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Session A

Food Production

MANAGING FOOD LOSSES AND WASTE ALONG THE SUPPLY CHAIN: THE ANALYSIS OF ITALIAN PASTA AND TOMATO SAUCE PRODUCTION PROCESSES THROUGH A CIRCULAR ECONOMY PERSPECTIVE

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1. Background

In recent years a growing number of studies and contributions have been developed on the analysis of food losses and waste (FLW), due to the importance and seriousness this phenomenon has reached at international level, above all in industrialized countries Indeed, approximately a third of the food produced worldwide is lost or wasted along the entire Food Supply Chain (FSC) from the agricultural production phase to domestic consumption, generating avoidable economic, environmental and social impacts and therefore representing one of the biggest problems for the sustainable development of our Planet. The reduction of food waste was included both in the Sustainable Development Goals developed by the United Nations and in the European Circular Economy package in which the notion of food waste and the commitment to reducing it expressly was therefore included in EU legislation.

Up to now, most of the literature in the developed countries focused on household food waste. However, since significant food losses happen also in the early stage of the FSC, researches should also focus on it and this will especially involve food companies. According to the *Road Map to Achieving Sustainable Development Goal Target 12.3* (Champions 12.3) several of the world's largest food companies are currently measuring and a growing number are publicly reporting on food loss and waste within their operations, but more must also do so. Indeed, this measure – expressed by the percentage of the world's 50 largest food companies which have quantified base year FLW and have started measuring and reporting on FLW - should increase up to 40% for the period 2019-2021. In this perspective, the Circular Economy approach could be an accelerator to reach the goal. However, the transition from the current model of linear to circular economy - in which a reduction in waste and environmental impacts is expected - requires the rethinking of market strategies towards a new integrated model of production, distribution, consumption as well as new entire models of companies.

2. Purpose and methodology

This study focuses on the analysis of food losses and waste along the pasta and tomato sauces FSC in Italy, by referring to Barilla production processes. Specifically, the main aim of the research is to illustrate the main FLW and their causes along the various stages of FSCs and to understand if and to what extent these FLW have effectively been or could be reused, according to the CE approach.

The reference standard used for the analysis of pasta production process was the global Food Loss and Waste Accounting and Reporting Standard (FLW Standard) which requires users to define and report on four components: (i) timeframe: the period of time for which the inventory results are reported; (ii) material type: the materials that are included in the inventory (food only, inedible parts only, or both); (iii)

destination: where FLW goes when removed from the food supply chain; and (iv) boundaries: the food category, lifecycle stage, geography and organization.

3. Results and conclusions

Firstly, by focusing on the pasta process we referred to the Barilla pasta production process, as global leader in the pasta market, and as one of the first in Italy who decided to analyse the entire life cycle - from field to table -of the pasta that it produces. We found that food losses in the field proved to be very limited (less than 2%) while the straw collected during the harvest is normally used as animal feed and litter. The losses generated during the grinding of the wheat and pasta production amounted approximately to 2% of the total FLW. The overall results of our analysis showed that the FLW occurring along this production chain can be effectively reused for other purposes thus provided us with valuable insights on the application of the CE perspective in order to reduce FLW.

Secondly, by focusing on the tomato sauce production process we started the analysis from losses deriving on field (from seeding to harvest), then we concentrated on the logistic phase (distinguishing transportation of tomatoes to the industry for tomato sauce production) and lastly emphasizing losses and reuses (as by-products) related to industrial transformation.

Reporting effective Circular Economy implementation practices can be of help to companies to gain and increase knowledge on sustainable economic and business models as well as on sustainable consumption and production patterns.

GLEANING ACTIVITIES AS CONTRIBUTION TO FOOD WASTE REDUCTION

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According to FAO (2011) roughly one-third of food produced for human consumption is lost or wasted globally, which amounts to about 1.3 billion tons per year.

Food is lost or wasted throughout the whole supply chain, from initial agricultural production down to final household consumption. Production of food starts at the field and food losses also already occur at this stage. Within the last years more and more researches were done to identify losses and gather data in the first stage of the food production. Still there is a big data gap to be closed.

Within the STREFOWA project (www.reducefoodwaste.eu), a project which was implemented through financial assistance from ERDF funds of the CENTRAL EUROPE CP, different options to reduce and manage food waste in Central European countries will be tested by pilot actions. This paper focus on waste prevention in primary production, mainly on fresh fruits and vegetables which do not reach the next step of the supply chain either processing or distribution and retail.

Losses of fruits and vegetables in agriculture occur because of different reasons, starting by non-harvesting, if e.g. an overproduction of the specific product leads to low prices or due to technical reasons. An Austrian study (GZ, 2016) provides a first insight on food losses of fruit, potatoes and vegetables from agriculture. In total 462 producers and 78 suppliers of 25 different fruits and vegetables were asked by questionnaires on their realistic assessment (estimation) of quantities, composition and reasons for food losses. The main reason for non-harvesting and/or non-sales to food retailers is indicated by producers and suppliers with their declaration that these products do not meet the food retailer's criteria. Lacking edibility as well as overproduction or other reasons were mentioned (Hrad et al., 2016).

Important and established initiatives in terms of preventing food waste in primary production, concrete at farmer's level are gleaning activities. Gleaning means picking fruits and vegetables not harvested by farmers. Fruits and vegetables are used by the collectors themselves or are given to charitable institutions involved in food redistribution.

Another place where food loss in primary production occurs is within the processing phase at the farm. After contacting relevant farmers it turned out that up to 20% of the harvested food becomes unusable. A large proportion of the unmarketable surplus is generated due to retail requirements. Here it is to find buyers or takers for the products which arise during the processing phase. Also gleaning activities will be carried out to gather more data for the amount which remains on the field after harvesting.

References:

FAO. 2011. Global food losses and food waste – Extent, causes and prevention. Rome

GZ (2016): Global 2000, Kurzbericht Food Waste und Landwirtschaft 2013/14

Hrad M., Ottner R., Obersteiner G., Fink R., Comploi K. (2016): Fortführung der Erhebung von Lebensmittelverlusten in der Landwirtschaft; im Auftrag des BMLFUW; Wien. Final Report. Not published.

WASTE PREVENTION IN THE AUSTRIAN FOOD INDUSTRY

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Waste prevention is the supreme principle of European waste policy and in particular the reduction of avoidable food waste must be prioritised for ethnic, moral, ecological, social and economic reasons.

Food waste is generated along the entire value chain - agriculture, production, trade, gastronomy and households. By the time this study was prepared, Austria had assumed an annual volume of around 756,700 tonnes of food waste. Of these, 491,000 tonnes were considered avoidable. So far, there has been no well-founded data on agriculture and food production as well as on certain disposal routes in households (self-composting, sewerage, ...).

The study "Waste Prevention in Austrian food industry" is the first in Austria to have established valid data, reasons and activities for the status quo of avoidable food waste in food industry.

Data collection was carried out by a qualitative survey and a quantitative method by waste analysis in companies. This method has determined the amount of waste and waste compositions as well as activities and causes related to food waste. The results allow an extrapolation to the annual quantities in Austria.

Austrian food industry converts between € 13.5 and € 20 billion per annum and consists of around 3,500 companies employing around 70,000 people.

In total, food industry generates 121,800 tonnes of avoidable food waste per year. For nearly half of the avoidable food waste in the food industry, (51,700 tonnes), are bakeries responsible. 35,600 tonnes of this are bread and pastries, which food retailer returns to the producers as part of free returns. The least amount of avoidable food waste is generated in the fats and oils industry at around 200 tonnes per year.

Furthermore, the study found that 1.3 million tonnes of unavoidable organic by-products, materials or wastes are generated annually in Austrian food industry.

Austrian food industry has an annual goods input of about 10 million tons and a goods output of approximately 8.6 million tons. It follows that a total of 14% of the raw materials used are lost as a result of the manufacturing process, 1.2% in relation to the goods input could be avoided.

A synopsis of avoidable food waste in Austria according to current knowledge shows that about 577,000 tons per year are generated along the food value chain, excluding the quantities from agriculture and wholesalers.

- Food industry: 121,800 tonnes (including 35,600 tonnes of returned bread and pastries as free returns from the food retailers)
- Food retailer: 74,100 tonnes
- Hospitality sector: 175,000 tonnes
- Private households: 206,000 tonnes

FOOD LOSSES IN FRUIT AND VEGETABLE PRODUCTION IN GERMANY: REASONS AND COUNTERMEASURES

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Background

Food losses occur in all agricultural value chains. The share of food losses varies across the different value chains for different crops. The collaborative research project "Pathways to Reduce Food Waste (REFOWAS)" was designed to achieve more sustainable production and consumption patterns in Germany by quantifying the food losses in the agricultural and the food sector and identifying measures to reduce food losses. This study focusses on the fruit and vegetable sector, where comparatively high shares of food losses occur. In order to understand reasons for the emergence of food losses and to identify potential countermeasures the fruit and vegetable value chains were analysed in detail.

Purpose

The main objectives of this study are (a) to quantify food losses of selected fruit and vegetable crops on different levels of the value chain, (b) to identify main reasons for food losses, and (c) to develop effective measures for the reduction of these losses. As a part of the REFOWAS project this study is funded by the German Federal Ministry of Education and Research (BMBF).

Methodology

Case studies of different fruit and vegetable crops were carried out. Fruits and vegetables vary in storage suitability. For this reason one product with a long and another with a short shelf life were selected for each of the two categories. For the fruit sector, apples and strawberries were analysed and for the vegetable sector carrots and lettuce were addressed in the case studies. For each of the crops, two major production regions in Germany were included in the case study.

Structured interviews with experts and actors from different levels of the value chain were conducted in collaboration with partners from regional horticultural consultancy services. Interview results were validated in workshops with some of the interviewees and other experts. Overall, 84 Interviews and 8 workshops with producers, as well as representatives of wholesalers, producer organizations, food retail, and the food and beverage processing industry were carried out.

Results

Results show that food losses at producer level can be significant. On average, more than 25 percent of salads and carrots are lost at the producer level. For the fruits, there is a larger difference in food losses between the easily perishable strawberries with a share of 15 to 20 percent and apples with only 6 to 16 percent food losses on the farm level. Hence, food losses in fruit production tend to be lower as compared

to vegetables. However, results vary greatly due to the strong influence of varying weather conditions. In years with unfavourable weather losses of lettuce and strawberries can even increase up to 50 percent.

At the retail level food losses of the storable products carrots and apples vary between 2 and 5 percent due to breakage and spoilage. Losses of the perishable crops strawberry and lettuce are well above this average.

In the food and beverage processing industry food losses account 4 percent on average. The amount of these losses depends on the batch size and the specific requirements for the output product. More food losses occur with small batch sizes and smoothies because of more frequent rinsing processes.

The identified reasons for food losses in the fruit and vegetable value chain are in detail:

- Pests and diseases often lead to products that are not suitable for human consumption.

- Unfavourable weather conditions, e. g. frost, hail, and extreme weather events, can lead to minor quality losses due to optical damage up to total failure of the crop.

- Short-term weather conditions have a great impact on the amount of the demand in food retail and on the production level, e. g. people eat less salads and strawberries in rainy weather.

- Enlargement of the production area beyond the level required in average production conditions to fulfil sales contracts securely often leads to overproduction in years with favourable weather conditions.

- Low product prices due to oversupply have a tremendous influence on the amount of food losses. Crops will not be harvested if harvesting costs cannot be recovered. This is in particular true for the easily perishable products salad and strawberries.

- The predominant high and strict quality standards of the food retail sector with regard to aesthetic standards, e. g. size or shape of the product, and to pesticide residues have a strong influence on the proportion of marketable products.

- -The food retail's requirements regarding the best-before date are mainly responsible for food losses in the processing industry. Upon delivery, it is required that two-thirds of the best-before date must still be given.

- The lack of opportunities for market products, that do not meet these standards, influences the level of food losses, precisely because alternative market channels are scarce.

- The purchasing management of the grocery shops is determining the level of food losses, e. g. ordering managers have to take into account that sales of fruits and vegetables depend as well on customers' disposable income.

Measures to reduce food losses in the fruit and vegetable production focus on the production level and on downstream value chain levels:

- Technical solutions to prevent weather influences on fruit and vegetable production by means of irrigation, hail protection nets or protected cultivation, i. e. under glass or foil, lead to more weather-independent production conditions. These measures increase product quality and may reduce food losses considerably.

- Intelligent packaging could reduce bruises and moisture losses. Further, the handling of packed fruits and vegetables, e. g. in food containers, flow packs or trays, is gentler and more hygienic in food retail.

- Cooling systems on farm level, e. g. ice water cooling for carrots or vacuum cooling for lettuce, and cooling systems in the storage centres as well as humidification devices in the food retail could lead to continuous cooling chains thus preventing fruits and vegetables to deteriorate at an early stage.

- Greater tolerances in the prevailing high quality standards of the retail sector for size, colour, shape etc. of fruit and vegetable could help to increase the share of marketable products without reducing nutritional physiological quality of the products. The same applies to the restrictive requirements for the processing industry with regard to the best-before date.

- Management improvements on farm level, e. g. better training of seasonal farm workers with regard to professional and gentle harvesting of fruits and vegetables or an improved pest control management in crop production, could help producers to reduce food losses. A more specialized knowledge how to handle fruit and vegetable professionally is important for retail staff, e. g. purchasers and shop assistants, in order to reduce losses.

Conclusions

At production level potential measures to reduce food losses mainly focus on preventing quality deteriorating effects of poor weather conditions. Further, measures to extend the shelf life of fruits and vegetables such as cooling or packaging and better qualification of the staff involved should not only focus on the production level, but in particular also on the downstream levels of the value chains of fruit and vegetables, especially on the retail level. Finally, it is important to intensify cooperation along the value chains of fruits and vegetables to reach agreements between producers and retailers.

In a subsequent final step of the research the efficiency of these measures have to be assessed by means of identifying the avoidance potential, their costs and the implications of implementing them.

FOOD LOSS AND WASTE (FLW) PROTOCOL – INSIGHTS FROM THE IMPLEMENTATION IN BARILLA'S BREAD SUPPLY CHAIN

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Research motivations and relevance

Food waste is one of the most vital social, economic, and environmental issues facing our planet, as highlighted in the Sustainable Development Goals by the United Nations (https://sustainabledevelopment.un.org/). At a time in history where nearly one billion people are still dying of hunger or have to settle for inadequate nutrition every year, it is unacceptable that over a third of the world's food remains abandoned in fields or ends up in landfills. Food waste has serious environmental impacts. Today, we know that every product not only generates CO_2 throughout its life cycle but, also has a water footprint that weighs heavily on climate change. Producing food that will never end up on a table means unnecessarily aggravating the health of our planet. Besides the moral and environment effects, food waste has also resulted in the decreased social value of food. After years of agricultural industrialisation, the decline in food prices has been unstoppable and this phenomenon has fuelled the hopes of those who believe it would be possible to feed everyone on the planet. Unfortunately, the main result instead has been the loss of people's perception of the real value of food, that is to say the effort it takes to produce, cultivate and harvest food, throughout the whole supply chain.

Theoretical background

Adopting a supply chain perspective, there is the need to identify effective tools to measure and analyze food loss and waste (FLW), and in turn identify causes and propose solutions to tackle food waste addressing the aforementioned environmental, social and economic objectives. Parfitt et al. (2010) highlighted the importance of developing a deeper understanding of food waste at the supply chain level, calling for more effective quantification and in turn better resource efficiency. Currently, the supply chain management literature focusing on food waste is still fragmented (Despoudi et al., 2018): there is the need to take an integrated approach in analysing FLW at the whole supply chain level. Life Cycle Analysis (LCA) (Roy et al., 2009) provides an interesting opportunity to consider the impact of waste throughout the whole life cycle of product and the different stages of the supply chain; however, it is still not clear how to effectively implement LCA tools along the supply chain for food loss and waste analysis and reduction. Among these tools, the FLW protocol (http://www.flwprotocol.org) has been proposed and developed, but examples of its implementation are still scarce in the academic literature.

The objective of this paper is to describe and critically evaluate the implementation of the FLW protocol in an industrial context, focusing on key elements such as 1) the measurement of FLW through quantitative indicators, 2) the identification of the key causes of FLW, 3) the development of solutions for improvement and the related impact of proposed solutions. We discuss how the FLW protocol takes a LCA approach and provides opportunities for implementing a Circular Economy approach (Dervojeda et al., 2014).

Therefore, in this study we aim at investigating the following research question: *"How is it possible to implement tools for food waste reduction along the supply chains and what are the key sustainability implications?".*

Research methodology

In this paper we use a qualitative case study of Barilla's bread supply chain (i.e. interviews about the FLW protocol implementation process), integrated with quantitative analysis of FLW data to describe and critically discuss the implementation of the FLW protocol (activities, results, criticalities, opportunities for improvement).

Aware of the urgency emerging from the BCFN Foundation studies and in line with its purpose "Good for You, Good for the Planet" (www.goodforyougoodfortheplanet.org), Barilla, as food company, has started to analyse three of its supply chains (pasta, tomato sauce and bread) in collaboration with Last Minute Market (LMM), a spin-off from the University of Bologna. Their goal was monitoring the food losses and wastage all along the value chains, identifying the causes and the measures to reduce them. The reference standard used for this analysis was the global Food Loss and Waste Accounting and Reporting Standard (FLW protocol).

Data have been collected by:

- Barilla G.&R. Fratelli SPA, which supplied data and information concerning the processes of cultivation, milling, bread production and consumption.

- Last Minute Market Srl, accredited spin-off of the University of Bologna, which provided data about distribution and consumption.

- Ergo Consulting Srl, accredited spin-off of University of Bologna and Agricultural Sciences Department (University of Bologna), which collected data about the cultivation stage.

In relation to the different stages of the supply chain:

1. In regard to the cultivation stage, we analyzed documented research which provided an overview about field loss, particularly during the harvest stage. Through the comparison of various studies, we estimated the average field loss. In particular, we consulted 2011 FAO's "Global Food Losses and Food Waste" and a study about loss in primary production conducted by Barilla.

2. In regard to the processing stage (milling and bread production), we referred to data provided by Barilla and by the Italian primary and secondary processing plants that were taken into consideration. The data were specifically collected from one mill for the primary processing and from two production plants for the secondary processing.

3. In regard to distribution, we referred to data provided by Italian retail establishments. The data were collected by LMM through a survey conducted in 5 brands of the Italian large-scale distribution. The resulting data, useful for our analysis, were provided by four of these five companies. They refer to 1.700 points of sale, representative of the categories present in the Italian territory, from small supermarket to larger hypermarket.

4. The data referring to the last stage of the production, the consumption, derive from a number of sources. Specifically, for the data regarding domestic waste includes: a research conducted by Barilla, Project Europe Fusions (www.eu-fusions.com), Global Food Losses and Food Waste by FAO (2011), Monitoring Centre for domestic waste in Italian families by Last Minute Market (Waste Watcher).

5. For data regarding public catering, especially school catering, we looked at research conducted by Last Minute Market in various Italian towns, as well as the study conducted by Oricon (Monitoring Centre for mass catering and nutrition) and ANGEM (National Association for mass catering and various services) on the food waste in Italian schools.

Findings and contributions

Focusing on the bread supply chain, Barilla analyzed the entire life cycle - from field to table - of the pasta that it produces in Italy. It was found that this supply chain is an example of true circular economy, where quite nothing is lost. In our paper we discuss in detail the figures related to the food waste and loss at each stage of bread production.

In addition, as main contribution of our work, we discuss in-depth how the FLW protocol connects the LCA approach with specific KPIs, adopting a Circular Economy perspective (European Commission, 2014). This in turn is translated into more transparent reporting and disclosure for the company. We summarize our discussion by developing a framework including the following key aspects emerging from our findings:

1) measurement of waste (thus contributing to the literature on performance measurement and KPIs in the context of food waste)

2) identification of causes (an opportunity to connect with specific risk identification techniques)

3) development of solutions and discussion of their impact for improvement

4) a critical discussion of the implementation of the FLW standard, focusing on implementation issues and enablers emerging from the analysis of the bread supply chain.

We believe our study offers useful contributions to managers of companies which intend to apply the FLW standard, and to facilitate its diffusion as an opportunity for food waste reduction.

References

Dervojeda, K., Verzijl, D., Rouwmaat, E., Probst, L., Frideres, L., (2014). Clean Technologies - Circular supply chains. Business Innovation Observatory Report, European Commission.

Despoudi, S., Papaioannou, G., Saridakis, G., & Dani, S. (2018). Does collaboration pay in agricultural supply chain? An empirical approach. International Journal of Production Research, 1-22.

European Commission (2014), Towards a circular economy: a zero waste program for Europe, Brussels.

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: biological sciences*, *365*(1554), 3065-3081.

Roy, P., Nei, D., Orikasa, T., Xu, Q., Okadome, H., Nakamura, N., & Shiina, T. (2009). A review of life cycle assessment (LCA) on some food products. *Journal of food engineering*, *90*(1), 1-10.

Session B

Redistribution

TOWARDS A CIRCULAR ECONOMY: REDISTRIBUTING SURPLUS FOOD IN RETAIL CHAINS

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Purpose

Recently, the European Commission has proposed a programme to promote new models based on the concept of circular economy, defined as the systems that "*keep resources within the economy when a product has reached the end of its life, so that they can be productively used again and again and hence create further value*" (EU, 2014, pp.2). In this model, waste is considered as a resource to be revalorized through recycling and reuse (Dervojeda et al., 2014; Gregson et al., 2014). Following this concept, this paper investigates how retailers can convert food resources traditionally accepted as food "waste" into food "surplus" that, when managed appropriately, can provide further value. Previous studies offer some suggestions to decrease surplus food generation at source (Mena at al., 2011; Tupper and Whitehead, 2011), however, it is inevitable in some circumstances (Garrone et. al, 2014) and recovery of surplus food for social purposes has a great potential towards being an answer to food insecurity in developed countries (Tarasuk and Eakin, 2005; Gentilini, 2013). Although the literature (Garrone et al, 2014; Papargyropoulou et al, 2014) promotes reusing surplus food through redistribution for social purposes as a high priority option, there is a risk that implementation is not as straightforward as expected (Garrone et al, 2014). In fact, there are no empirical studies directly addressing this issue by mapping the whole process and highlighting the critical success factors that can increase the surplus food saved for human consumption by decreasing the disposed waste. The aim of this paper to study the supply chain process of surplus food management in various retailers operating in Europe, in order to provide a comprehensive framework of the factors (e.g. drivers, enablers, obstacles and criticalities) influencing this process, taking also the contextual differences (e.g. cultural and national characteristics) into account.

Research methodology

In order to understand *how the organizational processes should be designed to enable retailers to redistribute surplus food both at the strategic and operational level from a supply chain perspective*, a multiple case study approach (Eisenhardt, 1989; Yin, 2003) was adopted. A cross-case analysis was performed with 6 retail companies operating in Europe - Italy, Spain and UK have been selected in order to consider contextual factors influencing the surplus food redistribution process. The outline of the case protocol was sent in advance to ensure that the interviewees were properly prepared (Voss et al., 2002). Visits and company reports (Yin, 2003) were used as secondary methods of data collection. Results from interviews were analyzed independently, coded and put into a standard template and compared eventually.

Findings

Surplus food redistribution for social purposes in retail stores is not a common practice due to high complexity coming from large product mix and the daily frequency of surplus food generation due to the presence of a significant amount of fresh food and chilled products. On the other hand, retail involvement in this system can help reuse of food considered as "food waste" in the traditional linear system. This paper identifies the supply chain operations necessary for the surplus food recovery and donation and

highlights the critical success factors to consider within the concept of circular economy. The results show that there is a considerable potential to prevent surplus food become waste and utilize it for social purposes.

Relevance and contributions

This research offers original contribution to both theory and practice. From the theoretical perspective, this study contributes to the previous academic literature in operations management by providing a comprehensive framework to investigate the surplus food redistribution process with a contingency-based perspective, to prevent "one-size-fits-all" approaches. From the practical perspective, the clear view of the process, understanding the decision making factors towards surplus food donation will help firms to improve the current practices and will help non-profit organizations to collaborate more easily with the food donors and to collect a greater amount of food to distribute to needy. European policy makers will be able to use this information to innovate current policies related to surplus food redistribution to reduce food insecurity in their community. This paper draws on expertise and experiences from Europe. Contributions from other parts of the world would complement this study. Further research should be directed to understand generalizability of these results in different contexts by enriching the sample analyzed.

References

Dervojeda, K., Verzijl, D., Rouwmaat, E., Probst, L., Frideres, L., (2014). Clean Technologies - Circular supply chains. Business Innovation Observatory Report, European Commission.

Eisenhardt, K. M., (1989). "Building Theories from Case Study Research", *the Academy of Management Review*, 14 (4), 532-550.

European Commission (2014), Towards a circular economy: a zero waste program for Europe, Brussels.

Garrone, P., Melacini, M., Perego, A., (2014). "Surplus Food Recovery and Donation: The Upstream Process", *British Food Journal,* 116 (9), 1460-1477.

Gentilini, U., (2013). Banking on Food: The State of Food Banks in High-income Countries, Institute of Development Studies. Brighton.

Gregson, N., Crang, M., Fuller, S., Holmes, H., (2014). Interrogating the circular economy: The moral economy of resource recovery in the EU, Economy and society. 44, 218–243.

Mena, C., Adenso-Diaz, B., Yurt, O., (2011). "The Causes of Food Waste in the Supplier - Retailer Interface: Evidences from the UK and Spain", *Resources, Conservation and Recycling*, 55, 648-658.

Papargyropoulou, E., Lozano, R., Steinberger, J. K., Wright, N., (2014). "The Food Waste Hierarchy as a Framework for the Management of Food Surplus and Food Waste", *Journal of Cleaner Production* 76, 106-115.

Tarasuk, V, Eakin J., (2005). "Food assistance through "surplus" food: Insights from an ethnographic study of food bank work", Agriculture and Human Values, 22 (2), 177-186.

Tupper, J., Whitehead, P., 2011. Reducing Food Waste through Retail Supply Chain Collaboration. WRAP - Waste & Resources Action Programme, Oxon, 3

Voss, C., Tsikriktsis, N., Frohlich, M., (2002). "Case Research in Operations Management", *International Journal of Operations & Production Management*, 22 (2), 195-217.

Yin, R. (2003). *Case Study Research Design and Methods,* Sage Publications, London.

FOOD WASTE REDISTRIBUTION IN EUROPE: A STUDY ON POLICY FRAMEWORKS, AND THE SOCIOECONOMIC AND CLIMATE IMPACTS OF EUROPEAN FOOD BANKS

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The issue of **Food Loss and Waste** (FLW) is currently deliberated on high **academic** and **political** levels. This pertains both to FLW's large contribution to man-made **climate change**, and its moral dimensions regarding **food security** and **socioeconomics** at large. In the EU alone 88 million tonnes of FLW is generated annually; costing 143 billion € and emitting 170 million tonnes of CO_2eq.. **Food redistribution** can significantly cut FLW, for example through the operation of **Food Banks** (FB). FBs redistribute surplus food from the food supply chain through charity organisations to those in need. In the EU Circular Economy Package, FBs are defined as '**prevention**' and are thusly considered a **Best Practise** in tackling FLW. Despite this fact, many legislative and economic hurdles **constrict** the functioning and capacity of FBs.

Concentrating on five '**Case Study Organisations**' (CSOs) in five EU countries (AT, DK, FI, HU & PL), this Thesis work describes the **policy frameworks** that the CSOs operate in, and suggests Best Practises. Furthermore, the **socioeconomic** and **climate impacts** of the CSOs are analysed. It is found that in 2017 the five CSOs saved over **195,000** tonnes of **carbon** emissions combined: 27 tonnes of CO2eq. for every tonne their operations emit. A high **Return-On-Investment** of 10 euros for every 1 € invested was found. The combined economic saving of over **90 million €** was identified, even without considering the **social cost of carbon** and significant **social capital** incurred by the CSOs through providing crucial social services.

Through revised **legislation** and increased **investment** in Food Banks, the EU and national governments can not only reduce FLW, but cost-effectively mitigate the **socioeconomic** and **climate struggles** yet a reality in Europe.

TAKING UP THE CHALLENGE OF SOCIAL FOOD TRANSFER FROM CATERINGS AND OTHER KINDS OF PROVISIONING

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Background

Food waste presents major environmental and social impacts on a global level. The share of total waste produced is distributed almost equally amongst the parties along the whole value chain. In lower developed countries the main part arises in agriculture, storage and transport whereas in industrial countries the main part arises in retailing, gastronomy and private households. Food, that does not reach the customer or is not used for its origin purpose, not only means inefficient use of natural resources but also creates major environmental impact at different stages of the production chain, all in vain.

Although accurate estimates of losses and waste in the food system are unavailable, the best evidence to date indicates that globally around one-third of the food produced is lost or wasted along the food chain, from production to consumption (HLPE, 2014).

Food losses refer to the decrease in edible food mass throughout the part of the supply chain that specifically leads to edible food for human consumption. Food losses take place at production, postharvest and processing stages in the food supply chain. Food losses occurring at the end of the food chain (retail and final consumption) are rather called "food waste", which relates to retailers' and consumers' behaviour. "Food" waste or loss is measured only for products that are directed to human consumption, excluding feed and parts of products which are not edible (Parfitt et al., 2010). If you discuss the impact of food losses you soon get to the ethical dimension of the problem, because on the one side food is wasted on different grounds and on the other side there are many people living under the subsistence level.

Purpose

While passing on food items between retailers, producers and charitable institutions has successfully been established in Vienna, there is much potential in gastronomy and catering business. Due to the condition of the processed food and dishes and the associated food security concerns and logistic matters passing on and usage of valuable leftover food has been hampered and thus not widely established so far.

Individual behaviour is a major reason for food waste at the consumer level while more organisational and structural reasons account for the share of food waste in gastronomy and other forms of external food provisions and services. Insufficient purchase planning and storage management, over dimensioned offers at caterings or too big serving sizes on the plates and lack of communication as well as information are only some reasons to mention in this respect.

Methodology

To fill the gap, passing on food from gastronomy or other external provision services like business or care caterings should be fostered by developing a practical service concept for a successful implementation with local actors in Vienna. The potential of food which is suitable for passing on will be identified and the

co-developed service concept will be tested and optimized within the established network of partners by performing two pilot actions.

Results of the project

- Knowledge concerning the potential of food suitable for passing on

- Proofed service concept for an optimized course of action and practical instructions concerning communication and logistics

- Established network of catering facilities, gastronomy enterprises, socio-economic organisations and other NGOS which pass on food for people in need

- Reduction of food waste deriving from caterings and gastronomy via food transfer to charitable institutions

The project is located in Vienna and the co-developed service concept will be tested with local partners and should be transferable on other regions and partners also. The consortium consists of the Austrian Institute of Ecology, the Arbeiter-Samariterbund-Österreich and Cateringsolutions GmbH and cooperation will be set up with five catering and gastronomy companies for the testing phase. External support will be delivered by experts on food safety and the experiences made will be shared with interested parties in order to push the implementation of the tested and optimized service concept.

Conclusions

The project has started in January 2019 and will be finished in December 2019. At the time of the conference first results concerning quality criteria and positive list will be already defined as well as the framework conditions and courses for action for a successful passing on of suitable food. These will be presented and discussed with the audience.

CLICK TO FEED. MOBILE PHONE APPLICATIONS' ROLE IN IMPROVING FOOD SAVING AND FOOD ACCESS IN ROMANIA

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Background:

Following a sinuous path to adoption, which began in the early months of 2016, the Romanian anti-food waste law currently sets an option, not an obligation for economic agents to take food saving actions. The mandatory norms of enforcement that would see the law put into practice are missing, so that all food saving efforts are now a matter of individual responsibility to be undertaken by economic actors voluntarily and without any tax or other facilities. Moreover, the costly and complex infrastructure required for the food surplus to be redistributed to those in need does not exist, so that the promise of a relatively low-cost information technology-based solution connecting retailers to the hunger-combating non-profit sector appears as an appropriate, though imperfect bridge over the current legislative gaps.

Purpose:

This is an exploratory, qualitative study of the extent to which digital tools available to the Romanian public help improve access to food for those at hunger risk by allowing an easy redistribution of surplus resources. Therefore, this research focuses on four mobile phone applications self-described as combating food waste in Romania and examines their developers/owners' motivations in embarking on a food saving project, the specifics of the business model behind the respective applications as well as the interplay between the environmental and the hunger-combating aims of such tools.

Methodology:

The findings reflected herein are based on semi-structured interviews conducted with the developers/owners of the four mobile phone applications, on content analysis, as well as on the author's fieldwork as volunteer within a charitable organization that runs a soup kitchen providing cooked meals for a group of homeless and undocumented people in Bucharest. The applications considered here are the only digital tools of this kind currently available to the Romanian public; food-saving mobile applications created by Romanian developers, but not available to Romanian consumers are outside the scope of this research.

Results & Conclusions:

This analysis of food-saving mobile phone applications' role in improving food access in Romania and in helping surface systemic issues of social inequality has revealed that, while these tools mediate communication around and the idea of surplus redistribution, they do not aim or have the force to trigger social change yet. That is why they are merely incipient forms of "Internet-enhanced food activism".

In the case of the mobile applications considered, the precedence that monetization takes over donation within their business model is strongly influenced by a mix of heavy bureaucracy, inexistent infrastructure, non-sustainable financing and missing legal/tax incentives that would have to be overcome by any economic actor wishing to redistribute its surplus for the benefit of those in need. They do ensure a wider

access to food for some users who are budget-conscious, but who can still afford to buy food, but only as a collateral rather than as an intended effect. Discussions with the owners/creators of the applications revealed that they are aware of, but do not take active responsibility in combating hunger as well; in other words, they feel that their applications have reached their purpose at the point where food is no longer thrown away, while its possible redistribution to those in need is above and beyond such purpose.

Session C

Food Service 1

DIGITAL MEASURING METHODS TO QUANTIFY FOOD WASTE AT CONSUMER LEVEL TOWARDS AN IMPROVED FOOD MANAGEMENT

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Introduction and objectives

The prevention of food waste at the consumer level depends on several boundary conditions and individual parameters. In household kitchens, the specific waste quantities differ depending on parameters like the household size, demographic and socio-economic characteristics. In gastronomic kitchens, the specific prevention potential depends on aspects such as menu planning, produce specifications, guest numbers, degree of convenience, production efficiency, kitchen type (single kitchen, central kitchen) and the catering system (sous-vide, cook&serve, cook&chill, cook&freeze, cook&hold). Therefore, the derivation of actions towards an improved food management requires in many cases a quantification of food waste at place, considering the individual boundary conditions. The objective of our research was to develop digital measuring methods to quantify food waste in gastronomic kitchens, allowing the derivation of measures towards an improved food management.

Methods

Within our research, we applied the method of self-assessment in a gastronomic context in addition to existing operational waste management systems. For the experimental setup, we developed a software application connected with an electronic scale to automate the self-assessment process (see figure 1). This offers the possibility to document disposals directly at source and to offer a real-time feedback of the wasted food for the user. Additional to the recording of the quantities, institution-specific complementary parameters are stored in a separate database. The simultaneous access of valuation parameters such as costs allows a direct monetary assessment of the wasted food. This digital measuring method contributes to raise the awareness of the kitchen staff on the one hand and provides important information for an optimized food management on the other hand.

Figure 1 Self-assessment in gastronomic sector (RESOURCEMANAGER-FOOD)

The connection to *Enterprise Resource Planning (ERP)* and accounting systems is an important aspect towards a semi-automated system optimization. We installed this waste management tool in more than 20 different gastronomic facilities and collected food waste data to derive individual actions of prevention. In the meantime, we are developing an online version of this monitoring instrument in order to enable a larger usage of this application. The real time tracking of current operations allows flexible decision-making processes and offers dynamic planning parameters to optimize resource management and production processes.

Results

Within the oral presentation, we will give a brief insight in the findings of our research, showing different aspects regarding digital measuring methods to quantify food waste in gastronomic kitchens. Based on this, we developed individual avoidance strategies and solution approaches. Further, we exemplarily discuss measures contributing to an improved food management and a prevention of food waste. Through demand-oriented menu planning, food production as well as adapted portion sizes and serving quantities, significant savings were achieved. The amount of food waste in the pilot restaurants reduced in most cases, showing a clear improvement compared to the status quo.

"REDUCING FOOD WASTE BY IMPROVED PRODUCTION PLANNING IN SCHOOL CATERING"

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Background

The study at hand is integrated in the AVARE project (Adding Value in Resource Effective Food Systems, AVARE is part of the ERA-Net SUSFOOD2 with funding provided by national/regional sources [MMM, BMEL, RCN, FORMAS] and co-funding by the European Union´s Horizon 2020 research and innovation program). It deals with the school catering sector, where on average one fourth of the food served ends in the bin (IFWC 2016; Borstel et al. 2017; Eriksson et al. 2017). This leads to around 17 kg of food that is wasted in a year by children (IFWC 2016). Estimation of demand (51%), trimming waste (30%), and overproduction (17%) were mentioned as the main reasons for food waste in schools by the IFWC (2016). Steen et al. (2018) found the main factors influencing serving waste to be the type of kitchen and the rate of overproduction in school and pre-school catering units. Derqui und Fernandez (2017) developed guidelines for tracking food waste in schools and measured food waste in four Spanish schools. They determined that management practices (meal planning process or procurement practices), infrastructures and equipment, and human resources issues, such as staff awareness (or lack of awareness) on food waste are factors favoring food waste. All aforementioned studies demonstrate that production planning based on reliable numbers of meals served bears a great potential for food waste reduction in school catering.

Purpose / objective

As production planning strongly affects the occurrence of food waste, the study at hand targets to reduce school catering waste by optimizing the production planning system. In the study, the organization of school catering is compared in the countries of Norway, Finland, Sweden and Germany and risk factors favoring food waste will be identified. Moreover, three case studies are conducted in Germany. In these studies, the production planning process in the three school catering units is analyzed and subsequently optimized in a participatory approach by integrating the relevant stakeholders. In order to assess the success of the measures, a reference and control measurement of food waste is done before and after implementing the measures. Moreover, the information transfer in Germany from responsible bodies to the school catering units is analyzed in this study. This analysis is used to develop a transfer concept to improve the transfer of food waste prevention strategies to the school caterers.

The following research questions are given in this study:

1. What are the factors that influence production planning in school catering (e.g. how is the ordering of meals organized) and how can the planning be improved? (Norway, Finland, Sweden, Germany)

2. Does improved production planning lead to less food waste? (Case study: Germany)

3. What are the differences in the organization of school catering among the participating countries and do the differences have an effect on the amount of food wasted? (Norway, Finland, Sweden, Germany)

4. How can the transfer of information on food waste prevention strategies to the school caterers be optimized? (Germany)

Methodology

In order to answer the research questions a multiple methods approach is applied. For research questions #1 and #2 a literature research on the organization of the school catering system is performed and case studies are conducted. The case studies will be carried out in Germany. The case studies includes five consecutive steps. Three schools with different serving systems (1x cook & chill, 1x cook & hold, 1x fresh) are chosen for the case studies. As the first step, a status quo analysis is carried out in the schools. For this analysis, the meal ordering process and the production planning processes are analyzed in detail by a process analysis. The latter comprises expert interviews with the kitchen managers, an analysis of relevant documents, and a detailed food waste measurement to determine the actual level of food wasted in the organizations (reference level). The duration of the food waste measurement is two weeks. From the status quo analysis the relevant factors that affect the planning of production volume negatively will be determined. In the second step, a workshop with relevant actors of the catering process is carried out. The relevant actors will be chosen according to the results of the status quo analysis and might also include staff from the schools, suppliers or from responsible bodies. In this workshop measures improving the meal ordering and production planning processes are developed in a participatory approach. In the third step the schools implement the measures. An evaluation of success is done in the fourth step. The evaluation comprises a control measurement of the level of food waste and also interviews will be conducted with the relevant staff members. In the fifth step recommendations for the participating schools are derived and generalizable conclusions are drawn.

In order to answer research question #3, a desk research on school catering (describe school catering as a partial segment of the hospitality sector, school forms with school catering, responsible bodies, support given for school caterers, financial infrastructure, personal resources, dishes offered, company forms, responsibilities, level of food waste) is done. A criteria system is derived that serves as the basis for the cross-country comparison of the school catering systems and conclusions related to the level of food waste are drawn.

The transfer of information is subject of research question #4. Expert interviews with school caterers, responsible bodies, and supporting units will be conducted to receive the relevant information. Recommendations for the transfer of food waste prevention strategies to the school caterers will be derived.

Results

- Optimizing production planning

The case studies (optimizing the meal ordering and production planning processes) have started in December 2018. Results of the status quo analysis (analysis of production planning and meal ordering system, as well as food waste reference measurement) are expected for February 2019. Results of the workshops for the development of measures are expected for March / April 2019. Hence, at the time of the conference preliminary results will be available.

- Improving transfer of information to school caterers

The expert interviews related to the transfer of information to school caterers have started in January 2019. Recommendations for a transfer concept (communication channels and transfer activities) are expected for March 2019.

- Cross-country comparison of food waste in school catering

Desk research on the organization of school catering has started in December 2018. Criteria system will be derived in March. Cross-country comparison planned for September 2019.

Conclusion

Recommendations will be derived for the organization of school catering (best practices of organizing production planning and meal ordering system) and transferred among all the participating countries.

Regarding the transfer of food waste related information, the recommendations that will be derived will improve the flow of information on food waste prevention strategies. This will raise awareness for the topic of food waste among German school caterers.

All in all, the results contribute to reach the stated goal of SDG 12.3 that calls for halving per capita global food waste at the retail and consumer level by 2030.

References

Borstel, Torsten von; Prenzel, Gisela Katharina; Waskow, Frank (2017): Ein Drittel landet in der Tonne. Zwischenbilanz 2017: Fakten und Messergebnisse zum deutschlandweiten Lebensmittelabfall in der Außer-Haus-Verpfl egung. Hg. v. United Against Waste e.V.. Available online https://www.united-against-waste.de/der-verein/zwischenbilanz, checked 15.01.2019

Derqui, Belén; Fernandez, Vicenc (2017): The opportunity of tracking food waste in school canteens: Guidelines for self-assessment. In: Waste Management 69; Jg. 2017-11-01, S. 431–444.

Eriksson, Mattias; Persson Osowski, Christine; Malefors, Christopher; Björkman, Jesper; Eriksson, Emelie (2017): Quantification of food waste in public catering services – A case study from a Swedish municipality. In: Waste Management 61, S. 415–422.

IFWC (2016): Skool-Report. Edited by International Food Waste Coalition. Available online http://internationalfoodwastecoalitionorg.webhosting.be/wp-content/uploads/2016/10/IFWC_SKOOL-Report2016.pdf, checked 10.01.2019.

Steen, Hjördis; Malefors, Christopher; Röös, Elin; Eriksson, Mattias (2018): Identification and modelling of risk factors for food waste generation in school and pre-school catering units. In: Waste Management 77; Jg. 2018-07-01, S. 172–184.

TRANSFORMING CITY FOOD HABITS FOR LIFE – TRIFOCAL LONDON

K. FOX

Background

Nearly 75% of all food that is thrown out by the UK's Hospitality and Food Service Sector is food that could have been eaten. The value of this food waste costs the sector £2.9 billion a year with an average saving of £10,000 per outlet to be made by identifying where food is wasted and implementing low or no cost measures. These eye-opening figures demonstrate the huge problem that the TRiFOCAL London project is currently working to address. TRiFOCAL is an innovative initiative which addresses three key areas – healthy sustainable eating, preventing food waste and recycling inedible food waste.

TRiFOCAL[1] is a €3.2million three-year project funded by the LIFE programme of the European Union. It is delivered by project partners WRAP, the London Waste and Recycling Board (LWARB) and Groundwork London. The project started in 2016 and pilot delivery in London runs until March 2019, with learnings shared with 10 European cities as part of its replication programme. TRiFOCAL focuses on 4 audiences: householders, businesses, communities and schools.

Throughout the duration of the project we are working with leading businesses to pioneer and cascade good practice and knowledge across London to the different audiences by establishing:

- Best practice food mentor businesses to demonstrate savings and reinforce the business case for change.

- A London-wide working group of businesses to encourage and embed change on the ground.

We are working with restaurants, hotels, caterers and take-aways across London – to help them reduce waste, provide more healthy options for their customers and introduce food waste recycling in their kitchens and restaurants. The main delivery mechanism for this activity is the 'Your Business is Food - Don't Throw it Away' toolkit (https://partners.wrap.org.uk/campaigns/your-business-is-food/hafs/) which is a simple business-focused toolkit with a proven track record. The resources in the toolkit help businesses to measure and monitor the food thrown away, get their teams on board and make an action plan to reduce the amount of food thrown away, thereby saving money and boosting profits. Get cracking with tracking!

TRiFOCAL has also highlighted the benefits and practicalities of 'Your Business is Food, don't throw it away' from an environmental health practitioner's perspective, demonstrating how food waste prevention measures can be combined with food safety messages. Training videos to inform and empower food safety professionals to speak about food waste issues with the businesses they work with will be uploaded to the TRiFOCAL resource bank in February 2019 (http://resources.trifocal.eu.com).

Purpose

During the #reducefoodwaste conference, we will outline the benefits and practicalities of the TRiFOCAL approach, with a particular focus on the hospitality and food service sector and the toolkit 'Your Business is Food, don't throw it away'. We'll share the challenges and learnings from delivering TRiFOCAL in London and discuss how TRiFOCAL has engaged with stakeholders in London. We'll demonstrate how

[1] LIFE15 GIE/UK/000867. http://trifocal.eu.com/

food waste prevention measures can be combined with food waste recycling and healthy sustainable eating messages with the aim of changing business or consumer behaviour.

Methodology

Achieving the goals of sustainable food consumption is a complex social problem. Approaches such as the Collective Impact approach argue that no single policy, government department, organisation or programme can tackle or solve such increasingly complex social problems. Instead, organisations need to adopt a common agenda, shared measurement and alignment of effort, supported by centralised infrastructure that facilitates the shift from acting alone to acting in concert. In this context, the TRiFOCAL project plays the role of the backbone organisation, supporting project partners and stakeholders in shifting towards sustainable food systems in cities.

Drawing on the collective impact methodology, TRiFOCAL brings together a wide range of stakeholders working in different aspects of food and food waste in London including charities, restaurants, food businesses, bloggers, health advocates and educationalists. For many participants, the TRiFOCAL business working group provides the unique opportunity to network with organisations that they would not normally encounter.

TRiFOCAL's engagement with businesses has two key objectives:

1. **Influence businesses to change their behaviour by:**
   - Understanding existing food habits on site and recording change, primarily by encouraging businesses to use the toolkit 'Your Business is Food, don't throw it away'.
   - Targeting businesses to lead the change in food service staff behaviour (reducing preparation and spoilage waste, redistribution)

   To underpin this work, TRiFOCAL has created a London based Business Working Group to develop a group of industry leaders to pioneer and cascade good practice in London. Members of the Business Working Group are piloting the communications materials developed by TRiFOCAL and businesses are encouraged to pledge practical actions to encourage and embed change.

   Case studies are being developed to demonstrate savings and reinforce the business case.

2. **Influence consumers to change their behaviour, via business engagement by:**
   - Targeting businesses to change the behaviour of their own food service catering staff
   - Using messaging and materials which lead to the change in customer / consumer behaviour (plate waste reduction, raising awareness)
   - Reaching employees who are London householders via engagement with large employers

The project utilises a test, analyse and adapt model, where necessary changes/adaptions can be applied as progress is made in three delivery waves. Robust monitoring and evaluation has been set up and the relevant baselines have been established to measure impact of the project. The impact of the communications will be evaluated through a variety of means, including waste compositional analysis to assess changes in the amount of good food thrown away and food waste recycling rates. Changes in levels of awareness around the food-centric behaviours will be measured through surveys and focus groups after the main delivery waves. Two evaluation elements specifically relate to the project's engagement with businesses:

- **Hospitality survey:** The aim is to collect information on attitudes, self-reported behaviours and policies of hospitality industries in London to assess the potential impact of the business

engagement and delivery elements on profit and cost sector businesses food knowledge, behaviour and policies. A survey will be administered in spring 2019 to establish how TRiFOCAL influenced hospitality businesses and identify what they are doing differently.

- **Evaluation case study of hospitality businesses:** The in-depth evaluation case studies will provide a short, real-life narrative tool to help other European cities adopt actions to address business and consumer behaviour around reducing food waste, increase recycling and encouraging a move towards sustainable consumption.

Learnings from TRiFOCAL are being used to improve the effectiveness of the campaign and are shared with the EU replication cities. The London pilot also benefits from reciprocal exchange of knowledge/learnings as the replication cities adapt and deliver localised versions of the campaign.

Results

The intended outcome of the project will be to encourage positive behaviour change not just in London, but also within the European replication cities.

The full quantitative results of the project will be available from summer 2019 once the post-delivery evaluation elements have been completed and compared to the baseline. In the meantime, we can note the following positive impacts:
- 128 organisations have attended at least 1 TRiFOCAL event
- 109 pledges made by participants at the TRiFOCAL Business Working Group
- 48 influencers engaged
- 16 ambassadors who will promote the campaign, share materials and may act as spokespersons
- 13 champions who will use the materials and act within their own business
- The TRiFOCAL resource bank is a virtual resource centre for stakeholders to easily find and share information about innovative new approaches to behaviour change that aim to prevent food waste, encourage recycling of inedible food and promote healthy sustainable eating: http://resources.trifocal.eu.com/
- TRiFOCAL is referenced in two strategies published by the Mayor of London – the London Environment Strategy and the London Food Strategy.

Conclusion

By combining messaging on food waste with healthy sustainable eating in a comprehensive high impact campaign across time and place, TRiFOCAL aims to encourage sustainable food systems in cities.

The hospitality and food service sector in particular offers opportunities to reduce food waste, increase recycling of inedible food, and encourage a move towards sustainable consumption through healthy sustainable eating, drawing on existing tools and resources to demonstrate savings and reinforce the business case. Through this approach, TRiFOCAL is aiming to create a strong, evidence-based model for other cities to replicate.

FOOD WASTE GENERATION AND PREVENTION IN THE AUSTRIAN FOOD SERVICE SECTOR

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Abstract

Throughout the EU-28 about 88 million tons of food per year is wasted along the food supply chain (Stenmarck et al., 2016). Food waste in the food service sector, which is an important supply component in the tourism industry, has been identified as one of the main sources of food wastage, mounting to almost 11 million tons of food waste in the EU-28 during 2012 (Stenmarck et al., 2016). Nevertheless, current levels of food waste generation in this sector is associated with high uncertainties due to the lack of reliable, country-specific data. Improved and more detailed information on the actual magnitude of food waste and the potential for reduction is thus crucial and should be provided with this study.

72 catering establishments including restaurants, hotels, event catering and canteen kitchens have been assessed in the period from July 2014 to March 2019. In total, 22 hotels, 5 event caterers, 17 restaurants, 13 healthcare centers and 17 workplace canteens participated in the study. In each case the survey was carried out on a single day covering any food waste produced during that day. The generated food waste was divided into 5 distinct areas according to its origin, namely storage loss, loss during kitchen preparation, unissued meals, leftovers on the plate and from the buffet table. Food waste classified as being avoidable (this means without food loss during kitchen preparation) was further sorted into 9 product groups (e.g. fish/meat, vegetables/fruits, soup, starch side dishes, etc.). This distinction provided a better information basis for the identification of avoidance strategies. To evaluate the individual operating efficiencies, the calculation of the loss ratio (level of efficiency) was introduced as a benchmark. The loss ratio is the amount of avoidable food waste (in kg) in relation to the amount of meals served/sold (in kg) per survey day.

In total, 8590,8 kg of food waste was analyzed in all companies. Due to the heterogeneity of the companies and the relatively small number of samples the total amount of food waste as well as the share of avoidable food waste was strongly different between and within business types. On the contrary, considerably lower deviations within one business type were determined by calculating the loss ratio. The ratio between the amount of avoidable food waste (without beverages) and the meals served ranged from 3 (restaurant) to 60 % (event catering) in all companies. Catering business (34%) and healthcare center (28%) kitchens showed significantly higher loss ratios on average compared to hotels (20 % on average) and gastronomic businesses (14 % on average).

In hotels main food waste could be allocated to leftovers buffet and plate waste and consisted of vegetable & fruits, starch side dishes. In event catering surplus production contributed most to food waste amounts and sweet dishes have been identified as one main category. In restaurants main origin of food waste came from the plates which is also true for healthcare centers. Only in healthcare centers soup could be identified as one main food waste category.

The differences in amount but much more in composition of food waste of the different types of catering establishments shows the necessity of tailor-made measures for each business. With the support of independent consultants avoidance measures for each individual company have been identified. The general findings could be summarised for each distinct area (storage loss, loss during kitchen preparation, unissued meals, leftovers on the plate and from the buffet table) and business type, respectively.

Session D

Household

DEVELOPMENT AND EVALUATION OF TAILORMADE FOOD WASTE PREVENTION MEASURES

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Food waste started to become an issue of scientific interest in Austria about ten years ago - especially in the last years several measures were taken to prevent food waste along the food supply chain based on first compilations on the food waste generation in different sectors along the food supply chain. Most measures in the last year focussed on the retail and food service sector. Newly founded start ups as well as private initiatives to prevent food waste start to find support amongst environmentally conscious consumer groups – general awareness campaigns to prevent household food waste don't show satisfactory results or haven't been evaluated at all.

Therefore, within the framework of the project STREFOWA – "Strategies to Reduce and Manage Food Waste in Central Europe", implemented through financial assistance from ERDF funds of the CENTRAL EUROPE CP, in one out of 16 pilot actions the focus is laid on tailored food waste prevention at the household level.

For the implementation of such tailored measures as a first step an evaluation of actual barriers and existing awareness levels has been performed. Therefore, a large-scale online survey was developed and conducted in March-April 2017 in Austria, the questionnaire has been answered fully by 2159 participants. The results show current knowledge of consumers about food production as well as impacts of food waste, food storage or expiration dates. Furthermore, it is shown which measures for the prevention of food waste in households are already being used and. It is shown that leftover cooking, freezing and eating food items before the best before date are used most often (each by more than 80% of participants) to prevent food waste. Other methods like preserving (jam making) are only used by 27% of the participants. Additionally, the consumers preferences on their favourite way to be contacted as well as how often have been taken into account. The majority of consumers wanted to be contacted only once or once in a while (max. once a month) to be informed about where they can find necessary information about food waste prevention so they can look it up if they need to. Consumers prefer to find the necessary information on the product packaging or at supermarkets.

Based on a cluster analysis of the results it was possible to divide consumers that are to a full or large extent responsible for shopping and cooking at home into four different groups (Eager avoiders, Uninformed but eager, Informed but uninterested, Uninformed Squanderers).

Subsequently first aid boxes for food have been developed based on that findings as food waste. This measure is adoptable for different consumer groups. It has been distributed to 2000 consumers at retail stores in Austria. The contents as well as the results of the evaluation will be part of the presentation at the Conference on Food Waste Prevention and Management.

ATTITUDES AND PERCEPTIONS OF CONSUMERS AS A CONTRIBUTING FACTOR TOWARDS THE GENERATION OF HOUSEHOLD FOOD WASTE IN MANGAUNG SOUTH AFRICA.

Z. BUKU

UNIVERSTIÄT?

Background

Food waste is a major concern in South Africa, as it is globally. Estimates suggest that about 10 million tons of food go to waste in South Africa every year, which accounts for a third of the 31 million tons of food produced annually. This translates to R505 million per annum, of which R21.7 million is household food waste. This is undesirable as 30% to 50% of the South African households have insufficient food, or are exposed to an imbalanced diet as a result of low income. A total of 26% of households are food insecure, while 28% of households are at risk of being food insecure. This implies that more than half of the population is not certain where their next meal is coming from. South Africa has the highest food waste figures in Sub-Saharan Africa. There is very little data available concerning the measurement of food waste in third world nations, such as South Africa.

In 2004, the Waste Background research paper found that household food waste amounts to 8.9 million tonnes of the waste produced in South Africa. The Household Food Waste Disposal Study found that on average, every person in the country discards between 8 – 12kg of food per year. Food waste is increasingly becoming a global issue as many researchers feel that reducing food waste might one of the keys to achieving sustainable food security globally. Food waste is particularly an issue in developing countries such as South Africa, where the wasted food could be utilised to reduce food insecurity. Many researchers concur that the reduction of food waste could reduce the number of food insecure people. Reducing food waste would also free up resources, such as inefficiently used water and land, diminish environmental risk (unnecessary greenhouse emissions and diminished natural ecosystems) and avoid financial losses (reduction in farmers' incomes and increase in consumers' expenses). A reduction in household food waste may be of great assistance in managing food waste. Consumer behaviour plays a crucial role in the management of food waste in their own homes and in-store choices and purchases. Food can be deemed undesirable and subsequently wasted as a result of cultural and individual preferences. Educating people regarding the implications of food waste can alter their perceptions and attitudes towards it.

Purpose

There is a considerable void in research in South Africa specifically, relating to the attitudes, awareness and knowledge of consumers concerning household food waste. South Africa is a culturally diverse country, consequently, the perception, attitude and awareness amongst cultures and income groups play an important role in understanding and preventing household food waste. It was thus the aim of the study to attitudes and perceptions of consumers as a contributing factor towards the generation of household food waste in Mangaung South Africa. Furthermore, the household composition of South African household differs from that of the common Western household. This further emphasizes the need for research in this area.

Methodology

This study was conducted in the Mangaung Metropolitan area, South Africa, where 400 questionnaires were distributed. A Hierarchical cluster analysis was performed to cluster political wards into smaller

groups. Five clusters were chosen as these clusters represented a relatively homogenous sample. The questionaries' were paper based and reflected consumer behavior by probing consumers to highlight their attitudes towards food waste, practices regarding food waste, food storage practices and the knowledge and awareness regarding food waste. Data also included average household income, household size, level of education, type of employment and the number of household members.

Results

From the data collected consumers with a lower income proved to waste little or no food at all, which was the opposite for consumers who fall in the higher income category. Consumers with a tertiary had somewhat knowledge and awareness of the implications of food waste, yet they still exhibited some behavioural aspects that were wasteful. Consumers with a basic school qualification had no knowledge of food waste and were not aware of food waste, however, they wasted less or no food. Consumers with a lower income only purchased food once a month, whereas consumers who were in the higher income category went grocery shopping at least once in two weeks, or on a weekly basis. Furthermore, households that were smaller in size wasted more food compared to larger households. Consumers who had a lower income felt that it was necessary for them to finish food on their plates, the same results were found to be true for households with more than two persons residing in it. High income earning consumers were somewhat indifferent about finishing food on their plates. Concerning leftover food, consumers from low income households tend to prepare more food for dinner which will serve as breakfast the following day. Consumers who were more affluent in their income either kept left overs for lunch or kept in the refrigerator until it would go off in some instances and as a result throw it away.

Conclusions

Based on the above results it is evident that there is still a considerable amount of work that needs to be done to educated and sensitize consumers on food waste and how consumer behavior contributes to food waste. Intervention programs that will educated consumer on how to reuse left over food is another possible avenue that can be explored to reduced household food waste. Household food waste cannot be conceptualized as a problem of individual consumer behaviour since research suggest that policies and interventions might usefully be targeted at the social and material conditions in which food is provisioned. One in every five consumers would like more information or advice on food storage, correct amounts and expiry dates. Such consumers would be very receptive to recycling intervention programs.

PROMOTING SUSTAINABLE FOOD CONSUMPTION BY PREVENTING HOUSEHOLD FOOD WASTE AND OVERCONSUMPTION OF FOOD – AN ENVIRONMENTAL PSYCHOLOGICAL PERSPECTIVE ON MOST PROMISING ACCESS PATHS FOR INTERVENTION PRACTICE

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Background. Promoting sustainable food consumption represents a crucial leverage point for improving global environmental sustainability. In order to do so, intervention practice can take into account diverse types of consumers' food consumption (e. g., meat consumption, consumption of organic and/ or regional food etc.). In this context, preventing household food waste and overconsumption of food also represent promising access paths to improve global environmental sustainability. But in order to develop effective intervention programs, specific characteristics of consumers' performance of those behaviors affecting household food waste as well as overconsumption of food (e. g., consumers' performance of diverse planning, shopping, storage, preparation and consumption practices) should be (more) considered by intervention research and practice as done so far. On the one hand, these specific characteristics refer to the actual effect of consumers' behavioral performance on amounts of household food waste and overconsumption of food (i.e., *specific behavioral impact*). Although previous research typically examines consumers' behavioral performances as relevant drivers for household food waste and overconsumption of food (see e. g., Roodhuyzen et al., 2017), actual effects of these behaviors, especially compared with each other, are only rarely investigated. But information about such effects is needed for effective intervention practice, which should be mainly focused on consumers' performance of those behaviors characterized by highest effects on amounts of household food waste and overconsumption of food and, thus, by highest environmental impacts.

Furthermore, effective intervention practice also depends on consumers' opportunity to change their behavioral performances (i.e., *specific potential for behavioral change*). Only if intervention practice focuses on consumers' performance of those behaviors, which are characterized by low or moderate performance levels, high potential for behavioral change is given. Otherwise, resources needed for intervention implementation (e. g., money, time etc.) are wasted, as the targeted behavior is already performed in the desired way by most consumers. Thus, in order to use resources wisely, only those behaviors, which are characterized by lower performance levels, representing high potential for behavioral change, should be seen as most promising access paths for intervention practice.

Finally, creating effective intervention programs in order to change consumers' performance of those behaviors characterized by high behavioral impact as well as by high potential for behavioral change should be based on previous research on the underlying drivers determining these behavioral performances. Thereby, it should be mentioned, that although all of these behaviors affect amounts of household food waste and overconsumption of food, their behavioral performance should still be determined by specific drivers (i.e., *determination of behavioral performance by specific drivers*). For example, previous research indicated consumers' performance of relevant shopping practices (e. g., referring to unnecessary impulsive purchases due to quantity discounts in supermarkets) to be determined by consumers' preference for economical grocery shopping (see e. g., Aschemann-Witzel, Giménez, & Ares, 2018). Instead, their consumption of expired (but probable still edible) food was shown to be determined by perceived health risks (see e. g., Visschers et al., 2016). As these examples demonstrate, only if we know which specific drivers determine consumers' performance of specific behaviors affecting

household food waste and overconsumption of food, we can use our knowledge about these specific drivers as promising access paths for intervention practice.

Purpose. Against this background, main objective of the present research was to examine the specific characteristics of consumers' performance of diverse behaviors affecting household food waste and overconsumption of food. By doing so, we investigated specific characteristics (i.e., specific behavioral impact, specific potential for behavioral change and determination of behavioral performance by specific drivers) of consumers' performance of five behavioral categories (diverse planning, shopping, storage, preparation and consumption practices referring to leftovers and to expired/ suboptimal food).

Methodology and results. In 2018, we conducted an online survey (N = 402) with German consumers using self-report measures in order to capture amounts of household food waste and overconsumption of food, behavioral performances and diverse (psychological) drivers determining these performances (e. g., individual priority of household food waste prevention, frugality and good provider identity).

As generally expected, our data showed specific behavioral impact, specific potential for behavioral change and determination of behavioral performance by specific drivers varying significantly between the examined behavioral categories. For example, consumers' performance of relevant consumption practices referring to leftovers and to expired/ suboptimal food as well as their performance of relevant shopping practices were characterized by high behavioral impacts. Additionally, these behavioral categories were also characterized by high potentials for behavioral change. In contrast, consumers' performance of relevant storing practices was characterized by lower behavioral impact as well as by lower potential for behavioral change.

Conclusion. Taken together, the present research provides valuable implications for intervention research and practice in the domain of household food waste and overconsumption of food. By doing so, we provided empirical evidence not only for the essential reflection of specific behavioral characteristics in intervention research, but also for several promising access paths for intervention practice in order to (further) promote these important types of sustainable food consumption.

Literature

Aschemann-Witzel, J., Giménez, A., & Ares, G. (2018). Convenience or price orientation? Consumer characteristics influencing food waste behaviour in the context of an emerging country and the impact on future sustainability of the global food sector. *Global Environmental Change, 49*, 85-94.

Roodhuyzen, D. M. A., Luning, P. A., Fogliano, V., & Steenbekkers, L. (2017). Putting together the puzzle of consumer food waste: Towards an integral perspective. *Trends in Food Science & Technology, 68,* 37-50.

Visschers, V. H., 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.

REDUCING FOOD WASTE IN GERMAN PRIVATE HOUSEHOLDS BY TARGET GROUP ORIENTED COMMUNICATION – DEDUCING RECOMMENDATIONS FOR TARGET-SPECIFIC COMMUNICATION CONCEPTS

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Background

In the latest estimations, food waste in households accounts for 53% of total food waste in the EU (Stenmark et al. 2016). Most recently, the German GfK study carried out for the Federal Ministry of Food and Agriculture confirmed the relevance of the subject: On average, every German household throws away 109 kg of food each year, almost half of which is avoidable waste (see GfK 2017).

Reasons for the emergence of food waste in households are cited in many places in the literature (cf. van Geffen et al. 2016; Stefan et al. 2013; Beatty and Ferrell 1998; Parizeau et al. 2015; Neff et al. 2015; Quested et al, 2013; Williams et al. 2012; Koivupuro et al. 2012; Evans 2011; Cox and Downing 2007; Quested et al. 2011; Farr-Wharton et al. 2014; Terpstra et al. 2005; Katajajuuri et al. 2011).

In addition, the existing literature always calls for consumer education in order to reduce the manifest problem of food waste in households (cf. Jörissen 2015; Kranert et al. 2012; Priefer 2013). Thus up to now, there is a lack of concepts for addressing households in a way that is appropriate for the respective target groups.

Purpose

The aim of the study is to develop target group-specific recommendations for communication concepts in order to close the gap between two factors: Knowledge about the generation of food waste in households on the one hand and the communication approaches preferred by the different target groups on the other.

Methodology

Based on a systematic literature review on food waste in private households, an online survey was designed and conducted in Germany in August 2018 and resulted in a sample of n = 801. Only those being at least sometimes responsible for shopping and preparation of food in their households were included in the survey. The sample corresponds to the German population in terms of gender and age distribution. The questionnaire comprised – next to demographic questions – statements about food-waste related practices and attitudes, preferences regarding communication and knowledge-related questions. Data analysis was initiated by a factor analysis of 41 food waste-related items which resulted in 5 internally consistent factors. Those factors were subsequently subjected to a hierarchical cluster analysis yielding six distinct clusters. Finally the clusters were analyzed in terms of demographics, knowledge about food waste-related aspects and preferences regarding aspects of communication.

Results

The results show six distinct clusters whereof four clusters display characteristics which make them eligible target groups for food waste reduction campaigns or similar. Those four clusters are: "Well-planned providers" (2) (14,8%), "Ignoramuses" (4) (21,5%) "Enlightened unorganized" (5) (12, 4%)

"Indifferent planning sloths" (6)(5,2%). The two other clusters "Ethical food savers" and "Economists" are already aware of the food waste topic and do not specifically need to be addressed in food waste reduction campaigns.

The "indifferent planning sloths" show the most distinct scores in terms of risk for food waste to arise. This is confirmed as in terms of knowledge about food waste: Regarding the related questions the "indifferent planning sloths" show the least knowledge, followed by the "well-planned providers" and the "ignoramuses".

Concerning demographic characteristics the "indifferent planning sloths" are on average ten years younger than the mean (44.65 years) of the sample. The "enlightened unorganized" are as well younger (roughly 3 years) than the mean of the sample. The largest percentage of cases with the highest education is found in the cluster of "indifferent planning sloths".

The results of statistical analysis indicate how to best communicate with the respective clusters. Three aspects of communication were sampled: communication channels, (dis-)liked terms and way of address.

All four clusters prefer social media (especially Facebook), commercials (particularly on TV) and newspapers as communication channels. A summoning way of address is disliked by all groups.

For the "Well-planned providers" terms like "health", "safety", "harmony", "security" and "cleanliness" are well-liked. "Luxury", "convenience" and "trend" on the contrary are disliked by the "Well-planned providers". Asking about how to address them, they prefer a fun, informative or inventive manner.

The "Ignoramuses" also like the terms "health" and "safety", while they can also be addressed with terms like "coziness" and "nature". They also dislike "luxury" and additionally "exalted indulgence". Regarding the way of address, fun, informative, friendly and inventive are preferred.

The "Enlightened Unorganized" prefer the terms "Health", "safety", "security" and "nature", while "luxury" and "pity" are disliked. The "Enlightened Unorganized" favor to be addressed in a fun, inventive, informative and friendly way.

The "Indifferent planning sloths" prefer the terms "health", "quality", "adventure" and "security" and dislike the terms "pity" and "trend". They like to be addressed in a fun, informative or innovative way.

The data provide additional information on what characterizes the clusters in terms of food wasting behavior, attitude and knowledge. In this way, communication concepts can be tailored specifically for each one of the clusters.

Conclusion

The results indicate that there are distinct consumer groups in Germany in terms of food wasting practices. Yet the preferences regarding communication appear to be quite similar across all four clusters. A possible reason for this result is limited capacity of the online survey to grasp subtly nuanced preferences regarding communication preferences. Therefore further research in terms of qualitative methods is necessary in order to get a deeper insight on distinct communication preferences. Nevertheless the results of this study highlight the need for campaigns and other efforts to reduce household food waste to be tailored in a target group-specific way as there are varying attitudes, behaviors and knowledge regarding household food waste. In this way, the study at hand demonstrates the need for further research and thus contributes to reach SDG 12.3.

Literature

BEATTY, SHARON E.; FERRELL, M. ELIZABETH (1998): Impulse Buying: Modeling its Precursors. In: Journal of Retailing 74 (2), S. 169–191.

COX, JAYNE; DOWNING, PHIL (2007): Food Behaviour Consumer Research: Quantitative Phase. Hg. v. WRAP (Waste & Resources Action Programme) und Brook Lyndhurst.

Evans, David (2011): Blaming the consumer – once again: the social and material contexts of everyday food waste practices in some English households. In: Critical Public Health 21 (4), S. 429–440.

Farr-Wharton, Geremy; Foth, Marcus; Choi, Jaz Hee-Jeong (2014): Identifying factors that promote consumer behaviours causing expired domestic food waste. In: J. Consumer Behav. 13 (6), S. 393–402.

GfK; GfK SE (2017): Systematische Erfassung von Lebensmittelabfällen der privaten Haushalte in Deutschland. Schlussbericht zur Studie. Unter Mitarbeit von Helmut Hübsch und Wolfgang Adlwarth. Nürnberg.

Jörissen, Juliane; Priefer, Carmen; Bräutigam, Klaus-Rainer (2015): Food Waste Generation at Household Level: Results of a Survey among Employees of Two European Research Centers in Italy and Germany. In: Sustainability 7 (3), S. 2695–2715.

Katajajuuri, Juha-Matti; Hartikainen, Hanna; Jalkanen, Lotta; Koivupuro, Heta-Kaisa; Silvennoinen, Krisi; Reinikainen, Anu (2011): Reduction of food waste in Finnish food production chain as part of life cycle management. Helsinki..

Koivupuro, Heta-Kaisa; Hartikainen, Hanna; Silvennoinen, Kirsi; Katajajuuri, Juha-Matti; Heikintalo, Noora; Reinikainen, Anu; Jalkanen, Lotta (2012): Influence of socio-demographical, behavioural and attitudinal factors on the amount of avoidable food waste generated in Finnish households. In: International Journal of Consumer Studies 36 (2), S. 183–191.

Kranert, M.; Hafner, G.; Barabosz, J.; Schneider, S.; Lebersorger, S.; Scherhaufer, H. et al. (2012): Ermittlung der weggeworfenen Lebensmittelmengen und Vorschläge zur Verminderung der Wegwerfrate bei Lebensmitteln in Deutschland. Kurzfassung. Institut für Siedlungswasserbau, Wassergüte- und Abfallwirtschaft. Online verfügbar unter http://www.bmelv.de/SharedDocs/Downloads/Ernaehrung/WvL/Studie_Lebensmittelabfaelle_Kurzfassung. pdf?__blob=publicationFile, zuletzt geprüft am 13.03.2012.

Neff, Roni A.; Spiker, Marie L.; Truant, Patricia L.; Wiley, Andrea S. (2015): Wasted Food: U.S. Consumers' Reported Awareness, Attitudes, and Behaviors. In: PLoS ONE 10 (6), S. e0127881.

Parizeau, Kate; Massow, Mike von; Martin, Ralph (2015): Household-level dynamics of food waste production and related beliefs, attitudes, and behaviours in Guelph, Ontario. In: Waste Management (35), S. 207–217.

Priefer, Carmen; Jörissen, Juliane; Bräutigam, Klaus Rainer (2013): Technology options for feeding 10 billion people Options for Cutting Food Waste. Hg. v. Europäische Kommission. STOA. Online verfügbar unter http://www.europarl.europa.eu/RegData/etudes/etudes/join/2013/513515/IPOL-JOIN_ET%282013%29513515_EN.pdf, zuletzt geprüft am 30.10.2013.

Quested, T.E; Marsh, E.; Stunell, D.; Parry, A.D (2013): Spaghetti soup: The complex world of food waste behaviours. In: Resources, Conservation and Recycling 79, S. 43–51.

Quested, T. E.; Parry, A. D.; Easteal, S.; Swannell, R. (2011): Food and drink waste from households in the UK. In: Nutrition Bulletin 36 (4), S. 460–467.

Stefan, Violeta; van Herpen, Erica; Tudoran, Ana Alina; Lähteenmäki, Liisa (2013): Avoiding food waste by Romanian consumers: The importance of planning and shopping routines. In: Food Quality and Preference 28 (1), S. 375–381.

Stenmarck, Åsa & Jensen, Carl & Quested, Tom & Moates, Graham. (2016). Estimates of European food waste levels. 10.13140/RG.2.1.4658.4721.

Terpstra, M.J; Steenbekkers, L.P.A; Maertelaere, N.C.M de; Nijhuis, S. (2005): Food storage and disposal: consumer practices and knowledge. In: British Food Journal 107 (7), S. 526–533.

van Geffen, Lisanne; van Herpen, Erica; van Trijp, Hans (2016): Causes & Determinants of Consumers Food Waste. A theoretical framework. REFRESH.

Williams, Helén; Wikström, Fredrik; Otterbring, Tobias; Löfgren, Martin; Gustafsson, Anders (2012): Reasons for household food waste with special attention to packaging. In: Journal of Cleaner Production 24, S. 141–148.

Session E

Management

THE VALORISATION OF UNAVOIDABLE FOOD WASTE AND ITS POTENTIAL TO MITIGATE GLOBAL WARMING AND ECONOMIC CONSTRAINTS

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Food waste reduction is manifested in the Sustainable Development Goals, which are also followed by the EU circular economy package. Its urgency is not questioned, considering the fact that currently 173 kg of food waste is produced by each person in the EU along the food supply chain (Stenmarck et al., 2016). Yet, what about the food waste which cannot be reduced or prevented? What about residues from food manufacturers, such as brewer spent grain, animal blood, pomace or press cakes? The manufacturing of the driving products, such as beer, meat, apple juice or vegetable oil, drives the occurrence of those residues. To a limited extent, the accrual of residues can be reduced by improving technology or handling, but a remaining quantity is not avoidable. These side-flows often contain valuable nutrients or characteristics which can be processed into further food ingredients, animal feeds or used for other purposes (e.g. digested or combusted). As highest priority they could remain in the food supply chain. The benefits from the resource point of view seem to be clear. However, in practice the decision whether such side-flows are further used are often driven by economic factors rather than resource efficiency.

Therefore, it is crucial to show the environmental and economic impacts of the further use and recycling of unavoidable food waste, to identify the benefits and use the information for decision making (Östergren et al. 2018). There is no best option per se for each food side-flow. It is rather depending on many local factors and market conditions. This presentation will demonstrate the most influencing parameters for the valorisation, recycling and disposal of specific food side-flows. The environmental dimension is shown with regard to the GHG emissions and costs for energy and transport occurring during processing of the food side-flow and distribution to end-beneficiaries. The relevance of superseded products (e.g. brewer spent grain may replace soy bean meal to feed to ruminants) is furthermore shown in examples and its feasibility of replacement discussed.

References

Stenmarck, Å.; Jensen, C.; Quested, T.; Moates, G. (2016) Estimates of European food waste levels. Report of the project FUSIONS (contract number: 311972) granted by the European Commission (FP7).

Östergren, K.; Scherhaufer, S.; De Menna, F.; García Herrero, L.; Gollnow, S.; Davis, J.; Vittuari, M. (2018) D5.4 Simplified LCA & LCC of food waste valorization, Description of standardised models for the valorisation spreadsheet tool for life-cycle assessment and life-cycle costing. Report of the project REFRESH supported by the Horizon 2020 Framework Programme of the European Union (Grant Agreement no. 641933).

FOOD WASTE MANAGEMENT IN THE CITY OF OPOLE

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Food waste is an important issue in the global economy. In the EU many activities aimed at this topic are carried out, however in Central Europe is still quite pristine. There is lack of reliable data on food waste quantities in this region, and not many preventive actions are taken. To improve this situation the STREFOWA (Strategies to Reduce and Manage Food Waste in Central Europe) was initiated. It is an international project (Austria, Czech Republic, Hungary, Italy, Poland), founded by the Interreg Central Europe programme, running from July 2016 to June 2019. Its main purpose is to provide solutions to prevent and manage food waste throughout the entire food supply chain.

Within the project in Poland a pilot was initiated for the improvement of the collection of food waste from households. Currently, the level of biowaste collection in Poland is low, but rising. In 2007 only 2,3 kg/inh. was collected separately, whereas in 2017 the level had risen to 23,3 kg/inh (GUS 2019). In comparison to the national level, the level in the city of Opole is already relative high. In 2017 the combined amount of kitchen and garden waste amounted to 54,2 kg/inh (Gabor 2018).

Despite the fact that the separate collection of biowaste in Opole is already at a relatively high level, the city was chosen as a location for a pilot to further improve the collection results. Better effects for dissemination are expected from the improvement of already good practices than of the improvement of the worst cases.

In the city of Opole biowaste is collected in bins, in which the citizens can both gather garden waste and the waste generated in their kitchens. The waste management system in the city is based on a division of the households in three urban zones: low-rise buildings, high-rise buildings and a zone with up to four dwellings per house. In a representative district, with all of the three building types represented, the inhabitants receive an additional small bin to use inside their homes for the gathering of food waste in the kitchen. In order to enhance the use of these bins, they are accompanied with fitting biodegradable bags. These bags are thought to allow for a cleaner gathering of the food waste, preventing the bins from getting dirty and thus, unpleasant smells.

In order to determine the effects of the pilot actions, both the amounts of collected biowaste and residual waste as well their composition are monitored. Apart from information on the progress of the pilot this also allows for the determination of the level of food waste and wastage in Polish cities. Throughout a whole year, prior to and after the introduction of the home bins and bags, the amounts and types of wasted food are determined by the performance of waste sorting analyses in every season.

References:

GUS (2019) Główny Urząd Statystyczny, Bank Danych Lokalnych.

Gabor E. (2018): Analiza stanu gospodarki odpadami komunalnymi miasta Opola za 2017 rok. Urząd Miasta Opola.

FOOD WASTE REDUCTION AND MANAGEMENT USING THE RECYCLING BEHAVIOR TRANSITION (RBT) PROCEDURE

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Large amounts of food are generated each year, of which, according to the Food and Agricultural Organisation of the United Nations (FAO, 2013), approximately one-third is never consumed. This amounted 1.3 Gtonnes of edible food waste in 2007 (FAO, 2013). Similarly, the European Union generates approximately 88 million tonnes of food waste (Stenmarck et al., 2016), and Sweden generates 1.3 million tonnes of this waste (Westöö et al., 2018). Also, the global food demand is expected to increase by 70% by 2050 (FAO, 2013), which will further increase the amount of food waste.

In many countries there exists technical infrastructure to manage waste, including food waste. This infrastructure should aim to treat the waste in the best possible way, using it as a resource that can be reused (e.g., donations) or for other products (e.g., compost and biofuel) rather than landfilling or dumping. However, in order to be effective, the actors that generate the waste (e.g., households or supermarkets) must interact properly with the technical infrastructure. A recent review by Rousta et al. (2017) revealed that almost all of the studies that are done by researchers from the social science field focus on the actors, while almost all studies that are done by people from the engineering sciences focus on the technical system. The review identified a need for multi- or cross-disciplinary research that focuses on the interface between the actors and the technical system.

The RBT procedure (Rousta et al. 2016) serves the purpose of focusing on this interface. As shown in the figure below, this procedure consists of five steps: 1) In the first step one decides on the actor(s) that will be in focus. 2) In the second step, information on the waste generation and sorting behavior is gathered using, for example, pick analyses. This information can be used to perform an environmental impact assessment (life cycle assessment – LCA) and an economic analysis of the present and improved sorting behavior. 3) This information is used to interact with the actors to ascertain if they want to improve their sorting and, if so, what they think is necessary to improve their sorting. This could be changes related to their own behavior (e.g., improved incentives) or changes to the technical system (sorting infrastructure that is more relevant to their needs). 4) The interaction with the households identifies an intervention that is implemented in the fourth step. 5) The pick analysis is repeated to analyze the effect of the intervention. The final steps can be repeated to continually improve sorting and reduction of the waste.
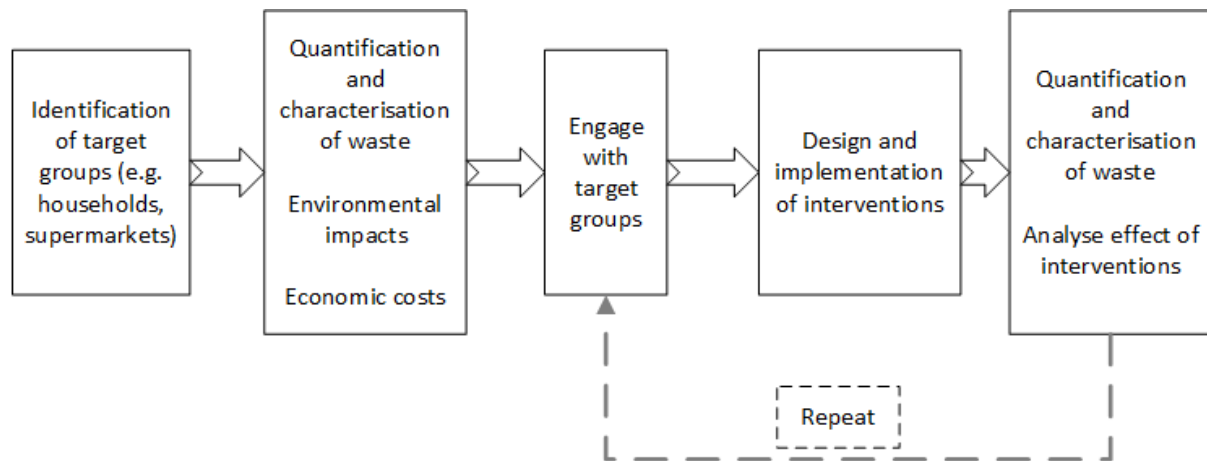
Figure The recycling behavior transition (RBT) procedure

The RBT procedure has been implemented at households in a suburb in the Swedish city of Borås (Rousta et al., 2015). It did not include an LCA study. One of the interventions that was identified (Step 3) and implemented (Step 4) was that relevant information needed to be provided at the proper time and places to reduce missorting in the food waste fraction. This led to a reduction of missorting in this fraction by 70%.

More recent studies based on food waste at supermarkets have also included the environmental impact of the food waste as well as the economic costs (Brancoli et al. 2017). It is expected that these studies will also lead to interventions that will reduce food waste and improve the management of the waste that is inevitable.

In conclusion, the RBT procedure can be used in any waste management system so improve the interaction between the generators of the waste and the technical system.

References

Brancoli, P., Rousta, K., and Bolton, K., 2017. Life cycle assessment of supermarket food waste, *Resources, Conservation & Recycling*, **118** 39.

FAO, 2013. Food wastage footprint: impacts on natural resources: summary report. Food and Agricultural Organization of the United Nations, Rome, Italy.

Rousta, K., Dahlén, L., Bolton, K., and Lundin, M., 2015. Quantitative Assessment of Distance to Collection Point and Information Effects in Source Separation of Household Waste, *Waste Management*, **40** 22.

Rousta, K., Bolton, K., and Dahlén, L., 2016. A Procedure to Transform Recycling Behavior for Source Separation of Household Waste, *Recycling*, **1** 147.

Rousta, K., Ordoñez, I., Bolton, K., and Dahlén, L., 2017. Support for Designing Waste Sorting System: A mini-review, *Waste Management & Research*, **35,** 1099.

Stenmarck, A., Jensen, C., Quested, T., Moates, G., Buksti, M., Cseh, B., Juul, S., Parry, A., Politano, A., Redlingshofer, B., 2016. Estimates of European food waste levels. IVL Swedish Environmental Research Institute, Stockholm.

Westöö, A., Jensen, C., Viklund, L., Sörme, L., Stenmarck, Å., 2018. Matavfall i Sverige–Uppkomst och behandling 2016. Naturvårdsverket.

ENERGETIC VALORIZATION OF THE ORGANIC FRACTION OF MUNICIPAL SOLID WASTE FOR CO-DIGESTION IN WWTPS – PART 1: REMOVAL OF IMPURITIES

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Introduction

Black bins are conceived for the collection of residual solid household wastes, however the material still contains about 32% of biodegradables, such as garden wastes, paper, cardboard and similar (BMNT, 2017). In Austria, for example, about 157,000 t/a of food waste end up in black bins (Marchl, 2018). To handle this mixed material and separate recyclables from non-recyclables, mechanical pre-treatment systems are in place, which mainly consist of shredding and screening units. The fines from the initial screening of mixed municipal solid waste (MSW) contains high concentration of organic matter, which could be used as a co-substrate in the digesters of wastewater treatment plants (WWTPs) (Meirer, 2018). This material also contains impurities, such as stones and glass shards, which cause abrasions and can damage pipes and pumps of WWTPs. The accumulation of sediments at the bottom of the digesters is a challenging issue, because it results in increased operational and maintenance costs due to the continuing reduction of usable digester volume. Also, the sediments need to be removed more frequently, and the ensuing interruptions of the normal operation result in economic losses. In addition, coarse material, such as pieces of wood and plastics can block pipes or form floating layers in the digesters. Furthermore, the presence of plastics in the digestate can reduce its dewatering properties.

The objective of this study was to test a wet mechanical pre-treatment technology for the removal of impurities from the fine fraction of MSW, in order to produce a suitable co-substrate for biogas production in the anaerobic digesters of WWTPs.

Material and methods

Approximately 19.2 t of MSW (fraction < 40 mm) was collected over a period of one week from a mechanical pre-treatment facility, which processes about 60,000 t/a of MSW from households by means of shredding and sieving at 40 mm and 250 mm. The collected waste was sieved at 12 mm by means of a trommel screen. The sieved fraction < 12 mm (about 5 t) was kept in a 7 m^3 container. During the entire sieving process, samples of the fraction < 12 mm were collected from the trommel screen's conveyor belt. After coning and quartering, a sample was collected to be analyzed in the laboratory for total solids – TS, volatile solids – VS, sample composition (organics and paper, combustibles, glass, metals, inert, and fines), and biogas production potential. For the TS determination, the sample was dried at 105°C for 24

hours. The dried sample was combusted to ash at 550°C for four hours. For the composition determination, a sample of the fresh material was hand-sorted for particles > 2 mm. The biogas production potential followed VDI 4630 (2014).

The sieved fraction < 12 mm was used as input material for the wet mechanical pre-treatment system. The pre-treatment system set-up consisted of a 1 m^3 container followed by a hydrocyclone configuration developed by Senfter (2018) (Figure 1). Since the hydrocyclone works under wet condition, the material was first mixed with tap water for 30 minutes. Three different total solids content of the mixture were defined: 5%, 9% and 13%, and two volume flows, 10 and 15 m^3/h, were tested. The mixed material was pumped to the hydrocyclone. Three repetitions were performed for each combination TS – volume flow.
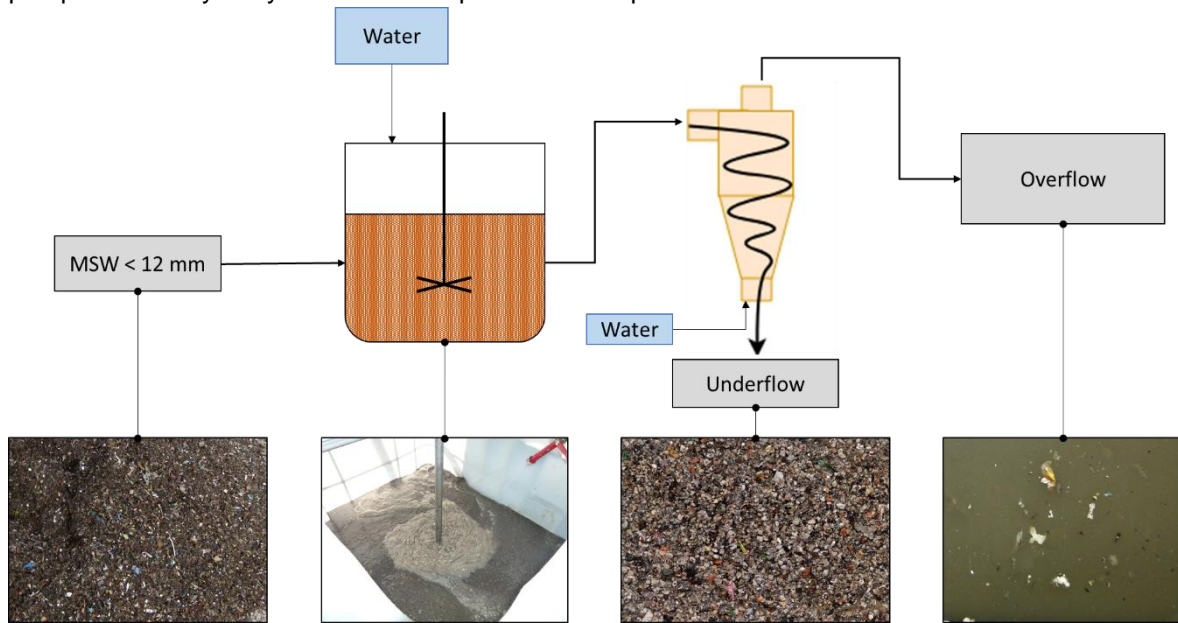

Figure 1. Process flow diagram of the wet mechanical system for impurities removal from MSW (fraction < 12 mm).

Samples of the pumped material to the hydrocyclone (input) and samples of the outputs of the hydrocyclone (overflow, i.e. the cleaned MSW, and underflow, i.e. the removed impurities) were collected. Input samples were collected by means of a scoop of 0.75 L during the mixing process until having approximately 2.5 L sample and analyzed for TS. With regard to the underflow, a container was placed under the hydrocyclone to collect the discarded heavy particles. Water was used to clean the hydrocyclone after each batch, thus the underflow also contained a small amount of flush water. The total weight of the underflow was determined and the liquid part was carefully poured off, weighed and the amount of the solid fraction (settled material) determined by difference. After thoroughly mixing each fraction, a sample of approximately 5 L was collected and analyzed for TS, VS and composition. An overflow sample was collected at 800 L, 700 L, 600 L, and 500 L levels, while the hydrocyclone was under operation. Since in the first 100 L the overflow was still transparent, no sample was collected. The collected 1 L samples at each level were joined into one 4 L sample and thoroughly mixed for further analysis. In total, 86 samples were collected during the experimental trials (2 weeks).

The TS and VS determinations of underflow and overflow were performed as previously described. Due to the liquid state of the overflow, the determination of the composition of the overflow was adapted: the samples were wet sieved at 4 mm and 2 mm. The fraction > 4 mm was hand-sorted for biodegradable materials (organics and paper), combustibles (plastics, textile, wood, non-biodegradable organics), metals, inert materials (stones, ceramics, egg shells), glass, and others. The hand-sorted material was

dried at 60°C in order to avoid alterations of the plastics, and the final weight of each category was determined. The fraction 2 – 4 mm was dried and combusted. The combusted material was considered as organics and the ashes as inert. The fraction < 2 mm was calculated by difference of weight. For the best configuration volume flow – total solids, the volatile solids of the fraction < 2 mm was determined by saving the washed out particles in a 10 L bucket. The 10 L was dried and combusted to ash. Again, the volatile solids of the fraction < 2 mm was accounted as organics and the ashes as inert.

Results and discussion

The TS of the MSW < 12 mm was 57.6% FM, VS at 43.7% TS, and the biogas potential 412 Nm^3/t VS. The material consisted of 55% biodegradables, 3% combustibles, 9% inert, and 32% fine particles < 2 mm, on a wet mass basis. The input to the hydrocyclone presented, in average, a TS content 23% lower than the pre-defined TS: 3.5% instead of 5%; 7.2% instead of 9% and 10.5% instead of 13%. The TS of the overflow was 3% to 10%, and VS from 61 to 70%, depending on the tested configuration. The TS of the underflow depends on the amount of water used for flushing the hydrocyclone after each run. Thus, only the VS of the underflow is presented, which varied from 12 to 4% TS.

Figure 2 shows the relation among the TS of the input material, the working volume flow and the inert concentrations in the output fractions. Apparently, a higher concentration of solids in the input led to a higher concentration of inert material in the underflow, i.e. less loss of organics. On the other hand, a higher concentration of inert material was identified in the overflow with increased TS of the input. No apparent difference between the two volume flows was observed.
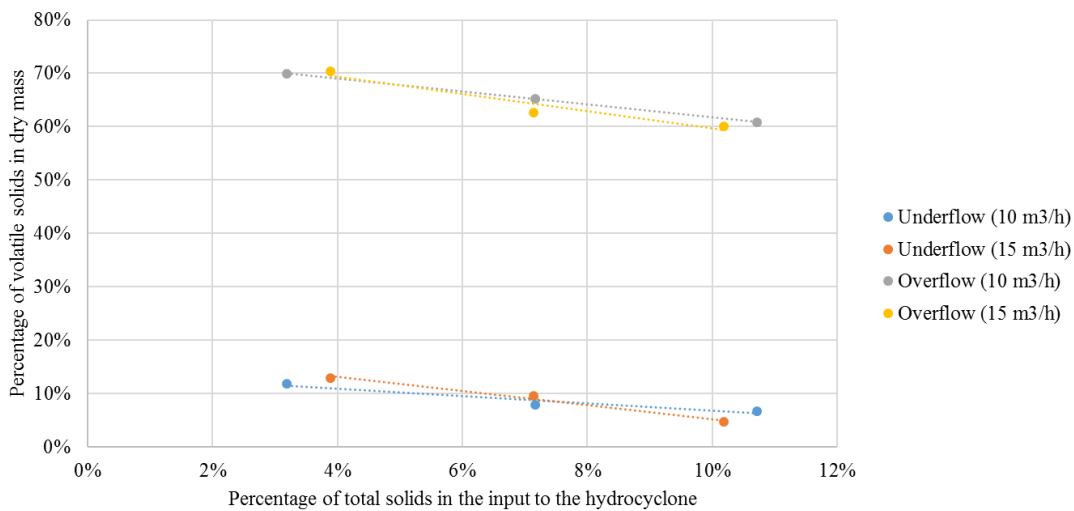

Figure 2. Average of the volatile solids of each output of the hydrocyclone (underflow and overflow) at each tested volume flow (10 and 15 m^3/h). The dots represent the measured data and the dash-lines the linear regression.

The hand-sorting of the underflow > 4 mm resulted in a concentration of inert materials (glass, stones, metals, eggshells etc.), ranging from 23% to 48% (dry mass). In the overflow, the concentration of inert materials ranged from 0.3% until 4.0 % (dry mass). Combustibles (plastics, wood, etc.) in the underflow were found in concentrations from 0.3% to 2.6% and in the overflow from 3.6 to 6.5% (in dry mass basis). Among the tested trials, the volume flow at 10 m^3/h with and an input of 9% total solids appeared to be the best option. Since there was no significant difference between volume flow 10 and 15 m^3/h, the use of a lower volume flow leads to a lower energy demand by the hydrocyclone. With regard to the total solids, very low total solids (5%) would lead to the need of higher volume and higher input of water to make the

material fluid. On the other hand, higher concentration of solids would require more energy for pumping the material. In addition, a higher concentration of inert particles in the overflow was observed with the increase of the TS.

The composition of the hydrocyclone outputs (underflow – settled material, and overflow) are presented in Figure 3 in dry mass basis for the best configuration. The distribution of each component throughout the system considering the mass balance is presented in Figure 4.
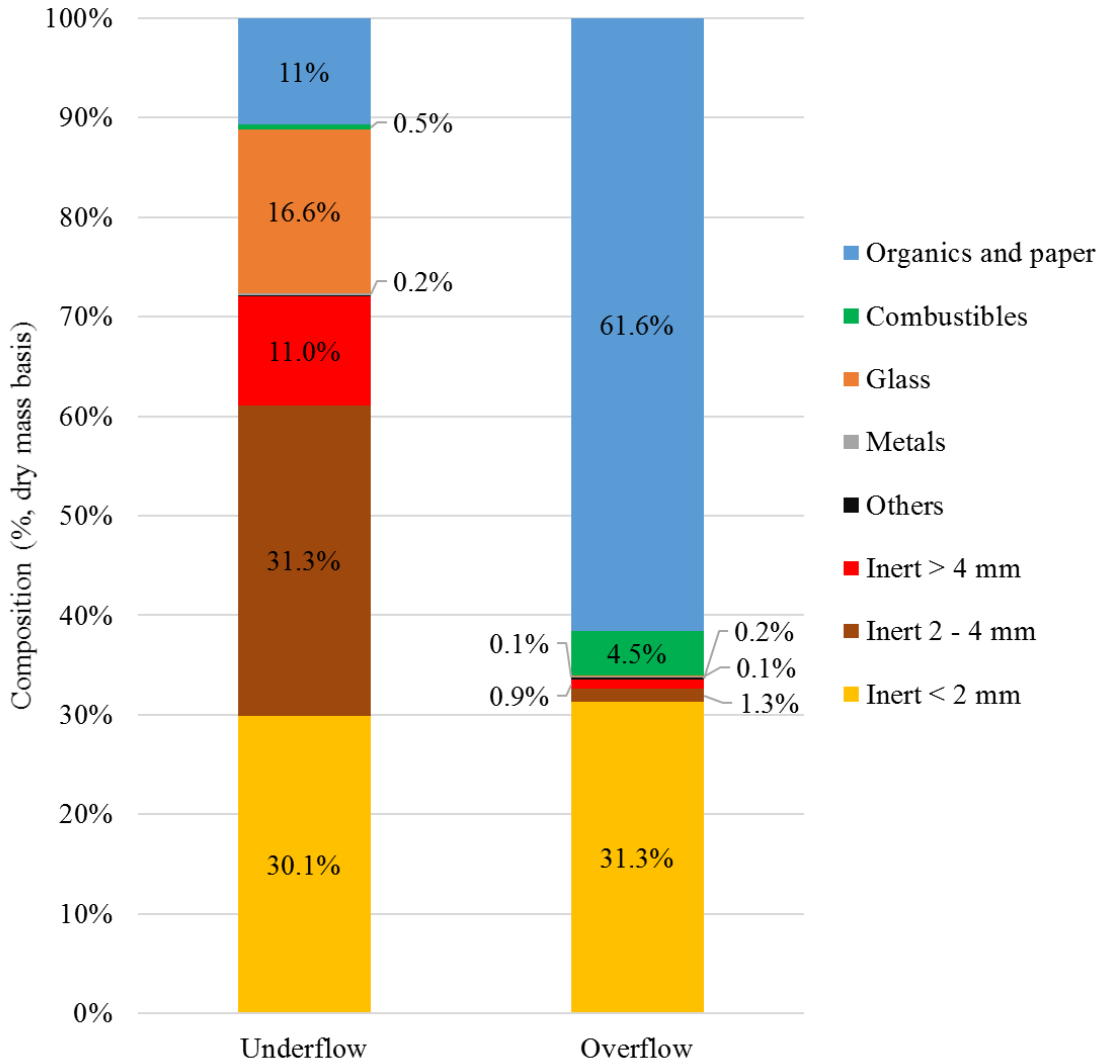

Figure 3. Composition of the hydrocyclone outputs using a volume flow 10 m^3/h and total solids of the input material as 9%.

The results of the mass balance show that, from the incoming total solids to the hydrocyclone, 84% end up in the overflow and 16% is removed (underflow). The underflow concentrated inert and heavy particles, while the overflow consisted mostly of organics and paper, but also inert < 2 mm. It is important to highlight that the particles < 2 mm represent the ashes from the combustion of the fraction < 2 mm. Thus, some particles are not necessarily consisted of impurities, but they originate from the mineral part of the organic matter.
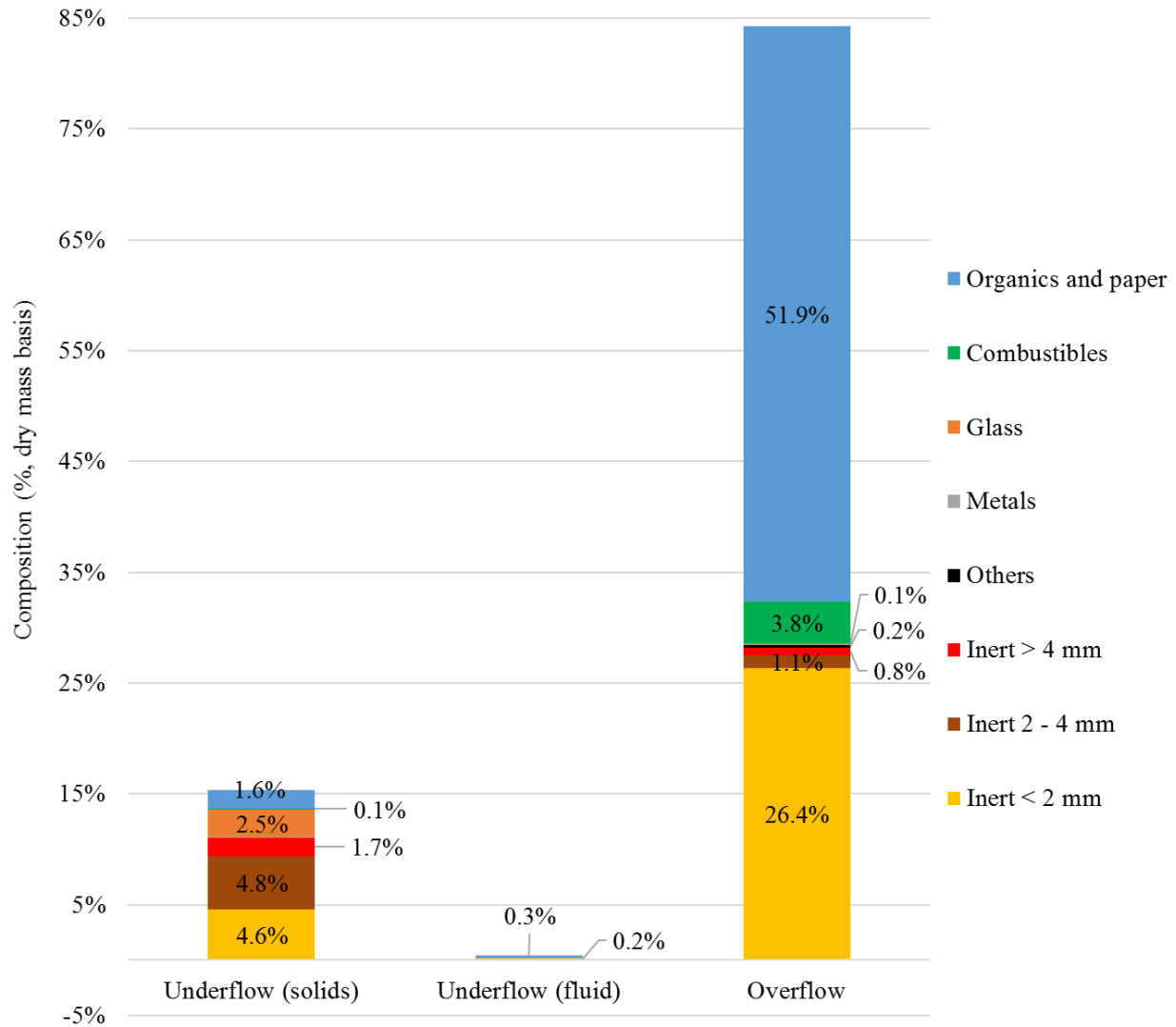
Figure 4. Distribution of each component in each output of the hydrocyclone.

Table 1 shows the transfer rates of each incoming component to each output of the hydrocyclone, in dry mass basis, for the best configuration (10 m³/h and 9% TS). From the organics and paper in the input material, 96% goes to the overflow, i.e. only 4% of the input organics are lost in the underflow. With regard to the inert particles > 2 mm and to the glass, most of them land in the underflow. On the other side, almost 100% of the incoming combustible material remains in the overflow. Particles < 2 mm were also mainly found in the overflow. However, it is important to highlight that, the particles < 2 mm are not only inert particles, such as sand and soil, but also the product of the combustion of the organic material (carbonates).

Table 1. Transfer rates of the MSW components to each hydrocyclone output, in dry mass basis

Component	Overflow	Underflow
Organics and paper	96%	4%
Combustibles	98%	2%
Glass	4%	96%
Metals	68%	32%
Others	97%	3%
Inert > 4 mm	31%	69%
Inert 2 - 4 mm	18%	82%
Inert < 2 mm	85%	15%

Final considerations

The hydrocyclone is a promising technology for the removal of heavy particles (glass, stones, ceramic, and egg shells) from MSW. However, most of the light material, such as plastics, were still found in the overflow. Particles < 2 mm still need to be further analyzed, since some of them are not necessarily impurities, but carbonates originated from the combustion of the organic matter. This is an ongoing project and the results regarding the potential biogas production out of the cleaned organics are planned to be performed soon in continuous laboratory reactors. In addition, the quality of the cleaned MSW will be compared with the quality of the actual co-substrate (biowaste) used in WWTPs. Later on, the phosphorous recovery from the digestate and the hazardous substances impacts present in the MSW for the WWTP will be evaluated.

References

BMNT, 2017. Bundes-Abfallwirtschaftsplan 2017, in: Tourismus, B.f.N.u. (Ed.), Vienna.

Marchl, L., 2018. Wertvoller Abfall, zukunft forschung. Leopold-Franzens-Universität Innsbruck, Innsbruck.

Meirer, M., 2018. Physikalische Aufbereitung von Restabfällen zur Co-Vergärung in Abwasserreinigungsanlagen. Doctoral Thesis. Universität Innsbruck, p. 213.

Senfler, T., 2018. Kontinuierliche Störstoffabscheidung in der Klärschlamm-Co-Fermentation mittels Zentrifugalabscheider. University of Innsbruck, p. 131.

VDI 4630. 2014. Verein Deutscher Ingenieure. Vergärung organischer Stoffe.

Session F

Food Service 2

AWARENESS AND PRACTICE: WASTE MANAGEMENT IN THE SWISS FOOD SERVICE INDUSTRY

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There are few sustainability topics that arise higher social interest and understanding than food waste. A stream of novel research highlights the mounting economic, environmental and ethical relevance of minimizing wastage generation (Filimonau et al., 2019; Martin-Rios et al., 2018). It is agreed that food waste is a complex, multilevel phenomenon that takes place at all stages of the global supply and demand chain. In particular, the foodservice industry at the very end of the food supply chain must develop appropriate waste management strategies because of their considerable weight in the global economy and the complex activities taking place on food establishments.

Food waste management has links to other global challenges including climate change, health, poverty, as well as sustainable production and consumption. SDGs. SDG Target 12.3 addresses this challenge, calling on the world to halve food waste and reduce food loss by 2030. Yet, questions loom large, is the foodservice industry aware of their role in the global problem of food waste? What progress have restaurants made to set targets, "measure to manage" food waste, and enact the right practices to achieve Target 12.3?

Foodservice businesses influence the sustainability of their natural environment by producing significant amounts of food waste. Despite the efforts undertaken to-date to combat waste, surprisingly there are still limited studies that analyze foodservice producers, their understanding and practices in food waste management. Thus, this paper focuses on the foodservice industry (Betz et al., 2015, Demen Meier et al., 2015; Siorak et al., 2015; Whiley & Boehm, 2014), to address the question of which major solutions and innovations business managers report regarding waste minimization and management in foodservice establishments.

Methodology and Results

This study reports primary data collected from a set of 67 restaurants and a total of 115 answered questionnaires (57% management and 43% kitchen staff) in Switzerland. A regression model was used to assess awareness about the food waste phenomenon (global awareness about production of food waste) and actual implementation of food waste-related practices in place in each establishment.

Results indicate that businesses with a high awareness of food waste quantities are more likely to produce low levels of food waste. Quantification, understanding of current legislation and the latest waste management practices allows them to make adequate decisions and changes reducing their waste production along with their financial losses. Results show that it is in their best interest to be knowledgeable about the quantities wasted annually in their establishments. The importance of awereness shows similar results than research conducted by Martin-Rios et al. (2018), which indicates that although businesses are aware of the issue of food waste, they show little interest in innovation practices targeting food waste. Conclusions drawn from the present study indicate that awareness of

innovative practices is limited among management in the restaurants analyzed. Yet, independent businesses showing high overall awareness produced less food waste. This results is consistent with previous studies (e.g. Beretta et al., 2013), businesses exhibiting high awareness tend to be more knowledgeable about the existing solutions at their disposal to reduce food waste production. This constitutes a robust indicator that emphasizing the existence of innovative solutions available on the market could have a positive impact on the foodservice industry's share of food waste production. Further, the high correlation between awareness about the efforts at the institutional level (Swiss Confederation and local authorities) and food waste indicates that foodservice establishments show interest in the efforts and solutions offered at a national and regional level. This supports the findings of observed in previous research (Filimonau et al., 2019) which highlights that policymakers have the potential to influence foodservice operations in dealing with food waste.

Conclusion

The unique contribution of this study is to provide a set of innovations which can be used in foodservice establishments for waste management minimization and mitigation. The study offers insights that could be used whether a restaurant is adopting innovative food waste practice or not, especially as waste minimization is an important aspect of food preparation process (Bloom, 2010). In addition to its practical implications, an important contribution of this study is its application of management practices to establish food waste systems for foodservice.

References

Betz, A., Buchli, J., Göbel, C., & Müller, C. (2015). Food waste in the Swiss food service industry–Magnitude and potential for reduction. *Waste Management*, *35*, 218-226.

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.

Bloom, J. (2010). *American wasteland*. Philadelphia, PA: De Capo Press

Demen Meier, C., Siorak N., Buri, S., Cornuz, C. (2015). Sustainable supply chains and environmental and ethical initiatives in restaurants. In Philip Sloan & Willy Legrand (eds.), *The Routledge Handbook of Sustainable Food, Beverage and Gastronomy*, Abingdon: Routlegde, pp. 267-278.

Filimonau, V., Krivcova, M., & Pettit, F. (2019). An exploratory study of managerial approaches to food waste mitigation in coffee shops. *International Journal of Hospitality Management, 76*, 48-57

Heikkilä, L., Reinikainen, A., Katajajuuri, J.-M., Silvennoinen, K., & Hartikainen, H. (2016). Elements affecting food waste in the foodservice sector. *Waste Management, 56*, 446-453.

Martin-Rios, C., Demen-Meier, C., Gössling, S., & Cornuz, M. (2018). Food waste management innovations in the foodservice industry. *Waste Management, 79*, 192-206.

Siorak N., Demen Meier, C., Buri, S., Cornuz, C. (2015). International and national regulations in favour of sustainable operations in food service. In Philip Sloan & Willy Legrand (eds.), *The Routledge Handbook of Sustainable Food, Beverage and Gastronomy*, Abingdon: Routlegde, pp. 379-390.

Whiley, D. & Boehm, A. (2014). Food culture and waste management in the foodservice sector: Lessons for tourism and hospitality. In Chien, P.M. (Ed.) *CAUTHE 2014: Tourism and Hospitality in the Contemporary World: Trends, Changes and Complexity*. Brisbane: School of Tourism, The University of Queensland, pp. 690-702.

EVALUATION OF FOOD WASTE QUANTIFICATION AS A METHOD OF REDUCING FOOD WASTE IN THE PUBLIC CATERING SECTOR

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Introduction

Food waste reduction is of emerging interest and now has a specific sub-goal in the United Nations Sustainable Goals (UN, 2017). While reducing food waste is not the only way to make the food supply chain more environmentally sustainable, as pointed out by Godfrey et al. (2010) and Garnett (2011), it has the added potential to save money and improve food security. Reducing food waste is also less controversial than e.g., reducing meat consumption or increasing productivity by extending the use of genetically modified organisms.

In some countries, the food waste itself creates a problem if it is landfilled or left at illegal dumping sites. In other countries, landfilling of organic waste is prohibited and surplus food is considered a resource that can be used for biogas production or, with some restrictions, for feeding people in need (Eriksson et al., 2015; Eriksson & Spångberg, 2017). It is therefore not the wasted food that should be the main concern, but the wasteful behavior that results in unnecessary food production. However, the energy recovery options used are not those most highly prioritized in the European Union (EU) waste hierarchy (EC, 2008). In terms of food waste valorization, Eriksson and Spångberg (2017) report that the potential to reduce greenhouse gas emissions increases significantly by going from energy recovery options to re-use options where surplus food is still used for human consumption. Waste prevention through source reduction can reduce the environmental impact even further (Gentil et al., 2011; Bernstad Saraiva Schott & Andersson, 2015; Eriksson et al., 2016), but in order to reduce food waste it is necessary to understand the exact problem to be solved (e.g., Steen et al., 2018). According to Eriksson (2012, 2015), detailed quantification is an essential first step in this process. Moreover, accurate food quantification is needed in order to evaluate the effect of any food waste reduction measures taken within a process of continuous improvement.

An obstacle to food waste quantification is the lack of a common standard for quantifying and reporting food waste, which makes results from different organizations difficult to compare. The Food Loss and Waste Accounting and Reporting Standard (World Resource Institute, 2016) can be used to discuss reasonable trade-offs between use of resource for waste quantification and relevance, completeness, consistency, transparency, or accuracy. Eriksson et al. (2018a) extended existing quantification methodology by demonstrating how different datasets can be compared and designed in a common framework. However, there have been no suggestions to date on the categories that should actually be recorded or for how long food waste should be quantified. According to material presented by Eriksson et al. (2018b), it appears that there are two main strategies used to collect data on food waste in catering services: either a few observations per day are made during a long period, or more observations per day are made, but during a shorter period. However, most catering units quantify the waste during selected

periods, making it less possible to generalize in comparison with random selection of days or continuous quantification. Moreover, the 30 public catering units studied in Eriksson et al. (2017) only quantify food waste during selected periods, although these periods are fairly long and with many observations made per day. Other studies (e.g., Engström & Carlsson-Kanyama, 2004; Barton et al., 2010; Betz et al., 2015) have quantified food waste during a long period, a continuous period, or with collection of many observations per day, but none seems to have considered which of these parameters are most important to facilitate food waste reduction.

Food waste quantification by itself can also be used as an action to reduce food waste, by increasing awareness of the amounts of food waste within an organization. However, not all food waste quantifications are the same, and it is still unknown whether it is more efficient in terms of waste reduction to quantify food waste according to ambitious targets, or whether low-effort quantification can give the same results. There might be a threshold at which small initial efforts can have a large impact, but greater efforts to further improve the quantification might not be as efficient in terms of waste reduction. This knowledge can therefore be used to improve waste quantification, in order to determine the best trade-off between accuracy and completeness in relation to resources invested.

The main objective of this study was to evaluate whether food waste quantification by itself can be used as a reduction measure, and to what extent a more detailed, more complete, or longer quantification period leads to less waste. The overall aim was to help food services find resource-efficient strategies for reducing food waste and through this increase sustainability in the food system.

Material and method

Data from 649 Swedish catering units producing meals for pre-schools, schools, and elderly care units were examined. These data were recorded in 12 municipalities of different sizes in various periods in 2012-2018. The catering units investigated used measuring scales to quantify the mass of different food components wasted and recorded these observations in spreadsheets. This was complemented by recording the number of guests, which was assumed to equal the number of plates used (counted at each meal served). Even though the municipalities used slightly different methodologies to quantify the waste, all were very similar to methodology described in previous studies (e.g., Eriksson et al., 2017, 2018a).

There is a methodological difficulty in evaluating a quantification process as a waste-reducing action, since there cannot be a baseline quantification before the action starts and there is no quantification afterwards to compare with. There is thus only the quantification period during implementation of the action. To handle this issue, the quantification periods used in this study were divided into two parts for each catering unit included. The first 50% of days when food waste was quantified were compared with the last 50% of days. If the quantification period included an uneven number of days, the middle day was allocated to the first period.

Certain aspects of a food waste quantification process determine the quality of the data, but also the demand for resources to conduct the quantification. According to the Food Loss and Waste Accounting and Reporting Standard (World Resource Institute, 2016), there is normally a trade-off between resources used and relevance, completeness, consistency, transparency and accuracy for the waste quantification. In order to evaluate the different quantifications, three quantifiable parameters (consistency, completeness, and relevance as defined by World Resource Institute (2016)) were identified in this study. Consistency was represented by the total number of days for which food waste was recorded, since tracking the information over time should help to identify trends and assess the performance of the reporting entity. Completeness was represented by the number of missing days in relation to the total number of quantification days, assuming that missing data represent incompleteness. Relevance was represented by the number of food waste categories used for the quantification, since better resolution of data potentially gives the user more relevant information in comparison with more aggregated information.

These parameters represent different aspects of a food waste quantification that could be given different priority. Since food services normally have limited resources, they will focus on one or two of these dimensions, but only a few will put efforts into determining all three.

In addition to the quantifiable parameters potentially influencing food waste quantification efforts, initial wasted mass per day and initial efficiency (i.e., mean waste per guest during the first quantification period) were determined. These two factors have little to do with quantification efforts, but could still be important obstacles to/opportunities for food waste quantification. High initial waste and low efficiency are both opportunities, since they may indicate greater potential to reduce food waste.

In order to quantify the impact of the different influential factors (consistency, completeness, relevance, initial efficiency, and initial waste) on food waste, a multiple linear regression (MLR) model was developed. According to Uyanik and Güler (2013), the advantage of using an MLR model instead of diverse correlations is the ability to quantify the total effect from relevant factors on the model outcome, as previously done by Steen et al. (2018) and Eriksson et al. (2014, 2016).

Backwards elimination was used to choose the best-performing MLR model. All explanatory variables significantly or almost significantly correlated to the food waste reduction per guest in catering were included. Explanatory variables that were not significant for the model outcome ($p>0.05$) were eliminated step-by-step, until all remaining explanatory variables significantly influenced the variation in the response variable ($p<0.05$) (Helsel and Hirsch, 2002).

Results and discussion

Of the food services included in the study, 58% reduced their food in terms of mass wasted during the last half of the quantification period in relation to the first half. This indicates that food waste quantification could be a useful activity to reduce food waste in food services, but also that quantification alone is not a guarantee of reduced food waste. The results of MLR based on the 382 catering units that had reduced their waste are displayed in Table 1 and since the model has a R^2-value of 0.78 this model explains a high degree of the waste reduction. As can be seen, three variables had a significant influence on food waste reduction. These were relevance, completeness, and initial efficiency. The other two variables tested (consistency and initial waste) did not have a significant effect on food waste reduction.

Table 1. Results of multiple linear regression (MLR), including coefficient, significance level, and standard error of variables, and intercept. Number of observations and adjusted R^2-value are also shown

Variable	Coefficient (standard error)
Relevance (number of categories used)	-2.6** (0.88)
Completeness (share of days with observations)	28*** (5.1)
Initial waste	0.69*** (0.018)
Intercept	-31*** (3.8)
N	382
R^2	0.78

***$p>0.001$, **$p<0.01$, *$p<0.05$.

The two non-significant variables could be assumed to be less important when designing a food waste quantification process. Relevance, which had a negative effect on food waste reduction according to our analysis, could also be seen as less relevant for food waste reduction. This indicates that the most two important factors in order to achieve food waste reduction through quantification are high completeness and high initial waste. High completeness means that it is more important to record every day than on many days. There are many possible reasons for this positive correlation, e.g., completeness may simply

be an indicator of the overall commitment of kitchen staff to food waste reduction. The importance of high initial waste is easier to explain, since high waste per guest served indicates that there is potential to reduce this waste. This is not a parameter that will be changed in order to facilitate reduction by an individual catering unit, but an organization can focus quantification efforts on catering units with high waste, since they provide the largest opportunities to reduce. It is not necessarily only catering units with most waste that provide this opportunity, but also those with the lowest efficiency (i.e., the highest waste per guest served).

Conclusions

Our analysis showed that efforts like long quantification time and usage of many categories devoted to non-continuous food waste quantification have a low effect on the actual waste reduction. Based on other findings, the recommendation is to ensure high completeness when food waste is quantified and, maybe even more importantly, to focus waste quantification efforts on catering units with the highest waste per guest served. These units have the greatest opportunities to reduce the waste through quantification, irrespective of size or how they prioritize efforts during quantification.

References

Barton, A., Beigg, C., MacDonald, I., Allison, S., 2000, High food wastage and low nutritional intakes in hospital patients. Clinical Nutrition 19, 445-449.

Bernstad Saraiva Schott, A., Andersson, T., 2015, Food waste minimization from a life-cycle perspective. Journal of Environmental Management 147, 219–226.

Betz, A., Buchli, J., Göbel, C., Müller, C., 2015, Food waste in the Swiss food service industry – Magnitude and potential for reduction. Waste Management 35, 218-226.

EC, 2008, Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008 on waste and repealing certain Directives. Official Journal of the European Communities, Brussels.

Engström, R., Carlsson-Kanyama, A., 2004, Food losses in food service institutions. Examples from Sweden. Food Policy 29, 203–213.

Eriksson, M., 2012, Retail Food Wastage: A Case Study Approach to Quantities and Causes. Licentiate thesis 045, Department of Energy and Technology, Swedish University of Agricultural Science, Uppsala.

Eriksson, M., 2015, Prevention and Management of Supermarket Food Waste: With Focus on Reducing Greenhouse Gas Emissions. Doctoral thesis 2015:119, Acta Universitatis agriculturae Sueciae, Swedish university of Agricultural Science, Uppsala.

Eriksson, M., Strid, I., Hansson, P-A., 2014, Waste of organic and conventional meat and dairy products— A case study from Swedish retail. Resources, Conservation and Recycling 83, 44-52.

Eriksson, M., Strid, I., Hansson, P.-A., 2015, Carbon footprint of food waste management options in the waste hierarchy - a Swedish case study. Journal of Cleaner Production 93, 115-125.

Eriksson, M., Strid, I., Hansson, P-A., 2016, Food waste reduction in supermarkets – Net costs and benefits of reduced storage temperature. Resourcses, Conservation and Recycling 107, 73-81.

Eriksson, M., Persson Osowski, C., Malefors, C., Björkman, J., Eriksson, E., 2017, Quantification of food waste in food canteens – a case study from Sala municipality in Sweden. Waste Management 61, 415-422.

Eriksson, M., Spångberg, J., 2017, Carbon footprint and energy use of food waste management options for fresh fruit and vegetables from supermarkets. Waste Management, 60, 786-799.

Eriksson, M., Persson Osowski, C., Björkman, J., Hansson, E., Malefors, C., Eriksson, E., Ghosh, R., 2018a, The tree structure - A general framework for food waste quantification in food services. Resources, Conservation and Recycling 130, 140-151.

Eriksson, M., Lindgren, S., Persson Osowski, C., 2018, Mapping of food waste quantification methodologies in the food services of Swedish municipalities. Resources, Conservation and Recycling 137, 191-199.

Garnett, T., 2011, Where are the best opportunities for reducing greenhouse gas emissions in the food system (including the food chain)? Food Policy 36, S23-S32.

Gentil, E., Gallo, D., Christensen, T.H., 2011, Environmental evaluation of municipal waste prevention. Waste Management 31, 2371-2379.

Godfray, C., Reddington, J., Crute, I., Haddad, L., Lawrence, D., Muir, J., Pretty, J., Robinson, S., Thomas, S., Toulmin, C., 2010, Food security: The challenge of feeding 9 billion people. Science 327, 812-818.

Helsel, D.R., Hirsch, R.M., 2002, Techniques of Water-Resources Investigations of the United States Geological Survey: Book 4, Hydrologic Analysis and Interpretation. United States Geological Survey. 524 pages.

Steen, H., Malefors, C., Röös, E., Eriksson, M., 2018, Identification and modelling of risk factors for food waste generation in school and pre-school catering units. Waste Management 77, 172-184.

UN, 2017, United Nations Sustainable Development Goals, Goal 12: Ensure sustainable consumption and production patterns, United Nations, New York.

Uyanik, G.K., Güler, N., 2013, A study on Multiple Linear Regression Analysis. Procedia - Social and Behavioral Sciences 106, 234-240.

World Resource Institute, 2016, Food Loss and Waste Accounting and Reporting Standard. World Resource Institute, Washington.

INCREASING THE EFFICIENCY OF MEASURES AGAINST FOOD WASTE FOR THE HOSPITALITY AND CATERING SECTOR - ADAPTING MEASURES TO THE SITUATIONAL FACTORS OF AN ORGANIZATION

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Background

The study at hand is integrated in the AVARE project (Adding Value in Resource Effective Food Systems, AVARE is part of the ERA-Net SUSFOOD2 with funding provided by national/regional sources [MMM, BMEL, RCN, FORMAS] and co-funding by the European Union´s Horizon 2020 research and innovation program). The project targets to reduce food waste in the hospitality and catering sector and to valorize food waste that is unavoidable. European food waste in total sums up to 88 million tons (Stenmarck et al. 2016). In a study by Kranert et al. (2012), the authors revealed that total food wasted along the value chain from manufacturing to consumption in Germany sums up to 11 million tons annually. Moreover, they found that the largest part is caused on the consumption stage, with end-consumers being responsible for 61 % (6.7 million tons), and large-scale consumers, such as food service facilities or restaurants, causing 17 % (1.9 million tons) of the food wasted. The reasons for food waste are diverse. Kranert et al. (2012) state that for food service facilities an inappropriate internal organization of the production and serving processes result in the wastage of food. This starts with the inadequate storage of the raw material or a lack of calculation basics for production planning and ends with portion sizes served to the customer, that are too large, and also relates to insufficient communication among all relevant staff members, i.e. kitchen chefs obtain no information about special customer needs (e.g. need for vegetarian food).

Gunders (2012) summarizes the drivers for food waste in food services as large portions, inflexibility in chain-store management and the pressure to supply enough food and large menu choices all the time. Mackenzie et al. (2011) identify poor stock rotation or inappropriate storage of stock, over production, poor preparation, and inadequate portion control techniques as the reasons for food waste in the hospitality sector. The aforementioned examples demonstrate that the root causes for food waste are as diverse as is the hospitality and catering sector itself. It is divided into the segments individual gastronomy and public catering. The latter can be split further into the segments business (e.g. canteens in private companies), education (e.g. school catering), and care (e.g. catering in hospitals or residential homes). Each of the segments faces specific challenges as concerns the specific needs of its target group, the financial and personnel capacities or the technical equipment. These different constraints lead to the effect, that not every suggested measure against food waste fits equally well to the needs of a company. For this reason, measures against food waste need to be adapted to the specific situational factors and constraints given in a business. There are many studies dealing with the root causes of food waste and suggesting measures. However, research on the linkage between situational factors and effectiveness of measures has hardly been conducted. Göbel (2018) has first analyzed situational factors leading to food waste and derived specific recommendations for the care sector. The present study targets to shed further light on the situational factors leading to food waste for all segments of the hospitality and catering sector in order to improve the effectiveness of the measures implemented.

Purpose / objective

There are four main objectives given in this study. The first objective of this study is to determine the situational factors leading to food waste that have not yet been determined for the hospitality sector. The second objective is to identify the inhibiting and supporting factors for the implementation of measures against food waste. The interviews should deliver information on the factors that promote the implementation of measures against food waste and also on the factors that inhibit the measures' implementation. The third objective is to derive the most efficient measures related to the situational factors present in an organization. With the help of the interviews, those measures should be identified, that fit best to the given organizational / situational factors in a company and that are most efficient (compare reduction effect and necessary effort). The fourth objective is to summarize the study's results in a guideline targeted to businesses of the hospitality and catering sector. This guideline comprises specific recommendations for the different companies and helps them choosing the measures that are most effective in their situational context. The following research questions are given in the study:

1. What are the relevant organizational structures / situational factors leading to food waste in organizations of the hospitality sector (e.g. meal ordering system, service system, cashing system, payment system)?

2. What are the inhibiting and supporting factors for the implementation of measures in how do they relate to the organizational / situational factors in the companies?

3. What are the most efficient measures for the reduction of food waste in the long-run and how do they relate to the organizational structures / situational factors?

Methodology

In order to answer the research questions, semi-structured interviews with different actors of the hospitality and catering sector are conducted. The following interview partners are chosen to cover all segments of private and public organizations from the hospitality and catering sector:

- Care (hospitals): 2-3
- Care (residential homes): 2-3
- Business canteens: 3-5
- Education: School catering: 2-3
- Education: Kindergarden catering: 2-3
- Education: University canteen: 2-3
- Hotels: 3-5
- Restaurants: 3-5
- System catering: 2-3

In total at least 21 companies are interviewed with two interviews per company (one interview with management and one interview with kitchen staff), i.e. at least 42 interviews are conducted.

The instruments applied during the interviews comprise an interview guide (for orientation and memory purposes of the interviewer), a tape record (to precisely and authentically gather the information provided

by the interviewees), a post scriptum (to capture specific impressions gained by the interviewer during the interviews), and a screener (to collect sociodemographic data).

The analysis of the interviews is done by qualitative content analysis (Mayring 2010) by which the complexity of the information provided is reduced by establishing a suitable category system. By doing so, the information provided by the different interviews are structured which facilitates their comparison. The category system applied is based on a mixed format, i.e. the main categories are based on the thematic blocks of the interview guide, and in a second step, the subcategories are built inductively.

Results

The interviews are envisaged for February and March 2019. First results are expected in April 2019. Hence, at the time of the conference preliminary results will be available.

Conclusion

The conclusions that can be drawn from the study will be used to develop target group specific recommendations for the implementation of measures against food waste. Hence, the results contribute to reach the stated goal of SDG 12.3 that calls for halving per capita global food waste at the retail and consumer level by 2030.

References

Göbel, Christine author (2018): Zum Umgang mit Lebensmittelabfällen in Care-Einrichtungen Elektronische Ressource: Situationsanalyse und organisationstheoretische Gestaltungsempfehlungen. München: oekom verlag (Hochschulschriften zur Nachhaltigkeit).

Gunders, Dana (2012): Wasted: How America Is Losing Up to 40 Percent of Its Food from Farm to Fork to Landfill. Hg. v. Natural Resources Defense Council (NRDC). Natural Resources Defense Council (NRDC). Available online http://www.indianasna.org/content/indianasna/documents/NRDC_Wasted_Food_Report.pdf, checked 09.01.2019.

Kranert, M.; Hafner, G.; Barabosz, J.; Schuller, H.; Leverenz, D.; Kölbing, A. et al. (2012): Determination of discarded food and proposals for a minimization of food wastage in Germany. Abridged Version. University Stuttgart Institute for Sanitary Engineering, Water, Quality and Solid Waste Management (iswa). Stuttgart. Available online http://www.bmelv.de/SharedDocs/Downloads/EN/Food/Studie_Lebensmittelabfaelle_Kurzfassung.pdf?__blob=publicationFile, checked 26.09.2016.

Mackenzie, Murray; Cheung, Catherine; Law, Rob (2011): The Response of Hotels to Increasing Food Costs due to Food Shortages. In: *Asia Pacific Journal of Tourism Research* 16 (4), S. 395–416. Available online https://doi.org/10.1080/10941665.2011.588869.

Mayring, Philipp (2010): Qualitative Inhaltsanalyse. Grundlagen und Techniken. 11. Aufl. Weinheim: Beltz. Available online http://www.content-select.com/index.php?id=bib_view&ean=9783407291424.

Stenmarck, Åsa; Jensen, Carl; Quested, Tom; Moates, Graham (2016): Estimates of European food waste levels. Edited by FUSIONS. Available online http://www.eu-fusions.org/phocadownload/Publications/Estimates%20of%20European%20food%20waste%20levels.pdf, checked 06.03.2017.

Session G

Campaign and Policy

EDUCATION CAMPAIGN BASED ON HOUSEHOLD FOOD WASTE MEASUREMENT STUDY

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Introduction

In developed countries, a major part of food waste is being generated in households, most of which could have been avoidable (Parfitt et al., 2010). The ratio of households equals approximately to 42% in case of the EU (EC, 2010). In Central Europe data on the amount of household food waste is limited. (Boer et al., 2017) Therefore measurement is a key issue to determine appropriate tools for intervention and to have an impact on consumer behaviour. However, it is a challenge to choose the most adequate methods to determine the exact quantity of disposed food related to improper consumer behaviour. The purpose of the research was to define and quantify the most dominant types of food waste in Hungarian households and to analyse the effect of demographic background and income as influencing factors.

Methodology

Data collection was conducted in 100 Hungarian households in 2016 by using the EU-FUSIONS methodology (FUSIONS, 2016) and following the recommendation of the European Commission. The weight and volume of food waste was measured for a whole week's period according to different categories (avoidable, unavoidable and potentially avoidable food waste) and different types (meals, bakery products, fruits, vegetables, dairy products etc.). Measurement covered solid and liquid food waste as well. Appropriate tools and a manual were provided to the households to ensure data consistency: general EC standard kitchen scale (accuracy in grams), measuring jug (600 ml) and datasheet that was edited to be as easy and ergonomic as possible. The manual gave a clear distinction between avoidable, unavoidable, and possibly avoidable food waste types.

Results

The main result of the study – an estimation by extrapolation of the one week's data – showed that an average Hungarian consumer generates 68.04 kg food waste a year, of which 48.70% would be avoidable. The most frequent food items disposed were: meals, bakery products, fruits and vegetables. The analysis covered also the destiny of the disposed food. We may conclude that about the half of the communal waste is derived from food, but a part of this amount is valorised as compost material or feed.

In case of some demographic categories different wastage levels were observed. The most influential factors were gender, habitation, age group, and household size. We can assume that generally men, people living in the capital city, people aged between 30-39 years, those who have children under 14 years, and three-person households tend to waste significantly more than the average (Szabó-Bódi et al., 2018). It was also confirmed that income has significant effect on food waste production that varies by foodstuff categories: bakery product waste was mainly dominant for middle income consumers, while fresh fruits were typically wasted by more affluent households.

Conclusions and practical implications

The amount of food disposed in Hungarian households is below the EU average, which is 92 kg per capita, however our research revealed a higher value than expected in previous estimations (EC, 2010).

Having specific data on food wastage and the most affected target groups, as well as information on the impact of the income will be useful for planning awareness raising campaigns.

This study is one of the first investigations based on primary data collection from the Eastern part of Europe and the very first related to Hungary. Based on the results, a communication and education campaign, called 'Wasteless' has been elaborated, with a special focus on primary schools.

References

B. Szabó-Bódi, Gy. Kasza, D. Szakos, (2018) "Assessment of household food waste in Hungary", British Food Journal, Vol. 120 Issue: 3, pp.625-638, https://doi.org/10.1108/BFJ-04-2017-0255

European Commission (2010): Preparatory study on food waste across EU 27

FUSIONS (2016): Food waste quantification manual to monitor food waste amounts and progression

J. D. Boer, P. Kobel, A. Dyjakon, K. Urbańska, G. Obersteiner. M. Hrad, E. Schmied, E. Boer (2017): Food waste in Central Europe – challenges and solutions

J. Parfitt, M. Barthel, S. Macnaughton (2010): Food waste within food supply chains: quantification and potential for change to 2050. Philosophical Transactions of the Royal Society B Biological Sciences, 365(1554): 3065–3081.

PILOT CAMPAIGN OF FOOD WASTAGE IN THE RETAIL SECTOR (SPAR-HUNGARY)

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Only in the European Union around 88 million tonnes of food is wasted annually with costs estimated at 143 billion euros (FUSIONS, 2016). The retailer sector is responsible for approximately 5% of the total food waste generated in Europe. However, the responsibility of the retail sector is bigger than their food waste rate shows since retailers can indirectly affect the increase or decrease of food waste amounts in other sectors as well.

The interest of all retailers has to be waste prevention – which refers not only to food waste. This should be a priority throughout all departments in the retail food chain.

Within the STREFOWA project (www.reducefoodwaste.eu), a project which was implemented through financial assistance from ERDF funds of the CENTRAL EUROPE, different options to reduce and manage food waste in Central European countries will be tested by pilot actions. This paper focus on waste prevention in retail sector, mainly on results of the pilot programme within Spar Hungary.

The aim of this pilot in SPAR Hungary was to raise awareness about the food wastage, which causes major problem not only in the retail sector but also in the households. The goal of the retail sector is supply the customer's demands – to expand product range, to offer innovate and better quality products for their customers -, reducing the amount of their unsold products, surpluses.

The shops are using the FIFO (First-In- First-Out) principle, where the shelves are loaded with goods from one side which are later retrieved from the other. If the customers follow the FIFO principles, the amount of the food waste could be reduced, avoided significantly in the households and also the shops. FIFO is intended to promote the selling of oldest products first, preventing them from going to waste.

The campaign has proven that no matter which product is chosen by the customers, the quality of them is same. The customer's responsibility and ability to plan the shopping and using of the food and the same time reducing the amount of the food waste. The campaign was very successful, and we would like to present the detailed results.

References:

FUSIONS, 2016: Estimates of European food waste levels

THE GERMAN REFOWAS-PROJECT, REDUCE FOOD WASTE

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Background

If food waste could be avoided, this would have a significant impact on the reduction of use of resources and emissions. This topic has been a public concern for several years and is becoming increasingly important. With the Sustainable Development Goal (SDG) ´Responsible consumption and production´ and its Target 12.3, the United Nations pronounces the ambition "By 2030, halve per capita global food waste at the retail and consumer levels and reduce food losses along production and supply chains, including post-harvest losses". Generally, food waste reduction is regarded as having great potential to improve resource efficiency and reduce environmental impacts caused by food production (FAO, 2013).

Purpose of the REFOWAS project

The overall goal of the REFOWAS project, which is funded by the German Federal Ministry of Education and Research (BMBF), is to analyze the portion of avoidable waste in Germany, and strategies and approaches for measures to avoid or reduce waste (https://refowas.de/en/). On the basis of case studies with vegetable and fruit producers, bakeries, school cafeterias and private households, we study the obstacles and possibilities for action in practice. On the basis of the results we want to identify and evaluate possibilities to develop a new consciousness of sustainable action and find ways to avoid food waste. We include relevant actors, develop strategies with them and discuss possible measures to develop incentives for such behavior.

Therefore we link two perspectives. Firstly, a holistic sectoral analysis of the entire system is carried out, in order to get insight in the environmental aspects of the food consumption of the German population. Secondly, different parts of practice are studied in detail on the basis of three sectoral case studies and the participation of actors, after which several food waste reduction measures are being explored. In the Case study „Agricultural Production" we analyze fruit and vegetable crops, processing and marketing. In the "Processing" case study, we look also more closely at bakeries. In a third case study we study "consumer behavior" to identify different consumer patterns and reasons for the creation of food waste in households and school canteens.

The present paper focusses on the first perspective, namely the entire German food sector with its environmental impacts of food waste as well as the environmental impact reduction potentials in the context of achieving the SDG 12.3 target and beyond.

Methodology of the sustainability assessment, the German food sector

A mass balanced material flow model of the German food sector was created to assess environmental impacts of the food sector and food waste. The model includes all supply chain steps from agricultural production, trade, processing to consumption and disposal. It differentiates between twelve food product groups including drinks. Material flow data is mainly based on official statistics (BMEL, 2016; Destatis, 2010) and representative studies on food consumption (Destatis, 2016; Kersting and Clausen, 2003;

Krems et al., 2013; Mensink et al., 2007), supplemented with data on food waste (Hafner et al., 2013; FAO, 2013; Hic et al., 2016).

Environmental information was added to the material flow data. Foreground processes were taken from Schmidt and Osterburg (2008) for agricultural production; from the German Environmental input-output-accounts (Destatis, 2018) for the life cycle steps trade, processing and out-of-home consumption, and from the multi-regional input-output-database EXIOBASE 2 (Tukker et al., 2013) for import processes. Environmental data for cooking, cooling and transport in private households was taken from different studies (Sima et al., 2012; BVEW, 2013). Environmental data on background processes was used from the LCA-database ecoinvent 3.3. The environmental impact assessment focusses on agricultural land use, greenhouse gas emissions and cumulative energy demand. All calculations were performed with the software openLCA (Di Noi, 2017). The functional unit is the German national food intake of 2010.

First we defined 500 activities in 12 groups of food products that represent the German food sector. Using this model we calculated the environmental indicators ´land use´, ´CO2-equivalents' and the cumulative energy demand (CED) that reflect the resource use of the whole supply chain from primary production to consumption within the losses on each step. We calculated the environmental burdens of the entire German food intake including two scenario analyses (see Figure 2) and also per kilogram product coefficients for twelve product groups for different food chain steps (see Figure 1). The first scenario refers to halving (in mass) the avoidable food losses and waste on the retail and consumer level as suggested by the SDG 12.3 target whereas the second scenario refers to eliminating all avoidable food losses and waste at each step along the food chain. Impacts for both scenarios are then compared to the situation of food losses and waste in Germany in 2010.

Results of the sustainability assessment

Environmental impacts of the German food sector per product group

Figure 1 shows, as an example, the greenhouse gas emissions (expressed in CO2 equivalents) associated with the twelve product groups at the farm gate level and at consumption level[2]. The results refer, on the one hand, to one kilogram agricultural product (farm gate) and on the other hand, to one kilogram of food ready to consume (consumption). Therefore all categories include not only the raw product but also finished products at consumption level, e.g., the product group "cereals" also contains bread and other grain products. The production of meat engenders very high ecological damage/stress per kilogram. A lot of beverages consist of sugar and water. Hence the starting product at agricultural level (e.g., fresh oranges) causes more CO2 equivalents per kilogram than the final product (e.g. orange juice). Whereas the potato primary production causes low negative impacts per kilogram, but the processing causes high impacts due to used oils (e.g., frying) and cooking.

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[2] Results for the other environmental indicators, as well as for other steps along the food chain are also
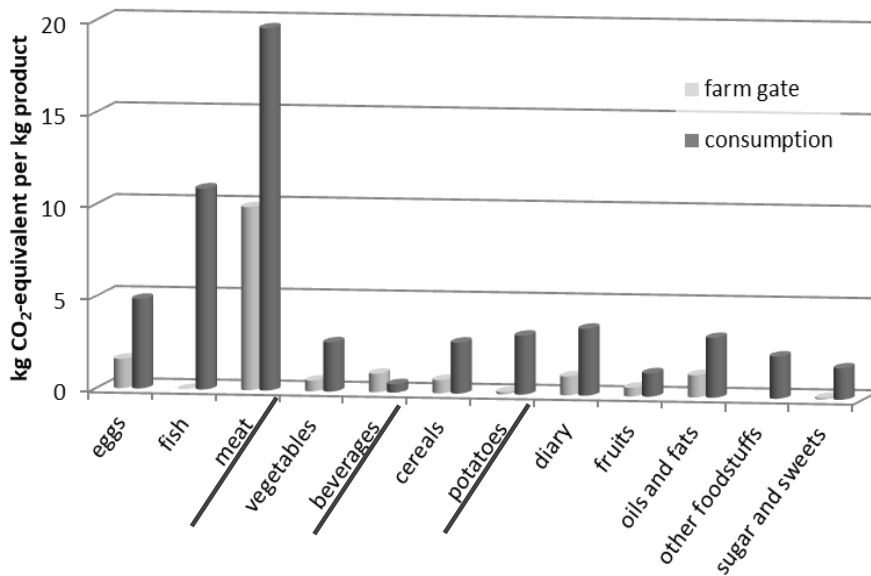
Figure 1: Greenhouse gas emissions per kilogram food product at the farm gate and at consumption (Source: own calculations)

Waste reduction scenarios for the entire German food sector

A view on the whole German food sector shows that 38 million hectares of agricultural area were occupied worldwide for the food consumed in Germany. A total of 177 millions of tons CO2-equivalents were emitted and a cumulative energy demand of 3.727 PJ can be calculated. Animal products hereby cause the highest negative impacts, about half of all emissions.

Fig. 2 shows this actual state of the ecological impacts of the food consumption as well as the impacts associated with the two food waste reduction scenarios. The total saving potential amounts to 4 million hectares of agricultural land use, 17 million tons CO2-equivalents of greenhouse gas (GHG) emissions and 370 PJ cumulative energy demand if avoidable food waste is halved according to SDG 12.3. This corresponds to 10 % of total use-related GHG emissions. In case of 100% food waste reduction, at all stages along the chain, thus also considering agriculture and processing, the benefits are only about twice as big as those in the scenario of halving waste at retail and consumption level. Food waste reduction in the retail and consumption sector therefore gains the biggest success.
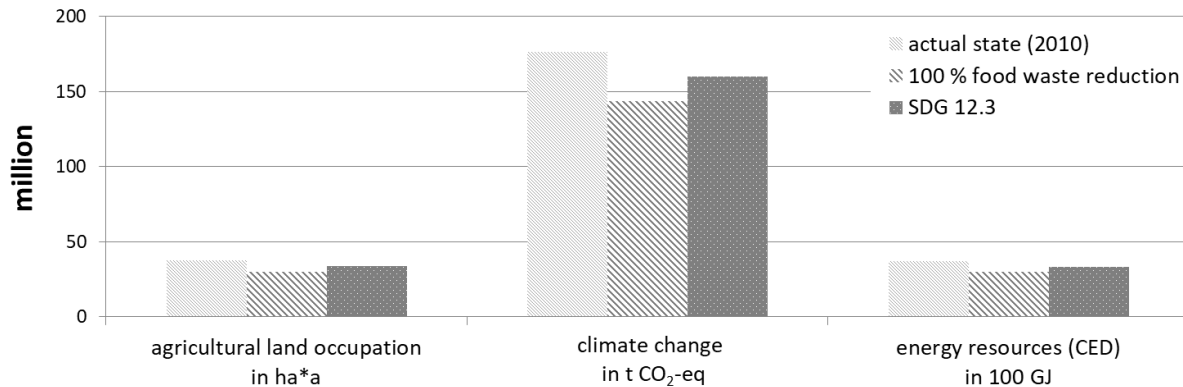

Figure 2: Ecological impacts of the food consumption and reduction potential in Germany, actual state and two scenario analyses (Source: own calculations).

Discussion and conclusion

Jepsen et al. (2016) also developed a material flow model of the German food sector and calculated the environmental impacts of food waste. However, the results of this more aggregated model differ from our calculations with 20 % more greenhouse gas emissions and 40 % less land use. While food waste rates are comparable, the absolute value of environmental effects is consequently disparate. Other results by Eberle und Fels (2016) belong to the same reference year, and also to the German food consumption including food waste, but calculated higher impacts: 21 % more CO_2-equivalents and 19 % more hectares of occupied agricultural area. Differences mainly result from the application of different databases, allocation methods, uncertainties and further decisions to close data gaps.

The FAO (2013) estimates the global footprint of food produced but not eaten as 3.3 Gt of CO_2 equivalents and 1.4 billion hectares of land use. Hence, German food waste comprises a share of approximately 0.5 % of the global greenhouse gas emissions and 0.3 % of the land use.

The great potential of food waste reduction and reducing environmental impacts seems an easy solution for a complex problem. But reduction activities and their environmental impacts should be considered as well. For example, cooling systems can prevent fruits and vegetables to deteriorate but cause additional environmental impacts. Sometimes these impacts can be compensated by the lower total impacts because of saving this food. But it is often not clear when the break-even point is reached. Furthermore the product category and its protein content has to be taken into account when it comes to reduce not only food waste mass but also the environmental burdens associated with food waste. That is because the environmental impacts (climate change and energy resources) of animal products are greater than of plant-based ones (see Figure 1), but because Meat has a high protein content it cannot be totally omitted without replacing the proteins with other products. Reducing food waste is similarly a question of food diets, which cannot be changed freely. Changes have to take the nutrients into account and therefore cause more environmental burden than before (Poore and Nemecek, 2018). The benefit of the SDG 12.3 in terms of sustainability therefore remains unanswered and all measures taken should be duly assessed.

References

Bundesverband der Energie- und Wasserwirtschaft e.V. (BVEW) 2013. Beiblatt Stromverbrauch im Haushalt.

BMEL 2016. Statistisches Jahrbuch über Ernährung, Landwirtschaft und Forsten der Bundesrepublik Deutschland. 60. Jahrgang. Landwirtschaftsverlag GmbH.

Destatis 2010. Vierteljährliche Produktionserhebung im Verarbeitenden Gewerbe, Wiesbaden.

Destatis 2016. Wirtschaftsrechnungen. Einkommens- und Verbrauchsstichprobe, Aufwendungen privater Haushalte für Nahrungsmittel, Getränke und Tabakwaren. Fachserie 15, Heft 3. Statistisches Bundesamt, Wiesbaden.

Destatis 2018. https://www.destatis.de/EN/FactsFigures/NationalEconomyEnvironment/ NationalAccounts/Methods/InputOutputAccounts.html> (last accessed 24 July 2018).

Di Noi, C. Ciroth, A. Srocka, M. 2017. openLCA 1.7, Comprehensive User Manual, Software Version: 1.7.0, Manual Version: v. 1.1, November 2017.

Eberle, U. Fels, J. (2016). Environmental impacts of German food consumption and food losses. The International Journal of Life Cycle Assessment 21(5):759-772.

ecoinvent. The ecoinvent database v3.3. 2016. Zurich.

FAO 2013. Food wastage footprint. Impact on natural resources.

Hafner, G. Leverenz, D. Barabosz, J. Riestenpatt, D. 2013. Lebensmittelverluste und Wegwerfraten im Freistaat Bayern. Stuttgart.

Hic, C. Pradhan, P. Rybski, D. Kopp, J. 2016. Food Surplus and its Climate Burdens. Environmental Science and Technology 50: 4269-4277.

Jepsen, D. Eberle, U. Fels, J. Schomerus, T. 2016. Entwicklung von Instrumenten zur Vermeidung von Lebensmittelabfällen. Endbericht. Umweltbundesamt.

Kersting, M. Clausen, K. 2003. Ernährungsphysiologische Auswertung einer repräsentativen Verzehrsstudie bei Säuglingen und Kleinkindern VELS mit dem Instrumentarium der DONALD Studie. Dortmund.

Krems, C. Walter, C. Heuer, T. Hoffmann, I. 2013. Nationale Verzehrstudie II: Lebensmittelverzehr und Nährstoffzufuhr auf Basis der 24h-Recalls (p. 16). Karlsruhe.

Mensink, G., Heseker, H. Richter, A. Stahl, A. Vohmann, C. 2007. Ernährungsstudie als KiGGS.Modul (EsKiMo). Forschungsbericht (p. 143). Bonn.

Poore, J. and Nemecek, T. 2018. Reducing food's environmental impacts through producers and consumers. Science 360: 987-992.

Schmidt, T. and Osterburg, B. 2011. Berichtsmodul ‚Landwirtschaft und Umwelt' in den Umweltökonomischen Gesamtrechnungen II. Braunschweig.

Sima, A. Moehrmann, I. Thomae, D. Schlich, E. 2012. Einkaufswege als Teil des Consumer Carbon Footprints (CCF) - Zum Anteil des Endverbrauchers an der Klimarelevanz von Prozessketten im Lebensmittelbereich. ErnährungsUmschau 59(9): 524-530.

Tukker, A. de Koning, A. Wood, R. Hawkins, T. Lutter, S. Acosta, J. Rueda Cantuche, J.M. Bouwmeester, M. Oosterhaven, J. Drosdowski, T. Kuenen, J. 2013. Exiopol – development and illustrative analyses of a detailed blobal MREE SUT/IOT. Econ. Systems Research 25(1): 50-70.

Wissenschaftlicher Beirat für Agrarpolitik, Ernährung und gesundheitlichen Verbraucherschutz and Wissenschaftlicher Beirat für Waldpolitik 2016. Klimaschutz in der Land- und Forstwirtschaft sowie den nachgelagerten Bereichen Ernährung und Holzverwendung. Gutachten Nov. 2016.

REDUCE OF FOOD WASTE IN AUSTRIAN GASTRONOMY AND CATERING WITH SMART KITCHEN – WASTELESS COOKING!

C. PLADERER, P. HIETLER

Smart KITCHEN was developed by pulswerk GmbH and Envicient OG, promoted within the framework of ÖkoBusiness and awarded the Viennese Environmental Prize 2016 and the Neubauer Climate Protection Prize KLIP 7 2016 as well as nominated for the VIKTUALIA Award of the Ministry of the Environment.
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In Austria, there are 577,000 tonnes of food waste each year which could be avoided. This is the result of the analysis of all current data for a study realised by the Austrian Institute of Ecology on behalf of WWF Austria. The study covers all current data from private households, out-of-home catering and food retailing. It is the first study which also includes date from food production. Due to the fact that there is a lack of data on agriculture and wholesaling one must suspect that the quantities of avoidable food waste are even higher.

Looking only at the out-of-home catering and gastronomy: about 175,000 tonnes of avoidable food waste are thrown away per year: Manufacturing food is extremely resource intensive, in addition it needs kilometre-long transportation. Food is cooled and processed to high-quality dishes. If it is thrown away, it must also be disposed of in a cost-intensive manner. In Austria, food with a value of approx. 320 million euros per year is disposed of the out-of-home catering and gastronomy. Around 35,000 tons of food waste accumulate every year in Viennese gastronomy and catering. This was the result of a study by the Austrian Ecological Institute commissioned by the Vienna Environmental Protection Department (MA 22). In addition to the burden on the environment, the disposal of this waste costs Viennese gastronomy companies about seven million euros per year.

In addition to already established and successful countermeasures such as food distribution and transfer to social institutions or increased awareness-raising activities among the population, there is still room for improvement in the catering industry. The objectives of the project "**Food Waste in the Viennese Gastronomy**" was therefore to find and describe best practice examples for the prevention and separate collection of food waste in the catering industry, the current situation in Viennese restaurants (from the restaurants, caterers and catering) and optimization measures (waste prevention and separate collection).

One result of the study was the development of a new **"smart KITCHEN"** consulting service within the framework of the Vienna Eco-Business Plan aims to develop strategies and implement measures to reduce food waste while at the same time saving operating costs.

smart KITCHEN - an event with workshop character was born.

The ongoing "smart KITCHEN Workshops" in Vienna show how this supposed waste can be avoided in an enjoyable way. How can vegetable waste, paprika seeds or avocado be processed with relish? Which 20 dishes can be prepared from just one chicken? Three to four times a year pulswerk GmbH the consulting company of the Austrian Institute of Ecology organising interactive workshop "smart KITCHEN" for the Viennese gastronomy, canteen kitchens, caterers and stakeholders from the environmental and sustainability scene. Over 90 participants from around 40 companies and organisations have so far taken part in this training programme.

The aim of smart KITCHEN is to raise awareness of the value of food in out-of-home catering. The participants receive suggestions that they can easily implement in their daily work. Even an experienced chef can learn new tricks and tips. A tasty pesto is prepared from the green of parsley and radish, while the delicious avocado chocolate layer dessert is already in the oven.

We have found an ideal partner for the practical part of the workshops in Max Stiegl, the award-winning chef from Gut Purbach in Burgenland. Max Stiegl is not only known for his extraordinary recipes but also for the fact that nothing is wasted in his kitchen.

The participants will also learn facts and figures about food waste. Topics such as shelf life, portion sizes and optimum use of goods are met with great interest during the workshops. Then comes the big challenge: Together, numerous dishes are cooked from a classic shopping basket with 40 ingredients - and if possible without any leftovers.

The Viennese gastronomy, canteen kitchens and caterers are sending a sustainable signal against food waste. smart KITCHEN companies are facing up to their responsibility and implementing effective measures to actually avoid avoidable food waste.

In our presentation we will show the results of our study about avoidable food waste especially in the catering and gastronomy sector. We will present measures to reduce waste und we will give an overview of smart KITCHEN.

References

Lebensmittelabfälle in der Wiener Gastronomie, im Auftrag der Wiener Umweltschutzabteilung – MA 22; Wien 2015: https://www.wien.gv.at/kontakte/ma22/studien/pdf/lebensmittelabfaelle-gastronomie.pdf

Lebensmittelabfälle in Österreich 2018: Aktualisierung der Daten, rechtlichen Rahmenbedingungen und konkreten Handlungsempfehlungen: http://pulswerk.at/download.php?f=532

Frisch verfault - aktuelle Zahlen in der WWF Broschüre von uns zusammengestellt: http://ecology.at/files/frisch_verfault.pdf

Lagebericht Lebensmittelabfälle in Österreich 2016: https://www.wwf.at/de/die-haelfte-der-lebensmittelabfaelle-ist-vermeidbar/

Faktencheck Lebensmittelabfälle - Mythen und Fakten: http://pulswerk.at/download.php?f=304

Ist das noch gut? Eine Gebrauchsanweisung zur sicheren Nutzung von Lebensmitteln und für einen sinnvollen Umgang mit dem Mindesthaltbarkeitsdatum (MHD): http://pulswerk.at/mindesthaltbarkeitsdatum.htm

BEST PRACTICE der betrieblichen Abfallvermeidung im Bereich Lebensmittel: http://pulswerk.at/best_practice_lebensmittelabfallvermeidung.htm

Session H

Retail

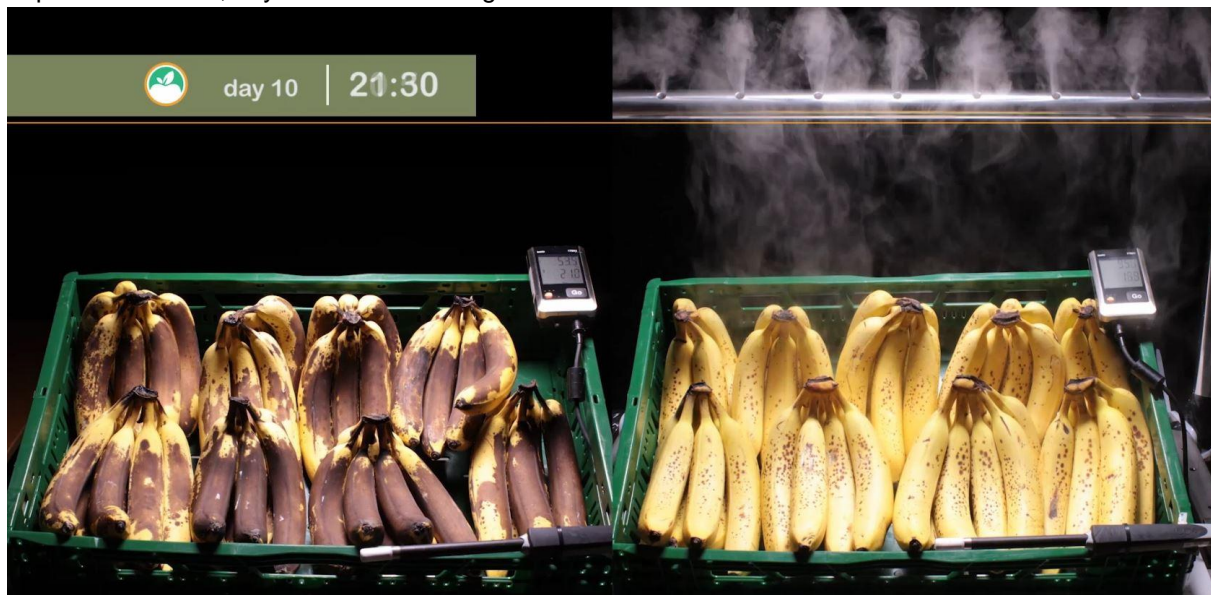**DRY MIST - EU HORIZON 2020 PROJECT: FRESH DEMO**

J. IJSSELMUIDEN

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Background

As 30% of the food harvested does not make it to the consumer's plate, we waste an obscene amount of food. Reducing food loss and waste is considered to be one of the most promising measures to improve food security in the coming decade.

Contronics has found a way to address food waste; with Dry Mist humidification. Inspired by the morning mist hanging over a crop field, we sought to replicate this natural phenomenon. The mist prolongs the freshness and shelf life of fruits, vegetables and other fresh products by keeping them hydrated and cool. Our systems are equipped with ultrasonic technology to make the finest mist from the purest filtered water.

Applied at every stage of the supply chain, from postharvest through storage and transport to the supermarket shelf, Dry Mist enables a significant reduction in food waste.

Purpose

Over the past couple of years Dry Mist has been subject of research to the Wageningen University, the EU 7th Framework Programme and the EU Horizon 2020 Programme. The EU Horizon 2020 Fresh Demo project is most recent and will be the focus of this abstract.

The Fresh Demo project was a response to the EU priority topic of food waste reduction and the creation of the circular economy. In the Fresh Demo project all effort goes to the most prioritized level of the food recovery hierarchy: source reduction. The Fresh Demo project researches an innovative ultrasonic humidification technology to preserve quality and freshness of fruits and vegetables along the entire post-harvest supply chain and contribute to food waste reduction.

Dry Mist is generated through ultrasonic humidification. Ultrasonic humidifiers produce a fine mist of water particles of 1 micron. The water particles evaporate and withdraw evaporation energy from the

surrounding air (adiabatic effect). Consequently, the temperature of the surrounding air will drop, providing a cool, humid, and bacteria-free climate. With that it has the ability to significantly reduce waste in the distribution chain by extending the shelf life and hygienic properties of fruit and vegetables.

The Fresh Demo project evaluated and demonstrated the benefits of this technology throughout the entire supply chain.

Contronics Dry Mist, producer of ultrasonic humidification equipment for fresh produce, and TTZ, a research organisation from Bremerhaven, came up with the idea of applying ultrasonic humidification all the way from the harvest to the supermarket shelves, thus significantly reducing dehydration and its negative effects. Together with seven other European partners — Univeg in Germany and Italy, PLUS Van Gurp supermarket in the Netherlands, the Technical University of Denmark (DTU), Freshfel Europe in Brussels, Bioazul in Spain, RTF in Germany and Polypan in Greece — the Fresh Demo project was started after submission to Brussels.

Methodology

Produce (both humidified and non-humidified) was tracked for 15 days after transport, storage and retail and tested daily for weight, flavour, mould, appearance (photos) and quality. On the first and fifteenth day, samples were taken to laboratory to test for sugar and vitamin content, BRIX value, nutrients (phytonutrients), acidity (pH) and bacterial growth.

Tests carried out (3x):
- Strawberries from Huelva (southern Spain) to Edeka supermarket in Bremerhaven
- Asparagus from northern Germany to a supermarket in Bremerhaven
- Nectarines and peaches from central Italy to the PLUS van Gurp supermarket in Roosendaal
- Grapes from southern Italy to the PLUS van Gurp supermarket in Roosendaal
- Cauliflower and curly endive from Cambrils (Spain) to the PLUS in Schijndel/Den Dungen
- Storage of lettuce in a distribution centre in Spain

Results

Products

Strawberry
- 72% less weight loss
- Longer shelf life (20%)
- More intense taste and aroma
- Crown stays fresh and green
- Higher vitamin (+4,4%) and polyphenol content (+25%)

Wild peach
- 52% less weight loss
- Longer shelf life (13%)
- More intense taste and aroma
- Higher vitamin (+13%) content

Grapes
- 40% less weight loss
- Longer shelf life (15-25%)
- Less stem browning and brown spots
- Higher vitamin (+30%) and polyphenol (+8%) content

Cauliflower
- 23% less weight loss
- Longer shelf life
- More intense taste and aroma
- Less brown spots
- Decrease in yeast and moulds

Escarole
- 46% less weight loss
- Longer shelf life
- More intense taste
- Leafs remain fresh green
- No brown stalks

Nectarine
- 50% less weight loss
- Longer shelf life (6%)
- More intense taste and aroma
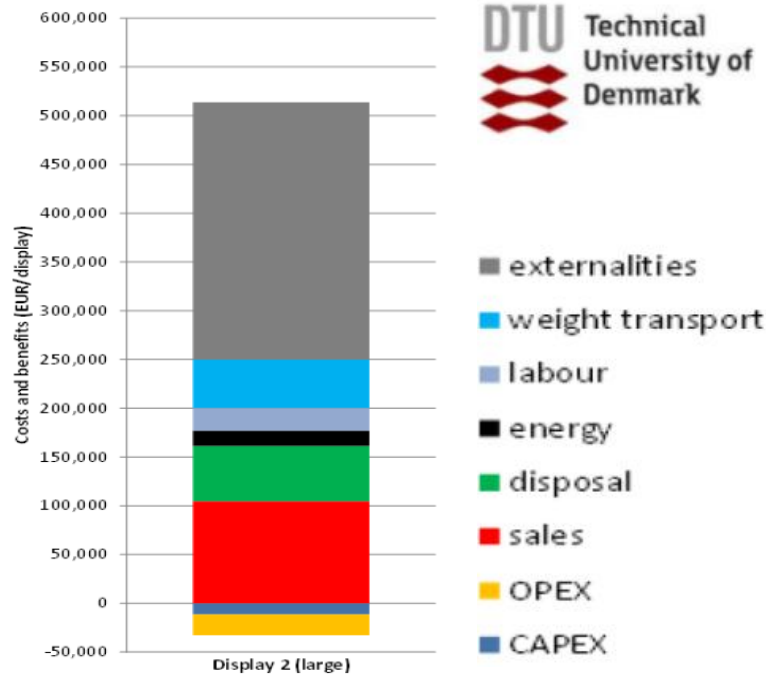- Higher vitamin (+12%) and polyphenol content (+10%)

Supply Chain – Cost Benefit analysis

Supply chain profit is up to €450K over 15 years, which is €30K per year. Environmental savings (externalities) excluded, benefits are still six times bigger than the costs.

Supermarkets – Business case

The table below was created by registering all the required data daily over the course of four years.

Supermarket with 30m² of moisturised shelves 2 x 5 x 3m²

Annual costs Investment: €15.000,-	Annuity 3%	Energy 7884 KW	Water 130m3	Maintenance		Total
2 humidifiers	€1,000.-	€946.08	€234.-	€1.000.-		€3,180.08
					Per day	€8.71
Annual revenue	Increased revenue on fruit and vegetables. 5% (1)	Increased revenue on all products (not measured) (2)	Reduced food waste 25% (3)	Reduced energy costs KwH (4)	Reduced labour costs; 28 minutes per day (4)	Total
	€9,600.-	€0.-	€5,200.-	€1,440.-	€2,138.98	€18,338.98
					Per day	€50.24

(1) Revenue was measured over the course of four years; during the project and beforehand. Per customer revenue remained the same, but more customers came.

(2) Store revenue increased by ten percent, but it cannot be guaranteed that this is due to the humidifiers and their mist. Interviews did show that customers were very keen on them.

(3) Waste numbers were recorded for four years. The amount of rubbish per product was noted every day. Humidifiers were used after the first year.

(4) As the mist has a cooling effect (roughly 5°C), it is unnecessary to move the produce into refrigerated storage overnight. This makes the storage facilities redundant and saves on energy.
Since produce need not be moved, labour costs are reduced as well, assuming an hourly wage of €10.61 as mandated for supermarkets (28 minutes).

The table shows that profits are increased by roughly €40,- per day, or €16 000,- annually. Additionally, food waste is reduced by 25% annually. Customers get healthier products of better quality. The extended shelf life indirectly reduces food waste even further.

Besides a better product quality, Dry Mist technology offers additional advantages, such as:

- More to sell on account of waste reduction;
- Sales growth through "in-store theatre" and better product quality;
- Dry Mist can contribute in the reduction of plastic packaging;
- Produce no longer needs to be moved to cold storage after closing, saving on labour costs;
- Produce will retain its nutrients for a significantly longer time;
- Reduction of Out Of Stock at the end of the day

Thought Experiment: Food waste at Tesco UK

In supermarkets alone, Dry Mist enables a reduction on food waste of 25% at the fruit and vegetables department (EU Horizon 2020 Fresh Demo Project, 2017).

An example to illustrate: Tesco UK's website shows that in the year 2016/2017 they had 46 684 tonnes of food waste. 35% of this amount is waste of fruit and vegetables, which comes down to 16 339,4 tonnes annually. Thus, on yearly basis, Dry Mist could reduce the waste of fruit and vegetables from Tesco UK by 4 048,85 tonnes. According to figures of Statista Tesco UK had 3739 supermarkets in 2017. Each supermarket has 12,5 tonnes of food waste (rounded), from which 4,4 tonnes is fruit and vegetable waste. This means Dry Mist can reduce fruit and vegetable waste with 1,1 tonnes per supermarket annually. Again, this is supermarkets alone. Imagine the impact when the entire supply chain would implement Dry Mist.

Conclusion

In general humidification results in increased product quality, minimized weight loss, increased shelf life and freshness in comparison to conventional transported products.

Besides, Dry Mist technology proves to have a positive cost benefit analysis for the supply chain and a viable business case for supermarkets.

In term of food waste, Dry Mist could reduce food waste by 1,1 tonnes per supermarket. This does not even take into account the food waste it can prevent in the supply chain.

References

EU Horizon 2020 Fresh Demo project, 2017: http://www.contronics.nl/wp-content/uploads/2017/11/fresh-demo-d-4-0-official-report-intro-english-.pdf

www.contronics.nl

Time lapse: https://www.youtube.com/watch?v=PoqJ_JIu6Kk

QUANTIFICATION OF FOOD WASTE AND IDENTIFICATION OF FOOD WASTE MANAGEMENT STRATEGIES IN BAKERIES

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Germany has an annual production of bakery products of 4.9 million tons. Food waste within this sector was found to be as high as 1.7 million tons a year whereof about 36% is occurring directly as return shipments in bakeries.

Within this research project, "Pathways To Reduce Food Waste"[3], the saving measures to reduce the number of return shipments in bakeries were analysed and the possible solutions that can be implemented to effectively reduce food losses of bakery products on the long term were investigated. The aim, therefore, was to establish a comparable database from which weak points within the system can be identified thus allowing the determination of where and why food waste of bakery products was generated. This allows the development of solutions while considering the weak points.

Together with selected praxis-partners, the approaches were implemented, and, in the end, an ecological assessment was carried out. For a practically applicable outcome of the research, it was necessary to distinguish among and thus cover the different sizes of bakeries such as single branch, small-sized (6-8 branches) and medium-sized (40-60) companies. This was due to the reason that it aimed to generate an impact by implementing solutions in the most common bakery structures. The praxis-partners have six bakery companies, two of each of afore mentioned branch type or size. Within these types, several branches were selected to carry out measurements within the assessment of accruing food waste.

The balance sheet classification for this assessment consisted of the different bakery sizes, in which data from more than 100 branches were collected and evaluated. A mass balance study regarding production and retour shipments was carried out within a time frame of a minimum of four weeks and a maximum of one year.

As a method for data acquisition and measurement, records of accruing food waste in single branch bakeries were taken and return shipments were weighted. In larger sized branches the available merchandise planning and control systems were used to determine the accruing of food waste.

As a result, the return shipment rates of the three different bakery sizes were analysed. The average return shipments were quantified with 11.4% in bakery companies with 40-60 branches, 18.5% in bakery companies with 6-8 branches and 4.85% in single branch bakeries. The occurrence of return shipments is dependent on the size and number of branches of the bakery companies and therefore the delivered quantity. The location and type, assortment and offer, and the weighting of retours were also influencing aspects of the resulting findings.

Through merchandise planning, control systems and the measuring of return shipments, the produced quantities of bakery products can be adjusted. Furthermore, for a better calculation of the production quantity, the relationship between the determined influencing factors and the purchasing behaviour should also be examined.

THE VOICE OF RETAIL STORES' STAFF ON FOOD WASTE: CAUSES AND STRATEGIES FOR PREVENTION EMERGED FROM FOCUS GROUP DISCUSSION

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Background

Retail food waste represents a minor fraction of the total food waste produced along the supply chain. It is believed to be tenfold lower than the quantity of food waste produced by consumers at home. Nonetheless, the issue of retail food waste is attracting attention by public opinion, policy makers and researchers, because the role of retailers is crucial in shaping both the behavior of the upstream food chain actors and the preferences of consumers. Moreover, the absolute quantities of food waste generated at retail stores are very significant with respect to the much more scattered food waste production at other stages of the food chain, e.g. at households. In the extant literature on retail food waste, the quantification of the losses as well as of the causes of food waste have been widely investigated. Among the main causes, the following have been identified: damaged or inappropriate packaging; surplus products remaining unsold after holidays or promotions; spillages, abrasion, bruising or excessive trimming of unpacked foods; excessive or insufficient heat; inadequate storage; technical malfunctions; overstocking due to inaccurate prediction of the number of customers; out-grading of blemished, misshapen, or wrong-sized foods by customers. However, few studies have involved the staff of the stores in the identification of the causes of food waste, while their point of view could be valuable as they can understand in depth the processes behind the stores' operations, and how they can eventually result in the generation of food waste.

The project REDUCE tackled the issue of retail food waste in Italy with a specific research action involving (i) the quantification of retail food waste in a sample of 16 supermarkets of a major chain and (ii) the analysis of the root causes and possible prevention initiatives at the store level, through the organization of focus group discussions with the staff of the stores involved in the study.

Purpose

This paper focuses on the second part of the research, as it aims to analyse the causes of food waste in retail stores, basing on the results of 6 focus groups held in 2017 with a total of 67 category managers.

Methodology

The discussion was guided by a moderator, who invited the participants to use sticky notes to keep a trace of the different causes they were pointing out, which were later discussed one by one and aggregated by

theme. After all the causes had been fully discussed, the moderator invited the participants to write down possible strategies against food waste, specifically addressed to the different groups of causes previously identified.

Results

The causes identified by participants belong to 10 thematic groups, as follows:

1. Consumer preferences: fashions, turnout, presence of competitors;

2. Management of orders and promotions: over-stocking, difficulty in predicting sales;

3. Technical issues: temperature of stores and fridges, breakage;

4. Logistics: damage during transport or handling at the store;

5. Management of expiration dates: attention to product rotation, time of withdrawal from the shelves, display of products with short expiration dates;

6. Behavior of the customers: accidental or intentional breakage, handling of fruits and vegetables, opening of multi-packs, fresh foods left outside the fridge;

7. Inefficiencies in internal production: exceeding preparation, scraps in cooking and preparing;

8. Massification: displaying loads of products can generate waste when the turnout is scarce;

9. Unsolicited unload of products by distribution platforms;

10. Assortment: cannibalization among similar products.

The first 5 points include causes of food waste that are widely recognized in national and international literature. Causes number 7 and 8, although not reported in the literature, were somewhat expected following the observations conducted at stores during the first research phase of the REDUCE project. The last 3 cases were instead unexpected; they essentially concern the relationship between the category managers and the distribution platform. Some differences in the pattern of causes could be identified between supermarkets of different dimension: while the causes related to consumer preferences, order management, technical problems, logistics and expirations dates emerged in both contexts, the issue of customers' behavior was much more relevant in larger stores than in small supermarkets. The participants suggested that the higher control of the departments in smaller stores may prevent incorrect behavior by customers, while in large stores the customers "have the idea that the food stuff belongs to no one, and therefore they touch, taste and open".

Some possible strategies against food waste were also identified in the second part of the focus group discussion. Most of them deal with improvements in the internal communication of the stores' staff. A better communication with the distribution platform and the stores' management were both identified as strategies to avoid part of the waste due to order management. Other strategies addressed the customers, to make them aware of the waste occurring as a consequence of their behavior at the store.

It should also be noted that, although in one of the stores involved in the study a redistribution initiative was in place (donation of edible food waste to a local charity), this option was not mentioned by the participants as a possible strategy to reduce food waste.

Conclusions

Results suggested that the voice of retail stores' staff is a good source to analyse more deeply the causes of food waste, as unexpected issues emerged from focus group discussions. The contribution of

participants to the identification of strategies against food waste in retail stores was also valuable, confirming that the involvement of personnel in such studies, and likely in the implementation of these strategies as well, may bring advantages to the stores' management.

PACKAGING'S CONTRIBUTION TO FOOD WASTE PREVENTION

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ABSTRACT

About 30% of the average European's carbon footprint is linked to the production and distribution of food. However, according to FAO about 30 % of food is disposed of along the entire supply chain. Reasons are different and depending on several circumstances. In the retail sector highest spoilage rates could be allocated to perishable goods like fruits and vegetable, bread and bakery and fresh meat. Especially for those goods optimized packaging might help to avoid damages during transport or early spoilage because of short best before dates. Denkstatt (2014) could show that plastic or other packaging can play a significant role in reducing food waste. This means that despite more packaging being used and disposed of, less food is being wasted. It could also be shown that this leads to a lower carbon footprint overall as the eco-footprint of the packaging is smaller than the environmental imprint of food production. Denkstatt (2014) could prove the reduction of food waste by optimized packing in retail of 16% for beef (rib-eye), 4.68 % for sliced cheese, 10.2 % for brioche bread and 5.8% for cucumbers.

Until now, there has not been too much research on the effect of optimized packaging on food waste in the household sector. Therefore, the presented study investigated the impact of optimized packaging by the use of several methodologies (online questionnaire, inquiry at the point of sale, consumer simulation, focus groups and food diaries).

As preconditions for a remarkable effect at household level the following could be defined:

- Consumer perception of optimised packaging
- Influence of the type of packaging on the purchase decision
- Correct use of packaging at home
- De facto longer use
- Ideally, the product should be stored in its original packaging
- After opening, the product must have at least the same shelf life as products with less optimised packaging
- Product must remain in the household for a sufficient period of time

The online survey shows that only 19% of respondents state packaging as the reason for their purchase decision. This is reflected in the figure of 90%, who think that food today is rather "over-packaged". Around 50 % see the advantages of the original packaging, yet many of the respondents, depending on the purchased product, repack the food immediately after the purchase (e.g. in plastic containers).
Only about 12% of respondents said that they had changed their habits due to storage information on the label. One fifth of the participants choose a specific packaging due to the extended shelf life, rather the material and the consumer friendliness of packaging play an overriding role. For selected products, the number of persons that would choose the optimised packaging also have been detected.

Poster

FOOD WASTE BASELINES WITHIN THE PUBLIC SECTOR

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Background

Issues relating to food waste have attracted significant attention in recent years, but there seems to be no obvious all-round solution for dealing with these issues. However, the political and global communities have started to address the challenges associated with food waste. In 2015, the topic was brought to the attention of world leaders when it became one of the targets for the United Nations (UN) Sustainable Development Goals for 2030. The target itself aims to: "By 2030, halve per capita global food waste at the retail and consumer level and reduce food losses along production and supply chains, including post-harvest losses" [1]. Other initiatives have been taken simultaneously, with the goal to cut food waste on various levels and with different methods and ambitions [2]. There is also a suggestion that the ambition set by UN might not be enough and that further food waste reductions might need to be achieved in order to counter climate change [3]. In order to approach and achieve the global directive to reduce food waste, it is necessary to gain insights into where, why, and how much food and/or inedible associated parts are removed from the food supply chain. The Food Loss and Waste Accounting and Reporting Standard aims to bring such insights on global level and also to promote consistency and transparency. This and the use of similar frameworks and the output from such frameworks can also give users hints on where to take action, which is reported to be a necessary step [4]. The quantification according to such frameworks can serve as an indicator of hot-spots, where the greatest potential for waste reduction lies, and provide guidance for further work. Moreover, the use of a standardized framework and its output has the potential to provide baselines, which would make measures to reduce food waste traceable and allow them to be evaluated as to whether they give the appropriate food waste reduction response [5]. Establishing baselines for food waste quantification in order to identify problems has been identified as a vital step in waste reduction [6]. Such baselines would also make it possible for different actors to compare, communicate, and benchmark different results among each other and within the community. Knowledge of effective measures can then be spread and shared between actors sharing the same features and organizational characteristics.

Public sector actors within the food system have been pointed out as having great potential for food waste reduction [7,8]. This is especially true in Sweden, where the public sector serves >50% of all midday meals [9]. Public catering covers government actors within the food system that provide food services through private actors or directly offer food in institutions such as kindergartens, schools, prisons, hospitals, elderly care units, etc. Previous studies have quantified food waste within subsets of the public sector (Table 1). However, these studies have used a relatively short amount of quantification days and been performed with different methods and aims, making it difficult to compare the results. There is therefore a need to provide a more systematic approach to examining how different subsets of the public sector actually perform over time, in order to establish a more useful baseline, as a reference point for further food waste reducing efforts.

Table 1. Quantification results from other studies

Kitchen type	Country	Units	Duration	Method	Waste (%)	Waste/person (g)	
Hospital	UK	1	28 days	Weighting	>40	-	[10]
Schools & restaurants	Sweden	4	2 days	Weighting	20	92,5	[11]
Hospital	Ireland	3	2 days	Weighting	19 – 66	-	[12]
Schools	Portugal	21	1 month	Weighting, visual	27.5	49.5	[13]
Kindergartens	USA	1	5 days	Weighting	45.3		[14]
Hospitality and catering sector	Finland	55-72	1 day - 1 week	Weighting	8-27		[15]
Schools and restaurants	Switzerland	2	5 days	Weighting	7.69 – 10.73	91.2	[16]
Public sector	Sweden	30	3 months	Weighting	23 (13-34)	75 (33-131)	[7]
Schools	Italy	4-5	5-10 days	Weighting	27		[17]

Purpose

This study aims to provide detailed baselines for different segments of the public sector, in order to have reference points for further food waste reduction efforts.

Material and method

The material for this study comprised data on public catering services in 12 Swedish municipalities, which was selected due to willingness to participate and share data. The municipalities ranged from quite small, with around 10 000 inhabitants, to large with around 100 000-300 000 inhabitants. A total number of 616 kitchen establishments, comprising 256 kindergartens, 296 schools, 39 upper secondary schools, 20 elderly care units, and five other types of unit, were included in the study.

The quantification work was performed by each organization and therefore the quantification periods differed in ambition and granularity in terms of how many days the quantification period lasted, the number of kitchens participating in the quantification, the waste process monitored, and the key performance indicators used for communication and further waste reduction efforts. These features also changed over time in some cases, e.g., one municipality changed the duration of its quantification period from 5 days a year to 15 days a year for each kitchen. The earliest quantification data were from 2012 and the latest from 2018, but not all municipalities actively quantified food waste during the whole period.

Three different methods for conducting food waste measurements were used within the municipalities: a paper-pencil-spreadsheet method, an IoT4-scale method, and a food waste quantification software method. Features in common for all these methods were that data collection was performed by the kitchen staff and that the data were sent to a central unit within the organization for further compilation and analysis. In order to find common ground between the different set-ups and ambitions regarding food waste quantification in the municipalities, the data from the organizations were converted to a common format, sorted into the different waste processes that occur on a kitchen level [18], which provided consistency and transparency. The data from the organizations were used to calculate baselines for the key performance indicator 'waste per person', since this measurement and the underlying data were

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[4] Internet-of-Things scale

available and consistent for all the organizations participating in the study. In order to calculate this key performance indicator, the requirement was that information on waste amounts and information about the number of guests per quantification day both had to be available. Days for which any of this information was not available were removed from the key performance indicator calculation. Another key performance indicator that was calculated from the data was 'relative waste'. This was computed in a similar matter as waste per person, i.e., by removing any data points lacking information on either waste and or amount of food cooked and compiling the key performance indicator for the relevant segment.

Results and discussion

The results showed that around 20% of all food served was wasted within the public sector catering units studied (Table 2).

Table 2. Relative waste (%) in the different sectors in the 12 municipalities studied

Sector	Waste (kg)	Cooked food (kg)	Waste (%)
Kindergarten	13 000	61 000	21
School	140 000	720 000	19
Upper secondary school	30 000	170 000	18
Elderly care	3000	14 000	21
Other	500	6000	8
Total	339 100	5 660 000	19

However, relative waste was not an accurate key performance indicator in the present case, as the data underlying the indicator were not extensive. The more reliable indicator of waste per person gave a more varied picture, with an average of 60 g per portion served wasted in the 12 municipalities studied. Elderly care was the segment with most waste per person (84 g), while schools and the 'Other' segment had the lowest waste per person (55 g and 30 g, respectively) (Table 3).

Table 3. Waste per person (g) in the different sectors in the 12 municipalities studied

Sector	Number of units (n)	Recorded waste (kg)	Recorded guests	Waste/person (g/guest)
Kindergarten	256	29 000	386 839	75
School	296	230 000	4 203 761	55
Upper secondary school	39	75 000	1 033 636	72
Elderly care	20	4500	53 420	84
Other	5	600	19 783	30
Total	616	339 100	5 697 438	60

The largest segment in terms of recorded guests was the school segment, with data from 296 units and around 4.2 million guests in the dataset. The schools showed quite a wide variation in number of recorded guests per day, which ranged from 14 to 1312 guests. The schools also provided most of the data on recorded waste, around 230 000 kg. Kindergartens, on the other hand, are normally quite small units with few children, but there are more of these units than of any other within the public catering organization in a municipality. The recorded number of guests per day in the kindergarten segment was 1 to 487 in this study, which was quite low compared with that in schools and upper secondary schools (Table 3).

Figure 1 shows a scatter plot of the distribution of municipal kitchen units and their recorded number of guests plotted against their waste per person, grouped into the different segments in the municipal public catering sector.
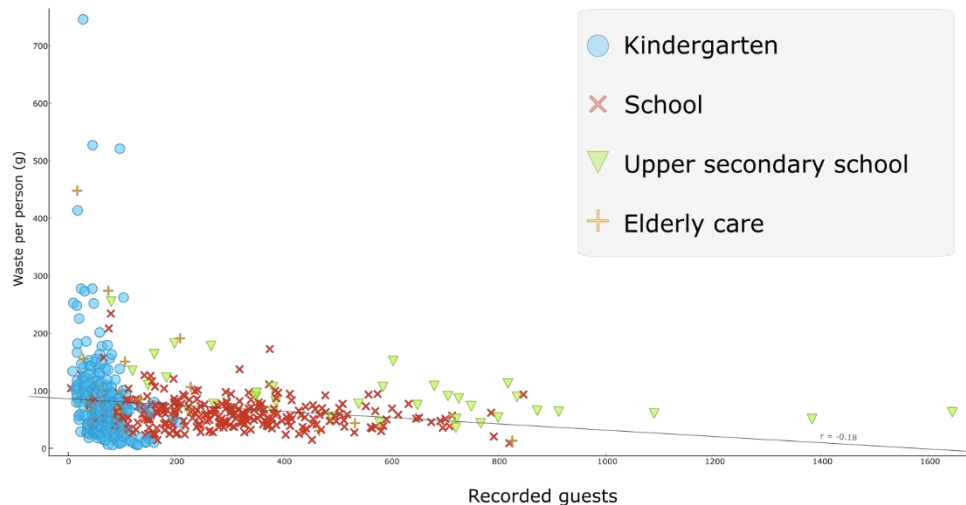
Figure 1. Scatterplot (with regression line) of waste per person and number of guests in the different sectors within public catering in the 12 municipalities studied.

Despite kindergartens having the potential to control food waste better than, for instance, upper secondary school units, the results showed that they generated almost the same level of waste per person. This contradicts earlier findings that kindergartens have lower waste per person than schools and upper secondary schools [7,19]. The potential of kindergarten units to reduce their food waste lies in that fact that they have lower levels of the risk factors involved in food waste generation. For example, the carers eat with the guests and can therefore monitor and encourage the guests to minimize food waste. The guests in kindergarten units also normally have fewer options to choose from the menu and cannot choose to eat elsewhere, which according to previous studies should have a reducing effect on food waste [20].

Conclusions

Previous studies of food waste within the public education system have shown that upper secondary school units generate more food waste than kindergarten and school units. In the present study, kindergarten units and upper secondary school units in 12 municipalities in Sweden had very similar levels of waste per person (75 g and 72 g per person, respectively). This indicates a need for more emphasis on food waste in kindergartens, since they generate almost as much waste per person as the oldest students within the public sector education system, but have the potential to have lower food waste than other public catering segments.

Bibliography

1.   United Nations Transforming Our World: The 2030 Agenda for Sustainable Development; New York, 2015;

2.   Tesco Tesco and Society; Tesco: Cheshunt, Hertfordshire, 2014;

3.   Springmann, M.; Clark, M.; Mason-D'Croz, D.; Wiebe, K.; Bodirsky, B.L.; Lassaletta, L.; de Vries, W.; Vermeulen, S.J.; Herrero, M.; Carlson, K.M.; et al. Options for keeping the food system within environmental limits. Nature 2018, 562, 519–525.

4.   Boij, A. Mindre matsvinn: utvärdering av Hushållningssällskapets nationella projekt; A. Boij AB Idé- och produktutveckling: Tranås, 2013; ISBN 978-91-979424-7-8.

5.   Vittuari, M.; Azzurro, P.; Gaiani, S.; Gheoldus, M.; Burgos, S.; Aramyan, L.; Valeeva, N.; Rogers, D.; Östergren, K.; Timmermans, T.; et al. Recommendations and guidelines for a common European food waste policy framework; 2016; ISBN 978-94-6257-959-0.

6.   Eriksson, M.; Sveriges lantbruksuniversitet; Institutionen för energi och teknik Supermarket food waste: prevention and management with the focus on reduced waste for reduced carbon footprint, Department of Energy and Technology, Swedish University of Agricultural Sciences: Uppsala, 2015.

7.   Eriksson, M.; Persson Osowski, C.; Malefors, C.; Björkman, J.; Eriksson, E. Quantification of food waste in public catering services – A case study from a Swedish municipality. Waste Management 2017, 61, 415–422.

8.   SEPA Minskat svinn av livsmedel i skolkök: erfarenheter och framgångsfaktorer.; Naturvårdsverket: Stockholm, 2009; ISBN 978-91-620-5979-8.

9.   Fakta om offentliga måltider Available online: https://www.livsmedelsverket.se/matvanor-halsa--miljo/maltider-i-vard-skola-och-omsorg/fakta-om-offentliga-maltider (accessed on Jan 9, 2019).

10.   Barton, A.D.; Beigg, C.L.; Macdonald, I.A.; Allison, S.P. High food wastage and low nutritional intakes in hospital patients. Clinical Nutrition 2000, 19, 445–449.

11.   Engström, R.; Carlsson-Kanyama, A. Food losses in food service institutions Examples from Sweden. Food Policy 2004, 29, 203–213.

12.   Sonnino, R.; McWilliam, S. Food waste, catering practices and public procurement: A case study of hospital food systems in Wales. Food Policy 2011, 36, 823–829.

13.   Liz Martins, M.; Cunha, L.M.; Rodrigues, S.S.P.; Rocha, A. Determination of plate waste in primary school lunches by weighing and visual estimation methods: A validation study. Waste Management 2014, 34, 1362–1368.

14.   Byker, C.J.; Farris, A.R.; Marcenelle, M.; Davis, G.C.; Serrano, E.L. Food Waste in a School Nutrition Program After Implementation of New Lunch Program Guidelines. Journal of Nutrition Education and Behavior 2014, 46, 406–411.

15.   Katajajuuri, J.-M.; Silvennoinen, K.; Hartikainen, H.; Heikkilä, L.; Reinikainen, A. Food waste in the Finnish food chain. Journal of Cleaner Production 2014, 73, 322–329.

16.   Betz, A.; Buchli, J.; Göbel, C.; Müller, C. Food waste in the Swiss food service industry – Magnitude and potential for reduction. Waste Management 2015, 35, 218–226.

17.   Boschini, M.; Falasconi, L.; Giordano, C.; Alboni, F. Food waste in school canteens: A reference methodology for large-scale studies. Journal of Cleaner Production 2018, 182, 1024–1032.

18.   Eriksson, M.; Persson Osowski, C.; Björkman, J.; Hansson, E.; Malefors, C.; Eriksson, E.; Ghosh, R. The tree structure — A general framework for food waste quantification in food services. Resources, Conservation and Recycling 2018, 130, 140–151.

19.   Steen, H.; Malefors, C.; Röös, E.; Eriksson, M. Identification and modelling of risk factors for food waste generation in school and pre-school catering units. Waste Management 2018, 77, 172–184.

20.   Eriksson, M.; Malefors, C.; Björkman, J.; Eriksson, E. Matsvinn i storkök – en kvantitativ fallstudie från Sala kommun. 32.

DIGITAL SUPPORT FOR FOOD WASTE REDUCTION IN PRIVATE HOUSEHOLDS

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Considering the entire value chain, the largest amount of food is wasted at the final stage in private households. In Germany, 55 kg of food per person and year is thrown away, 24 kg of which would still be suitable for human consumption. The reasons are multifactorial: 70% of consumers do not plan their meals ahead, 58% of food is stored incorrectly, 48% of consumers do not have an overview of their food stock and 42% of shoppers do not use a shopping list (Cofresco 2011; Nielsen 2017; GfK 2017, ISWA 2012).

The entitled project was initiated in June 2018, supported by the Bavarian State Ministry, with the aim to develop a digital application for consumers in order to reduce household food wastage. The tool enables users to manage their food in a more conscious and sustainable way by planning meals ahead, buying only required items according the automatically generated shopping list and receiving guidance on correct food storage and preparation.

Optionally users can track all foods stocked in their household by a mobile inventory system, which allows them to facilitate their meal planning activities and to receive feedback on their own food consumption and wastage behavior. Using this function, the app will in particular propose recipes based on available and shortly expiring ingredients and set a best-before alarm for expiration-critical items.

The suggested recipes take factors into consideration, such as household size, personal nutrition preferences, and focus on a creative use of leftovers. The planned integration of a food-sharing link allows redistributing food that cannot be consumed within the expiration date.

Besides saving time, money and energy, consumers will step by step become more conscious about their food management behavior when using the digital support and increase their awareness for handling food in a more sustainable and valued way. Incorporated nudging elements such as challenges, games and scores, will turn the usage of the app into a lively experience for long-term use.

From a methodological perspective, the end-users were repeatedly involved during the entire development process to gather feedback and adjust key elements of the application. Special attention was paid to the target groups' needs, wishes and barriers. In a first step, the app concept was tested for acceptance by means of a quantitative consumer survey among the general population (among app users and responsible persons for housekeeping). The results indicated a wide acceptance of the concept, especially among families, who were identified as the main target group for further prototype development. Second, the needs and barriers of families in their daily food management behavior were identified by subsequent in depth interviews and ethnographic research. Based on the learnings, a wide range of innovative ideas was generated in a design thinking workshop with experts from industry, research and start-ups. The winning ideas were subsequently turned into four concepts addressing specific needs of the targeted population. In the next phase, feedback on the four concepts was gathered from potential users to define the final range of functionalities that will be integrated within the app prototype. Next steps include the app prototype development phase with iterated user testing and the launch of the app mid-2020.

TRACING GEOGRAPHIES OF FOOD WASTE: TWO CASE STUDIES

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As Evans, Campell and Murcott explain in their edited collection *Waste Matters*, "food waste is a compelling and yet hugely under-researched area of interest for social scientists" (2013). Despite an increased number of developments and scholarly work on "waste" and discard studies, there has yet to be a complete analysis on food waste. The topic of food has also become an increasingly fashionable area of study, with numerous publications, media coverage, and even cookbooks to discuss food, cuisine, and culture. Recently, however, food waste has garnered more attention outside of academe in regards to policy and regulation engagement, cultural politics, and climate change. Institutions and organizations like the Food and Agriculture Organization have released staggering results, with data such as 1.3 billion tons of food is wasted each year, the third largest generator of greenhouse gases after the United States and China (FAO, 2011). It is with these drastic figures in mind that the exploration of geographies of food waste become important markers for our social structure and can help elucidate how waste functions in creating space and social relations. How does the materiality of food waste play into creating various spaces and places? Society and systems of production often label waste materials as 'outcast' and discarded value, can food waste categorization break through or transform these boundaries through its materiality?

In order to begin to analyze the questions above, I studied two different organizations attempting to use and revalorize food waste and surplus in an Italian and global context. I conducted ethnographic research and both informal and formal interviews as part of this process and use theories in waste studies, food activism, sociology, and geography to understand the interdisciplinary and interconnecting outcomes. The first organization is a nonprofit called Food For Soul, based out of Modena, Italy and created by the celebrity chef Massimo Bottura and his wife Laura Gilmore. Food for Soul's objective is to take food surplus from markets and suppliers in the area and create meals for people who have been marginalized from society or are in a need of a good meal. Similar to the ethics of the Slow Food movement, Bottura claims that everyone deserves to have a 'good' meal, and he also emphasizes the problem of food waste. For Food For Soul, the production and value of food exists, it just needs to be redirected. Tracing food waste from the market to the evening space where a weekly dinner is hosted, I connect this with a spatiality of ordering and matter out of place. The surplus food, through its travel from market to meal, attempts to give order to a social space created for vulnerable people. And while Food For Soul is based out of a small Italian town, it's reach and aim is global. The non-profit has partnered with other organizations in London, Paris, Rio de Janeiro, and now San Francisco to create the same model of redirecting food waste and turning it into valuable and tasty food.

The second group I encountered in my research is called Eat The Rich, a program that is located within an autonomous social space in Bologna, Italy. Eat the Rich also uses diverted surplus food and prepares weekly meals, calling it a 'popular lunch.' Eat The Rich has a very political message, situated within an anarchist space that is often fighting to preserve themselves, their very existence is based in a state of precariousness. The members of the group also organize lunches and meals in response to various political or social events that exist within the city or state. On one of the occasions that I joined their

lunches, they were protesting the bank BNL's activity in building a new migrant detention center in Modena. For them, the food represents a conduit to larger issues at hand.

While very different in their existence, aims, and styles, both Food For Soul and Eat the Rich manifest as relations brought about through the materiality of food waste. Their activities show the power of creating inclusive spaces where people can gather around food, and highlight that the meaning of discarding food and valuation varies to the context, place, and space that it travels through. Food waste can be the material that gathers people and groups together around a common cause, one that can extend in its scope and reach depending on the context. The spatial trajectories of food waste itself illuminate the social relations between local groups of people and even extend to global cooperation. Food waste can materialize to help place-make, pushing and transgressing normative boundaries of waste concepts.

STUDY ON THE HYGIENE KNOWLEDGE OF CATERING ESTABLISHMENTS EMPLOYEES IN THE CONTEXT OF POTENTIAL REDUCTION OF FOOD WASTE

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Background

FAO (Food and Agriculture Organization) data show that even 1.3 billion tons of edible food is wasted worldwide each year, which makes up 1/3 of global production. In 2011 the residents of 27 European Union countries were responsible for the waste of about 20-30% of purchased food (i.e. 89 million tons) (FAO, 2011). According to the European Commission, the current loss of food in the member countries is 100 million tons annually (Commission Staff Working Document, 2014). Poland in this shameful ranking is ranked fifth (about 9 mln tons of food annually). The biggest responsibility for the waste of food products in the European Community is borne by citizens and companies in the United Kingdom, Germany, the Netherlands and France (Monier, 2010).

The scale of waste is different, depending on the element of food chain. The majority of food waste is generated in households (42%), followed by distribution (39%), food service sector (14%) and retail and wholesale sales (5%) (Monier, 2010).

Causes of food wastage are different. In the developed countries, food losses and waste can be linked to inadequacies in the upstream production sector, retail and consumer refuse. In developing countries, food wastage can be attributed to poor food storage and infrastructure for example.

Purpose

The first aim of work was to indicate basic ways to reduce food ways in home and professional kitchen. The second aim of this study was to assess the Polish catering workers knowledge of personal and production hygiene.

Methodology

Taking into account the literature, ten basic ways to reduce food waste in domestic and professional kitchens were indicated. It was for example: (1) serve smaller portion, (2) plan out your meals, and make a detailed shopping list with the ingredients you'll need, (3) buy shapely, small fruits and vegetables, (4) store your food product in appropriate conditions, (5) during storage use FIFO (First In First Out) principle, etc. One of the proposed ways (number 9) concerned the hygiene of people working in the kitchen. Properly personal hygiene and the hygiene of the workplace is one of the factor which can reduce of food spoiling rate and minimize food waste then. Therefore, it was decided to assess the Polish catering workers knowledge of personal and production hygiene.

The study was conducted using a specially designed questionnaire prepared on the basis of Codex Alimentarius (CA) general principles of food hygiene (CCFH, 2003). The questionnaire consisted of two

sections: first one contained 30 questions (claims) related to the catering workers' knowledge of the causes of personal and production hygiene. The second section contained questions related to the demographic and social affiliation of respondents i.e. gender, education level, worplace and experience in gastronomy, which characterized the surveyed consumers. The questions scoring was based on the Likert scale, with 5 variants of responses   (the scale from "strongly agree" to "strongly disagree"). The study was conducted in the Mazowieckie Voivodship in the year 2017. One hundred and fifteen questionnaires were collected. To verify the relationship between the obtained results and to determine the impact of the gender, education level and experience on the response scores the ANOVA-tests was applied.

Results

The Polish catering workers showed a very high level of personal hygiene knowledge (over 90% correct responses) in the case of statements regarding hair hygiene, the need to wear during work protective clothing, including headgear, or the need to cover the mouth when sneezing. The employees were well aware of the obligation to take off jewelry before work (91,3% correct responses) and were aware that the sick person should not come into contact with food production (92,2% correct responses). In the case of personal hygiene employees had the biggest problem with the indication of correct answer to such issues as adequate protection of all cuts (64,4% correct responses) and places for eating meals by the staff (68,7% correct responses). On the basis of the conducted research, it was noticed that the personnel's knowledge in the field of production hygiene issues is lower in relation to the knowledge in the field of personal hygiene. Only in the case of four statements (15 possible) regarding production hygiene, catering workers showed a very high level of knowledge (over 90% correct responses). Among catering workers in Poland, the highest proportion of correct responses was found in the cases regarding the possibility of food contamination by persons who don't respect hygiene rules during preparation of meals (98,3% correct responses), the possibility of multiple tasting during the preparation of a meal with the same spoon (91,3% correct responsec), the possibility of re-freezing a previously thawed product (98,3% correct responses), or the use of separate small equipment for the preparation of various product groups (97,4% correct responses). The smallest share of correct responses was found in question regarding food defrosting at room temperature (28,7% of correct responses).

On the basis of the conducted research, it was noticed that the level of knowledge was determined by the education and experience level. The gender of respondents didn't have a significant impact on the obtained results.

Conclusion

Taking into account the obtained results, further targeted training of staff employed in gastronomy is recommended. In these trainings, particular emphasis should be placed to those areas where the knowledge of the staff is unsatisfactory.

The results of this study may play an important role in the prevention of food waste in the catering establishments by indicating which areas of employess' personal and food hygiene knowledge should be strengthened by educational activities.

FOOD WASTE AND RELATED TOPICS FOR THE FOOD-PROCESSING INDUSTRY IN COMMUNICATION WITH OTHER ACTORS ACROSS THE SUPPLY CHAIN

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Food loss and waste is a current topic with relevance to food-processing companies. In addition to consumers, politicians and scientists also demand more transparent discussion and reporting of this issue from food-processing companies. They claim self-regulatory targets and measures of companies to counteract food loss and waste. Previous studies show that companies have, in part, already taken measures against food loss and waste. Further, other studies show that communication about food loss and waste can provide a competitive advantage for food-processing companies. However, the information about efforts against food waste provided by food-processing companies is still inadequate to other actors across the supply chain.

The aim of the study was to identify and highlight recommendations with regard to food loss and waste for food-processing companies. In this conducted study in 2017, randomly selected food-processing companies were asked what measures were important to counteract food loss and waste. The survey was based on explorative interviews and filled questionnaires of 13 German food-processing companies. The companies belonged to different industry sub-sectors and business sizes. The interviews were transcribed verbatim and analyzed by qualitative summarized data analysis and inductive classification. The survey was supported by literature research.

The results show and confirm that communication is an important part of counteracting food waste for food-processing companies. This was mentioned by almost every food-processing company as recommendation. Further, the results show that there are several types of communication for food-processing companies. For a detailed analysis in relation to communication, the findings were divided into different topics and different actors in the supply chain.

As result, one of the aims of communication for food-processing companies is to improve processes and transparency in-house. This communication may include reporting on already performed activities, targeted goals, and results achieved. Further, communication about food loss and waste also includes employee training, measures needed to combat food waste, information for environmental reports, and clear statements for dealing with food waste. Another aim of communication which was mentioned by the participating companies is to gain the understanding of the customers and to increase their awareness of food loss and waste. The topics for customers may include information about storing aids, appropriate handling to increase storage life, best-before-date, finiteness of resources, etc. However, the results show that communication about food loss and waste can not only be reduced to internal communication issues or classical consumer information. For the companies it is important that the communication aims at an improvement of in-house processes as well as in the whole supply chain. Hence, communication about food loss and waste should also include supplier, trading partners, and other companies. The whole supply chain should be improved by coordination and cooperation amongst supply chain actors, exchange

with third parties, partnerships with networks and round tables, increasing supplier efforts, and analysis of opportunities for a joint.

The results could be used as recommendations for companies expanding their own sustainability strategy, as well as to enrich ongoing sustainability efforts. Further, the results support communication of food-processing companies about food loss and waste by highlighting relevant topics regarding food waste for communication with other actors across the supply chain.

FOOD WASTE QUANTIFICATION AND MANAGEMENT IN THE F&B SECTOR

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Poster Summary

Our poster explores the importance of measuring food waste on the establishment level to foster awareness and to promote food waste reduction through effective managerial practices.

In order to reduce food waste, KITRO has developed a concept for monitoring food waste in the Food & Beverage (F&B) industry. It consists of a device with camera positioned over the waste bin in a commercial kitchen. An image is taken every time, waste is disposed in the bin. This extended image data is fed into a deep neural model architecture. KITRO investigates a novel approach for automatic classification using artificial intelligence, where machine learning algorithms will classify the waste. Research on food waste reveals that 20% of the food in restaurants is being wasted, and 2/3 of that is avoidable food waste. Therefore, with accurate information about their wasted food restaurants can make data driven decisions to optimize their work practices and save roughly CHF 2'500 per month while lowering their negative impact on the environment.

The final part of the poster is devoted to the importance of establishing collaboration ties between private business like KITRO and educational institutions, like the Ecole hoteliere de Lausanne to carry out empirical, practical research concerning food waste mitigation and landfill avoidance.

CONNECTIVE POLICY THAT ENABLES SDG 12.3 ACHIEVEMENT

C. BUCATARIU

Abstract

Food loss and food waste have been on the global agenda since 1967. Nevertheless, only in 2014 the Committee on World Food Security addressed the two topics together in the context of sustainable food systems.

The paper is focused on identification and characterization of the main policy developments that took place in the last 10 years in all Regions of the world that facilitated SDG 12.3 identification within the 2030 Agenda. Among these, the paper will analyse the following:

The work plan set for the African Union (AU) Malabo Declaration target of 50% reduction in post-harvest loss by 2025

The process and current results for the Near East and North Africa Regional Strategic Framework for Reducing Food Loss and Waste (2014-2024)

The Community of Latin American and Caribbean States (CELAC) Regional Alliance for Reducing Food Waste and Losses and the establishment of national committees seeking to halve waste in the region by 2030 – that enabled regional considerations of an International Code of Conduct on Food Loss and Food Waste Reduction for the Region

The Asia and the Pacific Region Zero Hunger Challenge and country level strategies that include awareness raining, education, sustainable food supply chains agro-industry development

The Europe and Central Asia Region value-chain focus and the FAO membership in the European Union (EU) Platform on Food Losses and Food Waste.

The analysis will lay down a list of variables that are cross-cutting in all Regions allowing thus the identification of global connective policy elements that provide a matrix approach to identifying enabling factors for SDG 12.3.

Key words: SDG 12.3, connective policy, food loss, food waste, food literacy, right to adequate food

References

FAO. 2011. Global food losses and food waste – Extent, causes and prevention. Rome. Available at: http://www.fao.org/docrep/014/mb060e/mb060e00.pdf

HLPE, 2014. Food losses and waste in the context of sustainable food systems. A report by the High Level Panel of Experts on Food Security and Nutrition of the Committee on World Food Security, Rome. Available at: http://www.fao.org/3/a-i3901e.pdf

The Committee on World Food Security (CFS), 41st Session, 2014, endorsed Recommendations on Food Losses and Waste in the Context of Sustainable Food Systems. Available at: http://www.fao.org/3/a-av037e.pdf

The 2030 Agenda: Sustainable Development Goal Indicator 12.3.1 - Global food losses. Available at: http://www.fao.org/sustainable-development-goals/indicators/1231/en/

Global Panel. 2018. Preventing nutrient loss and waste across the food system: Policy actions for high-quality diets. Policy Brief No. 12. London, UK: Global Panel on Agriculture and Food Systems for Nutrition. http://glopan.org/sites/default/files/Downloads/GlopanFoodLossWastePolicyBrief.pdf

The UN Nutrition Decade "Strengthening nutrition action: A resource guide for countries based on the policy recommendations of the Second International Conference on Nutrition (ICN2)". Available at: http://www.fao.org/documents/card/en/c/CA1505EN; Please read Recommendation 11   Improve storage, preservation, transport and distribution technologies and infrastructure to reduce seasonal food insecurity, food and nutrient loss and waste.

FAO. 2017. Infographic on food loss and on food waste. Available at: http://www.fao.org/resources/infographics/infographics-details/en/c/414196/

EIT FOOD: MULTI-STAKEHOLDER ENGAGEMENT SUPPORTING A CIRCULAR AND SUSTAINABLE BIO-ECONOMY IN EUROPE

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The European Institute of Innovation and Technology for Food (EIT Food) is a knowledge and innovation community that connects over 50 partners from leading businesses, universities, research centres and institutes across 13 countries in Europe. Using a consumer-centred approach EIT Food will empower innovators, entrepreneurs and students to develop world-class solutions to societal challenges, accelerate innovation, create jobs and increase Europe's competitiveness – across the whole food value chain.

A major ambition of EIT Food is to redesign the way we produce, deliver, consume and recycle our food and to create a future-proof and effective food sector supporting a sustainable and circular bio-economy. Our activities are geared towards a substantial reduction of the food system`s environmental impact by (a) tackling hotspots in the environmental footprint, (b) increasing market penetrations of ingredients from sustainable, alternative sources, and (c) driving circular excellence by valorising side streams.

Here, we show examples from our current activity portfolio to demonstrate the importance of an integrated end-to-end supply chain approach for an effective transformation of our traditional linear "produce-use-dispose" model into a circular bio-economy. Examples include activities addressing the primary sector ("transforming efficiency in primary food production"), food processing ("by-product valorisation and recycling"), wholesale ("sustainable packaging and waste management"), and the consumer ("better for me, better for the environment").

To foster EIT Food´s multi-stakeholder approach, activities are supported by pan-European education programmes for students, professionals (including farmers) and consumers to encourage a circular-economy mindset and global sense for resource stewardship.

UTILIZATION OF CEREAL GRAIN FRACTIONS TO IMPROVE OXIDATIVE STABILITY OF BEEF BURGERS UNDER CHILLED STORAGE

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ABSTRACT

source to improve the oxidative stability of beef burgers. The %DPPH scavenging activity of cereal grain fractions cleared that the sorghum milling fractions recorded the highest antioxidants activity (37.28-50.52%) compared with other milling fractions. The ability to scavenge DPPH radicals by fractions was in the order of coarse bran > fine bran > whole grain > flour for all studied samples. Peroxide values (PV) had gradually increased during chilled storage at 5±2°C for 15 days. The highest levels of PV varied from 13.32 to 20.92 (m. equv./kg fat) at 6 days for all studied beef burgers except in sorghum coarse bran formulas, the highest level was 14 m. equv./kg fat after 3 days of storage. Thiobarbituric acid (TBA) values of beef burgers increased throughout storage up to 9 days then decreased with the end of storage periods. The addition of cereal grain fractions as natural antioxidants this investigation was carried out to study the possibility of using some cereal milling fractions as natural antioxidants led to improve the oxidative stability of beef burgers. Sensory evaluation cleared that taste, odor, appearance and general acceptability of all tested meat burgers has not significant changes compared with control.

Keywords: oxidative stability, cereal fractions, PV, TBA, burger.

Biography

I am studying PhD at both of Heriot-Watt University UK and Sakarya University Turkey in Food Sciences and Nutrition, I interested with clinical nutrition systems. The recent project are we work in utilization of food wastes and extraction some bioactive components which use as additives in replacements in food industry.

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CAUSES AND PREVENTION OF FOOD LOSSES IN DAIRY PLANTS

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The extensive food waste is one of the most serious problem of the modern civilization. Irrational use of food beyond the amount of losses, is a threat to our environment because of excessive consumption of natural resources and is a causes of unmet nutritional needs of societies. Food waste is not only to generate financial losses, but also irreversible loss of energy. Although there is no clear and timely data on food losses in the supply chain, their size is certainly significant. According to EUROSTAT estimates, in Europe, nearly 35 million tonnes of food are wasted at the stage of processing (which accounts for 39% in the loss structure). In 2016, the EU Fusions project group indicated that the main sources of loss in the EU are households (53%) and processing (19%). Ways should be sought to limit food losses and to use food in accordance with its intended purpose.

The aim of the study was to develop a causes of food losses in dairy plants and to propose the way of their prevention.

The material for the study was data on losses of dairy products in the years 2013-2015 collected in five dairies located in Poland, differing in size and production range. The study was conducted on the basis of a survey.
In the studied plants following causes of the loss were diagnosed:

- Inadequate quality of raw material
- Absence of assessment of suppliers
- Lack of quality specification of raw materials
- Lack of experience, knowledge, relevant qualifications
- Non-compliance with job procedures
- Non-compliance with hygienic rules
- Absence of training courses
- Improperly functioning systems to ensure food safety
- Errors during the production process
- Break-downs
- Poor condition of repair
- Inadequate product management (overproduction).

A fundamental role in food production is played by access to raw materials of appropriate quality. Each plant should have a quality specification for incoming raw materials, containing information relating to the required characteristics. The risk of food loss is related, for example, to cooperation with inappropriate suppliers. Each company should establish and maintain processes to identify, select and evaluate its suppliers in order to continuously improve their ability to ensure that the products or raw materials they supply meet the needs of the organisation.

In any enterprise the key factor responsible for the formation of errors is human. The level of knowledge and qualifications among staff should be appropriate to the type of their activities. Lack of experience and relevant qualifications may result in errors leading to losses of food.

The manufacture of adequate quality products is also determined by maintaining proper hygienic conditions in the whole manufacturing process. All companies operating in the food business are obliged to comply with the requirements concerning, among others, personal hygiene, washing and disinfection control, security, pest control, waste and sewage disposal. The use of appropriate techniques, methods and procedures in the production process ensures the safety of food produced. The result of irregularities occurring can be obtaining a product that is dangerous to health, so must be disposed of and therefore is wasted.

To ensure the quality of food it is necessary to select appropriate production methods and technological parameters, and to ensure appropriate conditions during processing and storage.

Each company must have adequate material resources, including equipment appropriate to processes performed to be able to operate efficiently. Extremely important is the technical condition of machines, which should be regularly monitored. Any equipment failures involve the loss of raw materials, semi-finished or final product, and can be prevented by regular inspections and maintenance, which should be part of any business management system.

In the hierarchy of preventing food losses, prevention of their occurrence is considered a priority, then the allocation of surpluses to the needs of those in need.

"Waste prevention" involves:

- prevention of human errors by hiring suitably qualified and experienced staff, systematic training, implementation of quality systems, development of appropriate procedures,
- purchase of adequate quality raw materials
- proper production management, avoiding surpluses
- taking care of the technical condition of the machines
- products safe for health which do not meet the quality standards, should be handed over to charities or sold at a reduced price, instead of reprocessing.

In summary, risks of food losses must be prevented by eliminating any errors that may result in a product of inadequate quality characteristics. Another solution is to redistribute products suitable for consumption or sell them at a reduced price. This process of food reallocation to those in need is called "food rescue nutrition".

REDUCING FOOD WASTE IN THE FOOD SECTOR BY APPLYING A TARGET AUDIENCE-CENTERED APPROACH - THE CASE STUDY OF THE LAV PLATFORM

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Background

The German government has taken over the EU's objective of halving food waste on the retail and consumer level and reducing food losses along the food value chain. Specifically, the reduction of food waste contributes to fulfil the requirements of four governmental programs: The National Program for Sustainable Consumption (Nationales Programm für Nachhaltigen Konsum), the Waste Prevention Program (Abfallvermeidungsprogramm), the Climate Action Plan 2050 (Klimaschutzplan 2050), and the German Sustainable Development Strategy (Deutsche Nachhaltigkeitsstrategie). Besides being demanded by politics, the reduction of food waste also offers economic benefits for companies of the food sector. However, in Germany many businesses of the food sector face the challenge of high cost pressures, low staff capacities and time constraints, which hardly leaves them room for other work than the daily work routines. This is caused by the fact, that they are subject to a highly competitive market structure, where the five biggest food retailers have a market share of more than 70 % (BVE 2016). Moreover, most of the businesses belong to the group of small and medium sized (SME) companies. For example, in the hospitality sector in Germany more than 99 % of the businesses are part of this group (Söllner 2014) which often lacks extra capacities to initiate extraordinary projects. Hence, especially the SMEs need support in implementing initiatives to counteract food waste.

Nevertheless, there is already a large number of readily available support tools against food waste. The different tools focus on collecting or monitoring food waste data (e.g. food waste calculators, manuals to measure food waste). Moreover, they comprise films or posters to raise awareness or to educate staff, and other materials encompass concepts that concentrate on recycling or avoiding food waste for use in business. The tools have mainly been developed in the frame of academic projects or by governmental programs (e.g. World Resources Institute[5], WRAP[6], EPA Ireland[7], or the German Institute of Sustainable Nutrition (iSuN)[8]). However, it is unclear if those tools provide a severe benefit for the SMEs of the food sector, as the tools are widely diffused on the Internet. The companies might not even know about their existence, and searching for them requires personnel or time capacities. Further, the benefits the tools provide, may only be valid if they are applied by a specific branch of the food sector or by a specific group of employees. For instance, for German SMEs tools that are published in the English language and may be hard to understand for employees with lower qualification. This is a limiting factor for the tools' use in practice. A crucial aspect for the tools' successful application is, that they need to be set up and marketed according to their target audiences' needs. I.e. market orientation of the tools, which implies a focus on the specific target audience (e.g. baker, butcher, or the hospitality and catering sector), is required (Andreasen und Kotler 2014). However, as was revealed in a study in the UK, the USA, and Australia

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[5] http://www.wri.org/
[6] http://www.wrap.org.uk
[7] http://www.epa.ie/pubs/reports/waste/stopfoodwaste/
[8] https://www.fh-muenster.de/isun

auxiliary organizations, that do not work for profit often miss market orientation since they are still dominated by an organization-centered mindset in which marketing appears to be primarily defined by promotional activities (Dolnicar und Lazarevski 2009). While in profit-oriented businesses it is common sense that a market and customer orientation are necessary for commercial success, nonprofits still need to work on adopting an audience-centered mindset (Meffert et al. 2015b; Meffert et al. 2015a; Homburg und Becker 2000; Kotler und Keller 2006; Vahs und Brem 2015).

As a conclusion of the limitations outlined above, a concepts is required, which supports managers of small and mediums sized businesses from the food sector in their food waste reduction efforts.

Purpose of the study

In the study at hand, a food waste reduction concept for auxiliary organizations, such as research organizations or governmental agencies is developed and applied in a case study.

The following research questions are given:
1. How should a concept be set up, to support small and medium sized businesses to execute food waste reduction projects, i.e. how can the food waste reduction efforts of managers and auxiliary organizations, such as governmental initiatives or research institutes, be supported?
2. How should the support tools be designed to fulfil the specific needs of the target audience and how can their transfer be optimized, i.e. how can the branch specific transfer channels as well as the success and inhibiting factors of transfer applicable for each specific target group be identified in order to optimize the success of the transferring activities?

The key aim of this study is to provide a marketing guide for auxiliary organizations, mainly not working for profit, such as academic research institutes or government agencies that wish to develop and transfer support tools and services for SMEs in the food sector. The development of this guide proceeds in three phases (cf. Figure 5). First, the concept of target audience-centered marketing is presented and the specific challenges nonprofit organizations face are outlined. Second, the concept is applied in a case study. In this case study an online platform for food waste reduction, the LAV-platform, is developed and transferred to its target group. The target group consists of SMEs from the food sector including producers, retailers, and the hospitality sector in Germany. Moreover, the platform is also meant to serve as a role model for other international projects which have the goal of developing similar tool-gathering platforms. In the last phase, a guide for a marketing campaign based on the theoretical considerations of Phase I and the experiences gained from the case study in Phase II is developed. This guide enables nonprofits to successfully develop and transfer their services by adopting an target audience-centered mindset. The marketing campaign guide is specifically adapted to the requirements of the food sector.
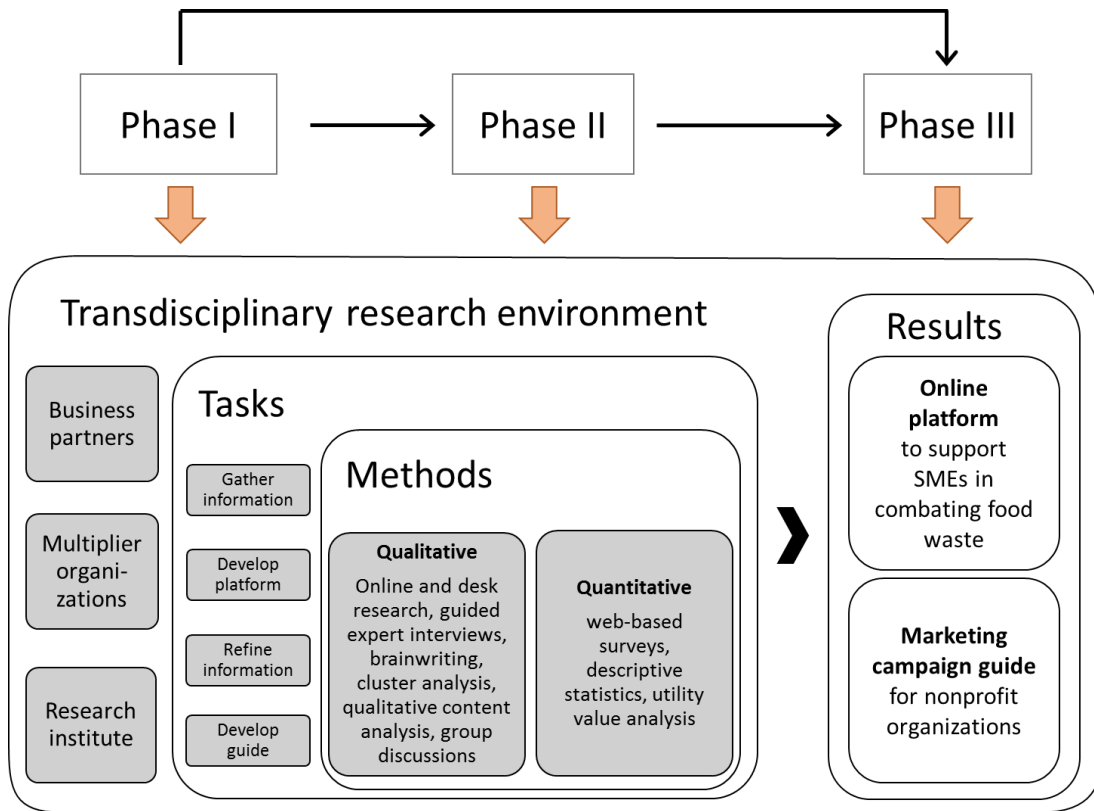
Figure 5: Project phases, transdisciplinary research environment, tasks, and methods of developing the marketing campaign guide for nonprofit organizations (Strotmann et al. 2017).

Results: The Marketing campaign Guide and the case study of the LAV platform

First, a general marketing concept for auxiliary organizations of the food sector is developed in this study and summarized in the Marketing Campaign Guide. This guide offers a systematic and target audience-centered approach and leads organizations through the various steps of a marketing campaign (cf. Figure 6), from defining the required values of a new product or service to ultimately launching it. In this marketing guide a research step is included, which is essential to identify the target group's needs and to provide a benefit to the target group. Further, the marketing campaign steps comprised planning, pretesting, implementing, monitoring, recycling and revision, transfer, and raising follow-up financing. In the concept it is specifically emphasized how the important the transfer step is, to ensure the tool's successfully dissemination to the target group.
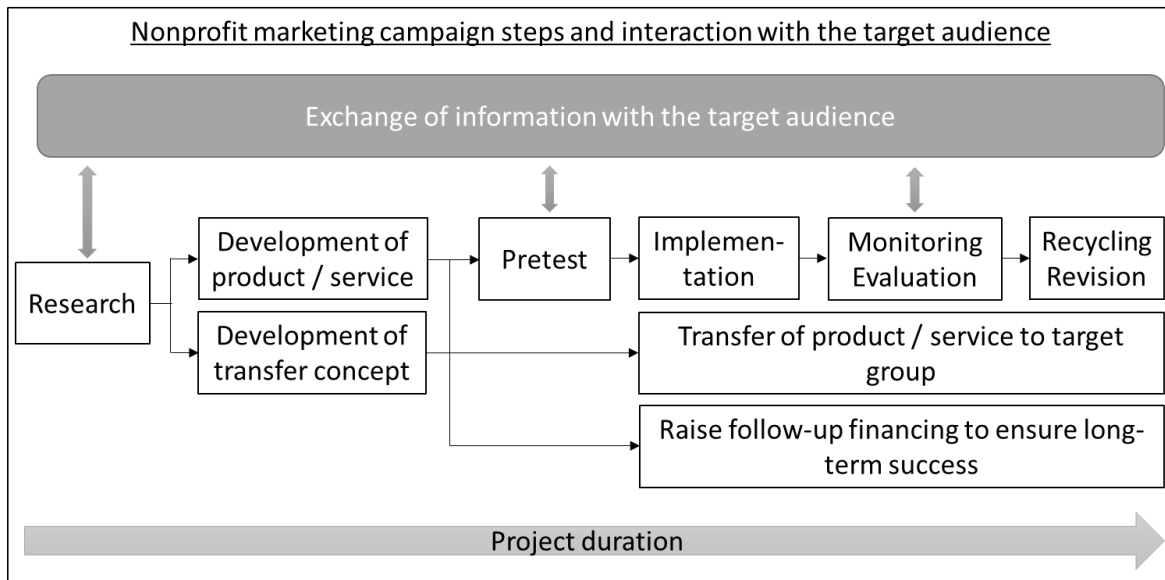
Figure 6: Nonprofit marketing campaign steps and interaction with the target audience (Source: Strotmann et al. 2017 based on Andreasen und Kotler 2014).

Secondly, the LAV platform9 (LAV—Avoiding Food Waste, German: Lebensmittel Abfall Vermeiden) and the associated transfer concept are developed. This platform supports German SMEs in their food waste reduction efforts by gathering, preselecting, and structuring the tools that are most relevant. The tools were categorized by the following goals: analysis and planning, raising awareness, measuring and monitoring, procedures, and benchmarks and best practices; and by the following sectors: meat and fish, dairy, bread and bakery, fruits and vegetables, other producers, retail, restaurants, and public catering.

Conclusion

The development of the LAV platform is a positive example of the application of the Marketing Campaign Guide and also for the coordinated work of all relevant stakeholders: During its development and transfer, the researchers worked hand in hand with businesses and branch associations. Besides, also politics was involved which lead to even more synergy effects after the platform had been finalized: At first, the platform's development and transfer to companies of the food sector was funded by the German Federal Environmental Foundation (Deutsche Bundesstiftung Umwelt) and after its finishing, the platform was taken over by the Federal Ministry of Food and Agriculture (Bundesministerium für Ernährung und Landwirtschaft, BMEL). In October 2017, the BMEL integrated the LAV platform on its newly established national platform against food waste10.

The Marketing Campaign Guide and the LAV platform both contribute to reach SDG 12.3 that calls for halving per capita global food waste at the retail and consumer level by 2030.

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9 http://www.lebensmittel-abfall-vermeiden.de/
10 https://www.lebensmittelwertschaetzen.de/

References

Andreasen, Alan R.; Kotler, Philip R. (2014): Strategic Marketing for Non-profit Organisations:Pearson New International Edition. United States Edition. Ed: Seventh ed., Pearson new international ed. Harlow : Pearson.

BVE (2016): Jahresbericht 2015_2016. Bundesvereinigung der deutschen Ernährungsindustrie. Available online http://www.bve-online.de/presse/infothek/publikationen-jahresbericht/jahresbericht-2016, checked 26.09.2016.

Dolnicar, Sara; Lazarevski, Katie (2009): Marketing in non-profit organizations: an international perspective. In: International Marketing Review 26; Jg. 2009-06-01 (3), S. 275–291.

Homburg, Christian; Becker, Jan (2000): Marktorientierte Unternehmensführung und ihre Erfolgsauswirkungen. eine empirische Untersuchung. In: Reihe: Wissenschaftliche Arbeitspapiere 2000.

Kotler, Philip; Keller, Kevin Lane (2006): Marketing management. 12. Aufl. Upper Saddle River, NJ: Prentice-Hall.

Meffert, Heribert; Bruhn, Manfred; Hadwich, Karsten (2015a): Dienstleistungsmarketing: Grundlagen - Konzepte - Methoden. 8. Aufl. Wiesbaden: Springer Fachmedien Wiesbaden.

Meffert, Heribert; Burmann, Christoph; Kirchgeorg, Manfred (2015b): Marketing: Grundlagen marktorientierter Unternehmensführung Konzepte - Instrumente - Praxisbeispiele. 12., überarb. u. aktualisierte Aufl. 2014. Wiesbaden: Springer Fachmedien Wiesbaden.

Söllner, René (2014): Die wirtschaftliche Bedeutung kleiner und mittlerer Unternehmen in Deutschland. Hg. v. Wiesbaden Statistisches Bundesamt. Available online https://www.destatis.de/DE/ZahlenFakten/GesamtwirtschaftUmwelt/UnternehmenHandwerk/KleineMittlere UnternehmenMittelstand/Methoden/BedeutungKleinerMittlererUnternehmen_12014.pdf?__blob=publicatio nFile, checked 20.09.2018.

Strotmann, Christina; Niepagenkemper, Linda; Göbel, Christine; Flügge, Fara; Friedrich, Silke; Ritter, Guido; Kreyenschmidt, Judith (2017): Improving Transfer in the Food Sector by Applying a Target Audience-Centered Approach—The Development of a Nonprofit Marketing Campaign Guide Based on a Case Study of the LAV Platform. In: Sustainability 9, S. 512.

Vahs, Dietmar; Brem, Alexander (2015): Innovation Management: From ideas to successful implementation ; Innovationsmanagement:Von der Idee zur erfolgreichen Vermarktung. Denmark, Europe: Schäffer-Poeschel Verlag.