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**Faculty of Tropical
AgriSciences**

**Reducing food losses and wastes in the cereal sector: an
option for strengthening global food security**

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Declaration

I hereby declare, that I have written this master thesis “Reducing food losses and wastes in the cereal sector: an option for strengthening global food security” by myself with the help of literature listed in references.

In Prague, on April 18,2016

.....

Adam Tomka

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Abstract

Feeding nine billion people by 2050 puts the challenge on sustainable consumption and sustainable use of resources. The food surpluses emerge through the all stages of food supply chain. The food surpluses may be either used as compost, animal feed, donation and incinerated with energy recovery or landfilled without further use. The food waste is associated with inappropriate management of food surpluses and occur mainly at retail and household level. The management of food surpluses is assessed by the degree of recoverability. The objective of this thesis is to identify the main food waste drivers of bakery products at consumer level in the Czech Republic, the consumers purchasing manners and the way consumers manage food surpluses of bakery products. The sub objective is to investigate the volumes of wasted bakery products and propose a potential solution. The data was gathered through a structured questionnaire survey which was answered by 251 respondents. The results show that the volumes of food waste are relatively low since the bakery products have high degree of recoverability. The least waste was identified at group of consumers over 50 years (about 4%). The critical factor influencing the purchase of bakery products is freshness and quality (56%), not the price as it was supposed. More than a half of respondents buy bakery products at supermarkets (about 60%). The main drivers of food wastage are the lack of freshness (48%) and that the bread perishes (41%). The 80% of respondents were not aware about the consequences of food wasting and do not know the initiatives dealing with food waste. The solution is to frame the problem to public and to associate food waste with all its negative impacts and costs.

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List of abbreviations

FSC	Food supply chain
FW	Food waste
ASRW	Availability-surplus-recoverability-waste model
TOPB	Theory of Planned Behaviour
DoR	Degree of recoverability
HH	Household
RESP	Respondents

Key words

Food waste, food surpluses, sustainable consumption, shopping behaviour, causes of food waste, food storage, food waste initiatives, environment, household survey, bakery products, bread

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Introduction

About 1.3 billion tons of food are globally wasted every year while hundred millions of people are starving (Gustavsson, 2011). There are two kinds of food waste – avoidable and unavoidable. The avoidable food waste (FW) refers to edible food which was thrown away, for instance leftovers, while unavoidable food waste derives from the food preparation and it is not edible, for instance bones, shells, peels, etc. (Secondi, 2015). But what the FW actually is? It can be defined as “any food, and inedible parts of food, removed from the food supply chain (FSC) to be recovered or disposed of (including composted, crops ploughed in/not harvested, anaerobic digestion, bio-energy production, co-generation, incineration, disposal to sewer, landfill or discarded to see, animal feed)” (Fusions, 2015). Food production encompasses lots of resources, and hence, food waste emerges every time the food is not eaten by humans, any further use of food is considered to be inefficient (Aschemann-Witzel, 2015). The costs of FW are economic, social and environmental (Scholz, 2014). First, the financial costs occur at the producers’ side as well as at the consumers’ – it is estimated that FW in the United Kingdom costs every household 480 £ a year. Second, the world population is about to reach 9 billion people by 2050, hence the FW has a negative societal impact as it contributes to a food shortage (Stancu, 2015). The OECD Green Growth Strategy has set reducing FW and pressures on the climate and resources as a future challenge to be met (OECD, 2011). Third, resources such as land, water, fertilizers are being used in vain. Furthermore, food sector is responsible for 20-30% greenhouse gases (GHG) emissions. Therefore, sustainable consumption is essential in order to minimize these GHGs and diminish the negative consequences (Aschemann-Witzel, 2015).

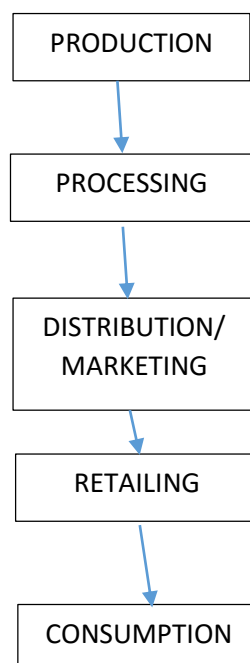
The aim of this study is to investigate one particular segment of sustainable consumption of food – food waste and from it just only consumption and waste of bakery products. The thesis is structured as follows: in the next part we review literature on food surpluses/waste in terms of its origin, categories, extent, drivers and approaches to its analysis. Afterwards, the objectives of the research are specified and the hypotheses stated. Methodology of study is mentioned in the following chapter. Before going to results, we will show some basic information regarding the location of study. Results of the survey are presented in Chapter Results. This is followed by discussion in Chapter Discussion and Limitations. In this particular chapter we will put our results in

the context of other studies. Last, the conclusions including suggestions for further research are given.

Literature review

The food waste and losses occur during the various phases of the FSC. According to Secondi et al. (2015), the FSC is divided into five different levels; the food production, processing, distribution, retailing and households (see figure 1). The food losses referring to losses during the production and processing are relevant for the developing countries due to a lack of technology and financial resources (Secondi et al., 2015); for instance, the inappropriate harvesting methods, lack of skilled labour force, no refrigerating trucks etc. According to Gustavsson (2011), about 40% of losses occur at the postharvest and processing stages in developing countries. A significant reduction in food losses could have a relevant impact on livelihoods of small farmers since they live on the margins of food security (Giroto, 2015). On the other hand, the food waste refers to waste at the retail and consumption stage and it is typical for the developed countries (Secondi et al., 2015). About 40% of food is lost at retail and household level due to inappropriate techniques, lack of coordination between actors in the supply chain, manners, inadequate planning etc. (Gustavsson et al., 2011; Giroto, 2015).

Figure 1) The Food Supply Chain



Source: SECONDI, Luca a Ludovica PRINCIPATO (2015). Household food waste behaviour in EU-27 countries. Food Policy. Pages 25-40

Retail related food waste

The retailers contribute to FW by poor stock management, high cosmetic standards, special discounts and favourable packaging. One may argue that they also contribute by the “use by” and “best-before” date labelling. However, these follows from regulations on food safety (Halloran, 2014; Aschemann-Witzel, 2015).

The high cosmetic standards encompass the visage of food; the colour, size, shape and freshness are typical indicators (Scholz, 2015). The problem is that people are accustomed to these standards and are not willing to pay the same price for food which does not meet them. On the other hand, Aschemann-Witzel (2015) stress that the consumers are willing to pay less for the food with visual imperfections. Moreover, the individuals with higher environmental awareness also tend to buy visually imperfect food (Aschemann-Witzel, 2015).

The retailers tend to “attract” customer by certain special offers; for instance “buy 2, get 1 for free”. This could be recognized as “nudging”, where retailers consciously influence or manipulate consumer’s choice (Thaler & Sustein, 2008). They still can buy only one piece, but it is more likely they will do opposite. On the other hand, the greatest retailer in Denmark, The COOP, started a campaign introducing a “single piece” goods in order to diminish the volumes of FW.

The use of date labelling such as “best-before” is not usually understood by consumers which leads to discarding edible food (Aschemann-Witzel, 2015); “best before” does not necessarily mean the food cannot be used after this date, it is only a recommendation saying when the food has the best quality. The lack of knowledge and awareness has led to the bad understanding of “best before” dates. (Godfray, 2010). Therefore, either further explanation or another measures should be provided in order to diminish FW; to make people understand the difference between “use by” and “best before”.

Consumer related food waste

Per capita food waste basis shows the difference between developed and developing countries – while a 95-115kg/year of waste is produced in Europe and North America, only 6-11kg/year is produced in Sub-Saharan Africa or in South/Southeast Asia

(Halloran et al., 2014). The EU project Fusions found out three general consumer-related factors regarding FW; the social factors, individual behaviour, perceptions of and expectations towards food, and consumers' lack of knowledge, awareness and skills (Aschemann-Witzel, 2015). By social factors it is meant for instance household composition, family life stage and lifestyles. It is likely that households including young children (under age of 15) waste more; for instance, due to uneaten leftovers, school snacks and pickiness of children. Aschemann (2015) argues that individual's perception and behaviour towards food are less affected by social norms since the food wasting is largely hidden. On the other hand, one may be unconsciously influenced by his environment; at some households, it may be normal to discard uneaten rest after the dinner, and therefore one might get easily used to it. Girotto (2015) stresses the need of individual to be perceived as a "good provider" in terms of supplying an abundance of healthy food for the family. Furthermore, some consumers dislike eating the same meal twice (Aschemann-Witzel, 2015). This triggers the over purchasing, where individuals tend to buy too much stuff which is afterwards discarded.

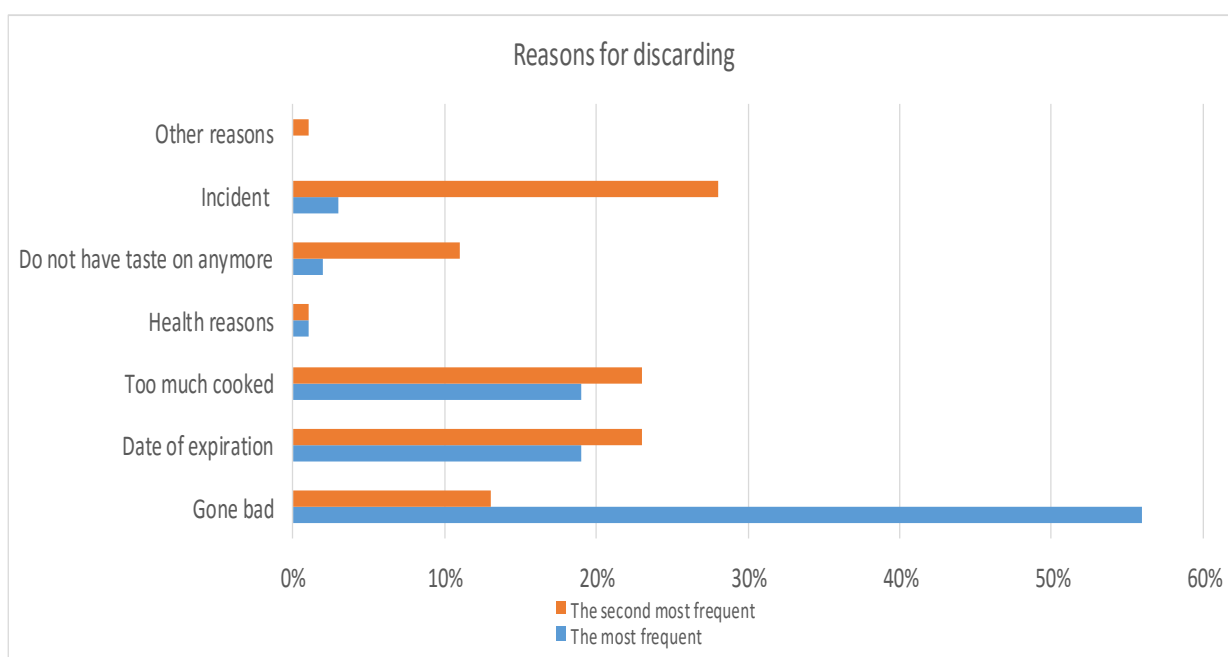
The last category identified by the EU project Fusions is lack of knowledge, awareness and skills (Aschemann-Witzel, 2015). The consumers may lack the knowledge of proper storage. Therefore, a significant part of purchased food ends up discarded. Different ways of storing food are recognized; freezing, refrigeration, pantry storage and drying. As T. Brown (2014) mentions, in the UK over 630 000 tonnes of "freezable" food worth £ 2.3 billion is being discarded annually. That food could have been frozen and eaten later if it had been put into freezer before it got spoiled; for instance, bread's storage life could be extended up to 3 months when it is properly frozen (Tom Brown et. al, 2014). However, the freezing of food is not only about putting into freezer, certain conditions have to be met in order to extend the storage life of food, the appendix 3) shows the appropriate steps regarding 12 basic groups of food. One may argue that freezing costs energy and produces CO₂ emissions. However, the study carried out by T. Brown et. al (2014) showed the opposite; both financial and environmental costs regarding food addition to freezer are much lower than wasting food itself.

The issue regarding storage is that consumers keep a stock of food which is potentially never used; the ingredients purchased for special recipes, items bought in special offer.

These goods are eventually thrown away at some point (Aschemann-Witzel, 2015). Again, this is linked to the skills and abilities of the consumer as these ingredients might be used in other way.

The Czech Sociological Institute (2014) analysed reasons leading to households' FW. The respondents had two options to answer; i) the most frequent reason, ii) the second most frequent reason. The 56% of research attendees argue that the most frequent reason for FW is that the food got spoiled. Furthermore, identically 19% of respondents chose expired "use by" date and over-cooking as the most frequent answer. This confirms the statement of Aschemann-Witzell (2014), that people are influenced by the "use by" and "best before" dates; they might discard food which is still edible. The 28% of citizens chose that the waste emerged by an accident; for instance, the burnt food, food fell on the ground, etc. (CVVM, 2014). The health issues and the other reasons were chosen by 1% of the respondents and therefore are not seen as the important causes of FW.

Figure 2) The causes of FW

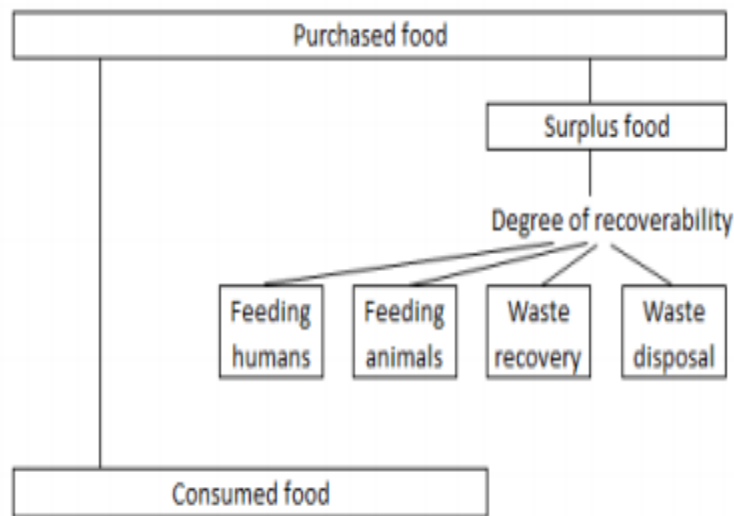


Source: CVVM (2014). Občané o způsobu zacházení s potravinami – duben 2014 (Citizens about the way of food handling – April 2014). Press release. The institute of Sociology, the Czech Academy of Sciences. <http://cvvm.soc.cas.cz/ostatni-ruzne/postoj-obcanu-k-plytvani-potravinami-duben-2014>

The management of food surpluses

Garone (2014) introduced the ASRW model (i.e. Availability-Surplus-Recoverability-Waste) which presents the possible ways of management of food surpluses. He distinguishes between four main categories of food surplus management; i) feeding humans, ii) feeding animals, iii) waste recovery and iv) waste disposal. The shift from surplus food to food waste is determined by the DoR, i.e. degree of recoverability (Garrone, 2014). The degree of recoverability differs amongst the different levels of FSC and food categories (Garrone, 2014). The households are supposed to manage food surpluses with low DoR level since they tend to get rid of these surpluses through disposal. On the other hand, the retail stage seems to have a potential for the high DoR, depending on the way of management (Garrone, 2014; Erikssen, 2015).

Figure 3) The ASRW conceptual model



Source: GARRONE, Paola, Marco MELACINI, Alessandro PEREGO, et al (2014). *Opening the black box of food waste reduction: A review*. DOI: 10.1016/j.foodpol.2014.03.014. ISBN 10.1016/j.foodpol.2014.03.014 Available at: <http://linkinghub.elsevier.com/retrieve/pii/S0306919214000542>

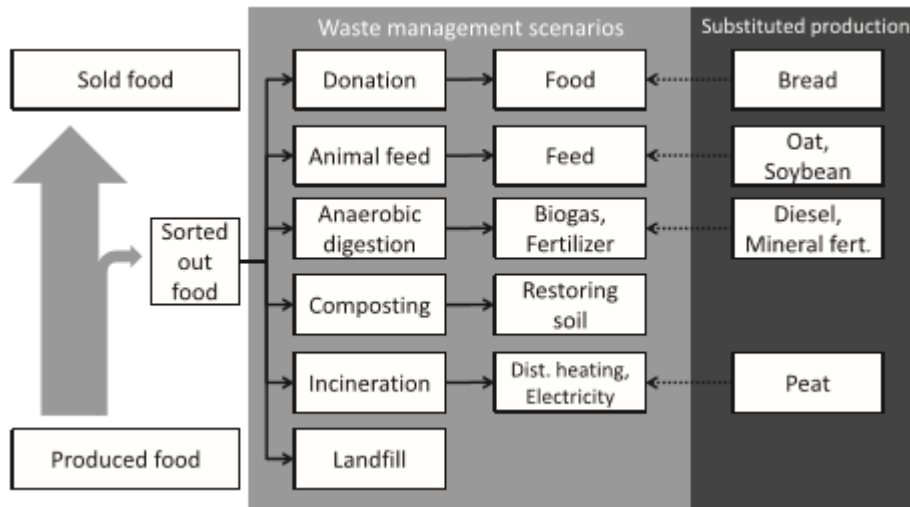
From production to retail

In general, the retail can be divided into two parts; the distribution centres and stores (Garrone & Melacini, 2014). The distribution centres have a high degree of food recoverability (DoR) since the most surplus food consists of packaged products which are ready for consumption and have a minimum remaining shelf life of one week (Garrone & Melacini, 2014). Therefore, the surplus food can be either donated or used as animal feed. On the other hand, the stores have a medium-low DoR. First, the shelf life remaining is usually very low. Second, there is not much space for surplus food at stores. Thus, the food is being disposed of instead of donation etc.

Eriksson and Strid (2015) distinguish between six possible ways of food surplus management, from production stage to retail; i) landfill, ii) animal feed, iii) anaerobic digestion, iv) composting, v) incineration and vi) donation (see Figure 4).

The landfill is a common way of food disposal worldwide (Menikpura, 2015), where the gathered organic waste is put into ground, compacted by machines and covered when full. Afterwards, the microbes consume carbohydrates, fats, proteins and other available carbon sources present in it (Eriksson and Strid, 2015). The lack of oxygen triggers the anaerobic digestion responsible for creation of methane, a potent greenhouse gas. As Erikssen and Strid (2015), the landfill has the highest environmental burden in terms of greenhouse gas emissions. The main GHG contributors are transport, maintenance of the machinery and the production of methane and carbon dioxide (Erikssen and Strid, 2015).

Figure 4) The Waste disposal from production to retail



Source: ERIKSEN, Mattias a Ingrid STRID (2015). Carbon footprint of food waste management options in the waste hierarchy. *Journal of cleaner production*. 57-65.

The incineration with energy recovery transforms the energy from waste burning into an electricity or heating. Besides the organic waste, peat, wood and oil are used as a fuel (Vattenfall, 2013). The example could be Copenhagen’s incineration plants which consume about 39% of all waste gathered covering the energy consumption of 70 000 households, 210 000 MWH of electrical energy and 720 000 MWH of heat (DAC&Cities, 2014). These plants nowadays replace the previous most common way of waste disposal in Denmark, landfilling.

Further way of waste disposal is composting. According to Eriksson and Strid (2015), the organic waste is dumped in the waste container at supermarkets and then driven to composting facility, where it is put into windrows. The compost is used as a soil amendment, replacing artificial solutions (Eriksson and Strid, 2015). The composting is also common way of consumer food surplus management, since the households with garden can use it for gardening.

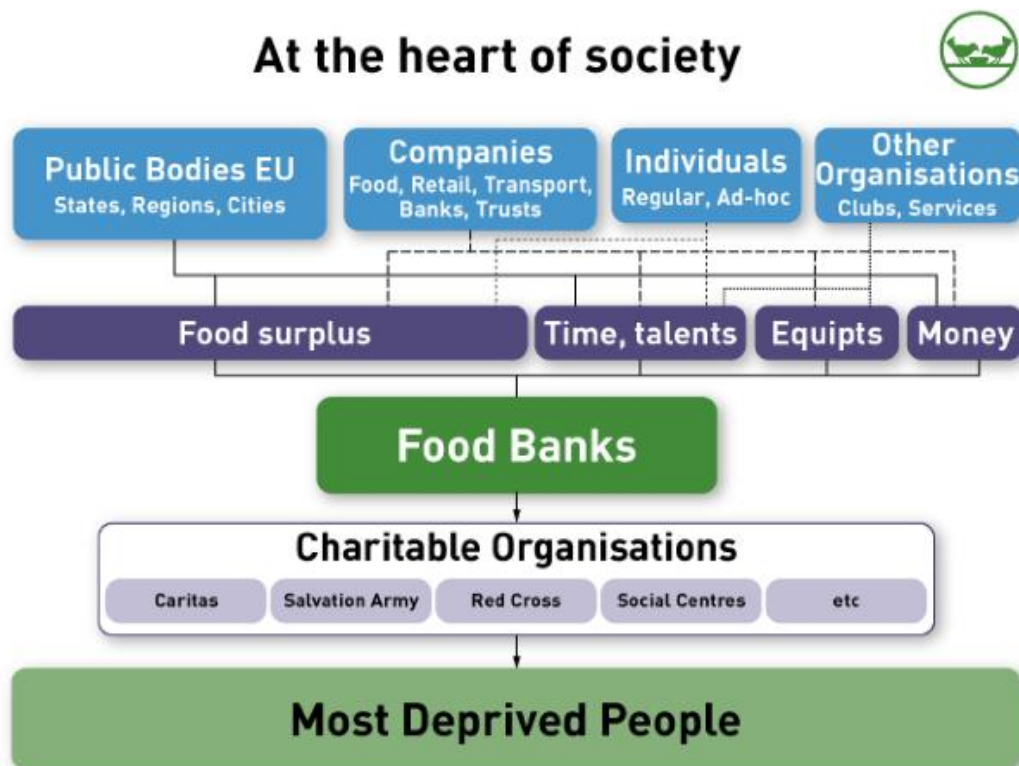
Feeding animals with food waste is highly restricted in the EU. To become eligible for feeding animals, supermarkets need to be registered as feed producer and separate all animal products from those with a vegetative origin (Erikssen & Strid, 2015). This option contains many risk so the rules are very strict for what can become an animal

feed. The example for animal feeding with waste is bread. Some producers take back unsold bread from supermarkets which is afterwards used as a feed for pigs, replacing oats as a primary feed (Erikssen & Strid, 2015). This option is environmentally friendly since the bread would have been otherwise landfilled or incinerated.

The anaerobic digestion transforms waste into slurry, which can be used as a fertilizer and into biogas, which can be used as a source of energy. This method is typically used in rural and semi-urban areas in developing countries, where biogas serves as an energy source for heating and/or cooking and slurry as fertilizers for growing crops (Macháčková, 2015). This way of waste disposal is seen as the most viable option in terms of GHG emissions (Erikssen and Strid, 2015).

The further way of food surplus management is food donation. The food which supermarkets consider to be unsellable even though it is still edible go to charity (Erikssen & Strid, 2015). This food must be safe to eat and supermarkets have to guarantee it. Therefore, some of the food is discarded due to damaged packages, passed use-by date etc. It is important to mention that this food would otherwise be thrown away. The typical organizations gathering donated food are the Food banks which collaborate with certified manufacturers, caterers and retailers (Euro Food Bank, 2015). First, Food banks gather food from all stages of FSC. Then the food is delivered to certified charities which finally give the food to people in need (Euro Food Bank, 2015). This way of food surplus management has an advantage that the food is consumed by people.

Figure 5) The Food Bank scheme



Source: Food bank scheme. In: EURO Food bank [online]. [cit. 2016-04-06]. Available at: <http://www.eurofoodbank.eu/food-banking/an-efficient-model>

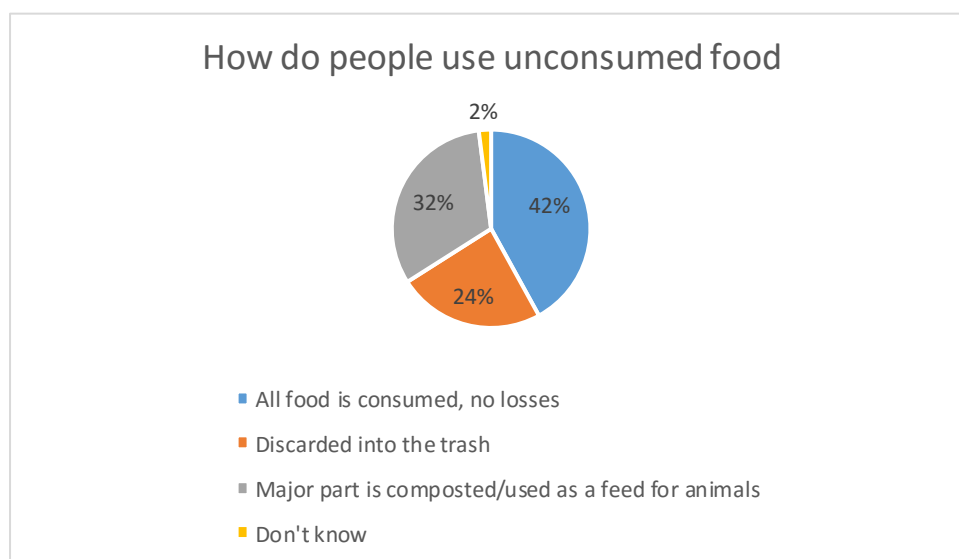
The study commissioned by the European Economic and Social Committee regarding current legislation and practices concerning food donation shows five main legislative hurdles; product liability, food safety and hygiene, food durability and date marking, tax legislation, and the food waste hierarchy (Euro Food Bank, 2015). The tax legislation was a recent topic in the Czech Republic, where donated food used to be taxed, and therefore supermarkets managed the food surpluses in cheaper way. However, the new zero tax policy was implemented and supermarkets now have the option to donate the food for free (Zprávy Aktuálně, 2014). Hopefully, this would lead to the higher share of food donations in food disposals while more people in need will have an access to it.

In general, the retail's food surplus management has a high degree of recoverability since the most surpluses consist of packaged products which are ready for consumption and have a minimum remaining shelf life of one week (Garrone & Melacini, 2014).

Consumers' management of food surpluses

The study conducted by the Czech Sociological Institute (2014) identified the consumers' food surplus management. The respondents were given four different options to choose; i) all food is eaten, no waste ii) discarded into trash, iii) composting/animal feeding and iv) do not know.

Figure 6) The way consumers deal with food surpluses



Source: CVVM (2014). Občané o způsobu zacházení s potravinami – duben 2014 (Citizens about the way of food handling – April 2014). Press release. The institute of Sociology, the Czech Academy of Sciences. <http://cvvm.soc.cas.cz/ostatni-ruzne/postoj-obcanu-k-plytvani-potravinami-duben-2014>

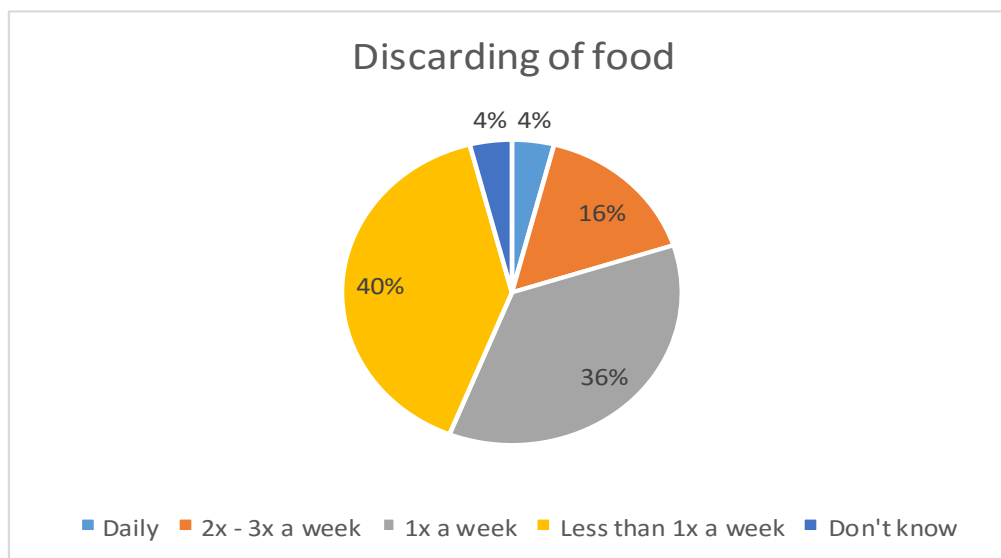
The results show that the major part of respondents indicated (believed) that they consume all food and do not waste (42% of respondents). Then second ended up animal feeding and composting (32%) followed by food discarding (24%). These results contrast with the study conducted by Garrone and Melacini (2014), where food disposal (throwing away) was found as the first option used by consumers.

Only 2% of respondents did not specify the way they deal with surpluses. In a deeper analysis, the results show that people from countryside and small cities (below 80 000 inhabitants) often use FW for composting and/or animal feed (CVVM, 2014). It seems logical since they have the access to garden and/or livestock. On the other hand, the

respondent from cities (above 80.000 inhabitants) claim that they discard food into trash. The area of stay therefore shows a significant influence on the way people deal with unconsumed food. Moreover, the influence of household income was analysed where HHs with higher salaries (above CZK 40 000) tend to waste more than the ones with lower incomes (below CZK 15 000).

As a link-up to the previous question, respondents were asked about the frequency of food disposal. The 40% of citizens claim they throw away food less than once a week. Further 36% of respondents dispose of food once a week. On the other hand, identically 4% respondents claim they either throw away food daily or they do not know. The results indicate that people from the countryside and smaller cities dispose of food more environmentally friendly, but also more often than people from the cities (CVVM, 2014). Furthermore, the non-economically active citizens tend to waste more often according to the results. The question is why people with lower incomes tend to waste more often.

Figure 7) The frequency of food disposal

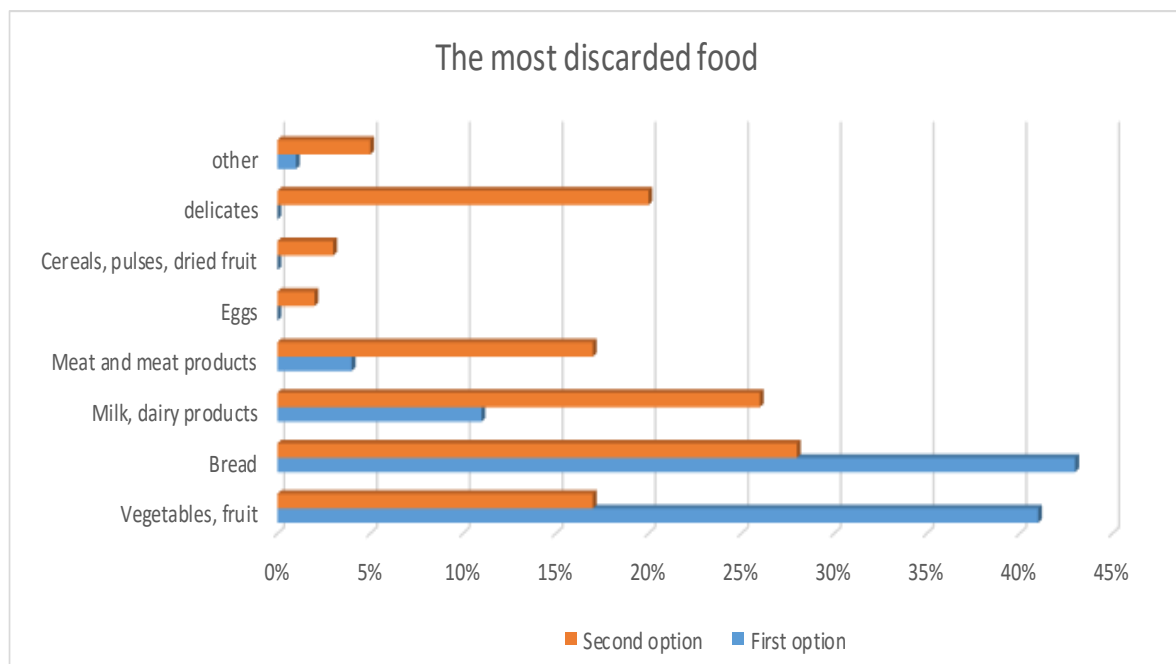


Source: CVVM (2014). Občané o způsobu zacházení s potravinami – duben 2014 (Citizens about the way of food handling – April 2014). Press release. The institute of Sociology, the Czech Academy of Sciences. <http://cvvm.soc.cas.cz/ostatni-ruzne/postoj-obcanu-k-plytvani-potravinami-duben-2014>

The food waste categories

The consumers' food wasting depends closely on the food category. The Czech Sociological Institute (2014) undertook a research regarding food waste in the Czech Republic in 2014. The data was gathered through structured interviews and survey, it contained five main questions. The answers were obtained by 590 respondents. The bread was chosen as a first (primary) option by the most respondents, followed closely by fruit and vegetables (CVVM, 2014). Bread also had the highest ranking in terms of second (secondary) option. This seems logical since bread, fruit and vegetables are likely to perish the easiest. Interesting is, that vegetables and fruits did not end up second in the second option (CVVM, 2014).

Figure 8) The categories of most discarded food



Source: CVVM SOÚ AV ČR, v.v.i., Our society 7. - 14. 4. 2014, 590 respondents older than 15 years, personal interview

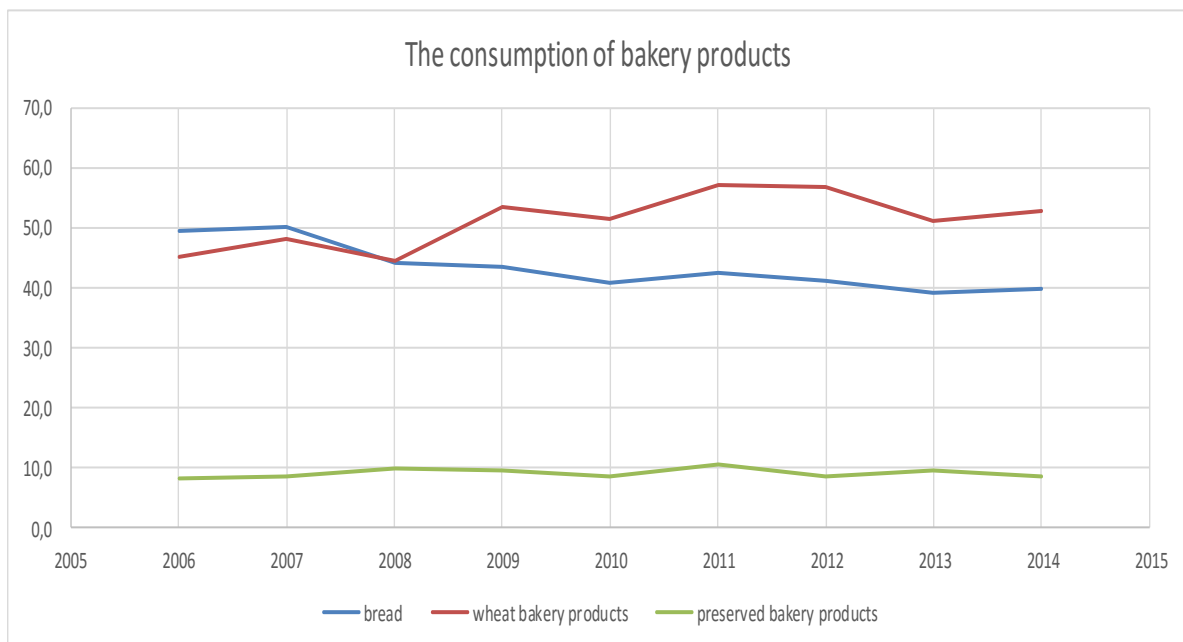
Fruit and vegetables take the first place in wasted food also in supermarkets. Scholz and Eriksson (2014) carried out a study focusing on food waste in six Swedish supermarkets and its environmental impact. Fruit and vegetables were responsible for 85% of wasted mass. However, it corresponds “only” to 46% of the overall GH emissions produced. On the other hand, meat products are not wasted in such volumes, but the environmental

impact is much higher. Unfortunately, bread was not a part of research so it cannot be compared with CVVM results.

The consumption of bakery products in the Czech Republic

The significant shift can be seen in the development of consumption of bakery products in the Czech Republic. During the last ten years, the consumption of bread has decreased by 10 kg from 49,5 kg in 2006 to 39,3 kg in 2010, per capita. In contrast, the consumption of wheat bakery products has been increasing, rising from 45,3 kg in 2006 to 52,7 kg in 2014 (ČSO, 2014).

Figure 9) The consumption of bakery products in the Czech Republic



Source: Spotřeba potravin (The consumption of food). In: Český statistický úřad [online]. 2014 [cit. 2016-04-16]. Available at: <https://www.czso.cz/csu/czso/spotreba-potravin-2014>

Obviously, the younger generation tends to buy other types of bakery products; this was analysed through the focus groups in a study conducted by Ratering et al (2015). Thus, it is to focus on the motives influencing the purchase of bread. These will be analysed in the result chapter.

Initiatives fighting against food waste

The important factor influencing consumers' FW is the price of food. Nowadays, the food is relatively cheap in the developed world, so people do not pay much attention to FW (Godfray, 2010). The price of food refers to so called food accessibility which is one of four pillars of food security. The majority of people in developed world have the access to food and therefore they do not pay much attention to their wastage. The question is how to actually persuade consumers to pay some attention to the issue. Nowadays, many initiatives are trying to inform people on FW and on the ways how to prevent it. One of the best known initiatives is WRAP (Waste & resource action programme), established in 2000 and located in England & Wales (WRAP, 2016). Its program called "Love food, hate waste" provides people with information regarding FW, with tips and hints of proper storage, with advices on how to save food or how to recover it. Moreover, a useful cookbook is available online where citizens can find recipes with use of leftovers. Such initiatives may have a big influence on people's behaviour, highlighting not only financial burden of FW but also environmental and social impacts. "Love food, hate waste" is currently preparing a great event called "The Big Freeze", where people have a chance to get some knowledge about proper storage of food. More information is available online; <http://www.lovefoodhatewaste.com/content/big-freeze-10-cities-tour>.

Another interesting event regarding FW took place in Prague in 2013. The initiative called "Save food" arranged an event "The Feast for a thousand" where people were invited for a free lunch. All courses were prepared from food close to expiry date from supermarkets which would have been otherwise discarded. The famous local chefs were invited in order to give some credit to the event and to attract more potential visitors. The feast was followed by different seminars providing attendees with facts regarding FW and some useful knowledge (Zachraň jídlo, 2016).

The Food use for Social Innovation by Optimizing Waste Prevention Strategies (FUSIONS) is a programme funded by the European Commission Framework Programme 7 (Fusions, 2016). It has 21 partners from 13 countries, it collaborates with universities, research institutes, consumer organizations and private organizations. The project has the ambition to contribute to FW monitoring, improved understanding of the

extent to which social innovation can reduce food waste and the development of guidelines for future common EU policies (Fusions, 2016).

The potential for the action

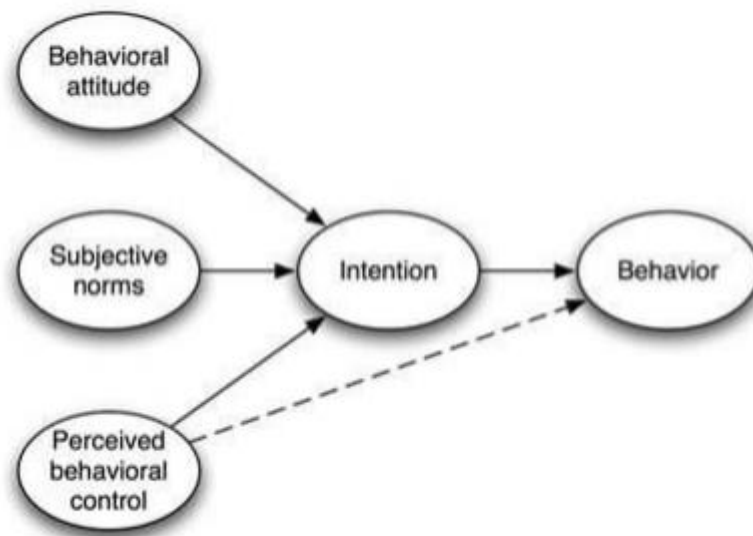
As Ascheman-Witzel et al. (2014) argue, one of the reasons for wasting is lack of awareness and knowledge of consumers. They do not associate FW with all the impacts, with the environmental burden as well as with social challenge of feeding 9 billion people in 2050. Therefore, helping people with understanding the consequences of their wasting seems to be a viable way in order to lower volumes of FW.

The appropriate framing of the FW issue might have a positive impact on consumers' awareness. The frames are built over a prolonged period of time and telling a certain message in different ways to various target audience (Lakoff, 2010). According to Kahneman (2011), losses evoke strong emotions as well as costs and thus this may cause a stronger emotion when thinking of food waste; simply associate food waste with losses and for instance financial costs. However, the framing might have an opposite effect as well; putting food close to expiry date for cheaper price might evoke a feeling that every food close to that date is low quality and therefore non desirable by consumers.

The Theory of Planned Behaviour model is based on assumption that people act intentionally and they seek to maximize their utility of a particular behaviour (Vernplanken, 2011). According to this theory, the behaviour is influenced by intentions which are determined by attitudes, subjective norms and perceived behavioural control (Vernplanken, 2011). Assuming that customers are economically oriented, it will make sense to them to seek the maximum utility when purchasing bread or bakery products. According to Stancu et al (2015), the consumers are waste aversive and therefore there is reason to believe that intentional processes might influence their FW behaviour. Moreover, the results of study conducted by Stancu (2015) show, that intention not to waste is determined by attitudes and norms; the more individuals believe that they should not waste, the stronger their intention not to do so.

However, they may lack the knowledge of how to store food or manage food surpluses. Therefore, helping people in these areas by for instance leaflets in supermarkets, campaigns, cookbooks with recipes of leftovers etc. might lead to lower FW produced by them – simply show the benefits of appropriate storage or consumption planning (Vernplanken, 2011).

Figure 10) The Theory of Planned Behaviour



Source: Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes*, 50, 179-211

This theory might be implemented amongst the entire FSC; every stage has a potential in decreasing the FW emitted..

Objectives

The objectives of this study are to identify the main causes of waste of bakery products made by consumers in the Czech Republic, analysis of consumers' purchasing manners and the development of proposal of the potential action. The sub objectives are to determine the amount of FW of bakery products generated by consumers, to identify the way in which consumers actually manage the food surpluses. Last sub objective is to specify the FW drivers/triggers.

Hypothesis

The price is assumed to be the main driver influencing purchase of bakery products. The consumers are supposed to purchase the most of the bakery products at supermarkets. The disposal of bakery products is expected to be mainly due low durability (freshness). Moreover, the older consumers are likely to waste less due to their lower incomes. The respondents from small cities and countryside are assumed to treat food surpluses more environmentally friendly; feeding animals, composting. Last, the consumers are assumed that they do not plan their consumption in advance.

Methods and Data

For the literature review, the databases Science Direct and Scopus were searched in order to get underlying knowledge, using “food waste” as a key word, title, abstract. Different approaches were found in the literature; the composition of discarded food in bins (Schott & Andersson, 2014), structured surveys, food consumption and waste diary, etc. The analysis of discarded food in bins is an accurate method, but very costly. Furthermore, the method identifies the composition of waste and volumes, however, it is impossible to count the volumes per capita. The diaries are difficult to maintain as they have to be updated daily and not many respondents would be willing (and able) to do it. On the other hand, this method might at the same time reduce the food waste and thus serve as a food waste prevention technique; the consumers have to think about their waste and that may evoke the feeling of guilty every time they throw something away.

The three main methods are used in the analysis; i) questionnaire survey on consumption and waste of bakery products at Czech households, ii) comparison of different data, iii) data mining regarding the recent changes in consumption of bakery products.

Primary data was gathered through structured online survey consisting of two parts. The first part included eleven questions focusing on identification of respondents – the age, income, origin, level of income etc. The second part consisted of fifteen questions focusing mainly on study objective – what kind of bread do consumers buy, how are they dealing with leftovers etc. Moreover, one open question was included at the end of the survey. See the list of questions in the appendix 1). The questionnaire was posted in January 2015 online and had been active for three weeks. The answers might be distorted since the respondents could not have answered sincerely. The data set was afterwards processed using pivot tables, where different variables were sorted according to specific characterizations (for instance waste sorting according to age of respondent). The Analysis of Variance (ANOVA) and Chi squared test were used in order to test significance of data. The Chi squared test was conducted by the MS Excel function `chisq.test`, where observed and estimated values were put as an input.

The Chi square test is used where the results are represented by frequencies where ANOVA is used at questions with attempts; for instance, the respondents were given a certain amount of points and they had to distribute it amongst four different options.

The secondary data was obtained by data mining and analysis of previous research carried out by the Czech Sociological Institute (2014) regarding Food waste and the causes behind it.

The basic economic indicators

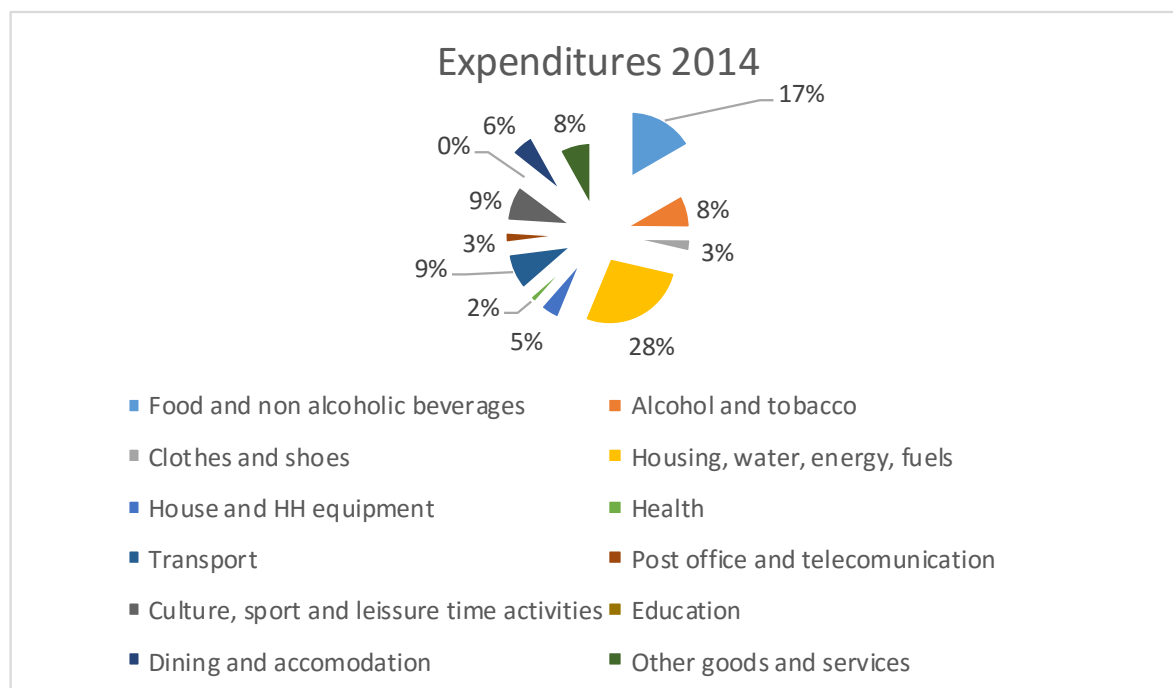
According to the server Finance (2014), the GDP per capita is CZK 369 507 in the Czech Republic. The distribution of GDP is shown as percentage shares in the following figure; as can be seen, the greatest share of 59.3% stands for Services, followed by 38% share for industry and 2.7% for agriculture (see the figure in appendix).

The HDI (human development index) is 0.87, which classifies Czech Republic between developed countries (World Bank, 2014). The unemployment rate of 7.5% was observed by the Czech Statistical Office in 2014 (ČSÚ, 2015). Last, average salary in 2014 reached CZK 25 560 (ČSO, 2015).

The Household expenditure categories

The study was conducted in the Czech Republic as a representative of developed country, where the FW occur mainly at retail and HH stage. According to the Czech statistical office (ČSÚ), average Czech HH spend the most part of its income on housing, energies, fuels and water. Surprisingly, about 17% of its income is spend on food (ČSÚ, 2014). Therefore, it seems logical that HHs might save significant amount of money by consumption planning.

Figure 11) The distribution of Czech household expenditures



Source: Spotřeba potravin (The consumption of food). In: *Český statistický úřad* [online]. 2014 [cit. 2016-04-16]. Available at: <https://www.czso.cz/csu/czso/spotreba-potravin-2014>

On the other hand, the Czech HH spend the least money on HH equipment, post office/telecommunication and education; 5%, 3% and 0%, respectively (ČSÚ, 2014).

Results and discussion

Identification data

This part shows the composition and characteristics of sample of respondents. It serves for the explanation of data sample; it shows the age distribution of respondents, the origin, the gender, the income, the composition of households in terms of members and children.

The Table 1) shows the gender composition with respect to the age of respondents. The table shows that the sample is relatively well distributed in terms of age category but not in terms of gender. Therefore, the results are likely to be biased.

Table 1) The age/gender distribution of sample

Age category/gender	Men	Women	Total
19 - 29	20	44	64
30 - 39	21	32	53
40 - 49	6	33	39
50 - 59	10	37	47
60 and more	17	31	48
Total	74	177	251

Source: own research

The economic status and the origin of respondents are included in following Table 2). Seven different economics statuses were used to the study; i) unemployed, ii) student, iii) student with job, iv) fully employed, v) partly employed, vi) retired, vii) retired with part time job). It shows that the main part of respondents is fully employed and comes from the big cities (more than 100 000 inhabitants). Some of the groups are merged in the second part of research. The place of origin is divided into three categories; i) countryside consisting of less than 5 000 inhabitants, ii) small city with up to 100 000 inhabitants and iii) city with more than 100 000 inhabitants.

Table 2) The economic status/residence of respondents

Economic status/origin	Countryside	Small city	City	Total
Unemployed	1	1	4	6
Student with job	12	5	19	36
Student	4		12	16
Retired	7	4	13	24
Retired with part time job			10	10
Partly employed	2	1	6	9
Fully employed	28	16	106	150
Total	54	27	170	251

Source: own research

The income is generated by all members of the households together. The Table 3) shows the number of family members with respect to the income; the more members in households, the higher the income. The income values are in thousands CZK. The average income in this sample could be calculated as follows:

$$\sum \frac{\text{Mid value of interval} * \text{count of members}}{\text{total members}}$$

$$= \frac{(15\,000 * 34) + (25\,000 * 39) + (35\,000 * 67) + (40\,000 + 111)}{251}$$

$$= 32\,948 \text{ CZK}$$

However, the result is distorted since the upper boarder of last interval is unknown.

Table 3) The size and income of HHs

Count of members/income	10 - 19.9K	20 - 29.9K	30 - 39.9K	> 40K	TOTAL
1	14	6	3	2	25
2	12	23	25	25	85
3	5	5	13	37	60
4 and more	3	5	26	47	81
TOTAL	34	39	67	111	251

Note: the values in quadrants are frequencies -> for instance, 23 respondents are from the HH consisting of 2 members with income between CZK 20 000 – CZK 30 000.

Source: own research

As can be seen, the most represented group is a HH consisting of 2 members and the income above CZK 30 000.

The same formula is used for the calculation of average income of each household, depending on number of household members. Results are as follow:

Table 4) The average income with respect to number of HH members

	15K	25K	35K	40K	Average HH income
1	14	6	3	2	21 800,00 Kč
2	12	23	25	25	30 941,18 Kč
3	5	5	13	37	35 583,33 Kč
4 and more	3	5	26	47	36 543,21 Kč

The results show the higher the count of members the higher the household income. Results might be distorted due to the unequable distribution.

The last identification part focuses on the influence of education on waste sorting. From 251 respondents only twenty (8%) argue they do not sort waste. The difference shows up if the focus is taken on each category; 18% of respondents with vocational education, 13% of resp. with maturita and only 5.6% of resp. with university degree do not waste, respectively.

Table 5) The education/ level of waste sorting of respondents

Education/sorting of waste	NO	YES	TOTAL
Primary		3	3
Secondary - vocational	2	11	13
Secondary - maturita	10	75	85
Third	8	142	150
TOTAL	20	231	251

Note: 1) the count of each quadrant is in absolute values

Source: own research

The results are similar to the study of Czech Sociological Institute (CVVM, 2014A) where 83% of citizens sort waste on regular basis.

Research results

For the beginning of analysis, the perception of FW amongst respondents with different education was analysed. The resp. were asked if they perceived FW as an actual social problem to be solved. The education categories were aggregated in order to undertake Chi square test and distributed into two groups; i) respondents with secondary education, ii) resp. with tertiary education. The resp. were given four options to answer; i) yes, but there are another problems with higher priority, ii) no, it is natural, iii) do not know and iv) definitely. The results indicate that resp. with higher education tend to perceive FW as a problem more than ones with secondary education; 96% and 87%, respectively. Only 9 respondents claim that FW is natural and do not consider it a problem. Better sample of respondents is needed to prove the influence – reaching more individuals with primary education.

Table 6) The perception of FW

Education/FW perception	Yes	No, it is natural	Do not know	Definitely	Grand total
Secondary and less	37%	6%	7%	50%	100%
Tertiary	32%	2%	2%	64%	100%
Grand TOTAL	34%	4%	4%	59%	100%

Source: own research

Despite the fact, that the most respondents consider FW to be an actual problem, they are not aware of programs and initiatives which are dealing with this issue. This was analysed through an essay question. The results indicate that 20% of respondents mentioned at least one programme/initiative regarding FW.

The table below analysis the influence of gender on purchasing plan of food. The results indicate that major part of respondents (65%) plan their consumption for 2-3 days; 68% of men and 64% of women. The least respondents (16%) plan their consumption for 4 and more days; 14% of women and 20% of men. It seems that men tend to plan their consumption for a longer period than women. However, chi square test for ($\alpha 0,05 < X^2 0,15$) admits the null hypothesis, thus gender has no influence on consumption planning and is not statistically significant.

Table 7) The consumption planning by gender

	1 day	2 - 3 days	4 days and more	Grand TOTAL
Female	38	114	25	177
male	9	50	15	74
Grand TOTAL	47	164	40	251

Note:1) each quadrant shows the count of responses – total 251, respondents were enabled to select only one possible answer. The table shows observed values

Source: own survey

Table 8) The consumption planning by gender - estimated values

	1 day	2 - 3 days	4 days and more	Grand TOTAL
Female	33,14342629	115,6494	28,20717131	177
male	13,85657371	48,3506	11,79282869	74
Grand TOTAL	47	164	40	251

The estimated values for the chi square test are obtained by this formula, giving first quadrant as an example: $\frac{\text{Sum of first column (47)} * \text{sum of first row (177)}}{\text{total repondents (251)}} = 33.14$

The result for chi square was obtained by MS excel function chisq.test -> 0,15, where both observed and estimated data are analysed. The α value of 0,05 was used in order to test the significance of data set. After the mutual comparison is clear, that gender has no influence on consumption planning -> $\alpha 0,05 < X^2 0,15$. The null hypothesis is therefore admitted, the sample is random. Further data should be obtained in order to prove significance. This calculation serves as an example for the following tables.

The planned length of consumption was analysed also with respect to the way of storage. The respondents had four different possibilities to answer; i) store in a plastic bag, ii) in a freezer, iii) in a basket and iv) differently. Moreover, they had the possibility to circle all options. The results indicate that 57% of people who plan their consumption of bread for a one day prefer to store bread in a plastic bag. It seems logical since they do not know what they will do with rest at another time. On the other hand, the respondents who plan their consumption for four and more days, chose storing

in a freezer over other options. Since the quality of bread decreases with every day, it makes sense to put into a freezer when you have an overview of your consumption.

The respondents had the option to write the different way of storing directly into the answer. The most mentioned answers were as follows; in a wooden box, in a towel or in a paper tissue.

The results were analysed by Chi square test and were proven to be highly significant at $\alpha = 0,01$.

Table 9) The length of consumption planning with respect to storage

Consumption planning/storage	Basket	Freezer	Plastic bag	Differently	Grand TOTAL
N. of Responses	328				
2 - 3 days	22%	20%	46%	13%	100%
4 and more days	16%	39%	30%	14%	100%
Everyday	23%	11%	57%	9%	100%

Note: the respondent had the opportunity to choose all the answers

Source: own survey

The respondents were asked about their buying frequency of bread. The answers were structured as follows; i) every day, ii) 2 – 3x a week, iii) once a week and iv) less than once a week. The answers were analysed with respect to a gender of respondent. As can be seen at Table 10), the data are more or less same for both genders; about 70% of respondents buy bread twice/three times a week. The 20% of resp. claim that they purchase bread on daily basis. Last, about 10% of respondents buy bread once/less than once a week; these two groups were unified in order to proceed statistical analysis. The output is not significant at $\alpha = 0,05$.

Table 10) The shopping frequency by gender

Gender/shopping frequency	2-3x a week	Every day	Once/less a week	Grand TOTAL
Male	67,57%	16,22%	16,22%	100,00%
Female	68,36%	21,47%	10,17%	100,00%
Grand TOTAL	68,13%	19,92%	11,95%	100,00%

Source: own survey

The questionnaire survey also included a question regarding the purchase location of bread. The respondents were asked where they usually purchased bread and other bakery products. They had 100 points to distribute amongst four different options. The results are analysed with respect to the origin of respondent; countryside, small city and big city. The assumption was that people from big cities purchase bakery products at supermarkets, whereas the citizens from smaller cities might buy it at bakeries. The results indicate, that major part of bread is purchased at supermarkets regardless the origin of respondent. This make sense since the density of supermarkets is higher than bakeries in the Czech Republic. Moreover, the price of bakery products tends to be lower in the supermarkets, due to the volumes sold. The bakeries ended up second with 23% of all points. The bakeries are preferred more at small cities. Furthermore, people do not bake their own products in general, the share of 6% of all points. According to these results, the respondents from countryside tend to bake their own products a bit more than the ones from big cities (difference of 4%).

Table 11) The purchase place by residence of respondent

Origin/place of purchase	Supermarket	Bakery	I do it myself	Another place	Grand Total
Small city (up to 100K of resp.)	59%	25%	6%	9%	100%
Big city (over 100k of resp.)	66%	21%	4%	8%	100%
Countryside (up to 5k of resp.)	59%	22%	8%	11%	100%
Grand Total	62%	23%	6%	9%	100%

Source: own study

The tendency towards shopping in supermarkets was observed by Incoma GFK (2014); in their study the 84% of respondents chose supermarkets over other options. The statistical significance was proven by using two way ANOVA for $\alpha = 0,05$.

The 82% of respondent buy bakery products for the entire household, whereas only 18% buy it only for themselves. The HH

The next table analyses the factors influencing purchasing of bakery products. The question was formulated in terms of preferences – each respondent had to put the answers into favourable order. The respondent had five different options; routine, price, shop proximity, quality/freshness and origin of product. The most declared factors for the first preference are the freshness/quality and routine, followed by price, shop proximity and lastly origin. The result is that consumers do not care much about the origin of bakery products (put as a 5th preference by 51% of respondents). On the other hand, they care about the quality and price; quality was marked as the first preference by 56% of respondents and price by 34% of resp. as the second preference. However, the hypothesis for this question was, that price would be the main driver influencing consumers' choice.

Table 12) The factors influencing purchase of bakery products

		Routine	Price	Shop proximity	Quality/freshness	Origin
On average	1st	24%	7%	11%	56%	2%
	2nd	12%	34%	16%	19%	19%
	3rd	16%	30%	36%	8%	11%
	4th	25%	20%	21%	17%	17%
	5th	23%	9%	16%	0%	51%

Source: own survey

The following table analysis the bread type preferences of respondents. Each respondent was given 100 points which could have been distributed between four different options; common bread, common rolls and bulks, special bread (rye bread, whole grain bread, etc.), special rolls (rye, whole grain, etc.). Common bread was chosen to be the most purchased type of bread (9148 points of 25100), whereas special rolls/bulks ended up last (4078 points of 25100). People under 40 buy more normal rolls/bulks. On the other hand, respondents over 40 tend to buy more normal bread. Respondents over 50 prefer normal bread over other types. This might be influenced by the price where special rolls usually cost more than special bread in terms of price for a gram. The results are confirmed by the data of development of bread consumption mentioned in chapter *, where the consumption of normal bread has been decreasing; young people prefer to buy other types of bakery products.

Table 13) The bread preferences of respondents

	Common bread	Common rolls	Special bread	Special rolls	TOTAL
Total points given	9148	5679	6195	4078	
Age groups	The shares within the age groups				
All					
19 - 29	30%	22%	31%	17%	100%
30 - 39	34%	30%	21%	15%	100%
40 - 49	36%	24%	23%	18%	100%
50 - 59	37%	18%	28%	16%	100%
60 and more	48%	18%	18%	16%	100%

Note: The points given are shown as shares of each column.

Source: Own survey

When the data were aggregated into two age groups, the significance was proven by using ANOVA at α 0,01, except for special rolls&baguettes.

Table 14) The bread preferences - aggregated

Age categories	Common bread	Common rolls/bulks	Special bread	Special rolls	TOTAL
19 - 49	33%	25%	26%	16%	13045
50 and more	43%	18%	23%	16%	7977
TOTAL	38%	22%	24%	16%	25100

Source: own survey

The study also analyses the amount of purchased bakery products. The respondents were asked about the amount of bread they usually buy. There were five different options to answer; i) less than 260g, ii) 260g (equal to quarter of bread/6 rolls), iii) 525g (half of bread/12 rolls), iv) 1050g (entire bread/25rolls) and v) over 1050g. The groups were aggregated into three categories. The higher income of HH results in greater amount of bread purchased. It seems to be obvious since the HHs with greater salaries have more members. Therefore, it was analysed that on average a HH with an income up to CZK 30 000 has 2 members. Furthermore, the HHs with income over CZK 30 000 has on average 3 members.

About 46% of HHs with income over CZK 30 000 buy usually a half of bread/12 rolls. On the other hand, HHs with income up to CZK 30 000 buy 260 grams and less (53%). The data is significant for $\alpha = 0,05$.

Table 15) The volumes of purchased bakery products

Income	1050g and more	260g and less	525g	Grand TOTAL
30 000 - 39 999,-	19,40%	34,33%	46,27%	100,00%
40 000,- and more	22,52%	30,63%	46,85%	100,00%
10 000 - 29 999,-	13,70%	53,42%	32,88%	100,00%
Grand TOTAL	19,12%	38,25%	42,63%	100,00%

Note: the HH income is in CZK

Source: own study

The amount of purchased bread was also analysed with respect to frequency of bread purchase. The assumption was that more frequent purchase of bread would lead to the less amount of bread. Nevertheless, the analyses resulted in surprising fact that HHs which buy bread once a week and less purchase mainly 260 grams of bread and less. However, the data was not significant at $\alpha = 0,1$ and therefore the influence cannot be justified, the sample is random.

Table 16) The volumes of purchased bread according to shopping frequency

Frequency of shopping	1050g and more	260g and less	525g	Grand TOTAL
1x a week and less	23,33%	50,00%	26,67%	100,00%
1x-3x a week	18,55%	36,65%	44,80%	100,00%
Grand TOTAL	19,12%	38,25%	42,63%	100,00%

Note: the bread amount are explained in the previous paragraph

Source: own study

Following question identifies the influence of price decrease on HH purchase of special bread. The respondents had following possibilities to answer; i) buy it for a test, ii) buy it more, iii) has no influence and iv) shift from normal bread to special one (answers in the table are shown as these). The answers were analysed in terms of HH income; groups were aggregated in order to perform Chi-squared test. Results show that 37% of HH with income lower than CZK 40.000 buy special bread for a test when the price decreases. Both income groups do not tend to buy more special bread when the price goes down. Furthermore, 44% of respondents with HH over CZK 40.000 are not influenced by the price decrease. Chi-squared test indicated no statistical significance of the sample $\rightarrow X^2 = 0,13 > \alpha = 0,1$.

Table 17) The influence of special offer

HH income/special offer	I	II	III	IV	Grand TOTAL
40 000,- a více	23%	8%	44%	24%	100%
10 000 - 39 999,-	37%	6%	34%	22%	100%
Grand TOTAL	31%	7%	39%	23%	100%

Source: own study

The respondents amongst different age categories were asked about the way they dealt with the food surpluses; i) resp. consume everything and do not waste, ii) resp. compost iii) use for animal feeding and iv) throw away without any further use. These possibilities were chosen with respect to study of Garrone (2014) and Czech Sociological Institute (2014), where these food surpluses management techniques were identified. The respondents had the opportunity to pick two answers.

Table 18) The management of food surpluses by age categories

	Number of responses	Consume everything, no waste	Feed animals/composting	Throw away
Number of responses		127	118	57
Total responses 302				
19 - 29	76	38%	38%	24%
30 - 39	69	38%	36%	26%
40 - 49	48	40%	42%	19%
50 - more	109	49%	40%	11%

Source: own research

The results show that almost 80% of all answers were distributed between animal feeding and no waste (total recovery, for instance bread crumbs etc.). That more or less confirms the results obtained by the study of Czech Sociological institute (2014); note that the animal feeding was put together with composting. According to the results, the people over 40 years tend to waste less and to dispose of food more ecologically; people over 50 years almost do not throw away any food. On the other hand, the respondents under 40 years manage food surpluses less ecologically; 24% and 26% of each group throw food away. Obviously, people chose animal feeding as the second option since they did not consider it as waste. Moreover, the results might be distorted due to the respondents' level of sincerity. Categories "feed animals" and "composting" were aggregated as well as two age groups – "50-59" with "over 60) in order to conduct Chi square test. The statistical test showed no significance at $\alpha = 0,05$.

The management of surpluses was also analysed with respect to the origin of respondent. The results show that the people from the countryside (up to 5k of citizens) manage food more ecologically; they either recover food for their own purposes or they feed animals, "only" 13% of respondents throw food away without any further use. The same outcome was obtained by the Czech Sociological Institute (2014). It makes sense since they usually have the access to compost and might breed some livestock as well. The results amongst the respondents from small and big cities do not vary and are more or less the same – about 20% of respondents throw the food away without further use. What seems surprising is, that 32% of respondents from big cities either compost or feed animals. Furthermore, the results show that the most food is thrown away in small cities which stands in contrast with the study of Czech Sociological institute (2014), where the opposite was proven.

Table 19) The management of food surpluses by residence of respondent

Origin	Consume all	Feed animals/compost	Throw away	Grand TOTAL
Big city	47%	32%	21%	100%
Countryside	31%	56%	13%	100%
Small city	39%	39%	23%	100%
Grand TOTAL	39%	42%	19%	100%

Note: the respondent had the choice to pick two answers, total number of responses = 302

Source: own research

The results also indicate, that people from bigger cities tend to consume all; use leftovers for bread crumbs etc. The data was analysed by Chi square test and are significant for $\alpha = 0,05$ which goes in contrast with the analysis of previous data set.

The respondents were asked about the volumes of waste they produced. The answers were analysed with respect to whether the respondents bought bread for the entire HH or for themselves. As mentioned in the previous analysis, 82% of respondents buy bread for the entire HH whereas 18% buy it for themselves. The volumes of waste were originally divided into five groups; i) less than 5%, ii) 5%, iii) 10%, iv) 20% and v) over 20%. The answers were aggregated into two separate groups in order to conduct Chi square test; less and greater than 5%. As can be seen from the table, the individuals who buy bread only for themselves waste less by 5%. However, the analysis proved no significance at $\alpha = 0,05$.

Table 20) The volumes of FW

Bread purchasing	5% and less	more than 5%	Grand total
For the entire HH	75,24%	24,76%	100,00%
For myself	80,00%	20,00%	100,00%
Grand total	76,10%	23,90%	100,00%

Source: own study

When the waste volumes were analysed with respect to purchase planning length, the results indicate that the longer purchase planning results in lower food waste ($\alpha = 0,01$). This contributes to the fact that planning has an impact on the volumes of FW. The question is how to persuade consumers to start thinking and planning their consumption.

The respondents were asked whether they were satisfied with offered bakery products or not, they had four different options to answer; i) satisfied, ii) satisfied with packaging, not with assortment, iii) satisfied with assortment, not with packaging, iv) not satisfied at all. The 64% of respondents claim that they are completely satisfied. On the other hand, only 11% of respondents are not satisfied at all. Furthermore, 15% of respondents are not satisfied with the assortment and 10% not satisfied with packaging.

Table 21) The level of satisfaction with bakery assortment

Satisfaction with products	Total
Yes in both cases	64,37%
No in both cases	10,93%
Satisfied with packaging, not with assortment	14,57%
Satisfied with assortment, not with packaging	10,12%
Total	100,00%

Source: own research

When the respondents were asked whether they changed their purchasing behaviour recently or not, about 50% of them claimed that they started to buy less bakery products. Furthermore, about 15% of respondents claim that they buy products of higher quality. Last, about 37% of them did not change anything recently. However, the results are not significant so the null hypothesis is admitted, sample is random.

Table 22) The recent changes in purchasing behaviour

Age category	NO	Buy less	Buy better quality goods	Grand TOTAL
19 - 39	40,17%	46,15%	13,68%	100,00%
40 and more	35,07%	50,00%	14,93%	100,00%
Grand TOTAL	37,45%	48,21%	14,34%	100,00%

Source: own research

The results in Table 22) show that there are no big differences amongst the answers in terms of age of respondent. It was assumed that younger people changed the behaviour more recently since the waste had become a discussed topic online. A more detailed analysis should be performed in order to get the causes of change in that behaviour. Afterwards, certain moves might be taken and the focus can be concentrated.

This study also asked the respondents about the causes of their waste. They had four different options to answer and had to rank them from the first to the last (first standing for the best option). They were given following causes; freshness of products (not fresh, but still edible), uneaten leftovers (uneaten bread with honey), bread perishes (it is not edible anymore) and different.

Table 23) The causes of FW at HHs

Preference	Uneaten leftovers	Freshness	Bread perishes	Different	Grand TOTAL
1st	6%	48%	41%	5%	100%
2nd	38%	36%	25%	1%	100%
3rd	51%	15%	32%	2%	100%
4th	5%	0%	2%	92%	100%

Source: own study

As can be seen, the freshness along with the expired shelf life play the main role in food waste at consumers; the 89% of them chose those two options for the 1st preference. The most chosen 2nd preference are uneaten leftovers (38%) followed closely by the freshness (36%). As the 3rd preference with the highest number of responses ended up uneaten leftovers (51%). The results are supported by the study conducted by the Czech Sociological Institute (2014), where the freshness ended up first as well.

The last preference is represented mainly by the option “different” (92%), where the respondents mainly claimed they did not waste at all. The open question might be a good tool in order to analyse more causes.

As a link to the causes of FW, the respondents were asked about the possible ways which might result in its lowering. There were given following options to answer; i) better planned purchase, ii) better management of consumption, iii) better storage, iv) purchase of more durable goods and v) different. The 247 respondent participated in this question since it was created after the survey had already been posted. The 57% of respondents chose the “the better planned purchase” for their 1st preference. As a second preference was chosen better consumption management (45%).

Table 24) The potential solution for FW reduction

Preference	Better planned purchase	Better consumption management	Better storage	Purchase of more durable goods	Different
1st	57%	17%	10%	12%	4%
2nd	26%	45%	18%	11%	0%
3rd	11%	22%	56%	11%	0%
4th	5%	15%	15%	63%	1%
5th	0%	1%	2%	4%	94%

Note: own survey

The results indicate that people do not plan their purchase and consumption. These two are connected to the causes of FW mentioned above; freshness and shelf life of bakery products. When the consumer does not plan the consumption, the problem with freshness and shelf life emerges.

Discussion and limitations

The food waste definitely is a world problem carrying different burdens; social, environmental and financial (Scholz, 2014). When you imagine that the population is going to reach 9 billion by 2050, the FW is a luxury that we cannot afford. Furthermore, hundreds millions of people are starving while we in a developed world throw the food away. The major part of FW occurs at retail and household level in developed world. This study focuses mainly on waste emerging at household level and analysing its causes. The discussion focuses on the potential solution of problem.

The main reason for FW obtained by this study and also by Czech Sociological Institute (2014) is the “freshness” of bakery products; the 48% of respondents chose it as the first preference. It makes sense since the bakery products belong to those which lose their quality relatively quickly. The consumers are in general accustomed to fresh, crunchy or soft bread, depending on type. Once it loses this characteristic, people are likely to throw it away regardless the fact, that it is still edible. The further reason for discarding bread is that it perishes. One may argue, that it is the same as freshness, but it is not; once the bread finishes, it is not edible anymore, thus cannot be used/recovered. The bread which is not “fresh” anymore but it is still edible might be used for instance for crumbs, baking etc. which cannot be done with perished bread. Furthermore, the “uneaten leftovers” also play a significant role in FW; this tend to occur more at HHs with children, where they do not necessarily eat all food they are given. It may occur also due to too much cooked stuff (CVVM, 2014).

It is important to stress the influence of age on FW volumes. The sample proved that older people do treat food surpluses more environmentally friendly, they barely throw food away without any further use. The people under 40 years claimed more often that they throw food away (about 25% of responses). It may be due to the limited resources since the customers over 60 years usually do not work anymore and are dependent on social aid.

If we know all of this, the question is how to face these causes and diminish their impact? The respondents were asked about the possible solution. The 57% of them claim that better planned purchase (consumption) might lead to food waste reduction.

This is also supported by the factors influencing the purchase, were 26% of respondents answered that they were influenced by routine. The deduction there is, that consumers are simply lazy to think about the consumption; they know the potential solution, but still they do not act. The problem might be in time; people are not likely to spend their free time on food consumption. The consumers also claim (60%) that they buy bakery products in supermarkets. There the customers are influenced by different special offers (buy 2, get 1 for free), marketing etc., which may lead to over purchase of bakery products.

If we sum up the data, the educational campaign situated in supermarkets, targeting on people under 40, might bring some results. It would be worth to provide customers with some planning tool for instance, which would make the consumption planning easier. The proper storage of bakery products might also prolong the shelf life by days. Furthermore, the FW should be associated with all the impact; financial, social and environmental. First, showing the customers that food waste cost them relatively a lot of money annually might make them start think about it and change the attitude towards it. As Stancu et al (2015) argue, the losses evoke strong emotions and therefore showing the costs might be that effective. Second, raising the customers' awareness of environmental and social impacts may also lead to change. The following strategies might be implemented in order to direct the message to customers. The "nudging" gives customers an alternative behavioural action whilst preserving the free choice (Thaler & Sustein, 2008); in the case of supermarkets, it might be the offer of packages of different size. Thus, the customers would have an option of buying the amount they really need/want which may lead to FW reduction. Another way of reaching consumers is to frame the issue. The COOP introduced the cookbook with tips on how to utilise remains and get the maximum content out of your food. This is a form of challenging the frame and showing that what would otherwise be considered waste can actually be considered ingredients. As it is mentioned above, losses evoke strong emotions and therefore using money instead of kg for FW might also encourage the customers to behave differently.

It is important to mention, that many initiatives have already started campaign regarding FW in the EU; for instance, the WRAP, EU Fusions. It was according to decision of EU Parliament, which set up a goal of halving FW by half by 2025 (Secondi, 2015).

However, the lack of common harmonized methodology for FW data collection made the measurement of success very difficult (Secondi, 2015). The problem is that consumers are not aware of the programs/initiatives dealing with FW in the Czech Republic, only 20% of the sample named specific program/initiative. The measures against the FW might be also implemented by private companies; for instance, the COOP (the largest retail in Denmark) has its own program dealing with FW called Madspild Manifest (see Appendix 5). The COOP committed to reduce its waste and the waste of its customers. For instance, they inform customers about appropriate storage, they offer “single“ stuff (such as carrots, onions).

This study was limited by many factors. One of the major barriers was definitely the budget. The study was financed only by own financial resources which were strictly limited and therefore it was not possible to reach more respondents. Thus, the distribution of sample is not ideal in all cases; for instance, in terms of economic status, age, education etc. Moreover, it was not possible to get access to some paid databases.

The further limitation is the absence of food waste database and other studies focusing on food waste causes; there is no unified database containing data regarding food waste volumes among time and among countries. This was a hurdle since the comparison of data was not possible. Furthermore, the database would have helped with creating the hypotheses.

Last, the sincerity of respondents' answers is questionable; they may have answered in a way they felt it was right. Therefore, the data might be biased; the combination of different tools should be used in order to prevent bias – for instance analysis of disposed food in thrash, waste diaries etc. However, this was not possible due to limited financial resources.

Conclusion

The study indicates that the volumes of wasted bakery products are relatively low; the 75% of respondents claim that they waste about 5% and less of the purchased amount. This is contrasted by the study of CVVM (2014), where the bread was mentioned as the most wasted food by 27% (primary answer) and 42% (secondary answer) of respondents. It may be because the respondents did not consider feeding animals or composting as wastage. Moreover, the people above 50 years barely throw food surpluses away (only 4%), they treat them in more environmental way.

According to Czech statistical office (2014), the consumption of normal bread has been decreasing during last 10 years (by 10 kg), whereas the consumption of special bread was increasing (by 7 kg). The results of this study show that the normal bread is more preferred by consumers over 50 years (43%).

The respondents claim that they purchase bakery products mainly in supermarkets (about 62%). Surprisingly, the “quality/freshness” is seen as the most important factor influencing the purchase of bread and baguettes/rolls (56% of respondents chose it as first option). The consumers are relatively satisfied with both package sizes and assortment provided by shops (65% of respondents).

The main causes of FW are the “freshness” (48% for 1st preference) and “bread perishes” (41% for 1st preference) of product. The difference is that the goods with lower quality (freshness) might be still used for instance for bread crumbs/animal feeding whereas perished bread may be either thrown away or composted. This seems to be the consequence of bad consumption management (65% of respondents allegedly plan for 2-3 days).

The results show that people from small cities and countryside tend to manage food surpluses through composting and animal feeding, 36% and 53% respectively. It makes sense since they are likely to have access to garden and livestock. However, the residents from small cities also throw the food away most (23%).

The potential solution in FW reduction seen by customers is the better purchase planning (57% for 1st preference). This is supported by fact, that respondents are influenced by routines during shopping (26% for 1st preference). Priefer et al (2013)

three options for stimulating a change of behaviour; educating customers, introducing economic incentives and fees on waste. Thus, educative campaigns providing tips and hints on purchase planning, storage and food surplus management may have a significant impact on FW volumes. These campaigns should be focused on the individuals under 40 years and should cooperate with supermarket. Only 20% of respondents know specific initiatives/programmes dealing with FW. The different tools are identified in order to manage change in behaviour; the nudging, framing and theory of planned behaviour. The nudging might be used in supermarkets where different sizes of packages could be offered; this may lead to the reduction of FW as the customers are likely to buy the amount they really need. The framing stresses that losses evoke much stronger emotions than gains. Thus, mentioning the volumes of FW of bakery products in money instead of kilograms may have a positive impact and may start up the reflective system of consumers. The Theory of Planned behaviour suppose that attitude towards FW is influenced by injunctive norms and attitudes of consumers; therefore, reaching them may have and positive impact as well.

The further study should focus on further food waste causes and volumes as this research was limited by financial resources. Moreover, the impact of campaigns focusing on FW should be measured in order to prove the effectivity.

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Appendices

Appendix 1) Structured questionnaire survey

First part

1. What is your gender?

- a) Male
- b) Female

2. What is your age?

- a) 19 - 29
- b) 30 - 39
- c) 40 - 49
- d) 50 - 59
- e) Over 60

3. What is the type of your economic activities?

- a) Student
- b) Full time job (employed or individual)
- c) Part time job (employed or individual)
- d) Retired plus part time job
- e) Retired
- f) Unemployed

4. Where do you come from?

- a) Countryside (up to 5 000 citizens)
- b) Small city (up to 100 000 citizens)
- c) Big city (over 100 000 citizens)

5. What is your education?

- a) Elementary
- b) Secondary – maturita
- c) Secondary - vocational
- d) Tertiary

6. How many members do have your household?

- a) 1
- b) 2
- c) 3
- d) 4 and more

7. How many children are in your household?

- a) 1
- b) 2
- c) 3
- d) 4 and more
- e) None

8. What is your household income (in CZK)?

- a) 10.000 – 19.999,-
- b) 20.000 – 29.999,-
- c) 30.000 – 39.999,-
- d) 40.000 – more

9. Do you recycle household waste?

- a) Yes
- b) No

10. Do you perceive food wastes and losses as an actual problem?

- a) Definitely yes
- b) Yes, but there are more important issues to solve
- c) No, it is natural
- d) Don't know

11. Do you know any program focused on food wastes and losses?

- a) No
- b) If yes, write them:

.....

.....

.....

Second part

1. What kind of bread do you buy? (distribute 100 points amongst the options)

- a) Common bread
- b) Common rolls/buns
- c) Special bread (wholegrain, pumpkin)
- d) Special rolls (wholegrain, dark)

2. Where do you buy bread? (distribute 100 points amongst the options)

- a) Supermarket
- b) Bakery
- c) Do it by yourself (home bakery)
- d) Somewhere else, please specify:

.....

.....

.....

3. Are you the main buyer of bread for household?

- a) No, I buy it for me
- b) Yes, I buy it for the household

4. How often do you buy bread?

- a) Once a week
- b) 2-3 times a week
- c) Everyday
- d) Less than once a week

5. What does influence your decisions when buying bread? (Please rank, scale 1 – 5, where 1 stands for the biggest)

- a) Routine
- b) Price
- c) Distance from the shop
- d) Quality/freshness
- e) Origin

6. If price of quality bread gets temporarily reduced (promotion), do you

- a) Buy it for experimenting
- b) Switch from the common bread to this item
- c) Buy more
- d) Not affected

7. For how long are you planning your consumption?

- a) For 1 day
- b) For 2-3 days
- c) For 4-7 days
- d) For more

8. What quantity of bread/rolls do you usually buy?

- a) More than one loaf/25rolls (>1050g)
- b) A loaf/20 rolls (1050g)
- c) A half/10 rolls (450g)
- d) A quarter/5 rolls (200g)
- e) A less (<200g)

9. Are you satisfied with the bakery assortment offered?

- a) Satisfied with the assortment and package size
- b) Unsatisfied with assortment, satisfied with packaging
- c) Unsatisfied with package size, satisfied with the assortment
- d) Unsatisfied with both packaging and assortment

10. How do you store bread? (two options possible)

- a) Basket
- b) Freezer
- c) Plastic bag in the kitchen
- d) Another storing (write which one):

.....
.....
.....

11. What do you do with the old bread? (more options possible)

- a) Don't have an old bread/use it (for example for breadcrumbs)
- b) Bring it back to the bakery
- c) Compost/feed the animals
- d) Throw away
- e) Other:.....
.....

12. What is your average weekly (bread) waste?

- a) More than one bread/25 rolls (<1050g)
- b) One bread/20 rolls (1050g)
- c) Half of bread/10 rolls (450g)
- d) Quarter of bread/5 rolls (200g)
- e) A less (<200g)

13. What is the reason of your bread waste? (Please rank, scale 1 – 5, where 1 stands for the biggest)

- a) Freshness (You like the bread fresh)
- b) Uneaten rest with the other food (butter, cheese, ham..)
- c) Gone off
- d) If other, please specify:

.....
.....
.....

14. Have you change the quantity purchased in order to reduce wastes? (More options possible)

- a) Smaller loafs
- b) Lesser quantity (rolls)
- c) Higher quality which can last longer
- d) I have not

15. What would you consider as a solution for the problem with food losses and wastes? (Please rank, scale 1 – 5, where 1 stands for the biggest)

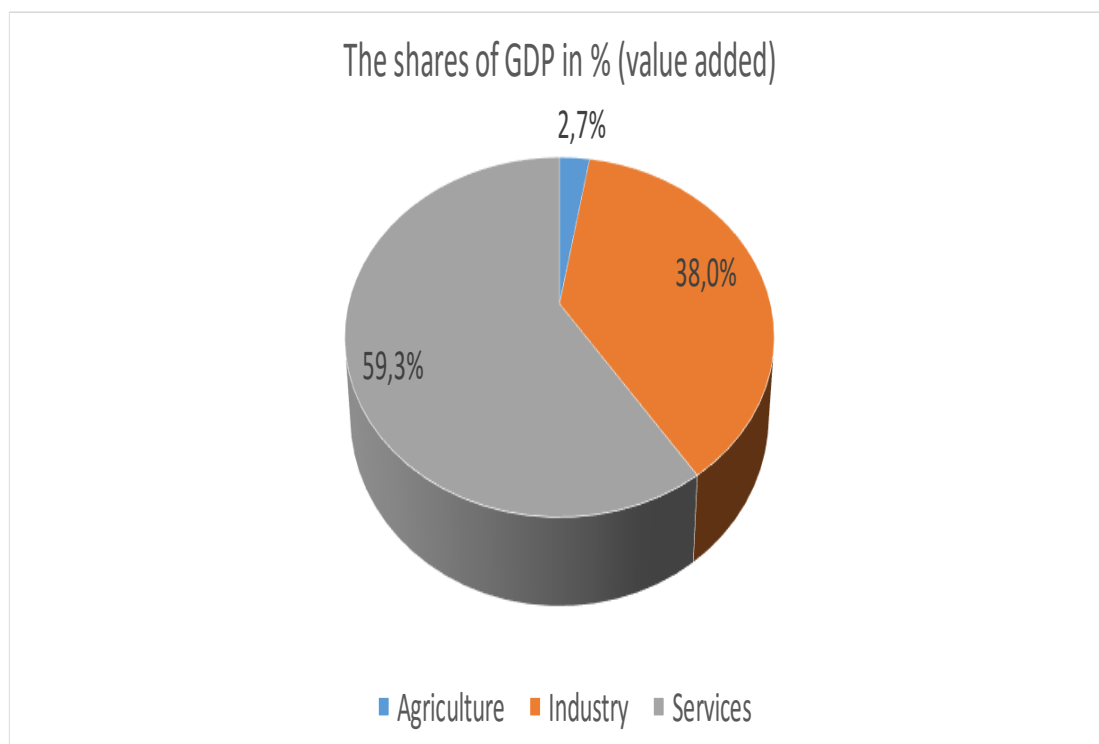
- a) The better purchase planning
- b) The better management of consumption
- c) The purchase of more durable products
- d) The better storage
- e) Different (write which one):

.....
.....

16. What is your average weekly waste?

- a) Less than 5%
- b) 5%
- c) 10%
- d) 20%
- e) Over 20%

Appendix 2) The % sector shares of GDP in the Czech Republic



Source: Czech Republic indicators. In: World Bank [online]. 2014 [cit. 2016-04-06]. Available from: <http://databank.worldbank.org/data/reports.aspx?source=2&country=CZE&series=&period=>

Appendix 3) The COOP's Madspild Manifest (2015) – translated in English

Food waste puts undue pressure on land resources, climate and the environment. In a world with limited resources, it is essential that food waste is limited as much as possible to the location. In Coop we define food waste as food that could have been eaten by humans, but which for one reason or another ends up being thrown out.

As the nation's largest supermarket, we take the problem seriously. We are aware that there is a lot of food waste out of our stores - and we will primarily address this. We are also concerned with the food that our consumers buy in our stores not just ending up in the trash. We know that the retail trade as a whole also has an impact on the food waste that occurs at the manufacturers and we will engage in dialogue with our stakeholders on how we can reduce this food waste.

Our goal

We cannot stop all food waste but as the country's largest supermarket we will do what we can. It makes good sense for business, for consumers and for the environment. Therefore, we commit ourselves in this manifesto for the period 2013-2015 to follow this action, which applies to all Coop's stores, including Kvivkly, SuperBrugsen, Dagli'Brugsen Irma and Fakta, and stocks:

- To reduce food waste in 2013 and 2014 from all our stores across the country, as well as stores across the country with a total of 10% per year, measured in relation to 2012.
- To disseminate knowledge and solutions for food waste among our 1.3 million members and customers through our available channels.
- To develop at least two measures in the period which help to reduce food waste by consumers or by suppliers.

How we will achieve our goal

In the shop and in stores

- All 1,200 stores have concrete reduction targets for food waste and the results are reported monthly to the chief executive of Coop. The findings are published once a year.

- All shops develop and implement a visual concept for food waste. Including special food waste logos that include is added to the so-called date items.
- All shops puts systematically date items down in price to ensure that they are being sold instead of being thrown out.
- All shops focuses påviden on food waste and sharing knowledge about food waste from Coop's 40,000 employees.
- At least one chain store or the like in addition Irmatorvet initiates cooperation with such. Food Bank.

With our 1.3 million members

- We will establish cooperation with consumerist Stop Wasting food in order to jointly disseminate knowledge and knowledge of food waste for consumers. At least once a year, we will offer newspapers to have information about food waste and knowledge about good advice on how to use left overs.
- Carry out at least one transverse campaign annually in member-owned stores.
- Develop at least one consumer-oriented food waste activity held at least 10 places in the country in 2014.
- We launch at least one product in the period which helps to reduce food waste by consumers.
- We actively participate in the public debate on food waste as well as in insurance projects designed to increase knowledge about food waste.
- In the role of independent observer and advisor engaged consumerist Stop Wasting Food to follow up on the achieved results and actions.

