



SEINÄJOEN AMMATTIKORKEAKOULU
SEINÄJOKI UNIVERSITY OF APPLIED SCIENCES

**This is an electronic reprint of the
original article (publisher's pdf).**

Please cite the original article:

Närvä, M., Alarinta, J., & Wirtanen, G. (2023). Needs to change behaviour in households producing lots of food waste. *International journal of food studies*, 12(1), 29–41. <https://doi.org/10.7455/ijfs/12.1.2023.a2>



Needs to Change Behaviour in Households Producing Lots of Food Waste

MARGIT NÄRVÄ^{a*}, JARMO ALARINTA^a, AND GUN WIRTANEN^a

^a Seinäjoki University of Applied Sciences, Kampusranta 9, P.O. Box 412, FI-60101 Seinäjoki, FINLAND

*Corresponding author

margit.narva@seamk.fi

TEL: +358 40 830 2433

Received: 19 September 2021; Published online: 18 April 2023



Abstract

The purpose of this research was to investigate avoidable food waste among households of students studying in higher education in Seinäjoki. The focus was to quantify the avoidable food waste in different-sized households. The focus was also to specify food categories wasted, and the main reasons for avoidable food waste accumulated. The participating households weighed all their food waste during the one-week monitoring period recording the data on an Excel spreadsheet. The university students taking part in the study were introduced to the work by video instruction. In total 421 households with 918 persons took part in this study. It was found that the average amount of avoidable food waste was equal to 25.2 kg/person/year. In single person households, the amount was 36.6 kg/year. The amount for households with five or more persons was 80.0 kg/household i.e. 14.1 kg/person. This research showed that 25 % of the households caused 56 % of the avoidable food waste, which means that main efforts should be targeted to this 'heavy wasting' group. One way of improving the good practices would be to share good habits related to lowering food waste among university students through peer learning. This study is aimed to awaken the 'heavy wasting' university student to change their attitude and behaviour.

Keywords: Avoidable food waste; Waste reduction; Type of food waste; Reasons for food waste; Finnish university students as consumers

1 Introduction

1.1 Definition of food waste

Definitions of food waste and food loss vary widely in the literature, which means that research on food waste is not directly comparable (Bräutigam et al., 2014). The terminology used within this study relied on the definitions used in international and European comparative studies and meta-analyses (European Commission, 2010). 'Food loss' refers to the decrease in edible food mass throughout the food chain where edible food is prepared. 'Food waste' is

described as loss occurring at the end of the food chain e.g., in retail and during final consumption (Parfitt et al., 2010). It relates to both retailers' and consumers' behaviour and takes place during post-harvest and in processing of food (Parfitt et al., 2010). In the processing stages, the reasons for food waste can be e.g., poor food preparation technique, inappropriate packaging technique, microbial or chemical contamination, spillage, poor storage conditions, lack of cooling facilities or cold storage, inappropriate conditions during transportation, as well as misunderstanding of 'best before' and 'use-by' dates (Parfitt et al., 2010). The term 'Avoidable or

edible food waste' consists of food thrown away prior to disposal and includes bread slices, fruit, cold cuts of meat etc. (European Commission, 2010). Silvennoinen et al. (2014) reported that the food waste in households can be divided into at least two types: 'avoidable' e.g., leftovers due to too much production as well as bio-waste e.g., bones, skin, tea leaves and coffee grounds. In the preparatory study on food waste across EU 27 (2011) 'possibly avoidable food waste' was described as food that some people eat, and others do not eat e.g., bread crusts and potato peels. In the same report 'unavoidable food waste' was defined as waste arising from food preparation e.g., bones, egg shells and peel of various fruits" (European Commission, 2010). In this research, food waste was defined as avoidable food waste.

1.2 The amount of food waste

In 2011, the Food and Agricultural Organization of the United Nations (FAO) stated that consumers in Europe and North America produce 95-115 kg food waste annually. Finland, as a part of the European Union, is working on halving the food waste by 2030. Furthermore, the target is to be climate-neutral by 2050 i.e. to be an economy with net-zero greenhouse gas emission (European Commission, 2020). In the Finnish food chain, a lot of the waste is accumulated in the households which is also the case in many other EU countries (European Commission, 2010). Several studies have been carried out in recent years in relation to food waste in the households (e.g., Aitsidou et al. (2019), Cantaragiu (2019), Delley and Brunner (2018), Herzberg et al. (2020), Landry and Smith (2019), Lanfranchi et al. (2016), Pellegrini et al. (2019), and Szabó-Bódi et al. (2018).

The amount of consumers' food waste in industrialised countries was almost as high as the total net food production in sub-Saharan Africa, respectively 222 billion kilograms and 230 billion kilograms (FAO, 2011). On global level, FAO estimated that roughly one-third of food produced annually, approximately 1.3 billion tonnes, for human consumption was either lost or wasted (FAO, 2011). Silvennoinen et al. (2022) stated based on their research that the annual originally edible food waste in Finnish households

was 23-28.4 kg/person. The amount of available food per person has increased during the last few decades in both the USA and the EU. One of the most important reasons for large amounts of consumers' food waste in developed countries is that people can 'afford' wasting the food cultivated and/or purchased. Retail stores offer large bargain packages and food manufactures produce oversized ready-to-eat (RTE) meals (FAO, 2011), which still can be seen in shops today. Buffets in restaurants serve food at fixed prices, which incite consumers to fill their plates with more food than they can actually eat (FAO, 2011).

1.3 Reduction of food waste

Wasted food is thus a burden on both economy and climate (European Commission, 2010). The sooner food systems are improved, the better, because the climate is strongly affected by food and drink waste produced in the households (Quested et al., 2011). Meeting the targets require cooperation between food producers, research organisations and consumers. Practical tools to monitor food waste and the possible reduction across the entire food chain continuously are also needed. Furthermore, the manufacturers should collaborate with the retailers on timely orders, working with optimization of packaging and through recycling to reduce food waste (WRAP, 2020).

The consumer attitudes and abundance of products lead to lots of food waste especially in industrialised countries (Beretta et al., 2013). There are knowledge gaps in our understanding of what drives the wasting behaviour (Schanes et al., 2018; Visschers et al., 2016). Interventions should be well designed and adequately evaluated (Hebrok, 2020). Today there is substantial academic and societal interest in finding ways to intervene to reduce the wasting of food in households (Beretta et al., 2013). This interest has commonly focused on avoidable food waste and not on unavoidable food waste e.g., vegetable peels and bones (WRAP, 2009). In the reduction of household food waste, effective policies and programmes have been developed (Hebrok, 2020; Schanes et al., 2018).

Pietilä (2019) reported an empirical study on consumers' motivation and knowledge about re-

ducing food waste. The main findings showed that young adults are aware of the responsibility to reduce food waste and many are motivated to do it. An effective motivator is environmental concerns. Morals also play a big role in this issue. People must be motivated to change e.g., to use leftovers and to plan shopping more carefully. Thus, the food waste will be reduced (Pietilä, 2019).

Much research has not shown any significant correlation between education level and amount of food waste (Herzberg et al., 2020). On the other hand, the study by Marangon et al. (2015) gives an indication that the wastage of food increases with growing educational qualification. Also Secondi, Principato et al. (2015) found that persons that are more educated generate more food waste than less educated. Active students take learnt behaviour further and the whole food chain is affected in a positive way. Thus, it is important to affect the behaviour of young, high-educated consumers.

In this paper, we report research that focused on finding out the amount and the type of avoidable food wasted in the households with students at Seinäjoki University of Applied Sciences. The major purpose of this research was to quantify the avoidable food waste in different-sized households and to specify the dominant food categories of avoidable food waste accumulated in Finnish households with university students. Furthermore, the main reasons for avoidable food waste accumulated were investigated. Avoidable food waste was defined similarly as in Silvennoinen et al. (2014), i.e. all wasted food and raw materials that could have been eaten, if stored or prepared differently. Vegetable peelings, coffee grounds, tea leaves, eggshells, bones etc. were not included.

2 Materials and Methods

The participating households quantified all their food waste through weighing during the one-week monitoring period starting on Monday and ending on the following Sunday. The one-week monitoring period was also used in the study of Szabó-Bódi et al. (2018). In the study by van Herpen et al. (2019) it was concluded that the diary study

method was suitable to understand the relative amount of food waste.

The data in this study was collected in 2019 - 2020. The respondents in the study did not correspond to the average population in Finland. They were students in a university of applied sciences with interest in the agri-food area. The students carried out the data collection as a task in two selected courses related to sustainable food systems and they were arranged twice in this period. The courses were arranged different times of the years. This task was mandatory, and it included two assignments, one on avoidable food waste and the other on food package waste. Depending on the course implementation the students carried out either both or only one of the tasks according to the student's choice. Each student performed the study in his/her own household, in which at least one participant was a university student. These students were young students or adults with children i.e. they represented various age groups. In Finland, the university students live in apartments with either kitchen or at least kitchenette facilities.

The study was performed using a formal Excel sheet in which the students marked the avoidable food waste during one week. They weighed the food waste using kitchen scales and recorded the results in the Excel sheet. There were similar tables for every day in the Excel sheet. The following food categories were used in this study: vegetables, berries, fruits, potatoes, rice and pasta, cereals including bread, oil and margarine, milk and milk products, fish, poultry, red meat, convenience food, and other. The students reported their reasons why food was wasted both verbally and using weighing results. The reasons can be compared to the work of Silvennoinen et al. (2014): the best before date was expired, used-by date was expired, food was spoiled, the respondent was uncertain about eatability of food, too large pack size, prepared too much, bought fresh or other food instead, plate leftovers, and other reasons. The monitoring period was meant to be as normal as possible, so the respondents did not get any further instructions to omit any food-stuffs like outdated food or leftovers in the beginning of the monitoring period. The students participated in various study courses, and they were allowed to choose the week in which they

made the findings of food waste.

Questaed et al. (2020) stated that there are some limitations related to this kind of food-waste diary studies i.e. the respondents might underestimate the amount of the food waste. Questaed et al. (2020) have grouped those limitations to the following groups: behaviour, misreporting, and biases due to measurement and selection. In this study, the behavioural aspects may have influenced the responses of a part of the university students. Selection biases mentioned by Questaed et al. (2020) was the weakness of this study. On the other hand, some students were reporting the amount of food wasted very accurately. Those that reported zero food waste in this study explained the reasons of the outcome. None of responses with zero waste without explanations were approved. Measurement biases were minimized through advising the students to weigh the food waste. The students were introduced to the monitoring work by using an introductory video. In the video, the researcher described how to monitor and report the household's food waste.

After collecting data, every Excel sheet was checked for faults. Seven Excel sheets were not filled accurately, and they were rejected. The reasons for rejection were incompleteness in background information and/or in weighing data. In total, there were 421 accurate data sheets collected over a period of two years. The approved sheets with raw data were thereafter merged into one Excel file. Firstly, respondents' background information, i.e., the size of households and age of members in the households, was analysed. Secondly, the total amount, type and reason of food waste were studied. Finally, the combination of households and food waste were investigated and reported according to the size of households.

3 Results and Discussion

3.1 Background information of households

In this study, totally 421 households did produce reliable and acceptable data (Table 1, centre). This data includes information of a total of 918

persons including both students and their family members (later respondents). Half of the respondents (51 %) were 19 - 40 years old. Due to the fact, that the youngest students were 19 years old the age classification was split between 18 and 19 years age (Table 1, upper part).

One third of respondents were 18 years old or younger. The biggest group (38 %) was single person households. The second biggest group (34 %) was households with two persons and out of these 8.4 % were single parent households (Table 1, centre).

Almost one third (31 %) of people were from two-person households. The sizes of other households included similar amount of people (Table 1, lower part).

3.2 Amount and type of food waste in different-sized households

The results shown in Table 2 revealed that single person's households produced more waste than other groups in average per person. The same kind of results are also reported by Questaed et al. (2011) as well as Silvennoinen et al. (2014). This study revealed that when the number of persons in households increased the average food waste per person decreased. The same type of results were also reported by Herzberg et al. (2020) and the Luke-research group (Silvennoinen et al., 2014).

In two, three and four person-households the food waste was quite similar per person. The variation in the amount of food waste was wide, especially in the groups of one- and two-person households. In those households the standard deviation was bigger than the average. Some households did not produce food waste at all (4.3 %), and some produced very large amounts of avoidable food waste (Figure 1). Attitude to food and food appreciation in zero food waste households was high. These households paid attention to their food consumption. Furthermore, the Finnish food prices are high (Eurostat, 2022), which affected the amount of food wasted especially for students. The upper quartile for total households included those households in which the food waste was at least 715.5 g/person i.e.

Table 1: Background information of respondents

	Number	%
<i>Age</i>		
<12	147	16.0
12-18	166	18.1
19-24	214	23.3
25-30	120	13.1
31-40	131	14.3
41-50	86	9.4
>50	54	5.9
Total	918	100.0
<i>Size of household</i>		
1	158	37.5
2	143	34.0
3	49	11.6
4	45	10.7
≥5	26	6.2
Total	421	100.0
<i>Total number of persons in households</i>		
1	158	17.2
2	286	31.2
3	147	16.0
4	180	19.6
≥5	147	16.0
Total	918	100.0

heavy wasting group. Those 106 households produced 55.6 % of total food waste.

The average amount of food waste was 484 g per person in this one-week study (Table 2), which equals 25.2 kg per person per year. By analysing the Hungarian results compiled by Szabó-Bódi et al. (2018) the amount of avoidable food waste was 637 g/ person/week, which corresponds to 33 kg/person/year. Correspondingly, Silvennoinen et al. (2014) stated that the annual average of food waste was 23 kg/person.

According to the study (Table 3) fruits and vegetables including potatoes was the biggest group of food waste, second biggest was milk and milk products and the third was meat and fish. The waste of fruit and vegetables (Table 4) divided into the three big groups: 1) vegetables including root vegetables except potatoes, 2) potatoes

and 3) fruits. The fourth group in this category was berries, but waste of fruits and vegetables corresponded only to 5 % of the total share. Waste of potatoes was almost as big as the vegetable waste. In Finland the consumption of potatoes is more common than rice and pasta. Consumption of potatoes was 46.2 kg/person in 2016. Correspondingly, the rice share was 5.9 kg (Luke, 2020). The third group, meat and fish (Table 5), corresponded to a ninth of the total food waste. Other studies are not directly comparable due to their different categorisation of food. Silvennoinen et al. (2014) reported that the biggest groups of food wasted were vegetables, potatoes; home cooked food and milk products. This is similar to the results in this study, but in this study home cooked food was divided into other categories. Szabó-Bódi et al. (2018)

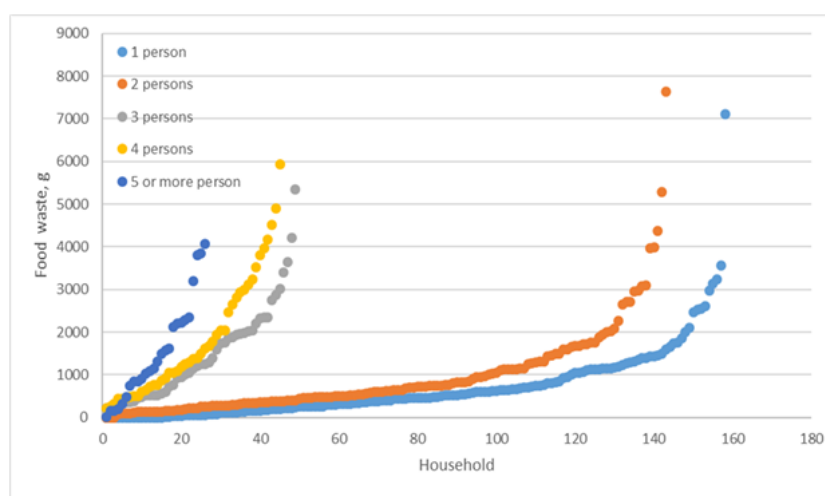


Figure 1: The amount of food waste during one week in the investigated households, the households comprised from single person to multi-person households. There were totally 421 investigated households.

reported that 56 g/person dairy products were wasted a week. In this study, there were more milk products wasted i.e. 98.4 g/person/week. Almost two thirds (62.4 %) of food waste is related to food spoilage or eatability quality. Giordano et al. (2019) stated similarly that the most frequently reason for food waste was spoilage. Waste of milk and milk products was mostly due to the spoilage or uncertainty of eatability (82 %), waste of fish and meat was respectively 56 % and fruit and vegetables 70 % (Tables 3-5). The percentage of fruit waste was 88 for spoilage and uncertainty of eatability. Best before or use-by date expired account for one fifth of the total food waste (Table 3).

Waste per person in single households was bigger than waste produced in households with two or more persons (Table 6). In particular, the difference in waste of milk products was very large, when compared to the other households. Single person households wasted almost five times more than in households with five or more persons (Table 6). The difference in cereal wasted was not so big, when comparing sizes of households. Single person households wasted 1.7 times more cereals than households with five or more persons (Table 6).

3.3 Reasons of food waste

In Table 7, the results were calculated using the percentage and amount of food waste per household. Furthermore, the amount per capita was calculated both in all households and in the heavy wasting group. The total amount of food waste was 2.6 times bigger in single person households compared to the households with five or more persons. Best before date or use-by date expired was more common reason for waste in single person household than in bigger households. The reason “spoiled” was the most common in households with two or more persons. Table 7 shows that the best before date or use-by date expired was the most common reason for food waste also in heavy-wasting, single person households. Correspondingly, ‘spoiled’ was the most common reason for heavy-wasters in households with two or more persons.

The reason ‘bought fresher/other food instead’ was not common for wasting food in any size of households. Uncertain of eatability was equivalent to 10-12 % independently of household size. ‘Prepared too much’ was a common reason for wasting food in households with two or more persons and ‘plate leftovers’ for households with three or more persons. In single person house-

Table 2: Amount and distribution of food waste in different-sized households taking part in the one-week study. The average amount of food waste per person was calculated based on facts from the households.

Size of household	Average, g	Standard deviation	Standard error	Lower quartile	Median	Upper quartile	Average g/person	Upper quartile, g/person
1	704,7	874,7	69,6	166,3	455,5	998,8	704,7	998,8
2	968,0	1078,8	90,2	329,0	628,0	1205,0	484,0	602,5
3	1484,5	1137,6	162,5	524,0	1260,0	2020,0	494,8	673,3
4	1826,4	1419,6	211,6	720,0	1375,0	2805,0	456,6	701,3
≥5	1537,5	1188,9	233,2	759,3	1232,5	2212,3	271,9	379,0
Total *	1056,2	1127,4	54,6	320,0	648,0	1400,0	484,4	715,5

*Upper quartile for total households includes those households in which the food waste was at least 715.5 g/person.

Table 3: Total food waste according to the type of food and the reason why the food is wasted

	Fruits and vegetables, g	Rice and pasta, g	Cereals e.g. bread, g	Oil and margarine, g	Milk and milk products, g	Meat and fish, g	Convenience food, g	Other, g	Total, g	Share of total waste, %
Best before date or use-by date expired	8114	624	6402	1942	50402	14958	8519	2993	93953	21,1
Spoiled	77233	1495	19729	300	16485	5017	3384	3672	127316	28,6
Uncertain of eatability	24789	3494	3988	62	6854	8221	3288	5576	56272	12,7
Too large pack size	1634	445	2580	100	6172	1019	4453	1548	17951	4,0
Prepared too much	18878	19362	5523	30	1484	8531	5418	4135	63361	14,2
Bought fresher/other food instead	2856	1147	1718	0	2020	1889	300	434	10364	2,3
Plate leftovers	13834	5515	5964	98	4873	7987	5411	3860	47542	10,7
Other	11104	1102	1668	95	2021	2927	2723	6271	27911	6,3
Total	158442	33184	47572	2627	90311	50549	33496	28489	444671	100,0
Share of total waste, %	35,6	7,5	10,7	0,6	20,3	11,4	7,5	6,4	100,0	

Table 4: Food waste of fruit and vegetables and the reason why this type of food is wasted

	Vegetables, g	Berries, g	Fruits, g	Potatoes, g	Total, g	Share of total fruit and vegetables waste, %
Best before date or use-by date expired	1922	100	842	5250	8114	5.1
Spoiled	26802	3929	35304	11198	77233	48.7
Uncertain of eatability	10725	1783	6567	5714	24789	15.6
Too large pack size	928	451	100	155	1634	1.0
Prepared too much	5933	100	145	12700	18878	11.9
Bought fresher/other food instead	490	0	1365	1001	2856	1.8
Plate leftovers	5128	477	979	7250	13834	8.7
Other	4468	1477	3436	1723	11104	7.0
Total	56395	8317	48739	44991	158442	100.0
Share of total fruit and vegetables waste, %	35.6	5.2	30.8	28.4	100.0	

Table 5: Food waste of meat and fish and the reason why this type of food is wasted

	Fish, g	Poultry, g	Red meat, g	Total, g	Share of total meat and fish waste, %
Best before date or use-by date expired	5679	4963	4316	14958	29,6
Spoiled	350	2010	2657	5017	9,9
Uncertain of eatability	821	2719	4681	8221	16,3
Too large pack size	70	404	545	1019	2,0
Prepared too much	985	2406	5140	8531	16,9
Bought fresher/other food instead	973	581	335	1889	3,7
Plate leftovers	1762	2935	3290	7987	15,8
Other	1453	632	842	2927	5,8
Total	12093	16650	21806	50549	100,0
Share of total meat and fish waste, %	23,9	32,9	43,1	100,0	

holds, the alternatives 'prepared too much' and 'plate leftovers' were not common. Too large pack size was the most common reason in single person households (Table 7). In Finland, 45% of the households are single person households (Official Statistics of Finland, 2020) and the number of these households will increase further, thus it is vital to enable the single person households to reduce their food waste. The food industry and retail stores should offer suitable package sizes to affordable prices to persons in small households. The food package could be segmented into smaller parts i.e. the consumer can open only one segment at one time and the rest of the segments are still sealed. Longer self-life helps households to reduce avoidable food waste. The food industry can play a crucial role in finding new solutions to extend the shelf-life of packed products.

Herzberg et al. (2020) drew similar conclusions. They stated that there are challenges in purchasing appropriate amounts of food products in small households. Furthermore, they also stated that households with children had challenges in preparing suitable amounts of food. Principato et al. (2015) stated the importance of planning food purchases. A shopping list especially helps young people in buying complementary food and thus it is a vital part in reducing food waste.

In the heavy wasting group, the reasons for food waste were investigated deeper using the open-ended answers. The explanations revealed that food was wasted at least once a week due to

spoilage in 87 % of households and correspondingly 60 % prepared too much and 53 % was based on negligence. With negligence it is meant that food was stored or prepared wrongly. Many times, food in big amounts was ruined because it was left at room temperature instead of being properly refrigerated. These persons need to plan their food purchases, avoid impulse purchases and more properly deal with their purchases. They should also learn to use their senses i.e. taste, smell and appearance in evaluating the eatability of food.

4 Conclusions

The average avoidable food waste in this study was 484 g per person per week, which equals 25.2 kg per year. When number of persons in households decreased the average avoidable food waste per person increased. In single person households the average avoidable food waste was 36.6 kg per year, correspondingly the annual avoidable food waste in five or more persons' households was 80.0 kg, which corresponded to 14.1 kg per person. In two, three and four person-households the annual food waste was quite similar per person, the amounts were 25.2 kg, 25.7 kg and 23.7 kg.

The variation between households was wide, the median was lower than the average in all household sizes. Furthermore, the standard deviation was bigger than usual in one and two person households. These facts show that the waste

Table 6: Type of food waste according to the size of household.

Size of household, persons	% of waste					waste (g per household)					waste (g per person)				
	1	2	3	4	≥5	1	2	3	4	≥5	1	2	3	4	≥5
	Fruits and vegetables	37,1624	33,916	33,7294	36,8165	38,3315	261,889	328,297	500,722	672,422	589,346	261,889	164,149	166,907	168,106
Rice and pasta	5,09492	6,49329	11,303	9,45872	6,32145	35,9047	62,8531	167,796	172,756	97,1923	35,9047	31,4266	55,932	43,1889	17,1905
Cereals (e.g. bread)	8,15463	10,6909	12,3089	11,8435	12,5228	57,467	103,485	182,729	216,311	192,538	57,467	51,7427	60,9095	54,0778	34,0544
Oil and margarine	1,01217	0,72966	0,49215	0,08517	0,1551	7,13291	7,06294	7,30612	1,55556	2,38462	7,13291	3,53147	2,43537	0,38889	0,42177
Milk and milk products	27,2186	22,4433	14,1301	15,7134	14,3715	191,814	217,245	209,765	286,991	220,962	191,814	108,622	69,9218	71,7478	39,0816
Meat and fish	10,2744	12,3906	12,9557	9,67652	11,4597	72,4051	119,937	192,331	176,733	176,192	72,4051	59,9685	64,1102	44,1833	31,1633
Convenience food	6,50231	5,37639	9,15992	10,1084	9,61351	45,8228	52,042	135,982	184,622	147,808	45,8228	26,021	45,3272	46,1556	26,1429
Other	4,58054	7,95984	5,92093	6,2978	7,22452	32,2797	77,049	87,898	115,024	111,077	32,2797	38,5245	29,2993	28,756	19,6463
Total	100	100	100	100	100	704,715	967,971	1484,53	1826,42	1537,5	704,715	483,986	494,843	456,604	271,939

Table 7: The reasons of food waste according to the size of households.

	% of waste					waste (g/household)					waste (g/person)					Heavy wasting group: wasted(g/person)				
	1	2	3	4	≥5	1	2	3	4	≥5	1	2	3	4	≥5	1	2	3	4	5
Size of household, persons	1	2	3	4	≥5	1	2	3	4	≥5	1	2	3	4	≥5	1	2	3	4	5
Best before date or use-by date expired	28,2	21,4	18,2	14,5	19,6	199	207	271	264	301	199	103	90,2	66	53,3	537	323	217	150	120
Spoiled	25,8	32,2	28,5	28,2	25,3	182	312	423	515	389	182	156	141	129	68,8	352	370	315	290	223
Uncertain of stability	13,4	13,7	13,4	9,78	11,5	94,2	133	199	179	177	94,2	66,3	66,5	44,7	31,3	196	128	163	62	145
Too large pack size	7,51	3,29	2,48	1,48	5,06	52,9	31,8	36,8	27	77,8	52,9	15,9	12,3	6,74	13,8	125	53,2	30,3	9,45	16,3
Prepared too much	8,07	13,8	19,8	17,9	15,5	56,9	133	294	326	239	56,9	66,6	98,2	81,5	42,3	151	195	183	186	56,8
Bought fresher/other food instead	3,53	2,16	0,16	2,78	2,61	24,9	20,9	2,31	50,8	40,2	24,9	10,4	0,77	12,7	7,11	74,7	22,8	3,03	34,2	56,8
Plate leftovers	7,39	6,99	14	17,7	12,3	52,1	67,7	208	323	190	52,1	33,8	69,3	80,6	33,5	113	80,1	102	174	113
Other	6,11	6,53	3,35	7,81	8,04	43,1	63,2	49,7	143	124	43,1	31,6	16,6	35,7	21,9	59,8	76,5	30,9	73,9	106
Total	100	100	100	100	100	705	968	1485	1826	1538	705	484	495	457	272	1610	1248	1044	979	781

varied from zero to large amounts of avoidable food waste. This emphasises that those households, which produce huge amount of food waste, have challenges in both attitudes and behavioural habits. Those heavy-wasting households were negligent in handling food.

The weight results revealed that fruits and vegetables including potatoes was the biggest group of food waste, second biggest was milk and milk products and the third was meat and fish. Milk and milk products, especially, were wasted in large amounts, even though properly processed and packaged milk products like yoghurt are safe to use after the best before date when the cold chain has remained intact during transportation and storage (Mercier et al., 2017).

The biggest reasons for food waste were that food was spoiled (28,6 %), best before date or use-by date had expired (21,1 %), too much was prepared (14,2%) and the uncertainty of eatability (12,7 %). Thus, almost two thirds of food waste was related to food spoilage or eatability quality. Proper handling of perishable products includes all steps from harvesting through processing and packaging to the consumer's freezer and fridge. All partners in the food chain are responsible for finding new solutions to tighten the lead time for food products from producer to the consumer.

This research emphasised that households independently of size are heterogeneous in attitude and behaviour. Twenty-five percent of the households, i.e. the upper quartile consisting of 106 households, produced 55.6 % of the avoidable food waste and the remaining seventy-five percent only 44.4 %. This study also revealed that some households with university students did not produce avoidable food waste at all. Also Knezevic et al. (2019) stated that there were various types of students. They found that university students need effective information on food waste to enable them to reduce their food waste (Knezevic et al., 2019). Various means to reduce avoidable food waste should be targeted to the 'heavy wasting' group. One way of improving good practices of university students would be sharing habits through peer learning i.e. from those student, who do not produce any or small amount avoidable food waste, to the heavy wasters.

Gabriel et al. (2021) insisted that awareness cam-

paigns are useful, but this means should not be the only way to inform about food waste reduction. Each student group needs tailored information e.g., lectures, workshops and other types of dissemination (Gabriel et al., 2021; Knezevic et al., 2019; Principato et al., 2015). Food waste prevention is a cultural challenge that must be supported in studies e.g., at universities Leal Filho et al. (2021).

The wasting of food leads to negative monetary, environmental, and social impacts (van der Werf et al., 2021). People studying sustainability of food systems at universities should be given the tools to increase their awareness of food waste reduction. This study was conducted in two courses with several iterations. The main limit of this study was that there was no sampling method used. In the future, it would be valuable to research more accurate attitudes toward food waste and how those attitudes can be affected based on improved knowledge.

References

- Aitsidou, V., Michailidis, A., Partalidou, M., & Iakovidou, O. (2019). Household food waste management: socio-ecological dimensions. *British Food Journal*, 121(9), 2163–2178. <https://doi.org/10.1108/BFJ-02-2019-0111>
- Beretta, C., Stoessel, F., Baier, U., & Hellweg, S. (2013). Quantifying food losses and the potential for reduction in Switzerland. *Waste Management*, 33(3), 764–773. <https://doi.org/10.1016/j.wasman.2012.11.007>
- Bräutigam, K.-R., Jörissen, J., & Priefer, C. (2014). The extent of food waste generation across EU-27: Different calculation methods and the reliability of their results. *Waste Management and Research*, 32(8), 683–694. <https://doi.org/10.1177/0734242X14545374>
- Cantaragiu, R. (2019). The impact of gender on food waste at the consumer level. *Studia Universitatis Vasile Goldis Arad*, 29(4), 41–57. <https://doi.org/10.2478/sues-2019-0017>

- Delley, M., & Brunner, T. A. (2018). Household food waste quantification: comparison of two methods. *British Food Journal*, *120*(7), 1504–1515. <https://doi.org/10.1108/BFJ-09-2017-0486>
- European Commission. (2010). *Preparatory study on food waste across EU 27: final report*. (tech. rep. No. 2010-054). Directorate-General for the Environment. Luxembourg. <https://data.europa.eu/doi/10.2779/85947>
- European Commission. (2020). *Climate Action: 2050 long-term strategy* (tech. rep.). European Commission. https://ec.europa.eu/clima/eu-action/climate-strategies-targets/2050-long-term-strategy_en
- Eurostat. (2022). *Comparative price levels for food, beverages and tobacco* (tech. rep.). https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Comparative_price_levels_for_food,_beverages_and_tobacco#Price_levels_for_food.2Cbeverages_and_tobacco
- FAO. (2011). *Global food losses and food waste: extent, causes and prevention : study conducted for the International Congress "Save Food!" at Interpack 2011 Düsseldorf, Germany*. <https://www.fao.org/3/i2697e/i2697e.pdf>
- Gabriel, A., Rombach, M., Wieser, H., & Bitsch, V. (2021). Got waste: knowledge, behavior and self-assessment on food waste of university students in Germany. *International Food and Agribusiness Management Review*, *24*(6), 951–970. <https://doi.org/10.22434/IFAMR2020.0145>
- Giordano, C., Alboni, F., & Falasconi, L. (2019). Quantities, determinants, and awareness of households' food waste in Italy: a comparison between diary and questionnaires quantities. *Sustainability*, *11*(12), 3381. <https://doi.org/10.3390/su11123381>
- Hebrok, M. (2020). *Food Waste: A practice-oriented design for sustainability approach* [Doctoral dissertation, NTNU]. <https://hdl.handle.net/11250/2676125>
- Herzberg, R., Schmidt, T. G., & Schneider, F. (2020). Characteristics and determinants of domestic food waste: a representative diary study across Germany. *Sustainability*, *12*(11), 4702. <https://doi.org/10.3390/su12114702>
- Knezevic, B., Kurnoga, N., & Anic, I.-D. (2019). Typology of university students regarding attitudes towards food waste. *British Food Journal*, *121*(11), 2578–2591. <https://doi.org/10.1108/BFJ-05-2018-0316>
- Landry, C. E., & Smith, T. A. (2019). Demand for household food waste. *Applied Economic Perspectives and Policy*, *41*(1), 20–36. <https://doi.org/10.1093/aep/ppy037>
- Lanfranchi, M., Calabrò, G., De Pascale, A., Fazio, A., & Giannetto, C. (2016). Household food waste and eating behavior: empirical survey. *British Food Journal*, *118*(12), 3059–3072. <https://doi.org/10.1108/BFJ-01-2016-0001>
- Leal Filho, W., Salvia, A. L., Davis, B., Will, M., & Moggi, S. (2021). Higher education and food waste: assessing current trends. *International Journal of Sustainable Development and World Ecology*, *28*(5), 440–450. <https://doi.org/10.1080/13504509.2020.1865474>
- Luke. (2020). Food waste and the circular economy of the food system.
- Marangon, F., Tempesta, T., Troiano, S., & Vecchiato, D. (2015). Food waste, consumer attitudes and behaviour: A study in the North-Eastern part of Italy. *Italian Review of Agricultural Economics*, *69*(2-3), 201–209. <https://doi.org/10.13128/REA-16922>
- Mercier, S., Villeneuve, S., Mondor, M., & Uysal, I. (2017). Time-temperature management along the food cold chain: a review of recent developments. *Comprehensive Reviews in Food Science and Food Safety*, *16*(4), 647–667. <https://doi.org/10.1111/1541-4337.12269>
- Parfitt, J., Barthel, M., & Macnaughton, S. (2010). Food waste within food supply chains: quantification and potential for change to 2050. *Philosophical Transactions of the Royal Society B*, *365*(1554), 3065–3081. <https://doi.org/10.1098/rstb.2010.0126>

- Pellegrini, G., Sillani, S., Gregori, M., & Spada, A. (2019). Household food waste reduction: Italian consumers' analysis for improving food management. *British Food Journal*, 121(6), 1382–1397. <https://doi.org/10.1108/BFJ-07-2018-0425>
- Pietilä, S. (2019). *Consumers' motivation to reduce food waste: A quantitative study on young adult's motivation and actions to reduce food waste* [Doctoral dissertation, Aalto University]. <http://urn.fi/URN:NBN:fi:aalto-201910135653>
- Principato, L., Secondi, L., & Pratesi, C. A. (2015). Reducing food waste: an investigation on the behaviour of Italian youths. *British Food Journal*, 117(2), 731–748. <https://doi.org/10.1108/BFJ-10-2013-0314>
- Quested, T. E., Palmer, G., Moreno, L. C., McDermott, C., & Schumacher, K. (2020). Comparing diaries and waste compositional analysis for measuring food waste in the home. *Journal of Cleaner Production*, 262, 121263. <https://doi.org/10.1016/j.jclepro.2020.121263>
- Quested, T. E., Parry, A. D., Easteal, S., & Swannell, R. (2011). Food and drink waste from households in the UK. *Nutrition Bulletin*, 36(4), 460–467. <https://doi.org/10.1111/j.1467-3010.2011.01924.x>
- Schanes, K., Dobernic, K., & Gözet, B. (2018). Food waste matters: A systematic review of household food waste practices and their policy implications. *Journal of Cleaner Production*, 182, 978–991. <https://doi.org/10.1016/j.jclepro.2018.02.030>
- Silvennoinen, K., Katajajuuri, J.-M., Hartikainen, H., Heikkilä, L., & Reinikainen, A. (2014). Food waste volume and composition in Finnish households. *British Food Journal*, 116(6), 1058–1068. <https://doi.org/10.1108/BFJ-12-2012-0311>
- Silvennoinen, K., Nisonen, S., & Katajajuuri, J.-M. (2022). Food waste amount, type, and climate impact in urban and suburban regions in Finnish households. *Journal of Cleaner Production*, 378, 134430. <https://doi.org/10.1016/j.jclepro.2022.134430>
- Szabó-Bódi, B., Kasza, G., & Szakos, D. (2018). Assessment of household food waste in Hungary. *British Food Journal*, 120(3), 625–638. <https://doi.org/10.1108/BFJ-04-2017-0255>
- van der Werf, P., Seabrook, J. A., & Gilliland, J. A. (2021). “Reduce food waste, save money”: testing a novel intervention to reduce household food waste. *Environment and Behavior*, 53(2), 151–183. <https://doi.org/10.1177/0013916519875180>
- van Herpen, E., van der Lans, I. A., Holthuysen, N., Nijenhuis-de Vries, M., & Quested, T. E. (2019). Comparing wasted apples and oranges: an assessment of methods to measure household food waste. *Waste Management*, 88, 71–84. <https://doi.org/10.1016/j.wasman.2019.03.013>
- Visschers, V. H. M., Wickli, N., & Siegrist, M. (2016). Sorting out food waste behaviour: a survey on the motivators and barriers of self-reported amounts of food waste in households. *Journal of Environmental Psychology*, 45, 66–78. <https://doi.org/10.1016/j.jenvp.2015.11.007>
- WRAP. (2009). *Household food and drink waste in the UK: final report* (tech. rep.). WRAP. Banbury.
- WRAP. (2020). Food and drink. <https://wrap.org.uk/content/waste-reduction-processed-food-sector>