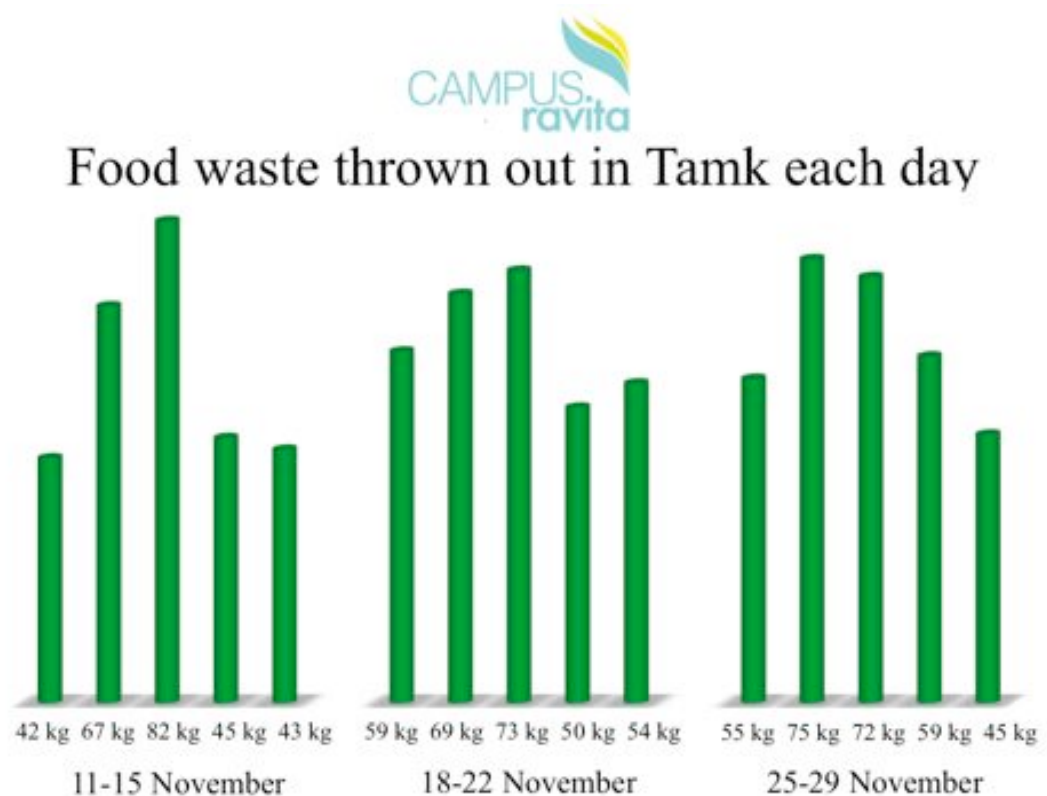


Figure 7. Poster displayed at the dirty dish return point during the study

3.2.3 Waste-bin signs

During the first weeks of data collection it became obvious that better signs need to be produced indicating what waste should be discarded in which bin. The previous signs were all black, with no images and sometimes lacked the translation in English. Since the bins for mixed waste and biowaste are identical the signs were placed in the eyesight level above the bins. The new signs contain pictures indicating what waste should be discarded in which bin and are colour coded – green for biowaste and black for mixed waste. The new signs for each of the waste bins can be seen in figure 8. It was important

to place images of waste actually created in Campusravita restaurant on the poster. The tissues and plastic wrapping on the posters were photographed from the restaurant's waste. This way the customers don't need to read any of the text or pay attention to what goes where, they simply see the picture of what should be put where.



Figure 8. New signs indicating what waste should be discarded in which bin

3.3 Data analysis

Initially the amounts of biowaste weighed in each of the locations were compiled to see the total amount of biowaste produced by the customers of Campusravita each day. Then based on the data from cash register the amount of biowaste produced per customer was calculated by dividing the total amount of biowaste created with the number of customers each day. Since data about biowaste created in the afternoons were not collected every day the missing figures were estimated based on all the existing figures. This was done by calculating the average percentage of biowaste discarded in the afternoons and then applying this percentage to the days where the data were missing. The overall amounts of biowaste created each day and week and the amounts of biowaste created per customer were then presented graphically.

The amounts of kitchen waste were added to the amounts of biowaste discarded by the customers to see the overall amount of biowaste created each day. These amounts were then compared to the available data from 2009. The number of customers has changed therefore some estimation had to be made.

3.4 Interviews

The restaurant manager Jaana Ahonen was interviewed to gain an overall picture of the waste streams in Campusravita and the daily challenges that the restaurant faces regarding biowaste. Property manager of Tampere University of Applied Sciences Mikko Luoto was contacted for financial aspects of the biowaste system and other practicalities.

3.5 Observations

In addition to weighing the biowaste it was monitored for any patterns. When discarded the most prevalent elements of the biowaste were noted for future reference. Customer behaviour was observed both before and after the EWW. The customers were observed when taking the food and when discarding it to find any possible methods to reduce the waste produced. Their attention to the informative campaign posters was noted too.

4 RESULTS AND DISCUSSION

4.1 Biowaste created by Campusravita customers

Table 1 shows the amounts of biowaste produced each day by the customers of Campusravita restaurant. The amounts for lunch and dinner waste are shown separately since some of the biowaste values for dinner servings are estimated based on overall values. In addition the average amount of biowaste produced by each customer are shown in last column based on the number of customers served each day. The amount of biowaste produced by customers varies from 30 kg on Mondays and Fridays to 75 kg on Wednesdays. The per customer amounts vary from 16 grams on some days up to 33 grams on other days.

Table 1. The amounts of biowaste created by the customers of Campusravita restaurant

Date	Lunch (kg)	Dinner (kg)	People (n)	Per Person (kg)
11.11.13	35.26	5.21	2480	0.016
12.11.13	60.90	9.00	2510	0.028
13.11.13	75.28	11.13	2334	0.037
14.11.13	38.66	5.71	2400	0.018
15.11.13	36.69	5.42	1900	0.022
18.11.13	53.28	7.88	2224	0.027
19.11.13	62.98	9.31	2535	0.029
20.11.13	66.92	9.89	2299	0.033
21.11.13	43.80	6.47	2350	0.021
22.11.13	47.88	7.08	1534	0.036
25.11.13	48.66	7.19	2420	0.023
26.11.13	68.86	10.18	2691	0.029
27.11.13	65.84	9.73	2088	0.036
28.11.13	52.44	7.75	2412	0.025
29.11.13	39.26	5.80	1972	0.023
3.3.14	37.13	5.83	2085	0.021
4.3.14	40.86	7.05	2230	0.021
5.3.14	46.46	8.50	2435	0.023
6.3.14	52.56	6.48	2365	0.025
7.3.14	30.13	2.76	1660	0.020

The overall values for the biowaste created by Campusravita customers are clearly correlating with the number of customers served each day. This can be seen from the consistent data in last column of table 1, however some outliers can be seen. In the first week of the study we can see that on 11th and 14th of November the per-customer amounts of biowaste are clearly much lower than on all the other days throughout the study. Some of this can be attributed to excellent food being served those days, however I think other factors might have influenced these values. There are many employees in Campusravita restaurants and some of them might not have known about the on-going study in the first week and discarded some of the waste before I had a chance to weigh it.

There are also 4 days that the biowaste amounts are above 30 grams per customer. This can be attributed to the menu that day. In some instances there were some fruits served that have peels therefore considerable increase in the biowaste amounts can be observed that day. In addition based on my observations, more biowaste was discarded on the days that whole boiled potatoes were served as side dishes. It might be hard to estimate the amount of food contained in these potatoes when they are as whole and leads to full potatoes being discarded in the biowaste. Based on my observations wastage of bread was the most consistent occurrence throughout the study. Every time when the biowaste was discarded I observed full bread slices in the waste. Biggest mass of the biowaste however consisted of small salad or side dish scraps.

Since paper tissues are also discarded in the biowaste the actual food waste is slightly lower. It is hard to estimate the exact weight of the tissues in the bin because the paper is contaminated with the food leftovers when disposed of. In addition large quantities of the tissues still end up in the mixed waste bin therefore the total amount of tissues can not be taken into account. To make some sort of estimate 10 paper tissues were weighed to get the weight of single tissue. Weight of each tissue was approximately 1.9 grams. If each customer disposes 1 tissue per meal the total weight of the tissues constitute 4 – 5 kg of the biowaste per day. Realistically each customer on average takes 2 tissues but I assumed that about half of them end up in the mixed waste bin based on my observations.

Table 2. Total amounts of biowaste created by the customers weekly

Week	Total biowaste (kg)	Biowaste per customer (kg)
1	247	0.024
2	275	0.029
3	275	0.027
4	207	0.022

Table 2 shows the total amount of biowaste created by customers each week and the average per-customer biowaste created each week. The overall amounts of biowaste are between 200 and 300 kg per week while the per customer amounts vary between 22 and 29 grams per customer per meal.

While the total amounts of biowaste alone do not provide a clear picture of the food wastage trends the average amounts of biowaste created by the customers per meal does. Portion sizes generally in the mixed sample size of customers range between 500 and 1000 grams per meal (Rolls et al. 2002). If we take a rough average then the average meal is 750 grams. This means that the customers of Campusravita wasted between 3% and 4% of the food that they have taken, which is consistent with the results observed by the earlier study done by MTT Agrifood Research Finland on food wastage in buffet type restaurants in Finland.

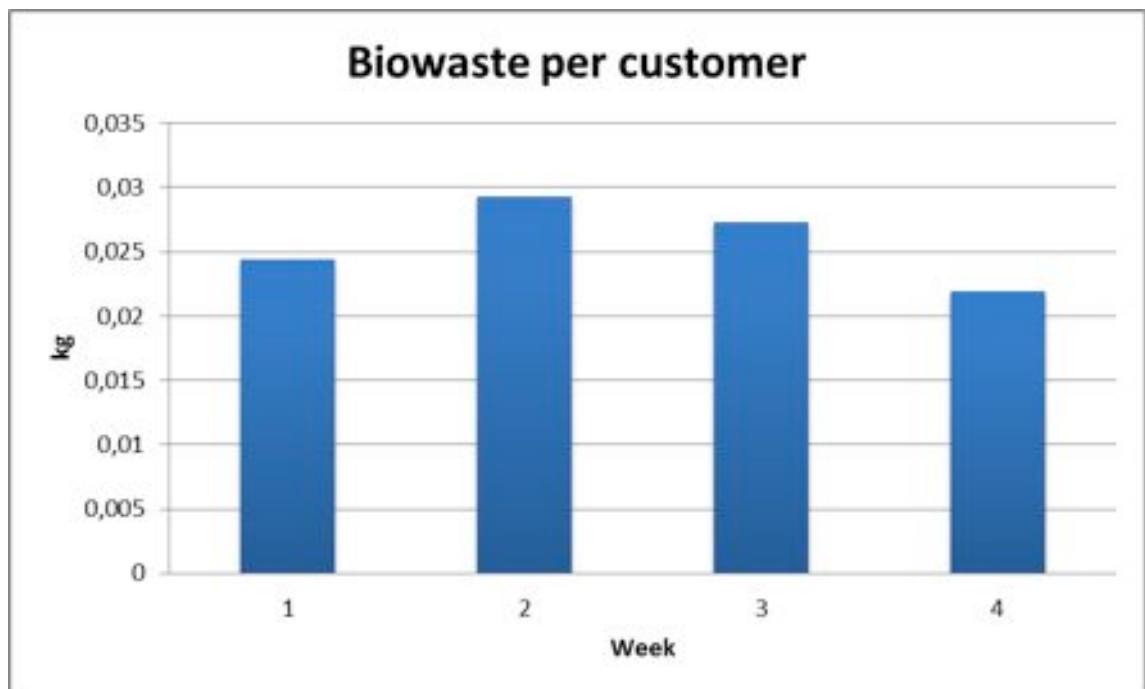
**Figure 9. The weekly average amounts of biowaste created per customer**

Figure 9 presents the average amounts of biowaste created per customers graphically. From the graph it is clear that the results are consistent and a slight decrease in the biowaste amounts can be observed towards the end of the study. As mentioned before there were two days in the first week that the average biowaste created per customer was suspiciously low. If these two days are considered as outliers and omitted from the data the graph looks considerably different. The new graph can be seen in figure 10. Although this is a speculation rather than hard data the overall graph fits better with the goal of the study. Figure 10 shows a decline in the biowaste amounts after the EWWR week's informative campaign on week 2. These results are inconclusive and a more extensive study should be done to confirm that the actual amounts of biowaste created per customer have decreased.

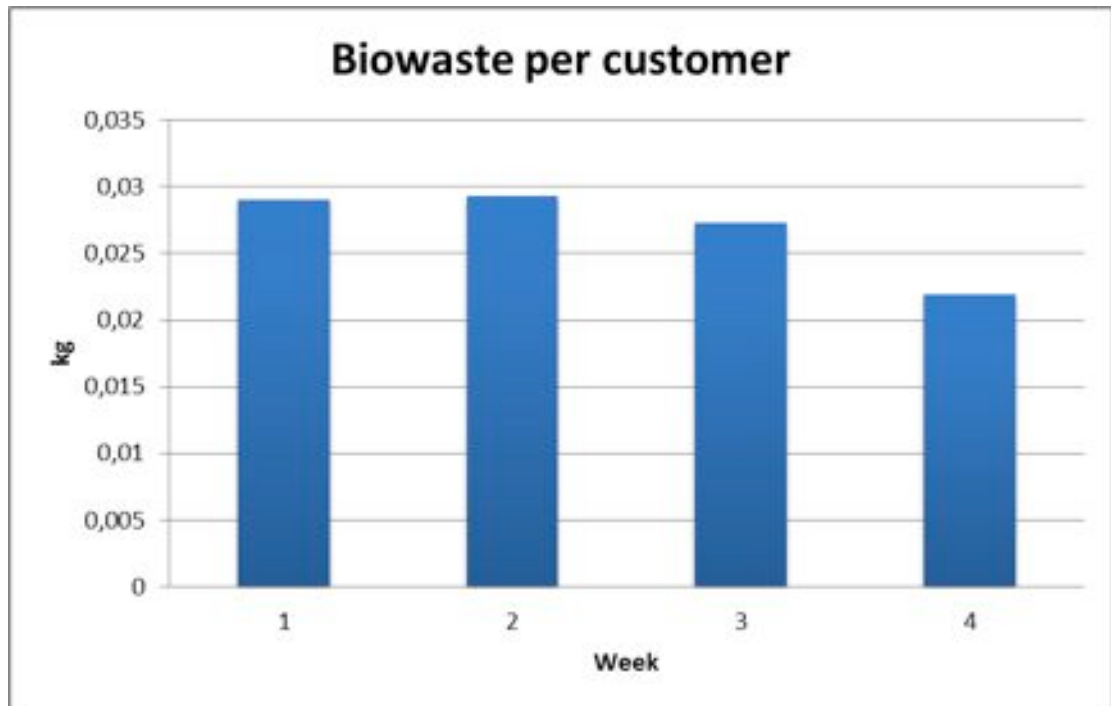


Figure 10. New weekly average amounts of biowaste created per customer

Figure 11 shows the total amounts of biowaste created by customers graphically. The results here are rather consistent too, however the amount generated on final week is considerably lower than the average amount of 251 kg per week. This is mostly due to lower amounts of waste created per customer, however also the total amount of customers was slightly lower on the last week.

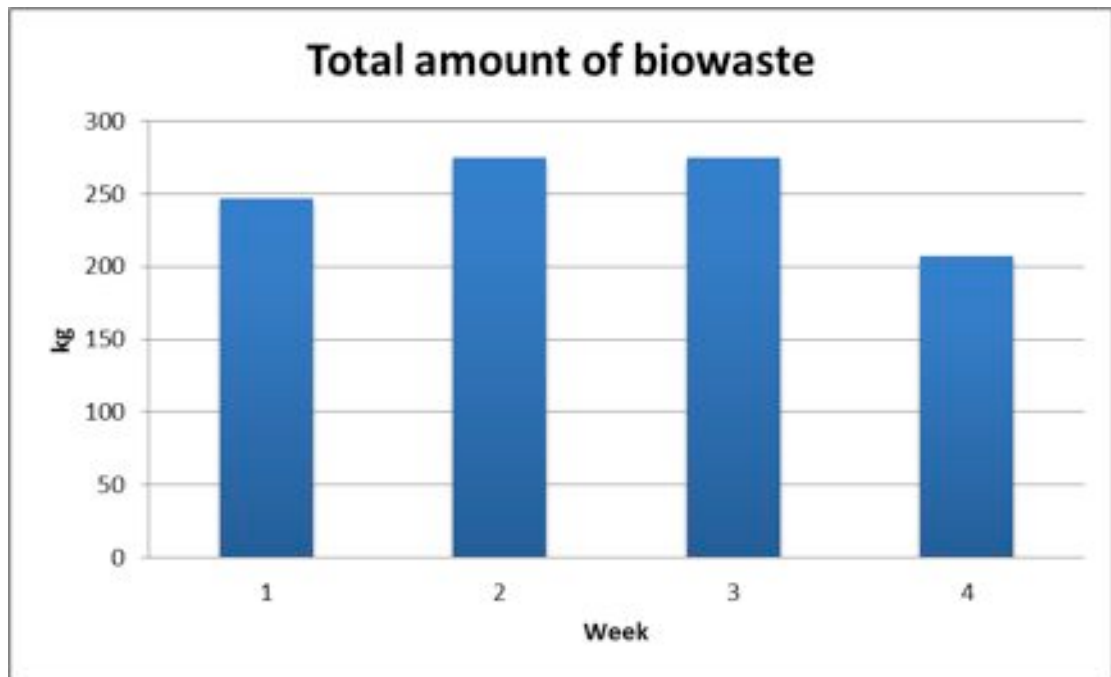


Figure 11. Total amounts of biowaste created by the customers weekly

4.2 Comparing amounts of biowaste to 2009

The kitchen food waste amount during the last week of the study was between 18 kg and 25 kg daily. Taking the average amount of biowaste produced by the customers and adding the total amount of biowaste produced by the kitchen I estimated that on a regular week the total amount of biowaste is 362 kg. This value is an estimate and is most likely bigger in reality. Based on my observations not all the kitchen staff discarded their food waste in the bins provided but rather discarded it straight to the vacuum system. The kitchen work is very busy and it is understandable that on some occasions the staff did this out of a habit.

The data from 2009 study done by Antila Sanna can be found in appendix 1. The total average biowaste amount in 2009 was 469 kg per week. This study was done before the implementation of the new vacuum system and includes all biowaste produced including coffee grounds, bones and other unavoidable biowastes. According to the restaurant manager Ms. Ahonen the number of customers has increased by around 500 customers daily since 2009. As can be seen from table 3 the amount of biowaste has decreased by more than 100 kg a week while the number of customers increased by 2500 a week. This means that the total biowaste amounts per customer served has decreased by 40%.

Once again we need to keep in mind that the 2009 study includes all sources of bio-waste while this study concentrates on the avoidable waste. Comparing to other studies both in 2009 and 2014 the amount of biowaste produced comparing to the total food served is very small. This can be partly attributed to buying already peeled vegetables and other pre-processed food, however some of the decrease in total biowaste amounts since 2009 can be attributed to higher awareness of Campusravita customers and staff as well as the newly renovated kitchen facilities with more efficient appliances.

Table 3. Difference in biowaste amounts comparing to earlier study

	Biowaste per week (kg)	Customers per week (n)	Biowaste per customer (kg)
Estimate week 4	3 62	11230	0.032
Average 2009	469	8730	0.054
Difference	107	2500	0.021

4.3 Other information

According to Ms. Ahonen there has been no considerable change in the way the food is prepared since the renovation in 2013, however some new efficient and fast cooking appliances have been installed, which means that the restaurant can adopt to the demand quicker. Generally the restaurant prepares the food in batches to avoid food wastage. The information about the current demand is transmitted from cash registers making it easy to supply the food when and how much it is needed. The new efficient appliances mean that smaller batches can be made towards the end of the day to ensure minimal leftovers. If there are any considerable leftovers, the food is offered free of charge along the food on the next day. The sustainability is important for the restaurant and they prefer to give the food without charge rather than wasting it. In reality this does not decrease the profits because people take this food together with the new food but pay for 1 meal. This means that less of the new food needs to be prepared balancing out the profit. Interestingly the bigger issue in the restaurant is the packaging that the food comes in. As mentioned before much of the food comes pre-processed or peeled, however it comes in relatively small plastic packages, which are placed in larger cardboard box leading to large amounts of packaging waste.

According to the Property manager of Tampere University of Applied Sciences Mikko Luoto the new biowaste container is 5 m³ in size and needs to be emptied on average once a month. There is a sensor in the container that sends out a signal when the container is full, ensuring efficient emptying process. The actual cost of the emptying service provided by Pirkanmaa Jätehuolto has increased in the recent years but that can be attributed to the increase in the amount of customers. According to Mr. Luoto the cost has gone up by 10-15%. During this same time period the number of customers per day has gone up by over 20%, therefore we can conclude that the cost of discarding the biowaste per customer has gone down.

5 FUTURE WORKS

5.1 Tutoring new students

Campusravita should work together with student tutors that guide the new students who start their studies at Tamk. When tutors are giving a tour for the new students through Tamk facilities and explaining how the restaurant works, part of the tour could explain how Campusravita and Tamk in general are trying to minimize their impact on environment and that minimizing waste in the restaurant is one simple way how this can be done by everyone studying at Tamk. Some basic facts could be told about the waste during the tour and about its impact on environment and what steps each and one of the new students can take to minimize their impact during their time at Tamk. To implement this as a standard procedure Campusravita needs to work together with Tampere University of Applied Sciences Students' Union (Tamko) to include this as part of the training for the new tutors. It would be relatively easy to implement this and would require no extra expenses from either of the parties involved.

5.2 Permanent signs in the restaurant

Permanent signs could be placed along the lines where food is taken reminding people not to waste food. As mentioned before, customers line and wait idle for the line to move providing a good opportunity to draw their attention to the signs if they are placed in well visible locations. In addition a poster displaying the amounts of biowaste produced could be displayed periodically near the biowaste bins. It would not take much effort from the employees of Campusravita to weigh the biowaste once a month and post the results visible for the customers. In addition to "shaming" the customers this would also give information on the amounts over a long period of time. Alternatively Environmental Engineering students could do this once a year during the EWWR. This way no extra work would be required by the employees of Campusravita and new ideas could be implemented, as each year different group of students would be in charge. A similar "Food for Thought" posters providing information on why waste should be minimized were recommended in other study done in Western Michigan University (Merrow 2012). Similarly to what I have done during this study they also recommended pub-

licizing the amounts of biowaste created by the customers by posting the results in school newspaper or posting them around the dining halls on the campus.

5.3 Rearranging the food lines

Based on the observations during the study it was clear that bread and salad are the biggest constituents of the biowaste. People take salad and bread sometimes automatically while waiting for the line to move further to the main course. To avoid this the salad bar and bread bar could be moved outside of the line. There is a lot of space in the dining halls that could be utilized for this purpose, however this could cause some confusion and additional lines could be created. On the other hand the main line would move faster and customers who choose not to take these items would not have to wait on the ones who do. People would have to go separately to them to take the bread or salad and could return for more whenever they want to. This way people would take the items only if they really want then and they will be able to return to take more when needed. Furthermore trays could be removed altogether forcing people to take each food separately, however this would require too much rearrangement and would render some of the infrastructure currently in place pointless and could frustrate the customers. But other studies suggest that this can lead up to 30 per cent reduction in food waste. In American University, Washington a survey of 360 students showed that going trayless could lead to up to 32% reduction in food waste and 27% reduction in dish use. (Spencer 2013) Realistically such savings could not be achieved in Campusravita due to already small food waste amounts currently, however this is an option that could be considered in a long-term.

6 CONCLUSION

Food waste is one of the biggest contributors to municipal waste created by humans worldwide. About 1.3 billion tons of food are wasted worldwide each year. This accounts to staggering one third of all food produced. It is important to note that this wastage happens throughout the food supply chain, however in high-income countries large part of the waste is produced in the final steps of preparation and consumer waste. In Finland about 20% of all food handled by the service sector is wasted. This food waste translates directly to negative impacts on environment. The ever increasing population of the world will require more food and increasing living standards will mean more waste per capita. This food wasting puts an extra strain on our already depleting natural resources that could be used in much more beneficial way. Reducing the food waste would solve some of these problems worldwide. In this study we attempted to minimize the food waste created by the customers of Campusravita restaurant, which is the student and staff restaurant at Tamk.

The food waste created by the customers of Campusravita was observed for 4 weeks altogether and an informative campaign was launched to promote waste minimization in the dining halls. Based on the data collected it can be concluded that each customer produces 22-29 grams of biowaste each time they dine. It cannot be concluded if the informative campaign was a success since the baseline data are nearly the same as the data from the last week of the study. However if the outlier data are omitted then the data are consistent as can be seen in figure 10. If these data are considered as final then a slight reduction of 7 grams per customer can be observed. This seems like a minute amount but it translates to about 20% reduction of the overall biowaste created by the customers.

While the data obtained in the study are not clear enough to draw conclusions on the success of the study in terms of biowaste reduction, it was clear that people noted the posters and signs posted during the EWWR. If nothing else then at least some people became more aware of the waste that they create. To further reduce the amounts of biowaste created by the customers some other methods are proposed. These range from permanent signs informing the customers about the amounts of biowaste created and promoting waste reduction to rearranging the whole system how the food is taken by the customers.

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8 APPENDIX

Appendix 1. Biowaste amounts in Campusravita restaurant from year 2009 (Antila 2009)

Taulukko 4: Biojätteiden määrä päivittäin 9. – 13.12.2008

Päivämäärä	Massa (kg)
ti 9.12.2008	106,6
ke 10.12.2008	169,3
to 11.12.2008	69,4
pe 12.12.2008	60,2
la 13.12.2008	22,9
Yhteensä	428,4

Taulukko 5: Biojätteiden määrä (kg) päivittäin 19. – 23.1.2009

Päivämäärä	Massa (kg)
ma 19.1.2009	62,5
ti 20.1.2009	78,7
ke 21.1.2009	121,1
to 22.1.2009	168,4
pe 23.1.2009	78,5
Yhteensä	509,2