Identifying and evaluating plate waste reduction potentials at a Swiss university canteen

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Table of contents

List of figures

List of tables

Declaration of independent work

I hereby declare that this study with the title:

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Jasmin Küng Zurich, 17.11.2015

Abstract

It is increasingly important to identify potentials to reduce food waste and implement changes accordingly. On the one hand, we have the high environmental impacts of food production, while on the other hand we have a constant increase in global food demand. Since the food that makes it onto a plate caused environmental impact upstream, it is important to reduce losses at this place. Therefore, this study focuses on the potentials to reduce plate waste in a university canteen in Switzerland.

In the first part of the thesis, a survey was performed to find reasons for plate waste and possible differences between the menus, visitors to the canteen, and food types. The first finding was that plate waste most often occurs with the special menu and the least plate waste occurs with the free choice. The recommendation based on this finding is to increase the offerings for the free choice and to add a smaller portion of the special menu to the offer. In addition, we found that women more frequently have leftovers than men and the side dish is more likely left over than meat and vegetables. One recommendation based on these two findings is to inform the customers at the canteen that their wishes regarding the portion sizes can be submitted to the staff at the ladling station. A second recommendation is to ladle less side dishes at first and just ladle more if asked.

In the second part, a Life Cycle Assessment (LCA) was performed to estimate the current environmental impacts and to simulate the effect of a potential reduction of food loss (especially plate waste) on these impacts. Therefore, five scenarios were created. First, the current situation was modeled with available data. For the ideal scenario, no avoidable food waste at the canteen was assumed. Based on the findings of the survey in the first part of this study, a best case scenario with minimal plate waste under real-world conditions and as a counterpart, a scenario with maximal plate waste under real-world conditions were created. Finally, the goal of the canteen, to reduce food losses at the preparation and ladling processes and due to plate waste by 15%, was used to simulate the to-be scenario. With the comparison of the current situation to the best case and to-be scenario, it was found that the goal of the canteen seems to be achievable with the recommended changes and would save 3.4 tons of food every year.

Finally, we conclude with the recommendation that all gastronomic businesses investigate their food loss reduction potentials and implement changes where possible.

Zusammenfassung

Die Reduktion von Lebensmittelabfällen wird immer wichtiger. Einerseits hat die Produktion von Lebensmitteln einen sehr hohen Umwelteinfluss, andererseits nimmt die globale Lebensmittelnachfrage stetig zu. Da die Lebensmittel, welche am Schluss auf einem Teller landen, in ihrem bisherigen Lebenszyklus schon einen grossen Umwelteinfluss hatten, ist es wichtig, den Abfall dieser Lebensmittel zu reduzieren. Aus diesem Grund befasst sich diese Studie mit dem Finden von Reduktionspotenzialen von Tellerresten in einer Mensa an einer Schweizer Universität.

Im ersten Teil wurde eine Umfrage durchgeführt, um die Gründe für Tellerreste und allfällige Unterschiede in der Häufigkeit von Tellerresten zwischen den Menüs, Personengruppen und Lebensmittelarten zu erfassen. Als erstes wurde ersichtlich, dass beim Spezialmenü am häufigsten und beim Buffet am seltensten Tellerreste entstehen. Die Empfehlung aufgrund dieses Resultats ist, das Angebot am Buffet zu erhöhen und beim Spezialmenü zusätzlich eine kleine Portion anzubieten. Ausserdem hat sich gezeigt, dass Frauen häufiger etwas übriglassen als Männer und dass die Beilage häufiger auf dem Teller bleibt als Fleisch und Gemüse. Eine Empfehlung dazu ist, die Gäste dahingehend zu informieren, dass Wünsche bezüglich der Portionengrösse dem Personal an der Schöpfstation mitgeteilt werden können. Ausserdem wird empfohlen, zuerst weniger Beilage zu schöpfen und auf Wunsch nachzutragen.

Im zweiten Teil dieser Studie, wurde eine Ökobilanz (LCA) durchgeführt, um den jetzigen Umwelteinfluss der Mensa zu schätzen und den Effekt einer potentiellen Abfallreduktion (vor allem Tellerreste) zu simulieren. Zu diesem Zweck wurden fünf Szenarien kreiert. Zuerst wurde der Ist-Zustand mithilfe verfügbarer Daten modelliert. Für ein ideales Szenario wurden alle vermeidbaren Lebensmittelabfälle weggelassen. Basierend auf den Ergebnissen der Umfrage im ersten Teil wurden ein Best-Case-Szenario mit minimalem Lebensmittelabfall und ein Worst-Case-Szenario mit maximalem Lebensmittelabfall unter natürlichen Bedingungen simuliert. Schliesslich wurde aufgrund der Ziele der Mensa ein Ziel-Szenario (to be) kreiert. Der Vergleich dieser Szenarien ergab, dass das Ziel-Szenario erreichbar scheint und dabei 3.4 Tonnen Lebensmittel pro Jahr eingespart werden können.

Zum Schluss kann festgehalten werden, dass jeder Gastronomiebetrieb seine Reduktionspotentiale bezüglich Lebensmittelabfällen untersuchen und nutzen sollte.

Introduction

We live in a world where resources are becoming scarce and the anthropogenic environmental impacts are severe. Therefore it is important to search for saving potentials and to use energy and material resources as efficiently as possible. Since nutrition causes about a third of the total environmental impact in Switzerland, it is an area of particular interest (Jungbluth et al., 2012).

In previous studies, it has been demonstrated that worldwide about one third of the produced food is lost during the whole life cycle(Gustavsson et al., 2011). Additionally, in industrialised countries more than 40% of the food losses occur at retail and consumer levels (Gustavsson et al., 2011).

As out-of-home food consumption has increased noticeably in the last decade (Lachat et al., 2005), it is especially reasonable to investigate the food service in canteens. To identify food loss reduction potentials it is important to first investigate, where and why food gets lost.

Therefore, this study concentrates on the food loss in a canteen. As a study site, the canteen at the Irchel campus of the University of Zurich (hereinafter Mensa Irchel) was chosen.

Questions regarding how often and why consumers do not finish their meal were investigated with a survey at the canteen. Of particularly interest was if there were differences between the consumers, the different menus and the food-type of leftovers. Therefore three research questions were formulated.

Question 1: Is there a menu-specific difference in the frequency of plate waste?

Question 2: Is there a gender difference in the frequency of plate waste?

Question 3: Is there a food-type specific difference of plate waste for the meat menu in case the portion was too big?

The Mensa Irchel offers diverse pre-ladled menus and guests can also arrange their meal by themselves at the buffet. With the buffet the guests can decide how much food they want and as such, less food waste is assumed to occur. In their literature review of food waste in US schools Buzby and Guthrie (2002) found interesting tendencies. A first finding was that girls tend to waste more food than boys. Although the studies they looked at were made with

children, one can assume that this tendency would be visible also in a group of adults. Especially given that women need less calories than men. Another finding of Buzby and Guthrie (2002) was that plate waste varies by food type. Salad, vegetables and fruits were wasted the most. Again we assume to find this with adults as well.

The findings of these surveys then led us to food loss reduction potentials, recommendations for the canteen and the second part of this study. To see the environmental impact of the canteen operation of a whole year, a life cycle assessment (LCA) was done. Further information about the method of life cycle assessments follow on page 12. With the findings of the survey and an interview with the leader of the canteen, five different scenarios were created and an LCA was performed. The environmental impact of all the scenarios were compared to see how much reductions of food losses at the canteen would change the environmental impact of the whole canteen operation.

Part I: Survey at the Mensa Irchel

Methods

Study site

The Mensa Irchel is located at the Irchel campus of the University of Zurich in Switzerland. There are 540 seats and each day around 2,000 guests are served. Most of the guests at the Mensa Irchel are students or staff of the University of Zurich, but the Mensa is also open for external guests. The Mensa Irchel is open from Monday to Friday between 11:00 and 14:00 (Greminger, pers. comm., 2015). Since 1914 the Mensa Irchel is managed by the Zurich women's association (ZFV). The ZFV has a long history in Switzerland and manages a total of 153 companies, including 61 university and school canteens all over Switzerland (ZVF-Unternehmungen, 2015). The ZFV is very dedicated to a sustainable dealing of natural resources and is a founding member of the association "United Against Waste". Therefore the ZFV is very interested in reducing food losses at their canteens. Since the University of Zurich is the largest university in Switzerland, the Mensa Irchel is an ideal place to investigate plate waste reduction potentials.

Offered Menus

The Mensa Irchel offers three main menus: the meat menu “Einfach gut”, the pasta menu “Immer Pasta” and the vegetarian menu “Natürlich vegi”. The components of the menus change every day and on Fridays the meat menu contains fish instead of meat. Additionally, a more expensive menu “Voll anders” (hereinafter called "special menu"), is offered. This menu contains more expensive food and it sometimes takes up seasonal vegetables or meat. A final menu, called "Hit", is always available and is either a breaded pork escalope or a grilled sausage with French fries and salad. Additional to these menus, two different sizes of a soup of the day are offered. Finally, there is the possibility for guests to arrange their menu themselves at the salad or warm buffet (hereinafter called “free choice”). This is the only menu that is paid by weight. For all the menus there are three different prices for students, staff and guests. Table 1 shows an overview of the different menus offered at the Mensa Irchel, a description of the content as well as the prices. Additionally, the average price on each menu for the two weeks of survey was calculated. This was done with the number of guests from each price category. This way it is possible to see how much was paid for each menu especially for the special menu and free choice, where the price is not always the same.

Table 1: The different menus offered at the Mensa Irchel, their names and prices

At the Mensa Irchel there are different prices for students, staff and guest. The table also shows the average prices from all the guests during the two weeks of survey. For the free choice only the average over the two weeks is available (Greminger, 2015).

			Price (CHF)				
Name at the Mensa Irchel	Hereinafter called	Components	Student*	Staff*	Guests	Average CW 17	Average CW 21
Einfach gut	meat menu	meat or fish (on Fridays), side dish and either vegetables or salad	5.40	7.00	10.50	5.98	5.92
Immer Pasta	pasta menu	pasta with sauce and either vegetables or salad	5.40	7.00	10.50	5.86	5.91
Natürlich vegi	vegetarian menu	a vegetarian protein source, side dish and either vegetables or salad	5.40	7.00	10.50	5.83	5.88
Salad and warm Buffet	free choice	a variety of salads and hot dishes	1.80 per 100g	2.20 per 100g	2.50 per 100g	7.00	10.50
Voll anders	special menu	more expensive food and sometimes seasonal specialities	The prices differ with every menu depending on the ingredients			10.24	10.55
Hit	hit	a breaded pork escalope or a grill sausage with French fries and salad	9.20	10.50	12.00	9.20	9.20

*subsidised prices

Data collection

To determine the food waste a survey was provided to visitors of the Mensa Irchel. Since the people at the University of Zurich are from all over the world, the survey was written in German and English (see Appendix 1). Prior to finalizing the survey, several trials were conducted to ensure that the survey was clear.

To have as many respondents as possible, two weeks in April and May 2015 were chosen for the survey. In fact, the calendar weeks 17 and 21 in the year 2015 were set as the time for the survey. Since the canteen is open Monday to Friday from 11:00 to 14:00 the survey was held in this time frame as well.

The survey was provided to people who had already finished their meal, but were still sitting at the table. This way it was ensured that the people were not biased while they were eating, but also took sufficient time to fill in the survey. Participation was voluntary and completed surveys were placed in a box at the entrance. Surveys were then digitized.

The respondents

After two weeks, 2,554 surveys were completed. For 509 of these surveys, the respondent had already filled in a survey. Therefore, 2,045 unique respondents filled in the survey. Twenty (1%) of the respondents did not specify their gender. Since the gender difference is of interest, these data were not used for the analysis. So 2,025 unique respondents with a given gender are used for the analysis (Figure 1). This does not match to the overall gender distribution at the Irchel campus (Appendix 2). In fact, more women than men study or work at the Irchel campus. But according to the management it corresponds to the gender distribution of the costumers of the Mensa Irchel (Greminger, pers. comm., 2015).

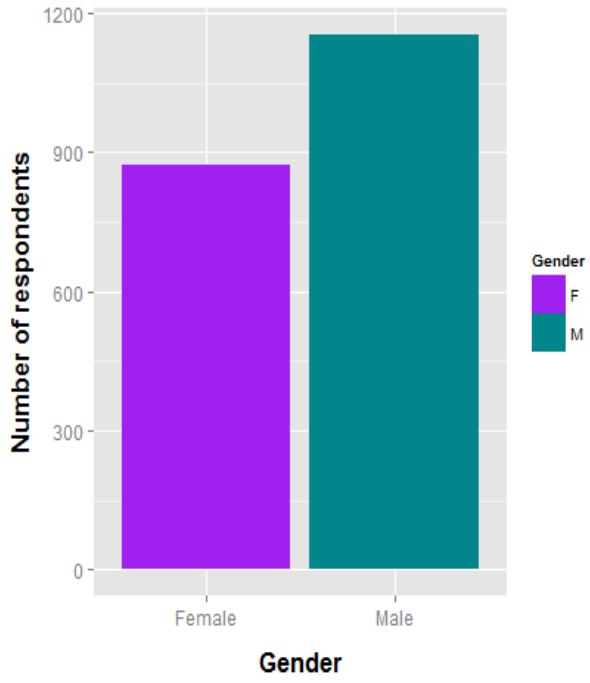

Figure 1: The total number of respondents and their gender.
A total of 1,154 males (57%), shown in turquoise, and 870 females (43%), shown in violet, participated in the survey about plate waste at the Mensa Irchel.

On average, 204 new respondents per day filled in the survey, with a minimum of 165 and a maximum of 341. This represents 9.4% of the daily visitation to the Irchel Mensa.

The age of the respondents ranged from 14 to 74 years old; whereby most of the respondents were 20 to 30 years old (70%). The age distribution among males and females was similar (Appendix 3). As for the menus, the meat menu was the most popular (37%), followed by the pasta menu (17%), the vegetarian menu (16%) and the free choice (15%). Especially males most often chose the meat menu (44%), whereas it was less popular with females (28%). The females chose the free choice more often than the males (22% / 10%) (Figure 2).

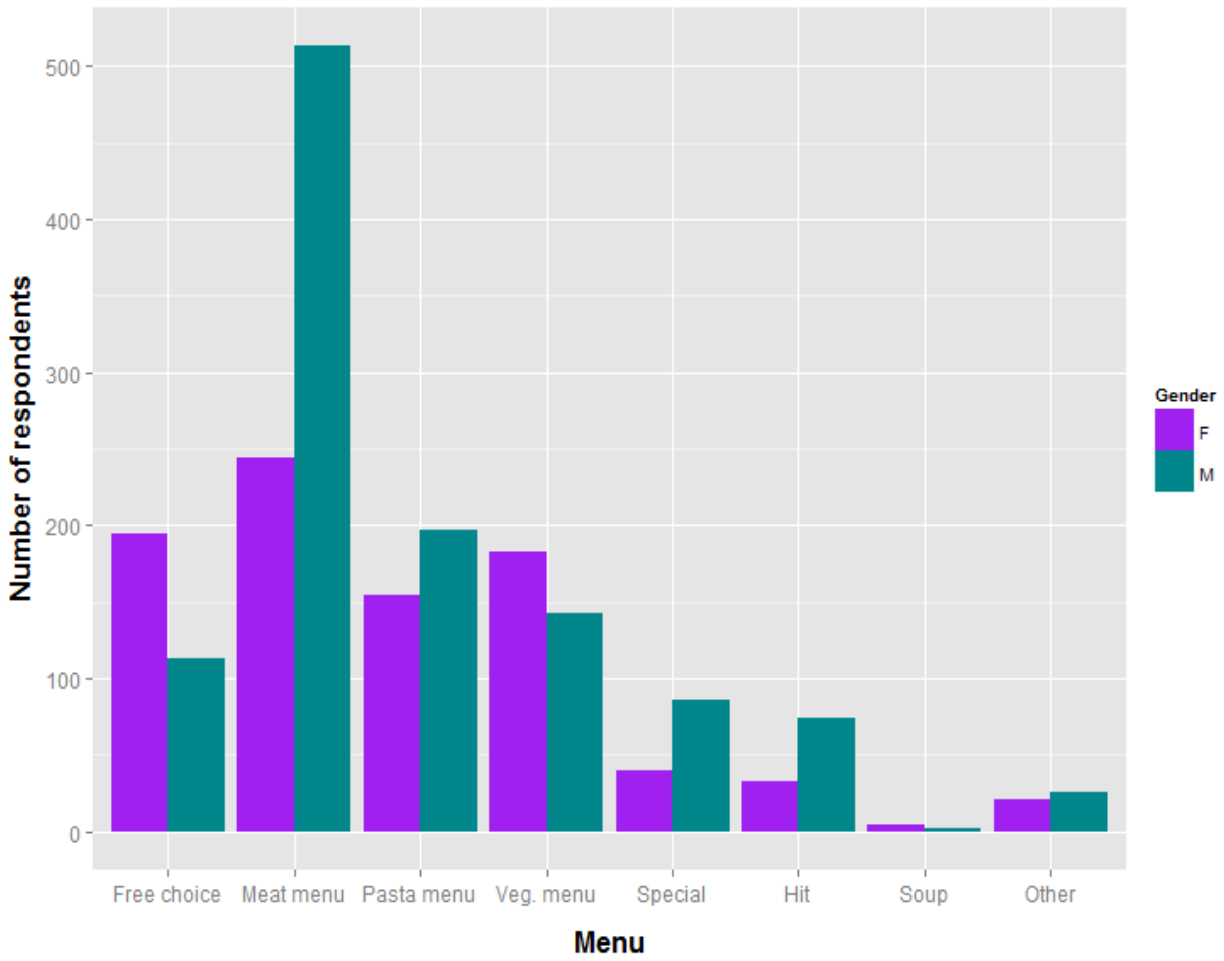

Figure 2: The total number of chosen menus for females (violet) and males (turquoise) at the Mensa Irchel. For further information about the different menus see table 1. "Other" refers to the respondent that ate none of the investigated menus.

Statistics

The statistical computing program R 3.1.1 was used for analysis and graphical representation of the data (R Core Team, 2014).

The response studied was the answer to the question whether something was left over or not. The possible answer to this question was "Yes" or "No", a binary response. Therefore, a generalized linear model (logistic model, family = binomial) was used to test for main effects. To ensure independence of the data, only the first completed survey per respondent was used (n=2,025). Nevertheless, an analysis with all completed surveys was also performed (n=2,554) (Appendix 5).

To further examine the type of the leftovers, only the data of those respondents who chose the meat menu and left something over because it was too much (n=60), was considered.

For overall main effects, Chi-square tests and associated p-values are presented (see also Appendix 4). For differences within main effects we present z-values and associated p-values, extracted from the summary table (Appendix 4)

Results

Overall, 85% of all plates were finished and only 15% of the respondents had leftovers. On average every customer produced 23g of plate waste.

Differences between the menus

A significant difference in the frequency of leftovers between the menus was discovered ($\chi^2_{7,1944} = 57.0$, $p < 0.0001$). As expected the free choice resulted in fewer plate waste than all the other menus (Figure 3). With the special menu (30%) relatively more plate waste occurs as compared to the free choice (9%) and the pasta menu (10%). The vegetarian menu, the meat menu and the hit lay in between. If we have a look at the total number of unfinished plates, the situation is different and most of the plate waste occurs with the meat menu (Figure 4). The other five menus are similar in the total number of unfinished plates.

To be able to explain the observed differences, the reasons for the leftovers were further examined (Table 2). For the special menu (74%) and the hit (79%), relatively more respondents indicated that the portion was too big, whereas fewer respondents addressed the same for the free choice (32%).

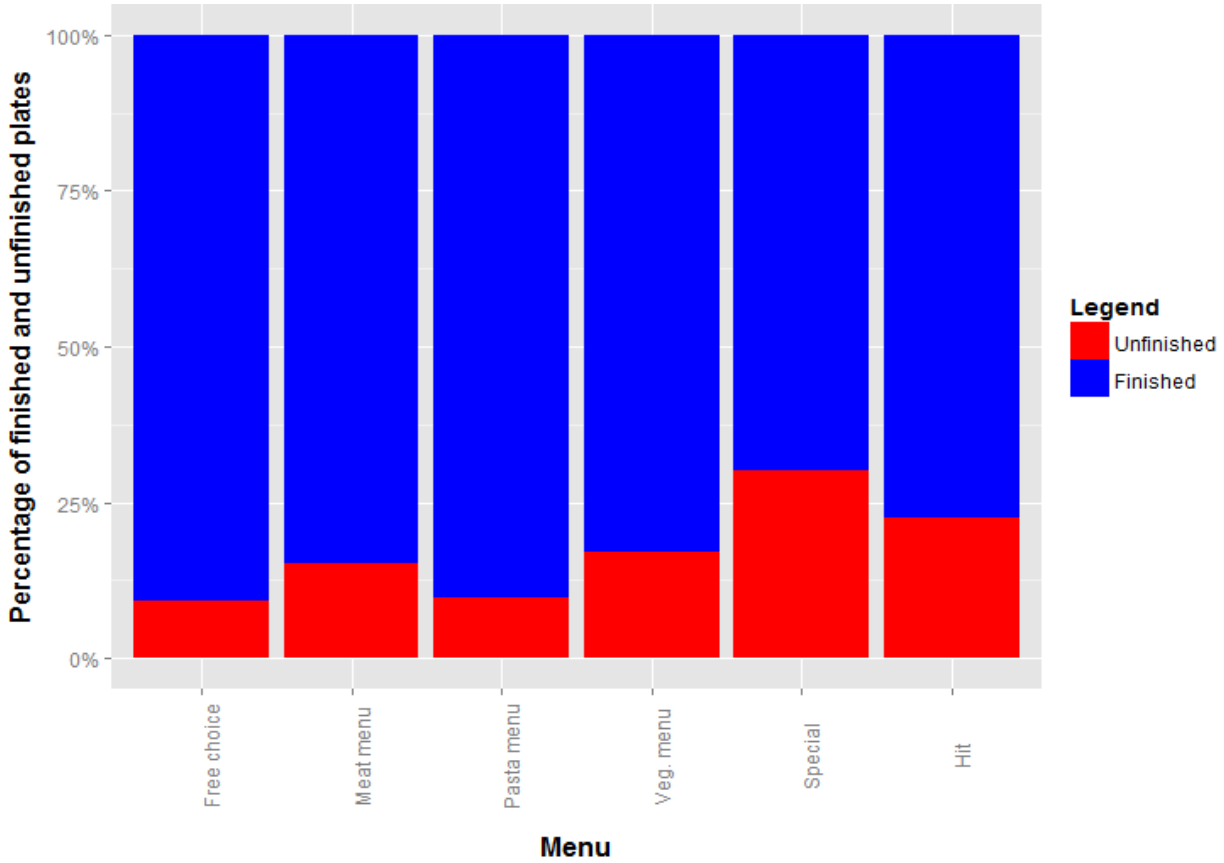

Figure 3: The relative amount of finished (blue) and unfinished (red) plates, at the Mensa Irchel, per menu. For further information about the different menus see table 1.

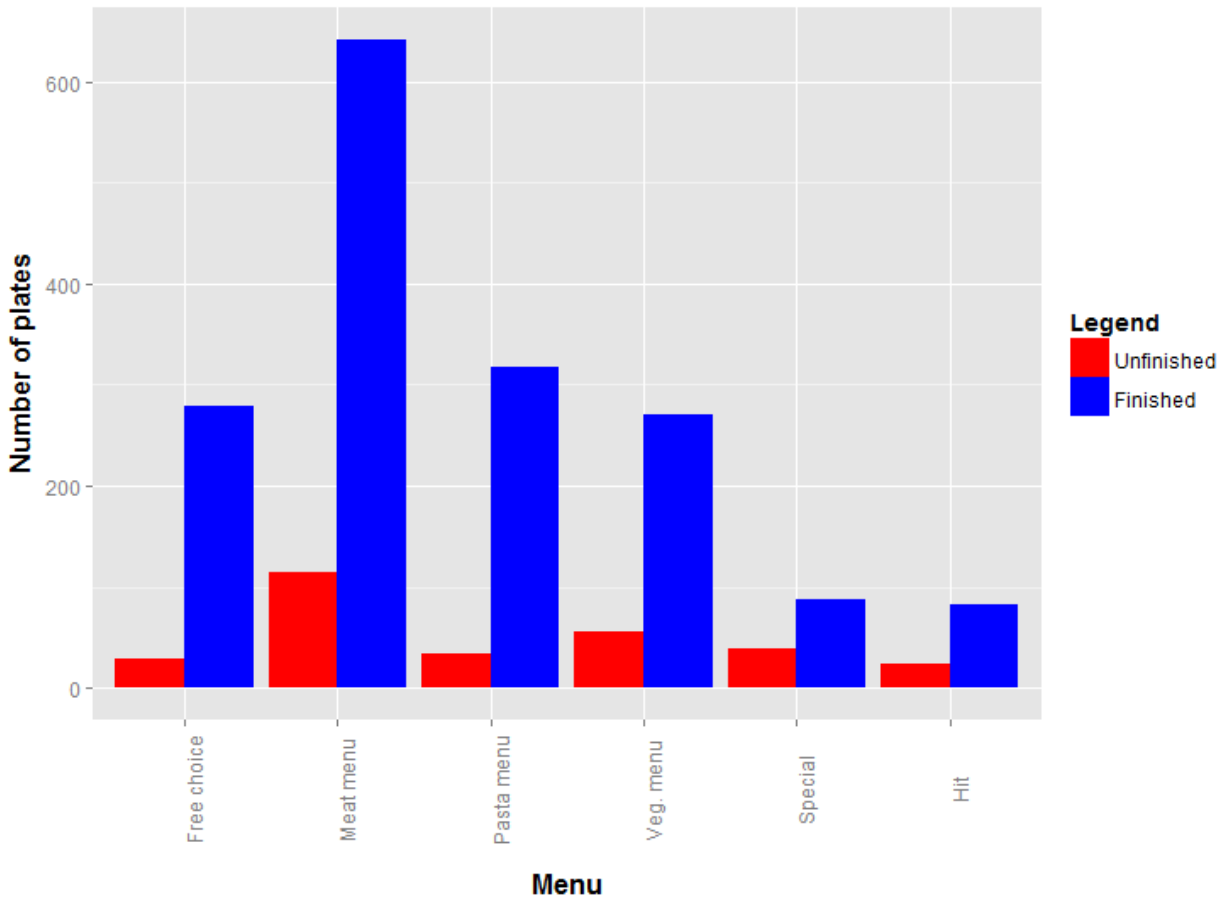

Figure 4: The total amount of finished (blue) and unfinished (red) plates, at the Mensa Irchel, per menu. For further information about the different menus see table 1.

Table 2: Reasons for the leftovers for each menu

The numbers stand for the total amount of unfinished plates for the respective menu. To be able to see the difference between the menus better, the relative amount of the different reasons is given in brackets.

	It was too much	I didn't like it	Other	**Total**
Free choice	9 (32%)	17 (61%)	2 (7%)	**28**
Meat menu	60 (52%)	48 (42%)	7 (6%)	**115**
Pasta menu	17 (50%)	16 (47%)	1 (3%)	**34**
Vegetarian menu	26 (47%)	28 (51%)	1 (2%)	**55**
Special menu	28 (74%)	8 (21%)	2 (5%)	**38**
Hit	19 (79%)	4 (17%)	1 (4%)	**24**

Differences between the genders

As expected a significant difference in the frequency of plate waste was found between the genders ($\chi^2_{1,1951} = 62.6$, $p < 0.0001$). As one can see, relative food waste occurs more often with females than with males (Figure 5). Again, to explain the difference more, the reasons for the waste were examined (Table 3). More females than males indicated that receiving too much food accounted for their leftovers.

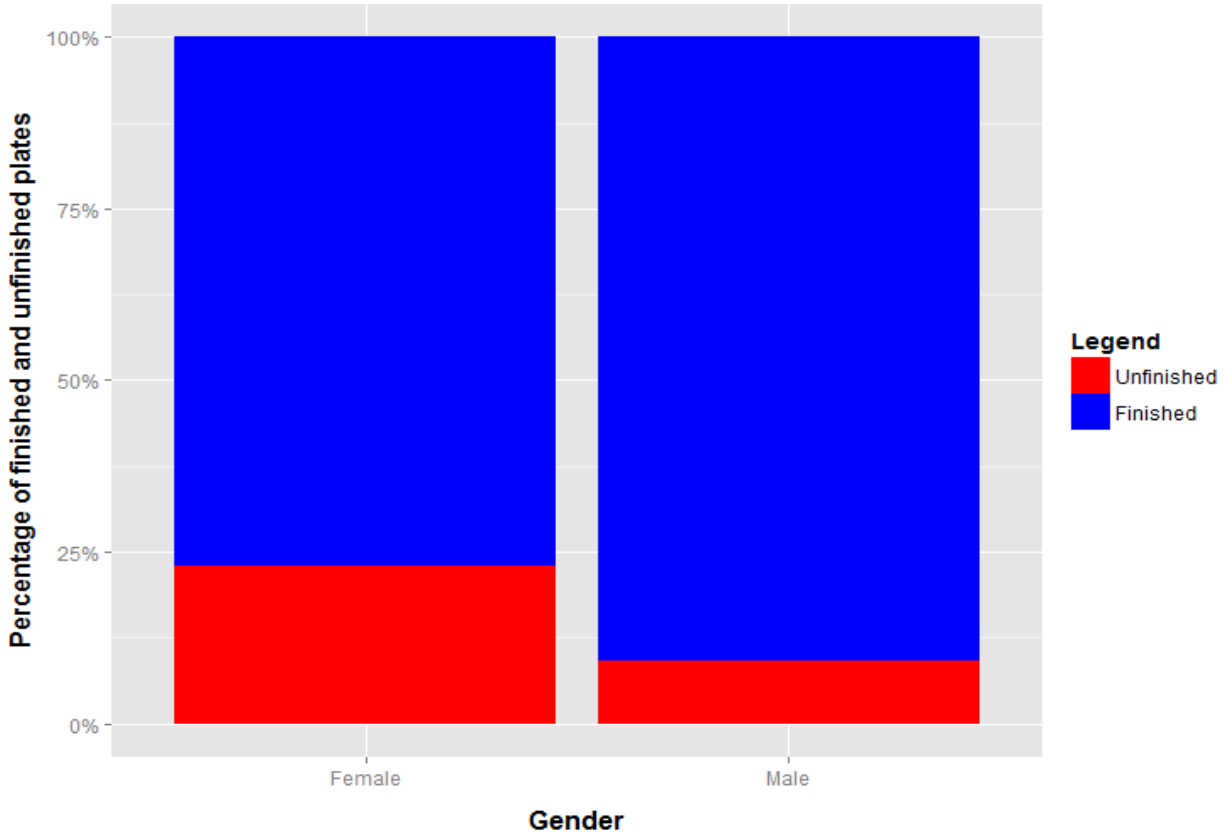

Figure 5: The relative amount of finished (blue) and unfinished (red) plates, at the Mensa Irchel, per gender.

Table 3: Reasons for the leftovers per gender

The numbers stand for the total amount of unfinished plates for the respective menu. To be able to see the difference better, the relative amount of the different reasons is given in brackets.

	It was too much	I didn't like it	Other	Total
Male	47 (45%)	51 (49%)	7 (6%)	**105**
Female	116 (59%)	73 (37%)	9 (4%)	**198**

Differences between the food types

There was a significant difference between the frequency of food types leftover ($\chi^2_{3,2} = 32.1$, $p < 0.0001$). In particular, the frequency of side dish leftover is significantly different than the frequency of meat leftover ($z_{3,2} = 3.50$, $p < 0.001$). This considerable difference is mainly for females rather than males (Figure 6). The frequency of vegetable leftovers is marginal higher than the frequency of meat ($z_{3,2} = 3.50$, $p < 0.001$).

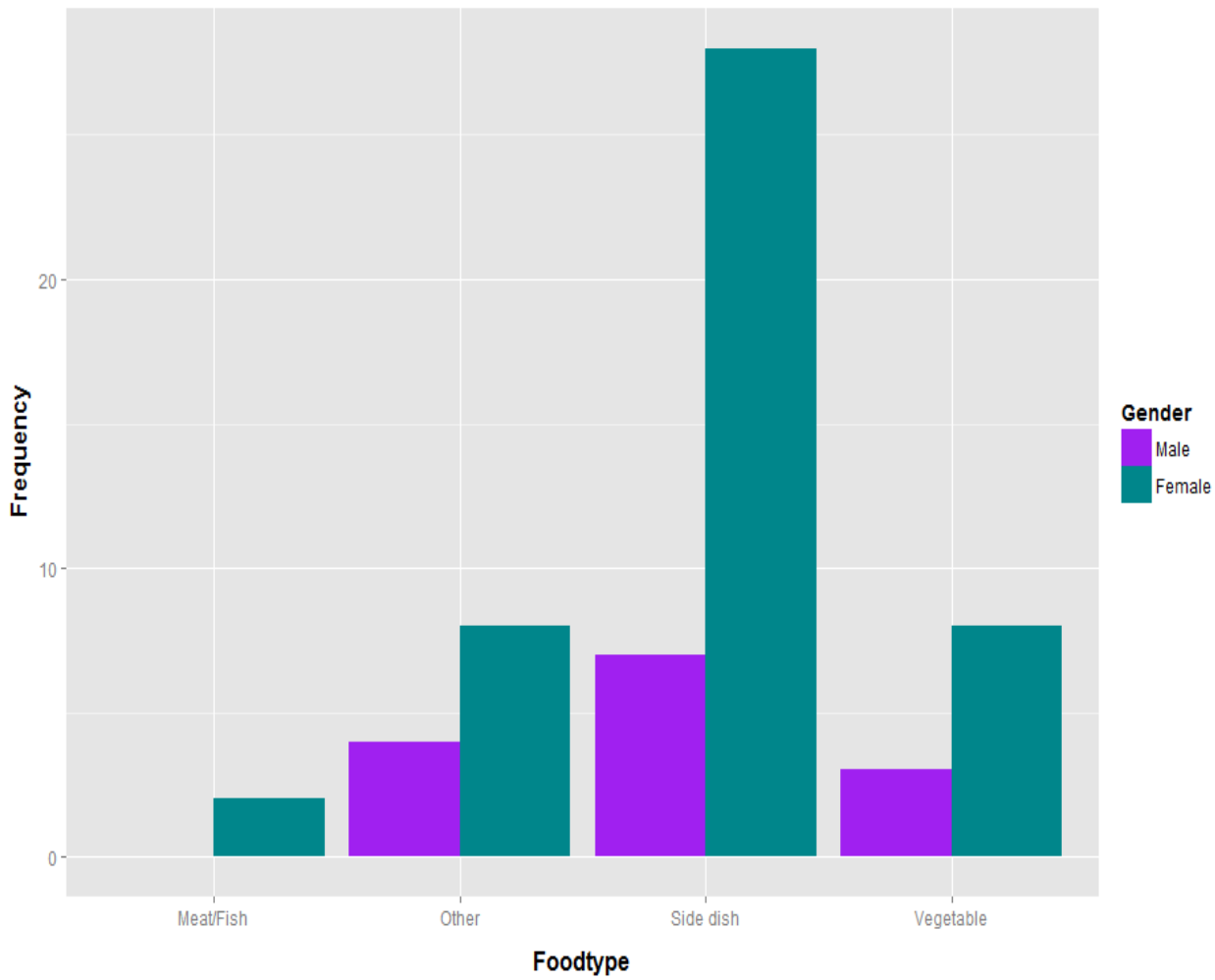

Figure 6: The total frequency of the leftovers for the different food types "Meat/Fish", "Side dish" and "Vegetable" per gender. "Other" refers to leftovers that were not specified.

Part II: Life cycle assessment of the food provided by the Mensa Irchel

Introduction to life cycle assessments (LCA)

This chapter gives an introduction to LCA which is applied to the Mensa Irchel in the following chapters. All the information is taken from Klöpffer & Grahl (2011). LCA is a quantitative method to evaluate the environmental impact of a product throughout its entire life cycle. It includes the production of the raw materials just like the recycling or disposal of the product. LCAs are therefore often called cradle-to-grave analysis.

An LCA can have different goals. Often it is used to gain a better understanding of the environmental impact of a product and to compare different alternatives. Another goal is to identify processes with a high environmental impact and potentials for reducing this impact. LCA focuses only on the environmental aspects and does not account for economic and social dimensions.

The precision of the results depends on the available data and its accuracy. Furthermore, often assumptions have to be made and they might be subjective. Since, it is nearly impossible to capture the whole life cycle as it really is with all the stakeholders.

The LCA concept is based on four parts:

- Goal and scope
- Inventory analysis
- Impact assessment
- Interpretation

Goal and scope

In this part the goal is formulated, which is essential for the further course of a LCA. The more precise the goal is defined, the easier the performance of the following parts will be. In addition the use and audience of the results are defined.

The specification of the scope helps to define the required information and the considered processes. The scope defines the boundaries of the LCA. Based on the defined goals, the use of the results and availability of data, the life cycle boundaries are defined. Additionally, temporal and geographical boundaries are defined. This step is very important for the repeatability of the LCA and essential if different products are compared.

Another important part is to define the functional unit. The functional unit is the crucial factor from which the environmental impact is estimated. Functional units are, for example, the production of one kilogram of a specific product or the impact of different packing materials.

Inventory analysis

This part contains the collection of the required data, defined with the goal and scope of the study. It includes the sources of the data and additional information to the unique processes. A model of the life cycle is done with this data, describing the processes included and their dependences on one another. The scope defined previously, give the boundaries of the model.

Impact assessment

After the modelling is completed, all material and energy flows get assessed and interpreted in terms of their environmental impact. There are many different factors that can be calculated to evaluate the environmental impact. Simple accumulation of a specific emission can be calculated as well as a specific impact, for example, global warming potential, which take into account all emissions that have this impact. So, in this part the used factors are explained and why this factors are used. The results and comparison of different life cycles also belongs to this part.

Interpretation

Finally, the impacts are assessed in terms of their significance and extent. Depending on the focus of the study the significance of the environmental impacts can be very different. This part shows the overall importance of the data and compares them with other studies. In this study the interpretation is included into the discussion part.

Goal and scope

The goal of this LCA is to assess the current environmental impact of the Mensa Irchel as an example of a university canteen in Switzerland. A special focus is on the effect of a potential reduction of food loss (especially plate waste) on the environmental impact. The main purpose of the results is to improve the environmental performance of the Mensa Irchel. But of course it can also be helpful to other university canteens in Switzerland. Even if it might not be representative for other kinds of gastronomic businesses, it can contribute to an understanding of the environmental impact of them as well. In addition it can be helpful to further studies to compare different kinds of canteen and gastronomic businesses in different countries.

The functional unit is defined as the required food at the Mensa Irchel for one year. This information was provided from the management of the Mensa Irchel and involves the purchased food in the year 2014.

As for the boundaries the LCA includes the production of the foods, the preparation at the Mensa Irchel (without energy use) and the treatment of the bio waste. Due to lack of information about the origin the transportation to the Mensa Irchel is not covered in the LCA. According to the management of the Mensa Irchel most of the food are produced in Switzerland and other European countries. Therefore the exclusion of the transportation should not lead to a highly underestimated environmental impact. The treatment of the wasted food is located in Switzerland and therefore data relevant to Switzerland was used.

Inventory analysis

The modelling was done with the software Umberto (ifu Hamburg GmbH, 2015). First the food flow within the Mensa Irchel was investigated. To be able to assess the environmental impact of the food production, available data was collected. Finally, the treatment of the bio waste was modelled as well (see also Appendix 6).

Within the Mensa Irchel

To understand the food flow at the Mensa Irchel the management was interviewed and a tour through the premises was made. Three main processes occur: After the food gets delivered it is brought to the kitchen, where it gets prepared and cooked. Shortly before the Mensa opens the cooked food goes to the ladling stations and from there on the plates. After the guests finish their meal, they bring the plate to a conveyor which transports the finished plates and the leftovers to the dish washing station, where the leftovers are put into a bio waste container.

Along this flow food loss occurs on three stations: (1) as waste from the preparing and cooking station, (2) as leftovers from the ladling station and buffet and (3) as plate waste from the guest. These three processes are presented in Figure 7.

The amount of food loss at each process was measured by the staff of the Mensa Irchel. In calendar week 25 the staff did a detailed food loss analysis and measured the food loss at different stages for each day. Additionally during the survey described in Part I (p. 3) the plate waste was measured during calendar week 17 and 21 every day.

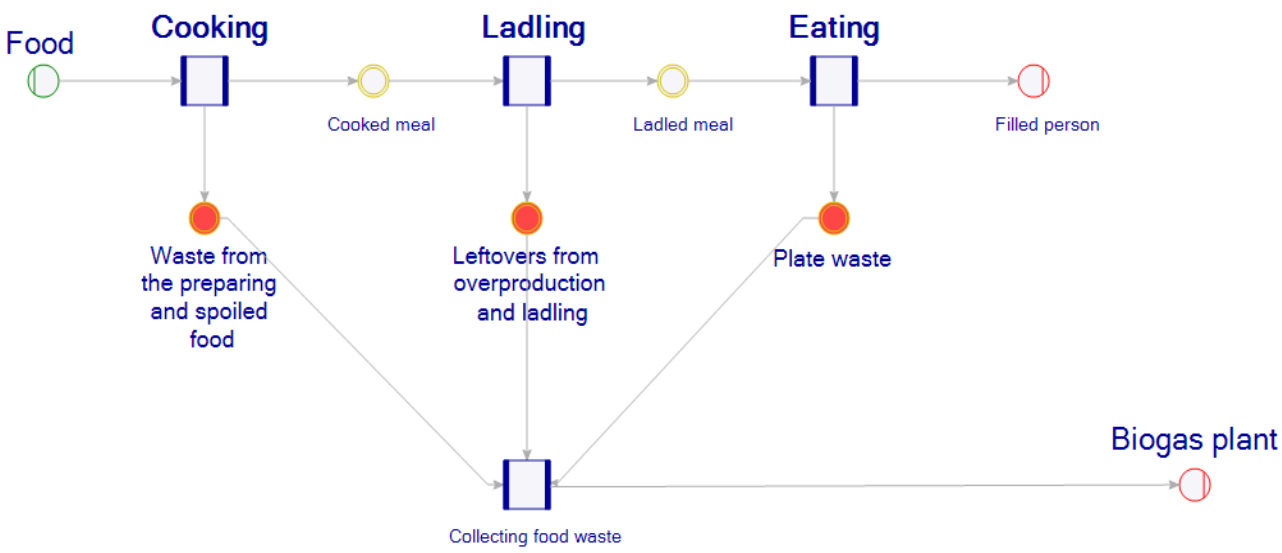

Figure 7: Model of the Mensa Irchel with the processes which cause food losses (red points)

Prior to the Mensa Irchel

The information about the purchased food from 2014 were provided from the management of the Mensa Irchel. To be able to calculate the environmental impact of the food production, upstream data from the database Ecoinvent 3.1 (Weidema et al., 2013) was used. For each food a suitable dataset was searched or a mixture of different datasets was created (see also Appendix 7). Below, the procedure for each food group is simply explained. Since all the data available end with the product at the farm, food losses caused by transportation and processing are not accounted for. To include these losses data from Gustavsson et al. (2011) was used. With all these data a food mixture was modelled to account also for the foods that could not have been defined.

Meat

The Mensa Irchel purchases different kinds of meat and for every type a suitable dataset was searched for. In particular the kinds of meat are cattle, pig, chicken, venison and lamb. Additionally there are meat products with no specific meat type purchased.

The data for cattle and chicken production was used from the Ecoinvent 3.1. Since there is no specific dataset for venison, the same dataset as for cattle was used. Depending on the proportions of cattle and chicken a meat mixture was modelled to include the meat without specific meat type. Data about the environmental impact of pig and lamb meat production was provided by the Zurich University of Applied Sciences (ZHAW) (Stucki, 2015), which used data from the database Agribalyse (Koch & Salou, 2014). Since all these data have the "animal ready for slaughter" as their output, the losses during the slaughter are no accounted for. Therefore, the slaughtering has to be modelled separately. Table 4 shows the used slaughtering for the modelling.

Table 4: The slaughterings used for the modelling of the meat production

Meat	Slaughtering (% of living weight)	Source
Cattle/calf	56.5	Fries et. al, 2001
Pig	81	Fries et. al, 2001
Lamb	50	Fries et. al, 2001
Chicken	75	AUSTRIA, 2015

Meat substitutes

As meat substitutes tofu and quorn are used at the Mensa Irchel. For tofu there is a dataset available from Ecoinvent 3.1, but none for quorn. Therefore both foods were modelled as tofu.

Fish and seafood

Since Ecoinvent 3.1 does not provide data about fish and seafood, again data generated from the ZHAW was used. Separate data for fresh water and salt water fishes from the database Agribalyse (Koch & Salou, 2014) were used. Depending on the proportions of fresh water and salt water fishes a fish mixture was modelled to include the fish with no further information. As for the seafood, data from LCA food (Nielsen et al., 2003) was used.

Vegetables

Ecoinvent 3.1 provides a lot of data for vegetable production. These data were compared with the vegetable purchases of the Mensa Irchel to find suitable datasets. Not for all purchased vegetable an available dataset was available. Therefore only the production of vegetables for which data was available was modelled. Depending on the proportions of the purchased amount of these vegetables a mixture was modelled (see also Appendix 7).

Fruits

Ecoinvent 3.1 provides a lot of data for fruit production. Similar as with the vegetables, the data were compared with the fruit purchases of the Mensa Irchel to find suitable datasets. Again, depending on the proportions of the different fruits a mixture was modelled to include all the fruits for which no dataset was available (see also Appendix 7).

Side dish

Different kinds of side dishes were purchased by the Mensa Irchel. They are mainly potatoes, rice, bread and pasta. For the potato and rice production the datasets available from Ecoinvent 3.1 were used. For bread no dataset is available in Ecoinvent 3.1, again data from the database Agribalyse generated from the ZHAW was used.

Since for pasta there is no dataset available the production was modelled with a simple process. The datasets for wheat flour and tap water were used to simulate the pasta production, with the following simple equation:

1 kg of tap water + 2 kg of wheat grain = 3 kg of pasta

With the production of potato, rice and pasta a side dish mixture was modelled to account for other side dishes.

There are also some foods which are a mixture of pasta and other foods, like ravioli. Most of these products contain either meat, vegetables or cheese and the proportion of pasta was assumed to be 50%. Therefore a simple process was defined to simulate this production, with the following equation:

3 kg pasta + 1 kg meat mixture + 1 kg vegetable mixture + 1 kg cheese = 6 kg of ravioli

Dairy products, eggs and oils

As dairy products the Mensa Irchel uses mainly cow milk, cream, and cheese. For these three product datasets from Ecoinvent 3.1 were used. For the modelling of the egg production data from the database Agribalyse (Koch & Salou, 2014), generated from the ZHAW, was used. As for the oils, only a dataset for rape oil is available and therefore this data was used for all kinds of oil.

Spices

Since there are no datasets available for spices a dataset for bouillon was used as an approximation for all spices. This dataset was generated by the ZHAW (Stucki, 2015).

After the Mensa Irchel

The bio waste that accrues at the Mensa Irchel is brought to the Recycling Energie AG in Switzerland, where it is used to produce biogas and electricity. Ecoinvent 3.1 provides datasets for this production. The dataset from Ecoinvent 3.1 has a biogas yield of 210 m^3 out of 1 kg of bio waste. But since the actual yield from the Recycling Energie AG is 95 m^3 biogas out of 1 kg of bio waste, the dataset was changed accordingly.

Impact assessment

Methods

For the life cycle impact assessment two different methods were used. To asses the total environmental impact the LCIA method "ecological scarcity 2013" was used. The ecological scarcity method is used to assess the impact of pollutant emissions and resource extraction activities on the environment. The main values of this method are eco-factors, which measure the environmental impact per unit of quantity (Frischknecht & Büsser Knöpfel, 2013). The unit of this methods are environmental impact point (UBP). This method was used in this study since it is very common in Switzerland.

Additionally, the method "IPCC 2013 - climate change, GWP 100a" (Stocker et al., 2013) was used, to asses the greenhouse gas emissions since they are the main indicator for the vision of a 2000-Watt-society (Bébié et al., 2009). The 2000-Watt Society is a vision which has the goal to reduce the energy consumption in Switzerland to 2000 watt per person and the emissions caused per person to 1 t CO_2 equivalents by the year 2100. CO_2 equivalents show the impact of different greenhouse gases to the greenhouse effect relative to CO_2. With this method, different scenarios can be compared in case of their total greenhouse gas emissions.

Finally, the total amount of required food and the total food loss at the Mensa Irchel were calculated.

Scenarios

To be able to see how a reduction of food loss would change the environmental impact of the Mensa Irchel, five different scenarios were defined. First, the current situation was modelled with available data. After that an ideal scenario was created, where no avoidable food losses occur. By avoidable food loss, losses from overproduction, leftovers from the ladling station and buffet as well as plate waste is meant. Since this scenario is not very realistic a scenario representing minimal plate waste under real-world conditions was created, called the best case scenario. As the first part of this survey has shown, the lowest frequency of plate waste occurs with the free choice. Therefore this frequency was taken as the minimal plate waste for this scenario. As a counterpart to the best case scenario, a worst case scenario was created, representing maximum plate waste under real-world conditions. As shown in the first part, most of the plate waste occurs with the special menu. Therefore this frequency was taken as

the plate waste for all menus. Since the Mensa Irchel itself has a quantitatively defined goal in reducing food losses, this goal was taken as a scenario, called to-be scenario. The goal of the Mensa Irchel is to reduce food losses from overproduction, leftovers from the ladling station and buffet as well as plate waste by 15%. Table 5 shows an overview of the different scenarios that were compared.

Table 5: Names and rules of the different scenarios compared in the LCA

Scenario	Rules	changes in the model
as is	as realistic as possible with the data available	
to be	the Goal of the Mensa Irchel	- 15% food loss at ladling and eating
best	all plate waste as with the free choice	- 40% food loss at eating
worst	all plate waste as with the special menu	+ 100% food loss at eating
ideal	no avoidable food loss	no food loss at ladling and eating

Results

With both methods the order of the scenarios, in case of environmental impact, is the same. The scenarios "ideal" and "worst" are on the lower and upper limit as they are designed for. The scenario "to be", which represents the goal of the Mensa Irchel, is in between the scenario "as is" and "best", and these three scenarios are close together (Figure 8 and Figure 9). The same order can be seen, when we look at the total amount of required food and the total food loss at the Mensa Irchel (Figure 10 and Figure 11).

The scenarios were compared to the as is state, to see the effect of a food waste reduction. The Mensa Irchel would reduce its total environmental impact by 0.81% or 14 millions UBP, if the goal of 15% less food waste is achieved and even more (1.16% or 20 millions UBP) if the best case is reached (Table 6). The emissions could be reduced by 6.5 t CO_2 equivalents (Table 7).

As for the amount of food needed at the Mensa Irchel, there is a reduction potential of 3.4 tons of food, because food losses could be reduced by this amount. In addition to avoided environmental impacts, real money could be saved. With an estimated price of CHF 5.50 per kilogram food this would be CHF 18,700 per year (Greminger, 2015).

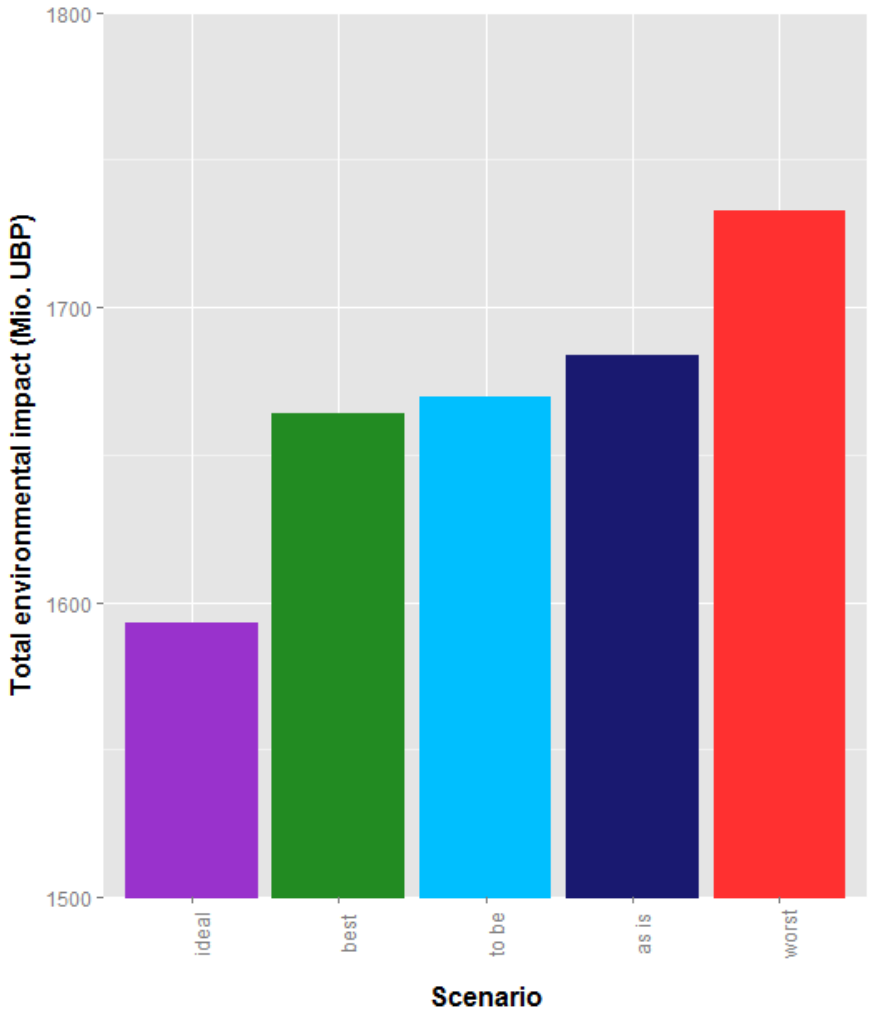

Figure 8: The total environmental impact of all five scenarios. For more information about the scenarios see Table 5.

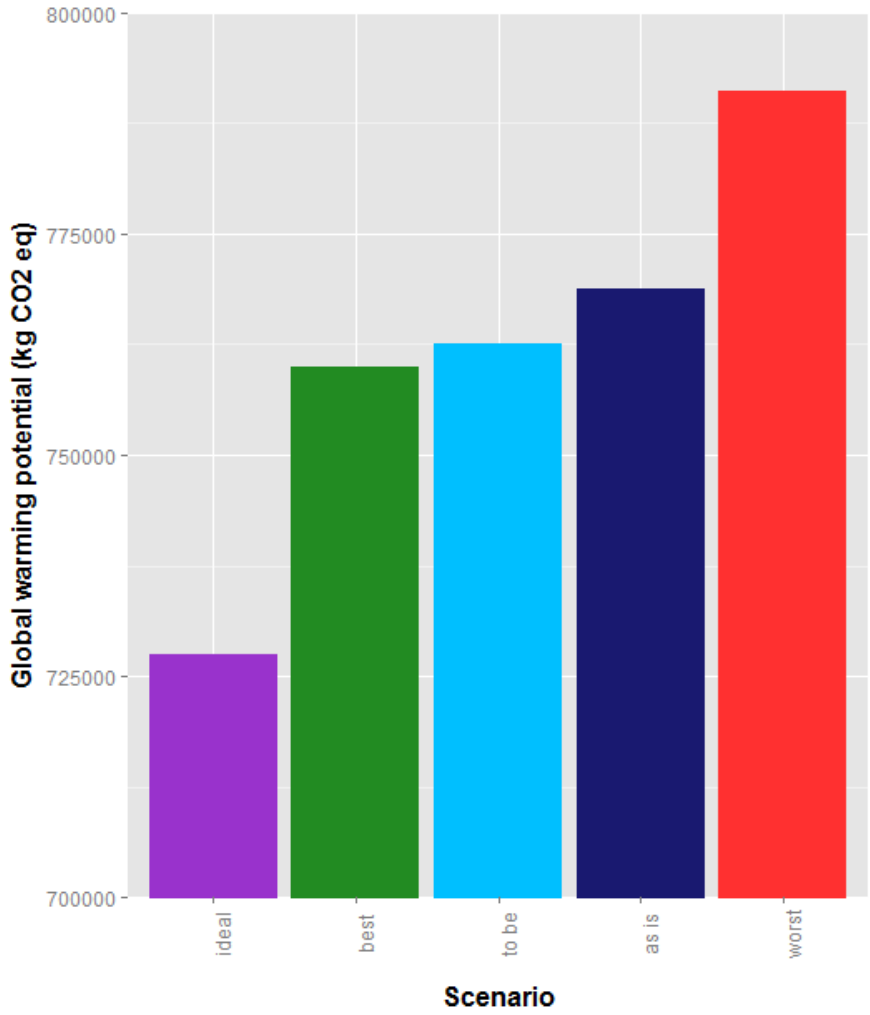

Figure 9: The global warming potential of all five scenarios. For more information about the scenarios see Table 5.

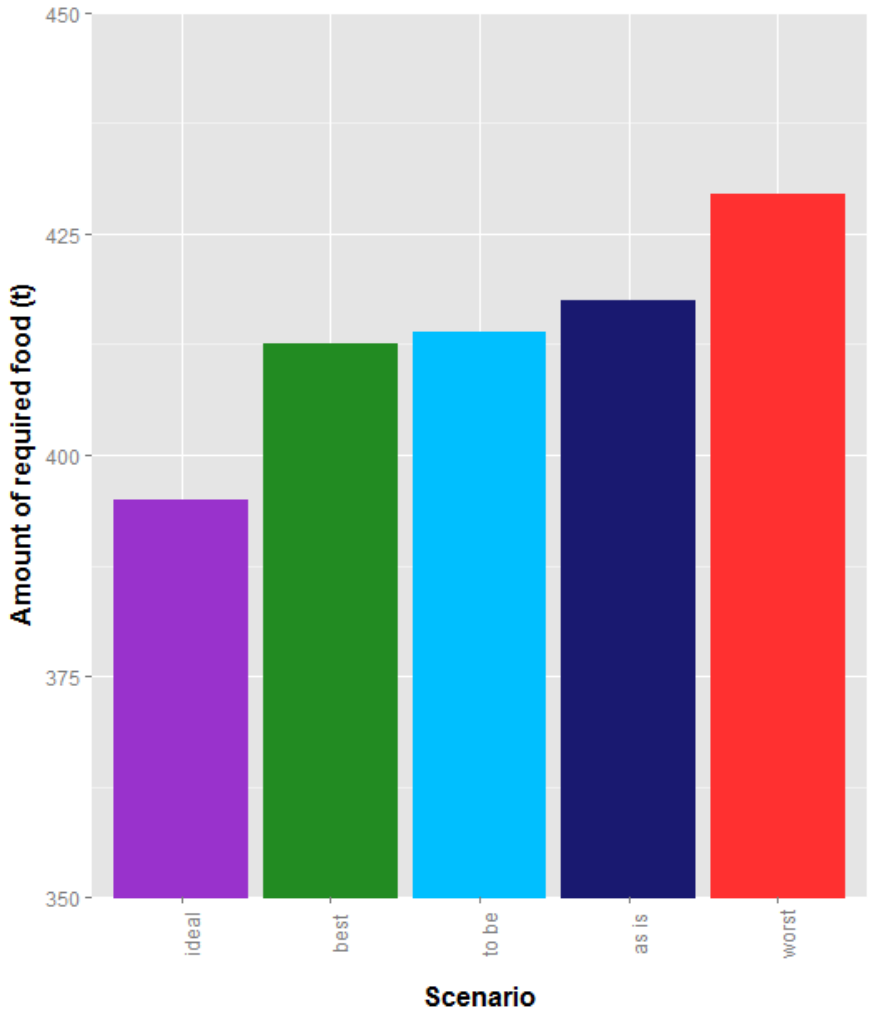

Figure 10: The required amount of food for all five scenarios. For more information about the scenarios see Table 5.

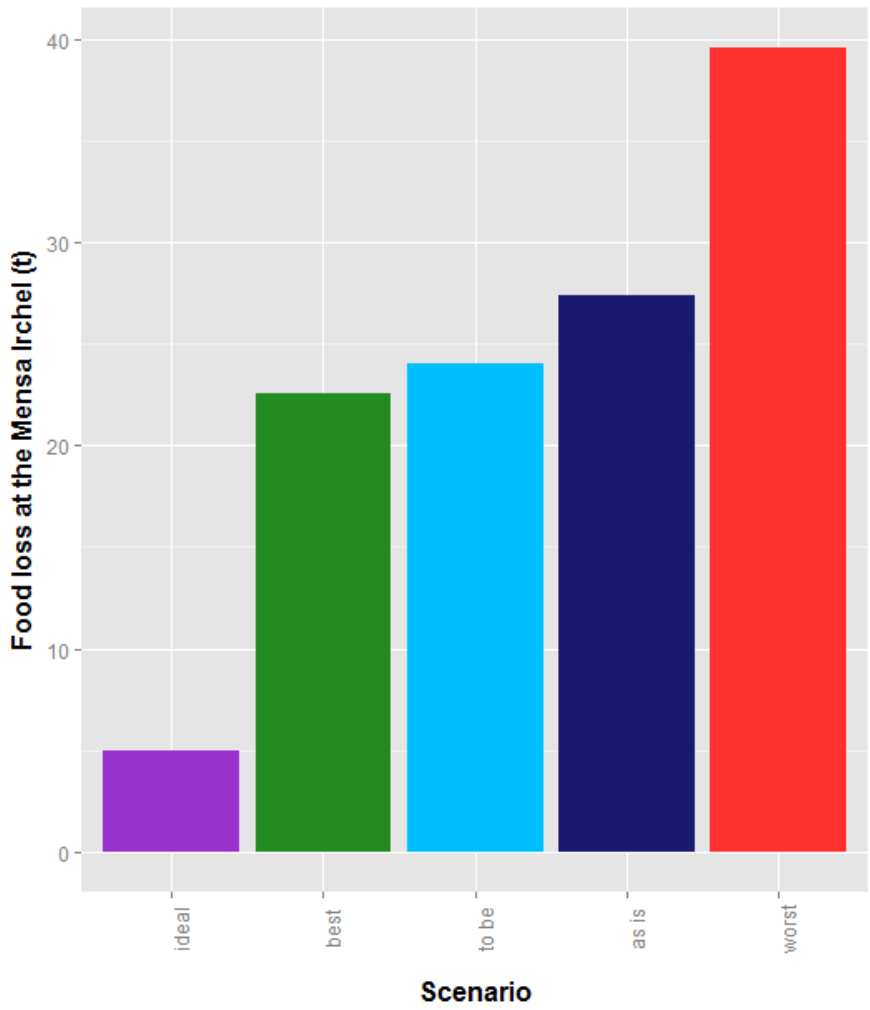

Figure 11: The food loss at the Mensa Irchel for all five scenarios. For more information about the scenarios see Table 5.

Table 6: Total environmental impact of all five scenarios and their differences to "as-is". For more information about the scenarios see Table 5.

Szenario	total environmental impact (Mio. UBP)	Difference to „as is“	
		relative	total (Mio. UBP)
ideal	1668.396	-5.38%	-94.799
best	1742.665	-1.16%	-20.531
to be	1748.870	-0.81%	-14.326
as is	1763.196		
worst	1814.502	2.91%	51.306

Table 7: Global warming potential of all five scenarios and their differences to "as-is". For more information about the scenarios see Table 5.

Szenario	GWP (t CO2 eq)	Difference to „as is“	
		relative	total (t CO2 eq)
ideal	759.451	-5.38%	-43.153
best	793.258	-1.16%	-9.346
to be	796.083	-0.81%	-6.522
as is	802.604		
worst	825.958	2.91%	23.354

Table 8: Amount of required food for all five scenarios and their differences to "as-is". For more information about the scenarios see Table 5.

Szenario	required amount of food (t)	Difference to „as is“	
		relative	total (t)
ideal	398.374	-5.38%	-22.634
best	416.108	-1.16%	-4.900
to be	417.574	-0.82%	-3.434
as is	421.008		
worst	433.261	2.91%	12.253

Table 9: Food loss at the Mensa Irchel for all five scenarios and their differences to "as-is". For more information about the scenarios see Table 5.

Scenario	**food loss at the canteen (t)**	**Difference to „as is“**	
		relative	**total (t)**
ideal	5.020	-81.85%	-22.634
best	22.753	-17.72%	-4.900
to be	24.219	-12.42%	-3.434
as is	27.654		
worst	39.906	44.31%	12.253

Discussion

Survey

We found that in relative terms most plate waste occurs with the special menu. This finding corresponds to another master thesis done in the same year at the ETH Zurich (Lanners, 2015). Therefore it seems that special menus tend to produce more plate waste. Of course, separate studies at other canteens would be the best way to find individual differences between the menus among different canteens. This way individual plate waste reduction potentials could be found and actions could be done. For the Mensa Irchel, this finding could be explained by the fact that the special menu is served on a bigger plate than the other menus. Therefore the recommendation regarding this finding is, to add a smaller portion for the special menu to their offer. At the canteens of the ETH Zurich the plate waste was reduced by 22% by including smaller portion sizes for their offers (Lanners, 2015). Since these canteens are similar to the Mensa Irchel in size, guests, menu offers and location the success of this action is likely to be similar. The management reacted very positively to the recommendation and is testing its feasibility. Since the special menu is the most expensive one, there could also be a price effect of plate waste, which means that expensive menus produce more plate waste than cheaper ones. To investigate this, further studies in other canteens are needed. In addition to plate waste and menu choice, questions about the income could be included to the survey.

A second finding was that the least plate waste occurs with the free choice. This could be explained by the self-service. With self-service the customers can decide what and how much exactly they want eat. Another reason could be the price system of the free choice. Since it is priced by weight the costumers might care more about how much they really eat, because it has an effect on the price. With the main menu it does not matter how much food is on the plate, the price is the same. Here the recommendation would be to increase the offer at the free choice. In particular, the warm buffet is not very big at the Mensa Irchel. According to Mr Greminger this is unfortunately not possible due to space issues (Greminger, pers. comm., 2015).

We have observed that women more often produce leftovers than men. This happens mainly because the portions are too large for the females. This finding corresponds with the study of Buzby and Guthrie (2002). An explanation could be the fact that women need less calories per day than men and need therefore less food. Of course an additional small portion for every menu would be great. Unfortunately this is not feasible at the Mensa Irchel, since it would

mean too much additional effort and space (Greminger, pers. comm., 2015). Another recommendation would be to inform the customers that their wishes regarding the portion sizes can be submitted to the staff at the ladling station. Gundlach (2015) found in her study at the ETH Zurich that the consumers are aware of the problem of food waste and an information campaign combined with additional small portion can clearly reduce food waste. Also, a study in the US (Whitehair et al., 2013) found that a simple information campaign can reduce plate waste. Although these studies might not be totally comparable, since the study of Whitehair et al. (213) was held in residence halls, similar effects are likely. Therefore an information campaign might be worth trying.

Finally, the survey found that most often the side dish is left over, in case the portion was too big. This finding corresponds with the study of Lanners (2015) at the ETH Zurich. It could be explained by the fact that meat is more expensive than the side dish and therefore is more valuable for the costumers. Another explanation could be that side dishes are often richest in calories and people might underestimate the amount they get. It might be helpful to ladle less side dish at first and ladle more if asked. The management reacted again very positive and explained that this topic was often discussed in the past.

Many of the findings correspond to the study at the ETH Zurich (Gundlach, 2015; Lanners, 2015). Therefore this study is at least representative to university canteens in Switzerland. To be able to compare other canteens in Switzerland more studies are necessary. A comparison to a few other studies in different countries makes it clear that the Mensa Irchel, together with the ETH Zurich, has a quite low plate waste (Table 10). So in other countries there might be even bigger food waste reduction potentials.

Table 10: A comparison with previous studies of plate waste at canteens

Study	Country	Plate waste (g/plate)
This study	Switzerland	23
Betz et al., 2015	Switzerland	86 - 91
Lanners, 2015	Switzerland	21
Whitehair et al., 2013	USA	57
Al-Domi et al., 2011	Jordan	70
Cordingley et al., 2011	England	42 - 72
Engström & Carlsson-Kanyama, 2004	Sweden	33 - 60

Life cycle assessment (LCA)

With the comparison of the different scenarios we found that the goal of the Mensa Irchel ("to be") is in between their as-is-state and the defined best case. Therefore the goal of a reduction of 15% food loss at the preparation side, ladling station and in terms of plate waste, seems to be reachable. Based on the survey in the first part of this study (p. 3) recommendations for the Mensa Irchel were formulated. It would be best to investigate the food losses again after changes are made.

With the LCA it was found that the emissions caused by the production of the required food for the Mensa Irchel come to around 802 t CO_2 equivalents (Table 7, p. 23). With about 455,000 costumers per year this would mean 1.76 kg CO_2 equivalents per costumer and meal. In an extreme case a person eats lunch at the Mensa Irchel 260 times a year and would cause 459 kg CO_2 equivalents (Table 11). With the scenario "to be", this amount could be reduced by 4 kg to 455 kg CO_2 equivalents. If we go for the best case scenario even 6 kg CO_2 equivalents could be saved. A reduction of 4 or 6 kg does not look like much, but if Switzerland wants to achieve the goal of 1 t of CO_2 equivalents per person and year, every saved kg is a step in the right direction (Bébié et al., 2009). Moreover, we have found that the Mensa Irchel has quite a low plate waste in comparison to other canteens (Table 10). So the reduction potential for other canteens might be even higher. Therefore the recommendation for all gastronomic businesses is to investigate food loss reduction potentials and try to use them.

Table 11: Caused emissions for one person who eats everyday at the Mensa Irchel

Scenario	kg CO_2 eq. per costumer and portion	kg CO_2 eq. per costumer and year
ideal	1.67	434
best	1.74	453
to be	1.75	455
as is	1.76	459
worst	1.82	472

In case of food losses, it is not only the environmental impact of the unused food that is an important topic, but also the famine in other regions of the world. At the moment the Mensa Irchel produces around 28 t of food waste per year (Table 9). This food is thrown away here, but could save lives in other places. If the Mensa Irchel could reach their goal (scenario "to be"), the food losses would be reduced by 3.4 t. This is food that could be used in other places to feed people. So, not only because of environmental, but also because of social issues, a reduction of food losses should be the goal of every gastronomic business.

Limitations

As always also this study has its limitations. First of all it would have been nice to be able to investigate more than one canteen. Fortunately, we were able to compare it to the study from Lanners (2015). This way information of another canteen in the same environment and with similar guest were available. Another important point is that LCA's always are based on a lot of assumptions and it is impossible to display the world exactly as it is. Since in the originally used database, Ecoinvent 3.1 (Weidema et al., 2013), there was no data available for the production of all different food other databases had been used. This could also have an impact in the accuracy of the results. Although limitations restrict this study it gives a good estimation of where plate waste reduction potentials can occur and how big their impact can be.

Further studies

Recent studies on food losses have focused mainly on households (Betz et al., 2015), and thus investigations in gastronomic businesses are very important to improve the understanding why and where food losses occur. Therefore, all questions dealt with in this study should be investigated further in other businesses and countries. Especially the differences between menu types needs further investigation to formulate clearer recommendations for gastronomic businesses.

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Appendix

Appendix 1: Survey in German and English

Bitte nach dem Essen ausfüllen

Fragen zum Essen

1. Welches Menü haben Sie heute gewählt?

☐ Einfach gut
☐ Immer Pasta
☐ Hit
☐ Suppe
☐ Natürlich Vegi
☐ Voll anders
☐ Buffet
☐ Anderes:_____

2. Wie hat Ihnen Ihr Menü geschmeckt?

Gar nicht	☐	☐	☐	☐	☐	Sehr gut
	1	2	3	4	5	

3. Haben Sie den Teller leer gegessen?

☐ Ja ⬇

4. Die Menge auf dem Teller war...

☐ > 20% mehr wären besser gewesen
☐ 20% mehr wären besser gewesen
☐ 10% mehr wären besser gewesen
☐ Gerade richtig
☐ 10% weniger hätten auch gereicht
☐ 20% weniger hätten auch gereicht
☐ > 20% weniger hätten auch gereicht

☐ Nein ⬇

5. Welche Teile des Menüs haben Sie übriggelassen?

☐ Fleisch/Fisch
☐ Gemüse
☐ Beilage
☐ Anderes:_____

6. Warum haben Sie diese Teile übriggelassen?

☐ Es war zu viel
☐ Es hat mir nicht geschmeckt
☐ Anderes:_____

7. Wie viel des gesamten Menüs haben Sie übriggelassen?

☐ Weniger als ein Achtel
☐ Weniger als ein Viertel
☐ Weniger als die Hälfte
☐ Mehr als die Hälfte

8. Hat jemand anderes Ihre Reste gegessen?

☐ Ja ☐ Nein

Fragen zur Person (ihre Angaben werden vertraulich und anonym behandelt)

Alter: _____

Geschlecht: ☐ W ☐ M

Grösse (in cm):_____

Nationalität:_____

Gewicht (in kg):_____

Aktuelle Uhrzeit (Bsp. 12:00): _____

Haben Sie schon einmal an dieser Umfrage teilgenommen?

☐ Ja, schon _____ Mal ☐ Nein

Please fill in after you have finished your lunch

Questions about your meal

1. Which meal did you choose today?

☐ Einfach gut (Simply good)
☐ Immer Pasta (Always pasta)
☐ Hit (Special)
☐ Suppe (Soup)
☐ Natürlich Vegi (naturally vegetarian)
☐ Voll anders (something different)
☐ Free choice
☐ Other:_____

2. How much did you like your meal?

Not at all	☐	☐	☐	☐	☐	Very much
	1	2	3	4	5	

3. Did you finish your meal?

☐ Yes ⬇

☐ No ⬇

4. The portion size was...

☐ > 20% more would have been better
☐ 20% more would have been better
☐ 10% more would have been better
☐ exactly right
☐ 10% less would have been enough
☐ 20% less would have been enough
☐ > 20% less would have been enough

5. Which part of the meal did you leave?

☐ Meat / Fish
☐ Vegetable
☐ Side dish
☐ Other:_____

6. Why did you leave this part?

☐ It was too much.
☐ I didn't like it.
☐ Other:_____

7. How much of the meal did you leave?

☐ Less than an eighth
☐ Less than a quarter
☐ Less than the half
☐ More than the half

8. Did anyone else eat your left over?

☐ Yes ☐ No

Personal information (your information will be treated confidentially and anonymously)

Age: _____

Sex: ☐ F ☐ M

Height:_____ Unit:_____

Nationality:_____

Weight:_____ Unit:_____

Current time (e.g. 12:00): _____

Did you already participate in this survey?

☐ Yes, _____ times ☐ No

Appendix 2: Gender distribution at the University of Zurich

Table 12: The gender distribution at the University of Zurich (UZH) in total and just the Faculty of Science (MNF) and the Vetsuisse faculty (main costumers at the Mensa Irchel) in comparison to the gender distribution of the survey (Abteilung Finanzen der Universität Zürich, 2015)

	Females	Males	Distribution (#males / #females)
UZH total	18,179	14,274	0.79
UZH only MNF and Vetsuisse	3,170	2,763	0.87
Survey of this study	870	1,154	1.33

Appendix 3: Age distribution of the respondents

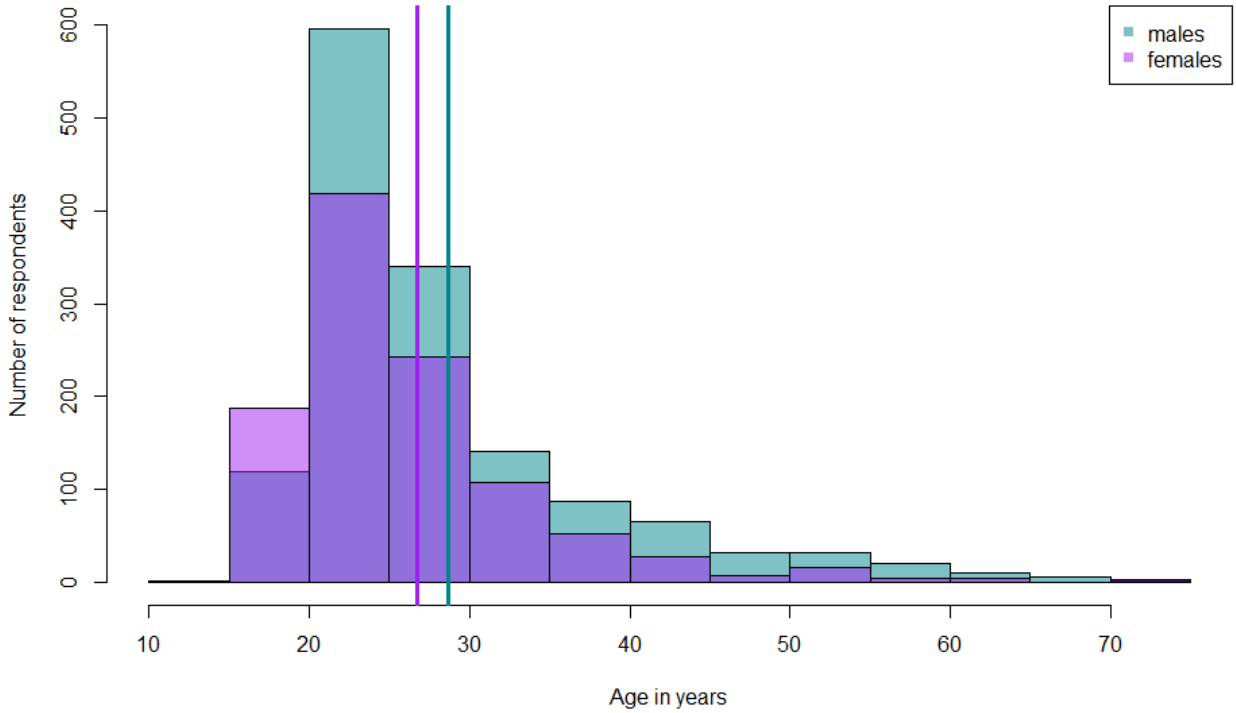


Figure 12: Age distribution of the respondents per gender

Appendix 4: Detailed statistics with the unique respondents

Question 1: Is there a menu-specific difference in the frequency of plate waste?

Question 2: Is there a sex-specific difference in the frequency of plate waste?

Model

glm(finished~age+BMI+sex+menu, family = binomial)

Anova Table

NULL			1954	1641.5	
age	1	3.8	1953	1637.7	> 0.1 .
BMI	1	10.0	1952	1627.7	> 0.01 **
sex	**1**	**62.6**	**1951**	**1565.1**	**> 0.001 *** **
menu	**7**	**57.0**	**1944**	**1508.1**	**> 0.001** ***

Question 3: Is there a food type specific difference of plate waste for the meat menu in case the portion was too big?

Model

glm(count~sex+leftovers, family=poisson)

Anova Table

	Df	Deviance	Resid. Df	Resid. Dev	Pr(>Chi)
NULL			6	43.031	
sex	1	10.0	5	33.015	> 0.01 **
leftovers	**3**	**32.1**	**2**	**0.914**	**> 0.001** ***

Summary Table

	Estimate	Std. Error	z value	Pr(>|z|)	
(Intercept)	0.6931	1.4285	0.980	0.32	
sexM	-1.1451	0.3068	-3.732	> 0.001	***
leftoversOther	1.5155	0.7673	1.975	> 0.05	*
leftoversSide dish	2.5859	0.7308	3.539	> 0.001	***
leftoversVegetable	1.4285	0.7723	1.850	> 0.01	.

Appendix 5: Detailed statistics with all completed surveys

Question 1: Is there a menu-specific difference in the frequency of plate waste?

Question 2: Is there a sex-specific difference in the frequency of plate waste?

Model

glm(finished~age+BMI+sex+menu, family = binomial)

Anova Table

	Df	Deviance	Resid. Df	Resid. Dev	Pr(>Chi)	
NULL			2449	2097.1		
age	1	5.0	2448	2092.1	> 0.05	*
BMI	1	11.3	2447	2080.7	> 0.001	***
sex	**1**	**82.6**	**2446**	**1998.1**	**> 0.001**	***
menu	**7**	**66.3**	**2439**	**1931.8**	**> 0.001**	***

Question 3: Is there a food type specific difference of plate waste for the meat menu in case the portion was too big?

Model

glm(count~sex+leftovers, family=poisson)

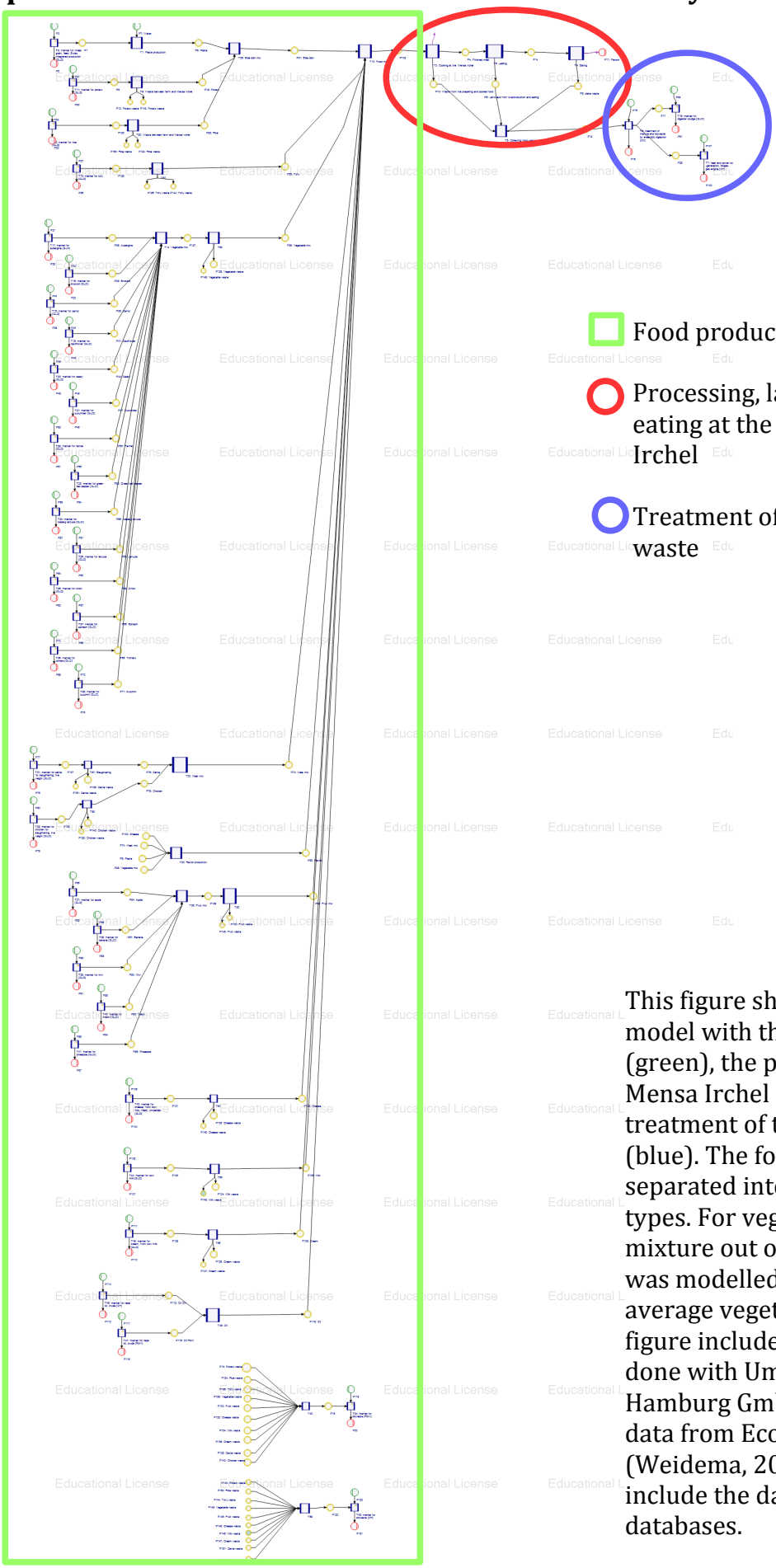
Anova Table

	Df	Deviance	Resid. Df	Resid. Dev	Pr(>Chi)	
NULL			6	53.870		
sex	1	15.4	5	38.473	> 0.001	***
leftovers	**3**	**36.2**	**2**	**2.311**	**> 0.001**	***

Summary Table

	Estimate	Std. Error	z value	z value	
(Intercept)	1.0986	0.5774	1.903	> 0.1	.
sexM	-1.2528	0.2835	-4.419	> 0.001	***
leftoversOther	1.4833	0.6294	2.357	> 0.05	*
leftoversSide dish	2.3877	0.6009	3.973	> 0.001	***
leftoversVegetable	1.2150	0.6436	1.888	> 0.1	.

Appendix 6: LCA overview of the food flow caused by the Mensa Irchel



Food production

Processing, ladling and eating at the Mensa Irchel

Treatment of the food waste

This figure shows the complete model with the food production (green), the processes within the Mensa Irchel (red) and the treatment of the food waste (blue). The food production is separated into the different food types. For vegetables and fruits a mixture out of the available data was modelled to create an average vegetable and fruit. This figure includes all modelling done with Umberto (IFU Hamburg GmbH, 2015) and the data from Ecoinvent 3.1 (Weidema, 2013). It does not include the data from other databases.

Appendix 7: Used datasets for the LCA

Table 13: Used datasets and comments

Side dishes			
Product	**Dataset**	**Database**	**Comments**
Bread	Bread, wheat, conventional, fresh	LCA Food DK	provided by the ZHAW
Pasta	market for wheat grain, feed, Swiss integrated production [GLO]	ecoinvent	
Potato	market for potato [GLO]	ecoinvent	
Rice	market for rice [GLO]	ecoinvent	

Vegetables			
Product	**Dataset**	**Database**	**Comments**
Aubergine	market for aubergine [GLO]	ecoinvent	
Broccoli	market for broccoli [GLO]	ecoinvent	
Carrot	market for carrot [GLO]	ecoinvent	
Cauliflower	market for cauliflower [GLO]	ecoinvent	
Celery	market for celery [GLO]	ecoinvent	
Cucumber	market for cucumber [GLO]	ecoinvent	
Fennel	market for fennel [GLO]	ecoinvent	
Pepper	market for green bell pepper [GLO]	ecoinvent	
Iceberg lettuce	market for iceberg lettuce [GLO]	ecoinvent	
Lettuce	market for lettuce [GLO]	ecoinvent	
Onion	market for onion [GLO]	ecoinvent	
Spinach	market for spinach [GLO]	ecoinvent	
Tomato	market for tomato [GLO]	ecoinvent	
Zucchini	market for zucchini [GLO]	ecoinvent	

Meat			
Product	**Dataset**	**Database**	**Comments**
Cattle	market for cattle for slaughtering, live weight [GLO]	ecoinvent	
Chicken	market for chicken for slaughtering, live weight [GLO]	ecoinvent	

Lamb	Lamb, conventional, indoor production system, at farm gate/kg/FR U	Agribalyse	provided by the ZHAW
Pig	Pig, conventional, national average, at farm gate/kg/FR	Agribalyse	provided by the ZHAW

Fish/Seafood			
Product	**Dataset**	**Database**	**Comments**
Freshwater fish	Small trout, 250-350g, conventional, at farm gate/kg/FR	Agribalyse	A mixture was made as a approach for all fresh water fishes, provided by the ZHAW
	Large trout, 2-4kg, conventional, at farm gate/kg/FR U	Agribalyse	
Saltwater fish	Sea bass or sea bream, 200-500g, conventional, in cage, at farm gate/kg/FR U	Agribalyse	provided by the ZHAW
Seafood	Shrimps, fresh, in supermarket (no quotas)	LCA Food DK	A mixture was made as a approach for all seafood, provided by the ZHAW
	Shrimps, frozen, in supermarket (no quota)	LCA Food DK	

Fruits			
Product	**Dataset**	**Database**	**Comments**
Apple	market for apple [GLO]	ecoinvent	
Banana	market for banana [GLO]	ecoinvent	
Kiwi	market for kiwi [GLO]	ecoinvent	
Melon	market for melon [GLO]	ecoinvent	
Pineapple	market for pineapple [GLO]	ecoinvent	
Diverse foods			
Product	**Dataset**	**Database**	**Comments**
Spices	A mixture was made out of vegetable ,	ZHAW	provided by the

	chicken and beef bouillon	Agrifood DB	ZHAW
Cheese	market for cheese, from cow milk, fresh, unripened [GLO]	ecoinvent	
Cream	market for cream, from cow milk [GLO]	ecoinvent	
Milk	market for cow milk [GLO]	ecoinvent	
Oil	market for rape oil, crude [CH]	ecoinvent	equal parts to both processes
	market for rape oil, crude [RoW]	ecoinvent	
Tofu	market for tofu [GLO]	ecoinvent	

Treatment of food losses

Product	**Dataset**	**Database**	**Comments**
Biowaste	market for biowaste [RoW]	ecoinvent	equal parts to both processes, for the upstream food loss
	market for biowaste [CH]	ecoinvent	
Biowaste	treatment of manure and biowaste by anaerobic digestion [CH]	ecoinvent	The output was changed from 0.21 to 0.095 m^3