SZENT ISTVÁN EGYETEM

SZENT ISTVÁN UNIVERSITY

THESES OF DOCTORAL DISSERTATION

The role of food waste in environmental burden

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Social judgment and engagement

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1. ANTECEDENTS OF WORK, AIMS TARGETED

Before industrialised production and complex logistical systems got widespread, food supply used to be scarce and accidental. Coping with such conditions people settled for a food saving lifestyle. This phenomenon is still proceeding in the developing countries, however in developed societies – including our country – have been experiencing serious changes in consumer habits. Through the modernisation of production methods real terms of food have been decreasing permanently according to the tendency demonstrated in the thesis. This has also significantly changed the role of eating in society and culture. The concept of "our daily bread" that used to be vital is available for an average consumer. It is relatively cheap, has turned into a mass product, its demand is fast to be satisfied. These changes have contributed to the fact that nowadays – according to the latest estimated figures referring to the EU – the highest amount of food waste measured along grocery store chains is not in the agriculture, processing, or trade, not even in the hospitality industry to find but in households.

The issue of food waste is an extremely complex scientific and policy question. Initiatives aiming moderation paint different pictures sector by sector and are debated. Nevertheless, in case of households shaping the approach of consumers is considered to be a good solution. It may indeed be efficient, but its appropriate professional foundation would need scientific research. Currently, the number of such research projects is minimal in the world including the data referring to the Central-Eastern European region. What is more, the different methodology and research focus may lead to controversy between the conclusions of different surveys in specialized literature. This may also make the examination of demographic factors more difficult. Supposedly, national characteristics may contribute to the heterogeneity of results, as well. That is why the currently available research experience in specialised literature is not to adapt to the Hungarian circumstances efficiently. Before the questioning examination in the topic led by the Faculty of Food Science at Szent István University there was not even such a research available in Hungary. However, this survey has shown that our country is also deeply affected by this problem. Having taken these results into account, the first programme aiming the prevention of food waste in Hungarian households was called into life with the support of the European

Committee. The project of the National Food Chain Safety Office got the title Wasteless (Maradék nélkül).
According to the experience of initiatives in European countries that have high purchasing power, shaping social attitude efficiently through programmes befalls if we get a detailed picture of the social environment we wish to influence. Food waste is an extremely complex phenomenon that cannot be characterized by the causal relation between two variables. The relation between variables is often not to foresee. Since it is latent, the traditionally adapted, more complex statistical methods with several variables will not ensure satisfying results. My thesis aims to analyse the factors that determine food waste of Hungarian inhabitants and to uncover the structures of the already existing coherence between factors by using a second-generation data analysis that can handle the problems mentioned.
Having synthesized the specialised literature available, I formulated the following four hypotheses. Knowing these may be essential when founding a programme that aims to shape social attitude.

H_1: The Hungarian consumers perceive the responsibility of the European households according to the reality in the case of food waste generation.

H_2: Apart from demographical factors, food waste is simultaneously affected by affective (emotional), cognitive (mental), and conative (behavioural) attitudes, from which the effect of the conative attitudes is the most prominent.

H_3: Unplanned food shopping practices contribute to the increase of household's food waste to a lesser extent than unreasonable amount of food preparation.

H_4: The amount of food waste is influenced by the consumers' demographic background and standard of living; among these, there is a significant difference between age and income groups.

In my thesis, besides the detailed presentation of the findings of research, I would like to provide information of their potential practical application

referring to content elements of influential communicative messages and target groups.

2. MATERIAL AND METHOD

Applied Research Methodology

Considering the complexity of the issue of consumers' food waste, research questions are arranged gradually according to the details written in my paper.

For uncovering the reasons of food waste-formation a quantitative questioning survey has been done. A majority of researchers in the topic apply the same method. We have also taken into account that the identification of factors that potentially influenced food waste was possible when using this particular method. The structure and content elements of questionnaires used for the quantitative questioning surveys characterized the evaluation of research findings fundamentally. That is why we had planned the questionnaires including direct as well as indirect questions and the method was also tested on a smaller specimen. We have applied open-ended, closed-ended 5 option scale questions. The latter two were exclusively applied for proceedings of analyses with several variables according to optional answers to different categories.

The questionnaire included questions in the following topics beside the ones referring to the demographic background of respondents:

- consumers' realization of food waste
- consumers' attitudes on food waste
- knowledge of consumers on marking and storing food
- foods that most often land in the dustbin.

Collecting Data, Constitution of Specimen

Collection of data took 3 weeks in the October of 2016. I actively took part in both the preparation and the arrangement of it. The structure of the questionnaire made it possible to fill it individually, but when needed we read out the whole document. We chose participants through a quote selection that belongs to the non-accidental techniques. Thanks to this technique the Hungarian population was represented according to

different age groups, sexes, and geographical regions (NUTS 2) relying on the latest data of the national census. Collection of data took place in Budapest and eight more cities (Szeged, Szolnok, Győr, Miskolc, Pécs, Debrecen, Nyíregyháza, Székesfehérvár). Overall, 1002 persons' data got in the specimen.

Statistical Methods Applied

The complexity of the topic required the use of various methods together. In the first part of my discussion I am demonstrating the data collection with the help of descriptive techniques (average, deviation, frequency) according to the topics detailed in research methodology. Relying on the descriptive statistical results, I used statistical methods including several variables (variance analysis, main component- and factor analysis, cross table analysis, correlation calculation) in order to uncover relations between certain variables. I used IBM SPSS Statistics V22.0 software to the statistical analysis mentioned above. As discussed above in the introduction, the measure of food waste may be determined by several, either observed or latent variables, so the methods mentioned above include information partly only. To solve this problem, I applied the Structural Equation Modelling (SEM) that is a so-called second-generation data analysis with several variables. More precisely, I chose the variance-based Partial Least Squares (PLS) considering the character of the data collected. The SEM may do two things simultaneously: the so-called indicator does the factor analysis and as a result of that the relation between latent variables is also being analysed through regression analysis. Considering the structure of the latent variable in social scientific questions, I found using the reflective construction most appropriate by means of single-item structures.

The PLS-SEM enabled us to analyse measures certain factors' effects, moreover, the percentage how much these factors affect our target variable. The data we got as result of modelling may be to use when preparing an influential communicational campaign.

I decided to use the programme Smart PLS to carry out the modelling because of its practical adaptability.

3. RESULTS

First, I would like to present my analysis results according to the topics mentioned in *Applied Research Methodology*.

Consumers' Realization of Food Waste

Findings in Consumers' Realization of Food Waste have shown that most respondents of the survey stated that households put out the biggest amount of food waste – agreeing with the EU's official viewpoint that in this area, households are responsible for the majority, 53% of food waste. This may be a result of the increased attention of media on the topic and that consumers get more and more knowledge concerning the issue. Meanwhile, it is important to emphasize that the most trustworthy realization of the problem may not correspond with the individuals taking responsibility for their own practice of wasting food. Moreover, it does not necessarily mean that they want to take part in initiatives aiming moderation. Results have shown that respondents consider food waste a problem in Hungary (A significantly greater number of women think like that).

Knowledge of Consumers on Marking and Storing Food

In this section we asked questions about proper storing of foods and tried to check the appropriate interpretation of label information with the help of a quiz. Because of the questions of different difficulty, the rate of good answers painted a diverse picture. I would like to demonstrate – the phenomenon that has already evoked controversy in the policy as well – how misleading the difference between the date of quality preservation and the processability can be. Only a small number of respondents (19.94%) were able to differentiate the two concepts. The vast majority (54.21%) of respondents considers the two things have the same meaning. It results that people tend to throw away preserved food that are – though out of date – not risking food safety according to professional agreement. From a practical point of view, we have to admit that though there are misunderstandings caused by the marking of expiration dates, the most frequently wasted food categories are not products with quality preservation dates. Supposedly, the lack of knowledge in this particular issue is not a reason of Hungarian food waste.

The Most Frequently Wasted Foods in Households; Preparation of PLS-SEM I.

When looking through the specialised literature I called attention to the fact that the amount and consistence of food waste in households is difficult to measure and to do survey on. The present methodology of research made it possible to ask for the top five wasted food types according to frequency (on a scale of 1-5). Compared to the real figures measured in our country as part of surveys, these frequency data paint a much more positive picture of the importance of the problem. At the same time, positive distortion seems to have appeared as it could be expected. Food leftover (2.66) was on top of the five-option scale and pastries (2.48) were also to highlight. Dairy products (2.19) were also mentioned with their high amounts, as well as, cold cuts (1.97) and fresh fruit and vegetables. The order above has not shown big difference from spontaneous listing. Based on the frequency averages that I had and with the help of main component analysis I could determine the target variable of the PLS-SEM modelling: the *aggregated main component of waste.* I was using the analysis system carefully.

The Extent of Waste Depending on Potentially Influential Factors

I analysed the aggregated main component of waste according to demographic and other factors with the help of variance analysis: A few of the most important conclusions of the analysis are the following: generations under 40 years, respondents with higher income, respondents not growing plants in their own gardens and respondents from the capital tend to waste more food in average.

Consumers' Attitudes in Connection with Food Waste; Preparation of PLS-SEM II.

Based on the descriptive statistical analysis of attitude variables in use for the PLS-SEM modelling, as well as the examination through cross table and variance analysis led me to the following findings. We may count it as a positive result that most respondents answered to have received an education that encourages to moderate food waste. Respondents of higher education showed an even better picture. Respondents seemed to agree with the objection to food waste regardless demographic background. On the contrary, the agreement on respecting the theoretical value of food was lower. There has been especially great heterogeneity among the different demographic groups: women, elderly, higher educated respondents found food of higher theoretical value than the average. The results show that the population examined found it less embarrassing if they must throw food away. This phenomenon is even more remarkable among generations under 30 years. The great amount of the income spent on food affects respondents with lower income obviously more severely. In case of women and elderly this kind of awareness is also to find though it is not by all means a consequence of a lower income. Environmentally friendly behaviour has proved to be low in average among respondents. Women and lower educated respondents have shown a somewhat higher sensibility in sustainability. Unfortunately, the lifestyle of the youngest generation has been characterised by being the least environmentally conscious. Big number of interviewed persons do their food-purchase consciously. Women and employees from 40-60 years have proved to do even more so. The question referring to the use of shopping lists has shown a lower level of agreement among respondents. Men and generations under 30 years have shown even lower agreement compared to the average. Food waste resulted by forgetfulness has been an issue to a medium extent only in the examined population, while respondents with higher income are more likely to forget about food in their fridges. Unfortunately, this negative attitude characterizes young adults (under 40 years). Cooking unnecessarily big amount of food (daily, and for special family occasions) has been an answer to medium extent, given generally an answer of respondents with higher income. Handling food leftover

inappropriately has been a less frequent answer. It may be an interesting finding that respondents with higher income and qualification handle food leftover more properly (they store food more appropriately).

To sum up this chapter, we can state that though respondents – in spite of the indirect questions – tried to paint a more positive picture of themselves, the differentiation of data collection referring to the answers given on attitude variables that potentially affect food waste can be called accurate. Consequently, it is suitable to model the behaviour of food waste.

In order to prove my hypotheses on mapping the relation between attitude variables, I completed an explorative factor analysis. My aim was to reveal all possible connections and so the latent structures (factors) behind variables – while paying attention to keeping the system of criteria in this type of analysis. This step served the preparation for the PLS_SEM modelling. When naming the different factors – aware of the information zipped in them and taking my aims in the paper into account – I thought it effective to use affective (emotional – 1. factor), cognitive (mind-wise – 2. factor) and conative (behavioural – 3. factor) names suitable for attitude theories.

Modelling Food Waste of Consumers with the Help of PLS-SEM

In conformity with the multidimensional attitude scale and the three components of attitude (affective, cognitive, conative components) I could demonstrate – in numbers – the aspects through which food wasting behaviour arises with the help of the so called *normative* model. This model is, nevertheless, less suitable for approaching causal aspects practically, therefore I set the *explicative* model of food waste using the same set of variables.

As part of modelling I paid special attention to checking the reliability and topicality of models set according to guidelines read in specialised literature, as well as the interpretation of results. I classified the models in two parts: with details on the parameters on both the inner and outer models. When evaluating the outer model, I presented latent structures,

while in case of the inner model I went into detail regarding the analysis of the significant relations between constructions and the predictive capability of the model. As a result of the detailed analysis we can state that both the normative and explicative models have fit the guidelines required by the PLS-SEM method (Cronbach's Alpha, construct reliability, average variance extracted, Fornel-Larcker test, path coefficients (β), R square). The outer element of the normative model is the affective component, while the cognitive, conative, and waste components all belong to the inner elements (*Figure 1*). The most important conclusion of the normative model is that according to all measures of effects on the variable targeted (food waste) the conative component of attitude (β=0,371) is the most decisive. The affective and cognitive components including the positive indicator factors from the perspective of food waste have a significantly decreasing effect on the extent of food waste. Evaluating how capable the normative model was to prognose, we can tell that the formulation of wasting as a behaviour pattern can be prognosed by 20% using the three components of attitude together. It counts as a relatively good explanative power in research of social sciences.

Considering that the explicative model contains more latent structures, it is more complex compared to the normative model, and so the number of regression lines is also higher there. Another difference is that the explicative model contains two latent structures of one element (environmentally conscious lifestyle, moderation of financial damage). An outer element of the explicative model is the emotional component, while all other elements explained belong to the inner elements – they are in the 2nd figure to find. Similar to the normative model, there are examples of positive, as well as negative effects. The component of careless storage (β=0,276) and preparing unnecessarily great amount of food (β=0,213) has an extremely strong, direct – mathematically positive – effect on food waste. Taking the general effects into account, the biggest problem in everyday life or even in case of family occasions as part of leisure time is that much more food is cooked than how much is consumed.

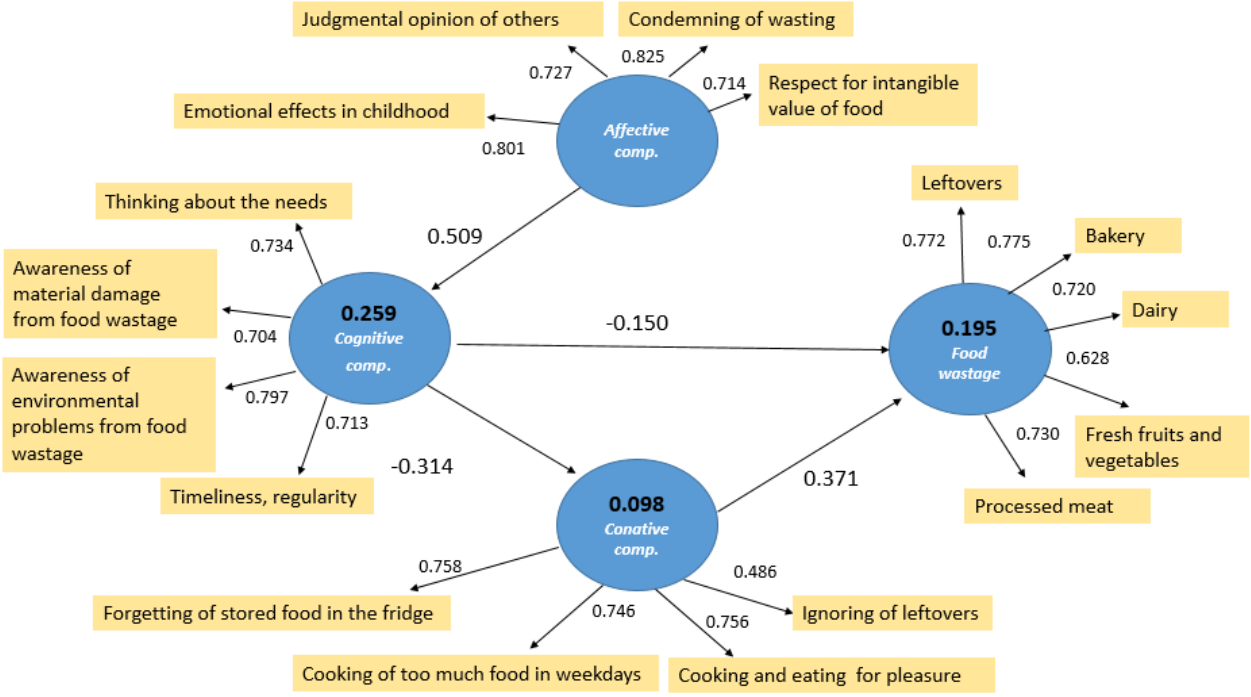

Figure 1: Normative model of consumer food waste behaviour

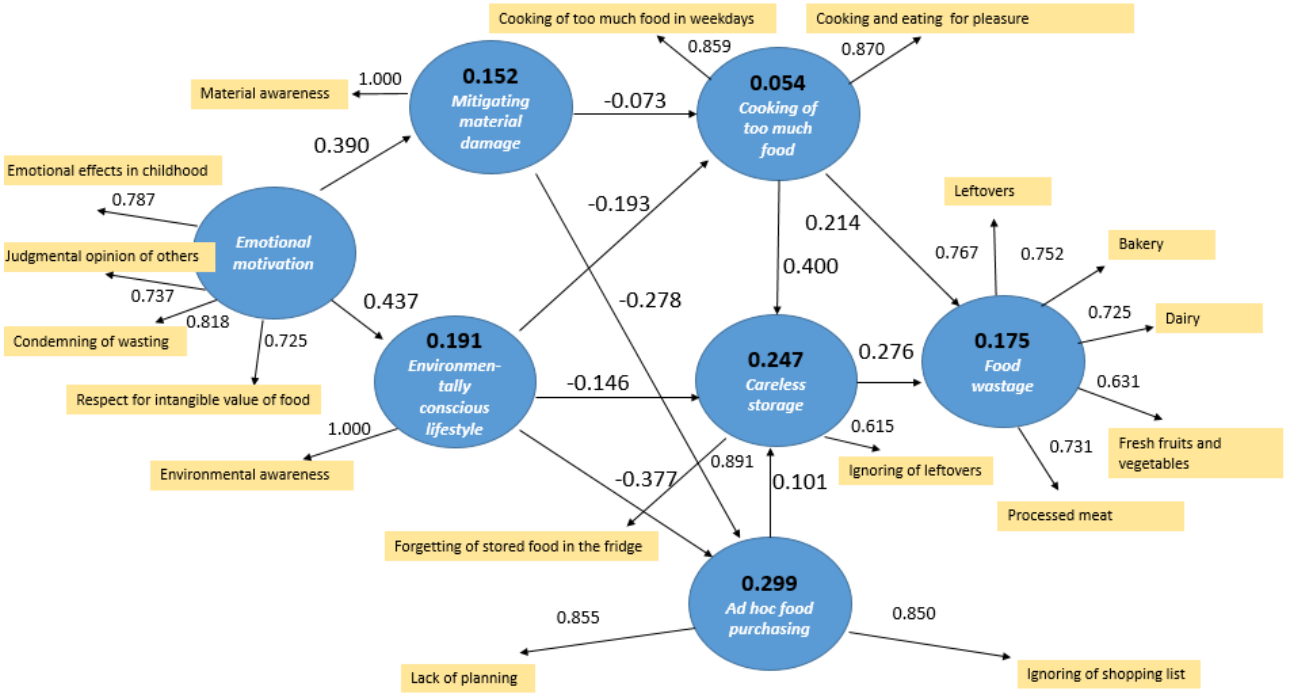

Figure 2: Explicative model of consumer food waste behaviour

3.1. NEW RESEARCH FINDINGS

Based on the above discussed, my research findings are the following:

1. With the help of mathematical modelling (PLS-SEM), I proved that in the development of food waste as a behavioural form, conative, cognitive, and affective components of consumer attitudes play a decisive role. Their significance and effect on each other could be handled differentially during model building. The so-called normative model proved that the most determinative force in the development of wasteful behaviour is the conative component of consumer attitudes.
2. By setting up the explicative model, I proved the existence of determinants of communicational standpoint (latent structures), which influence the amount of food waste of households both directly and indirectly. It was proven during the quantification of certain influencing structures that the food waste of Hungarian households is due to excessive amount of food prepared during weekdays or even for family events. The amount of food waste due to careless storing is also determinative, although the effect of unplanned food shopping is much smaller compared to these previously mentioned two factors. Another important result of the explicative model is that the environmentally conscious attitude of consumers and positive emotional motivations related to food significantly reduce the amount of consumer food waste. However, aspirations to mitigate material damage are less significant than these factors.
3. It can be considered an important finding that the majority of respondents are aware of the fact that

households are responsible to the greatest extent for the generation of food waste in the European Union.

4. The level of knowledge of consumers on proper food storage can be considered average. However, the difference between use by and best before date is not obvious for consumers. There are not such durable foods among the most frequently wasted foodstuff, which may potentially be wasted due to the misinterpretation of the expiration date.
5. According to the survey participants' own declaration, the most frequently wasted food categories are meals and bakery products, and dairy products, fresh vegetables, fruits, and lunch meats also appeared with a relatively high frequency. The results of the questionnaire survey are consistent with the research data based on the previously performed actual measurement in Hungary (Szabó-Bódi et al. 2018), which is also an important observation from a methodological point of view.
6. I defined the amount of food waste as aggregated waste component with the help of the most frequently wasted food categories through factor analysis. Statistical analysis conducted on certain groups confirmed that the thesis handled as a stereotype in certain international research studies is true in the case of Hungarian population: people living in more favourable financial situation waste more food. According to the results, the amount of food waste of the generation under the age of 40 is significantly higher compared to older generations.
7. It was also justified that increasing distance between the place of production of foodstuffs and the consumers results in higher wasting. Respondents from the capital and a group of respondents who do not grow fruits or vegetables at home throw away generally more food than those who live in villages or cultivate vegetable garden.

The amount of food waste was significantly differentiated between regions of the country. The population of the capital is particularly concerned in the issue of food waste in many aspects: they do not have direct, practical connection with food production and they are more likely to forget about the contents of their refrigerator.

8. Respondents over the age of 60 connect not only monetary value to food, but also serious moral value. Although, the control questions revealed that this does not always reflect in their behaviour. For the generation under the age of 30, this is much less or not at all characteristic. Younger people, in addition, feel environmentally conscious lifestyle rather far from them, and awareness in food shopping is also less characteristic of them. However, it can be considered a promising result that respondents who raise a child connected a fundamentally positive attitude to the moral value of food.

4. CONCLUSIONS AND SUGGESTIONS

Carrying out the analysis in my paper was justified from a scientific point of view and regarding the shaping of consumers' approach. Especially if we take into account that there has never been a detailed analysis concerning household food waste completed on Hungary. In the following, I would like to evaluate the hypotheses from the aims targeted in my research based on the findings of analysis already presented.

H_1: The Hungarian consumers perceive the responsibility of the European households according to the reality in the case of food waste generation.

In order to develop consumers' behaviour enhancing environmental sustainability, we get a picture of how people

perceive the issue of food waste in households. In my analysis I could prove that Hungarian consumers are over the first step of shaping approach. They have become aware that households take the greatest responsibility for wasting food in Europe.

H_2: Apart from demographical factors, food waste is simultaneously affected by affective (emotional), cognitive (mental), and conative (behavioural) attitudes, from which the effect of the conative attitudes is the most prominent.

Through the setting and the mathematical proof of the normative model it has been justified that the behaviour of Hungarian society towards food waste can be determined by the affective, cognitive, and conative components of consumer attitude. In the detailed analysis I point out that the conative component has the greatest direct influence of all mentioned. The affective component has an indirect effect, but it still has a significant direct and indirect effect on the forming of food wasting consumer behaviour.

H_3: Unplanned food shopping practices contribute to the increase of household's food waste to a lesser extent than unreasonable amount of food preparation.

Through setting the explicative model, I proved the existence of such latent structures that are important from a practical point of view and that affect household food waste either directly or indirectly.

The factors used for the explicative model had their origin among the explaining variables of the classic attitude model in the normative model. These factors show a tight correlation – even on their own – with the extent of waste. The modelling has made it possible to quantify the amount of different effects. This indicated a certain order according to their roles in the forming of food waste. Based on the overall effects of structures, it is clear that preparing unnecessarily great amount of food is to blame for most food waste of households. Unplanned (ad hoc)

purchase of food has quarter the significance in the issue according to the numbers in data.

The information we earned through proving the hypothesis, as well as the further important findings connected to the *explicative* model are to use in practice for campaigns aiming the reduction of food waste. I have recommendations on the target group and on the content of communicational message in socially influential campaigns based on the statements I got as results of the explicative model and on other consequences that I found.

H_4: The amount of food waste is influenced by the consumers' demographic background and standard of living; among these, there is a significant difference between age and income groups.

The findings proved that the extent of food waste is differentiated according to certain demographical categorisations. We may suppose that the effect of the social environment manifests on consumer attitude most significantly, though we may only influence that, if we can get our communicational message through to the demographic groups most concerned in the issue. On basis of the statistical trials done, it has been proved that there is a significant difference between certain age groups tested and in case of people with different incomes the extent of waste is highly differentiated. Additionally, the result that there is a significant difference according to people's residence is also interesting. What is more, the production in small gardens also represents a statistically justified effect on the extent of food waste. The population of the capital city, households with higher income, and the generation under 40 years count as the demographic groups that perform the highest food waste.

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Barbara Bódi, László Zsoldos, Gyula Kasza: Reducing food waste – what is behind good habits and good practices? A research methodology consideration, "Critical Issues in Science and Technology Studies", IAS-STS, Graz, Austria, 6-7 May 2013

Barbara Bódi, Gyula Kasza (2013): Consumers' opinion about their own food-purchasing habits-experiences of a quantitative study.With research for the success of Darányi Program. Food Science Conference, Budapest, 7-8 November, 2013 pp. 14-19, ISBN: 978-963-503-550-2

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