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# Reasons for Household Food Waste With Special Attention to Packaging

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## Abstract

The amount of food waste needs to be reduced in order to sustain the world's limited resources and secure enough food to all humans. Packaging plays an important role in reducing food waste. The knowledge about how packaging affects food waste in households, however, is scarce. This exploratory study examines reasons for food waste in household and especially how and to what extent packaging influences the amount of food waste. Sixty-one families measured their amount of food waste during seven days and noted in a diary why each item was wasted. Thirty of the families had participated earlier in an environmental project including education in environmental issues of everyday life. About 20–25% of the households' food waste could be related to packaging. Three packaging aspects dominate the packaging related waste: packages that the consumer noted as being too big and packages that were difficult to empty, and wastage because of passed "best before date". The environmentally educated households wasted less, especially of prepared food. They also wasted less food due to passed "best before date". These households were more observant to packaging aspects in relation to food waste. The observations made could be used to learn more about packaging attributes that affect food waste. Although they recognised packaging influence on food waste, these households expressed lower satisfaction with packaging functions and wanted packaging to a lower extent.

Keywords: *packaging functions, packaging development, food waste, environmental education, purchase habits, sustainable development*

## 1. Introduction

Large quantities of produced food are wasted along the distribution chain and by consumers. Wasted food is an important issue for several reasons. Food requires large amounts of energy and other resources during production and distribution. If it is wasted it represents a waste of the world's limited resources and lead to an unnecessary environmental impact. The waste handling itself of both food and packaging have an impact on the environment, which has to be accounted for. Food waste also has an important ethical dimension since a large part of the world's population is starving (FAO, 2010).

Food wasted by consumers and at food institutions has a higher accumulated environmental impact than food wasted in the distribution chain, and is therefore even more important to reduce. There are indications that the amount food wasted by consumers and food institutions in Europe and USA varies between 15% and 30% of the all purchased food (Kantor and Lipton, 1997; Engström and Carlsson-Kanyama, 2004; Ventour, 2008; Quested and Johnson, 2009). The wastage of avoidable food waste in average households in UK, Norway, and Sweden is about 4 kg/week (Quested and Johnson 2009; Fredriksen et al., 2010, SEPA, 2005). Avoidable waste means food that at some point prior to disposal was edible (Quested and Johnson, 2009)

The reasons for food waste have been investigated to some degree (Corrado, 2007; Cox and Downing, 2007, wrap 1, 2007; wrap 2, 2007; Fredriksen et al., 2010). In a study from the UK, it was found that about 40% of the food waste occurred because the households cooked, prepared and served more food than could be consumed (Quested and Johnson, 2009). Somewhat more than half of the food waste occurs because the food was not used in time (ibid.). In a behavioural study by Cox and Downing (2007), several reasons for food losses were given, e.g., '*lack of plan*' or '*change of plans*', '*buying too much*', '*do not want to eat leftovers*' and '*do not know what to do with them*' or '*high sensitivity to food hygiene*'. About two thirds of the families with children say that a lot of food waste is due to the children (wrap, 2007a).

Packaging aspects in relation to food waste have been investigated (Cox and Downing, 2007; Fredriksen et al., 2010). Packaging aspects that cause food waste were found both at the time of purchasing the food and when using packaging at home. The following reasons were frequently mentioned as regards the shopping occasion: '*buying too much*', '*offers to take three and pay for two*' and '*multi-packs*'. When

relating packaging to food waste in the homes '*food gone past its sell by date*' was mentioned as the main driver (Cox and Downing, 2007). Another study from the UK reveals a lack of knowledge about how to store food at home and how the wrong storing may cause the shelf-life of food to be reduced (wrap, 2007b). About 60% of the consumers in the UK believe to some extent that food waste is not an important issue since food is natural and biodegradable (wrap, 2007a).

Attitudes towards environmental issues of packaging and food waste have been highlighted in some studies. In a Norwegian study, 15% of the consumers said that packaging is an important cause for food waste, and 30% of the consumers stated that the too large packages are one important cause for food waste (Fredriksen et al., 2010). In the UK, between 75% and 90% of the consumers agreed that discarded packaging is a greater environmental issue than food that is wasted (Cox and Downing, 2007; wrap, 2007a). Consumers are not aware that packaging often represent only a few percent of the environmental impact from the food-packaging system (Hanssen, 1998) or that improved packaging – even if it has a higher environmental impact – often can be motivated if the amount of food waste can be reduced (Williams and Wikström, 2011). Previous studies have shown a large potential in packaging development, since effective packaging can reduce food losses both directly and indirectly (Williams et al., 2008). Variation in packaging sizes to meet various demands, or adding a lid to make the packaging re-sealable are examples of direct aspects. Providing information to the consumer of how to store the food item to make it durable for a longer period of time, or how to interpret the '*best-before-date*'<sup>1</sup> represent two indirect aspects. Legislators and the public debate has tended to focus on the negative environmental impact of consumer packages and especially on packaging waste at the same time neglecting the fact that packaging can be developed to reduce food waste, thereby decreasing the total environmental impact of the food-packaging system (Svanes et al., 2010; Williams and Wikström, 2011). It is still uncertain, however, how extensive the packaging related food waste is and, therefore, it is uncertain to what extent packaging can be used to reduce food waste (Sonesson et al., 2005; Fredriksen et al., 2010).

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<sup>1</sup> In Sweden, there are two systems for open-dating. The first, "consume-before-date", is for products that not should be consumed after certain date for hygienic reasons, for example minced meat. The second system, "best-before-date", was introduced to avoid unnecessary waste of good products. The manufacturer guarantees that the product is of the best quality before this date, if it has been stored properly, but it can normally be consumed safely for a longer time. However, many consumers discard food when the "best-before-date" is passed, something that could be avoided with more information on the package about how to judge the quality of the content.

In this study, the aim is to explore reasons for household food waste with special attention to food waste that can be related to packaging. Data were collected from two groups of households with 30 and 31 respondents, respectively. The study also incorporates an analysis of how behaviours, purchase habits, price awareness, attitudes, and environmental education can be related to packaging and household food waste.

## **2. Methodology**

This is an exploratory study with the main purpose of investigating packaging aspects in relation to household food waste.

### **2.1 Population and sample**

In total 61 Swedish households participated in the study. A vast majority (97%) of the families were living in the county of Värmland and remaining families (3%) were from counties adjacent to Värmland. The data were obtained during two two-month periods with beginning in April 2009 and May 2010. The families were asked to choose one for them normal week (without any special occasions) for the measurements. Thirty of the families (henceforth referred to as the “green group”) had previously received education concerning various environmental issues in an environmental project called “MiljöVarDag” (i.e., Swedish for “Environmental Issues in Every Day Life”). The average family in “MiljöVarDag” was comprised of individuals where at least one had university level education, and they were interested in environmental issues. Many of these families were already doing things to reduce the environmental impact before entering the project, e.g., sorting waste in different fractions and biking to work. In the “MiljöVarDag” project they learned more about how to act more environmentally conscious and reduce the household’s energy use. They had also learned about packaging recycling. This group of households was chosen for the study because they were believed to be more observant of reasons for food waste than ordinary households.

Thirty households from the “MiljöVarDag” project were willing to participate in our study. The intention was to enrol at least 60 participating households, and it was therefore decided to include other households coming from the same region as the green group. These households were randomly chosen based on willingness to participate in the study. The data from these households were obtained in 2010. The second sample consisted of 31 households (henceforth called the “blue group”) who were considered to be ordinary however, committed households, with similar demographic properties, but without any known former environmental education. The

blue group's participation in the study, however, shows that they had some interest in the food waste issue. Some families declined to participate, claiming that they wasted too much (or too little) food, which they did not want to exhibit.

In total, 67 households volunteered: 30 from the green group and 37 from the blue group. Since six families from the blue group did not complete the study, the final sample consists of 61 households. Seventy-five percent of the households had children below the age of 21. Only 3 respondents came from single households, all in the Green group. The mean size of the families in the green group was 3.1 persons, whereas the average size of the blue group was 3.6 people. The Swedish average household is 2.1 persons (Statistics Sweden, 2011). The average income is slightly higher in the green group.

A study period of 7 days was chosen based on the researcher's experiences with consumer studies. This is a compromise between a high rate of participation and more accurate results from a longer test period. In this study 91% finalized the work.

## **2.2 Food-waste-diary**

The food-waste-diary consisted of five parts:

1. Measurement instructions and examples of how to measure food waste.
2. Questions about the household and its shopping habits.
3. Diary of food waste – not in connection with meals.
4. Diary of food waste – in connection with meals.
5. Questions about the household's favourite and most disliked type of packages.

### ***Measurement instructions and examples of how to measure food waste***

In part one, the households were given instructions and examples of what should be noticed and how the amount was to be measured. The avoidable amount of food was in most cases weighed, however, sometimes it was more convenient to report the wastage in volume numbers for, e.g., products poured out in the sink. Products that are difficult to empty, e.g., yoghurt, were allowed to be weighed in their packaging.

### ***Questions about the household and its shopping habits***

In part two (the questionnaire) different statements regarding attitudes to food waste and to packaging, as well as purchase habits were posed to the respondents and they

were asked to grade them from 1(do not agree at all), to 7(do fully agree), a Likert scale<sup>2</sup>. In Figure 1 the questions that were used in the analysis are presented.

### ***Food Waste Diary***

In part three and four, participants were asked to report the avoidable amount of waste food, i.e., food that at some point prior to disposal had been edible. This was, as stated above, done between and in connection with meals, but did not include bones, peels or any other inevitable wastage. Food leftovers given to pets were not included in the study. The avoidable amount of food was in most cases weighed on a scale that was handed out to each household prior to the study. Sometimes, however, it was more convenient to report the wastage in volume numbers. For every wasted food item one or more reasons were given for the wastage. Food waste not in connection with meals was defined as food waste from storage, e.g., fruit, vegetables, meat, dairy products, and non-prepared semi-products. Respondents could choose between eight different reasons for wasting the item:

- a. Bought too much
- b. Too large package
- c. Difficult to empty completely
- d. Bought the wrong thing
- e. Accident
- f. Passed best before date
- g. Bad/broken package
- h. Food has gone bad (rotten, sour, mouldy, etc.)

In part four of the food waste diary, the respondents reported food waste in connection with meals. This part related to cooked or prepared food that was not eaten, e.g., leftovers in pots, homemade food from plates, prepared or heated semi-products. The respondents were given six answering alternatives to why the waste occurred:

- a. Prepared too much (not possible to save left-overs)
- b. Prepared too much (do not want to save left-overs)
- c. Prepared too much (did not taste well)
- d. Made a mistake while preparing
- e. Accident
- f. Saved left-overs not used in time

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<sup>2</sup> A scale used for measurement of individuals' attitudes to a topic. Developed by US psychologist Rensis Likert and described in his thesis, 1932 (*Oxford English Dictionary*)

The respondents had the possibility to note other reasons both for storage waste and meal waste than the alternatives given in the diary.

### ***Questions about the household's favourite and most unfavoured packages***

In part five questions regarding favourite and unfavoured packaging were asked. This was used as a complement to the diary section, in order to find aspects of packaging that cause or prevent food waste not mentioned in the diary.

### **2.3 Analysis**

The amounts of food waste were summarised in different categories, which are displayed in Table 1. The reasons for and number of occasions when food wastage occurred were summarised for the green and the blue groups separately. We analysed how packaging affects the household's food waste and calculated the size of packaging related waste. The weight of packaging was subtracted for products weighed in the packaging.

The result of favourite and unfavoured packaging was summarised and analysed.

Household food purchase habits were analysed in order to find correlations between purchase frequency, packaging sizes and food waste. An analysis of the two statements "*I/we buy most of my food on one big weekly shopping occasion*" and "*I/we make several purchases in a week*" was done for the green and blue groups. These statements were merged into one variable "*Purchase habits*", with inverted values for the second question, the numbers ranging from 2 to 14. Two groups were created based on the answers given for the two purchase questions: one group with answers from 8 to 14 who noted they purchased food more seldom, and one group with answers from 2 to 7 who noted they purchased food more often.

Household price awareness, caring about price/kg and the use of discount coupons was analysed in relation to food waste. Price awareness may influence the households to buy larger packages and save money per kilogram of food, which may result in more waste. Two of the statements in the questionnaire dealt with how price influences purchase behaviour: "*I/we look around and decide a lot based on price/kg*" and "*I/we purchase food items with discount coupons*". These statements were merged into one variable, "*Price awareness*", with numbers ranging from 2 to 14. Two groups were created based on the answers given for the two price statements, one group with answers from 8 to 14 that noted price to be more important, and one group with answers from 2 to 7 that noted price to be less important.



### 3 Results and analysis

#### 3.1 The noted amounts and reasons for wasting food

Household waste food in connection with preparing, serving, and eating meals, or discarded direct from storage. The total amount of food waste is summarised in Figure 2.

On average, the households discarded 1.7 kg of waste/household/week ( $SD=1.2$ ). About two thirds of the food waste came from storage and one third from meals. Fruit, vegetables and dairy products dominated the wastage coming from storage. About one third of the total food waste consists of prepared food: home-cooked food, heated semi-prepared food or cold mixed food, such as salads.

The green group wasted about half the amount of prepared food as compared to the blue group (0.33 kg/household/week compared with 0.66 kg/household/week). Both groups wasted about 0.5 kg of fruit and vegetables per household and week. The blue group wasted more dairy products as compared to the green group (0.45 kg/household/week compared with 0.3 kg/household/week). However, the difference can be explained by a few households in the blue group wasting larger amounts (>500g) of dairy products.

The amount of food waste in relation to the number of times a certain *reason for food waste* was given is presented in Table 2. Both groups state that almost 50% of the total amount of food is wasted because the food has gone bad. About 25% of the food is wasted because the households have prepared too much food.

The reason “children did not want to finish” was not a reason given in the diary, however, it was nevertheless stated by many of the respondents; it accounted for 17% of the food wastage coming from meals. The green group generally filled in more reasons for wasting food than the blue group. The blue group wasted more food related to ‘best before date’, both in absolute and relative numbers.

#### 3.2 Packaging influence on food waste

The green group specifies packaging to be the cause of food waste twice as often, both in number of times and amount. This group is apparently more observant towards the connection between packaging and food waste. The green group noted packaging to be the cause for 16% of the food waste as compared to 5% in the blue group, see Table 2.

Two reasons for food waste due to packaging were noted by the respondents, '*difficult to empty*' and '*too large packages*'. The '*difficult to empty*' reason represents a total waste of 4 kg out of which about 3/4 was yoghurt and sour milk from liquid packaging board, and 1/4 was liquid margarine, jam, porridge, mayonnaise and soups that were packed in plastic, glass, fibre or metal packaging. The packaging reason '*too large packages*' accounted for a total amount of 4.5 kg of waste. No patterns as regards certain products or packaging material were found for the '*too large packages*' aspect. One 1000 g board package with a screw lid for yoghurt (Fig. 3) dominates the '*difficult to empty*' aspect. These packages are emptied differently in the two groups. The average amount of leftovers from this package was 63 g for the green group and 100 g for the blue group. Yoghurt and sour milk are products with relatively high viscosity that adhere to the packaging surface and the package is therefore difficult to empty completely. The green group managed to empty or squeeze the packaging better and could hence use more of its contents.

Best before date is information printed on the package and can therefore be considered to be a packaging related aspect (see note above). If '*best before date*' is included in the packaging related causes for food waste, the total packaging influence will amount to about 25% for the green group and to about 20% for the blue group.

The households, however, only observed when the packaging was a direct cause of food waste, e.g., the package is difficult to empty. There were no comments from the households about waste due to a lack of packaging, e.g., for fruits and vegetables. The connection between preparing too much food and the package size, e.g., of semi-prepared food, is only noted twice. Nobody noted any connection between wastage due to '*food item gone bad*' and buying too much food. If these un-noted observations are added, the packaging related waste may well be even higher than the 20–25% found in this study.

In order to complete the diary section, where aspects of packaging that causes food waste were noted, the groups were asked to answer questions regarding favourable and unfavoured packaging. Here the respondents were allowed to express positive aspects of packaging that may prevent food losses. A summary of the result of these two questions are presented in Table 3.

The households liked packages that were easy to empty, easy to reseal and easy to recycle. The most disliked malfunction of a package is the package being difficult to

empty. Thirty-eight respondents indicated ‘*difficult to empty*’ while 20 respondents claimed to like packages that are easy to empty.

The liquid board was the most frequently mentioned package, both in favoured and unfavoured terms. Households claimed to like the Tetra brik, which is easy to empty, and to dislike the liquid board package with a screw lid, which is difficult to empty, see Figure 3. During the last five years, the package with a screw lid has taken over the market for milk, sour milk and yoghurt in Sweden, and it has also been frequently discussed in the media. Four households in this study indicated that they liked the liquid board packaging with a screw lid and 22 indicated that they disliked it.

### **3.3 Attitude’s influence on food waste**

The attitude of ninety-six percent of the respondents is that food wastage is not good. Further analysis of this attitude showed that there are some differences in attitude between the green and the blue groups. Households with a more lenient attitude towards wasting food, waste more in connection with meals. This is more obvious for the blue group.

When analysing the two groups and their attitudes towards packaging, some differences were discovered. A negative attitude towards packaging is displayed in the statements “If I/we could choose, the packaging should be removed” and “They are a waste of resources and should be minimised”. The difference between the groups is significant ( $p= 0.044$ ). The green group are more critical to packaging with an average higher sum of the two statements ( $M = 9.86$ ;  $SD = 2.23$ ) compared to the sum of the blue group ( $M = 8.35$ ;  $SD = 3.06$ ). In the green group, 25% of the respondents agreed to a high extent with the statement “If I/we could choose, the packaging should be removed” (noting 6 or 7 on the 7-graded Likert scale). In the blue group, 15% of the respondents agreed to a high extent with this statement.

Household **price awareness**; caring about price/kg and usage of discount coupons was analysed. The mean value of price awareness for all respondents was 7.72 ( $SD=3.03$ ). The median (8) was used to create two groups: one that noted price to be more important (equal or above the median, 29 households) and one that noted price to be less important (below the median, 27 households). In average, the households that noted price to be more important wasted 1.51 kg/household/week ( $SD=0.94$ ), which is less than the households that noted price to be less important, where the average waste was 1.86 kg/household/week ( $SD=1.16$ ). The difference is somewhat higher for the blue group, see Figure 4.

### 3.4 Other factors' influence on food waste

The influence of **household sizes** on amount of food wastage was analysed and presented in Figure 5. The amount of food waste/capita is somewhat reduced as the households get larger ( $b = -112,132$ ;  $t = -2,377$ ;  $p = 0.021$ ). The sample, however, is small and there are large variations within many of the household size groups.

The household **purchase habits** were analysed. The median (8) was used to create two groups: one group that purchase more seldom (equal or above the median, 29 households) and one that purchase food often (below the median, 27 households). The mean value for purchase habits for all respondents was 7.54 ( $SD = 3.64$ ). On average, households that noted they purchased food more often wasted 1.23 kg/household/week ( $SD = 0.68$ ), which is less than households that noted to purchase food more seldom, whose average was 2.03 kg/household/week ( $SD = 1.28$ ). The difference in amount of food waste depending on purchase frequency is larger for the blue group, see Figure 6.

No correlation was found between **household income** and food waste.

## 4 Discussion

This exploratory study has shown that packaging is one factor that influences the amount of food waste in households. Twenty to twenty-five percent of the food waste can be related to packaging. The households noted '*too big packages*' and '*packages that are difficult to empty*' as causes for food waste. Food waste due to '*best before date*' was included in the packaging related waste aspect. This is not generally thought of as a packaging attribute, but the packaging is a potential information carrier that can inform and explain how the consumer can use the best-before-date, for example by explaining that it is safe to taste the content and judge if it is good. The total packaging related waste might be larger than twenty-five percent if packaging aspects that the households did not note in this study are included, for example, too little packaging for certain categories, such as fruits and vegetables, or insufficient solutions for resealing packages. Other studies, however, have shown that the average food wastage is about 4 kg/household/week, which is considerably higher than in this study, where average wastage was shown to be 1.7 kg/household/week. It is therefore difficult to assess if this result is representative for other groups. There is also always the risk of social desirability bias with self-reporting; people respond/ behave more to what they believe is socially desirable rather than to be truthful in surveys and questionnaires (Podsakoff et.al., 2003; Banjo and Val, 2011). According to Cialdini's principle of 'Social Proof' people want to behave as the group they belong to or want to belong to, and it is not an acceptable behavior to waste food (Cialdini, 2007).

In the analysis of the differences between the green and blue groups, the environmental commitment and/or the environmental education of the green group makes a difference. It is uncertain whether their food management planning or their behaviour with food at home is the reason; however, the green group wasted half the amount of prepared food as compared to the blue group. Planning ability may affect the amount of food they prepare and how they take care of and use the leftovers. Their planning ability may influence their shopping frequency so that it does not have the same effect on food wastage as in the blue group. Planning ability is considered to be an important aspect in other studies (Baker et al., 2009). The green group wasted less due to '*passed best before date*'. The reason may be that they try, taste and smell the food to a greater extent and/or that they are more willing to eat such food, and however, it may also be due to better planning.

The households in this study that noted that price is important wasted less than those who noted that price is less important. The reason for this could be due to better planning ability or cost awareness in general.

The method chosen in the present study was useful when quantifying the packaging related food wastage. There are some methodological difficulties, however, that need to be addressed and handled in future studies:

**Household sample.** Ninety-six percent of the respondents in our study answered that wasting food is not good. This figure is very high in comparison with a study from the UK where only about fifty percent said they cared a fair amount or a great deal about wasting food (Cox and Downing, 2007). The total amount of food waste reported in this study is lower than reported for average households. Some families that were asked to participate said no because they wasted too much and did not want to show this. Both the green and blue groups can be considered to be more environmentally committed than the average household member. It is difficult, however, to motivate people to measure their food waste for seven days if they do not care about the issue. In future studies, it may be better to use household economic cost of food waste as a main case to be able to examine a larger sample. Other studies show that consumers care much more about the household economy than the environment (Cox and Downing, 2007; Baker et al., 2009). Household sizes have some effect on the amount of food waste. In general, smaller households waste more food/capita, which has been shown in other studies (Baker et al., 2009; Kjær and Werge, 2010). Since one-person households waste more per capita, and since it is an increasing household type in Europe, it would be interesting to further study this groups' packaging related waste.

**Household behaviour.** People feel bad about wasting food, and this will probably affect how they act during the test week. Some of the participants reported "cleaning out the refrigerator" prior to the study and the amounts of food wasted between meals are lower than in other studies. There were no reports about food wastage from freezers. Respondents may have forgotten to fill in the diary, which decreases the amount of reported food waste.

**Observation of packaging – a difficulty.** Households both have to note the amount of a wasted item and why it was wasted. The consumers' ability to observe the role of packaging for food waste varied in the sample. The green group observed twice the amount of packaging related waste compared with the blue group, even though their total food waste was less as compared to the blue group. It is not always obvious to

recognise that an item bought a couple of days or weeks earlier was too big and that the waste could have been prevented if buying a smaller package. Among the wasted food products in the categories *'food item gone bad'* and *'other reason'* there may be more packaging related wastage. In future studies it may be useful to pose many more packaging related questions from the start in the diary and include, e.g., *'too little packaging protection'*, *'difficult to reseal or storage'* *'information on the package'*, to make it easier for the respondents to perceive more of the packaging related issues.

One aspect regarding attitudes towards packaging in the present study is interesting to elaborate upon. The green group is more negative to packaging in general and states to a higher extent that if they could choose, the packaging should be removed. They do not see the risk of accelerated food waste amounts if the packaging is removed. The behavioural study from Cox and Downing (2007) reveals that environmentally conscious people are more likely to agree that packaging is a more important issue than food waste. Why are environmentally conscious people so negative towards packaging? Is there a packaging misconception?

The view of packaging as being something bad, which has to be minimised, has hidden the more important focus on packaging optimisation for a more comprehensive environmental approach (Svanes et al., 2010). Governments in Europe have focused on minimising packaging waste and made this clear to businesses and consumers (European Council, 1994). Businesses almost only market environmental packaging improvements when it concerns packaging material reductions or increased use of renewable materials (e.g., Coca Cola Company, 2010; Guardian, 2009; Wal-Mart, 2011; Whole foods market, 2010). The directive and business communications show the consumer that it is the packaging itself we should care about. There are no such directives for reducing food waste, which signals that this is less important than packaging waste. It is more difficult for governments to address issues where consumers should be reached (Geyer-Allely and Zacarias-Farah, 2003). Although we see some changes, with national target goals for food waste in, e.g., the Netherlands (Ministry of Agriculture, Nature and Food Quality, 2010), we probably have a long way to go before consumers realise that food waste is a more important environmental issue than packaging waste. Although consumer attitudes and behaviour finally determines the outcome, information and better packaging can promote a change towards less food waste.

## **5. Conclusions**

Packaging and its functions may play a significant role for the amount of food waste in households. In our sample, 20–25% of the food waste was related to the packaging design attributes, both the ones observed by consumers (easy to empty, too big packaging) and the one added by the authors (information attribute best-before-date). The households that participated, however, did not represent the average population, which makes the packaging related results uncertain. Participants with high environmental consciousness waste less food and are more observant of packaging and its role in food waste reduction. This observational ability could be utilised in further studies. However, there is a need for methodology development for how to study indirect causes where the packaging influence on food waste is less obvious for the consumers or when the absence of packaging cause food waste. This study emphasises the importance of learning more about how packaging attributes affect food waste in households.

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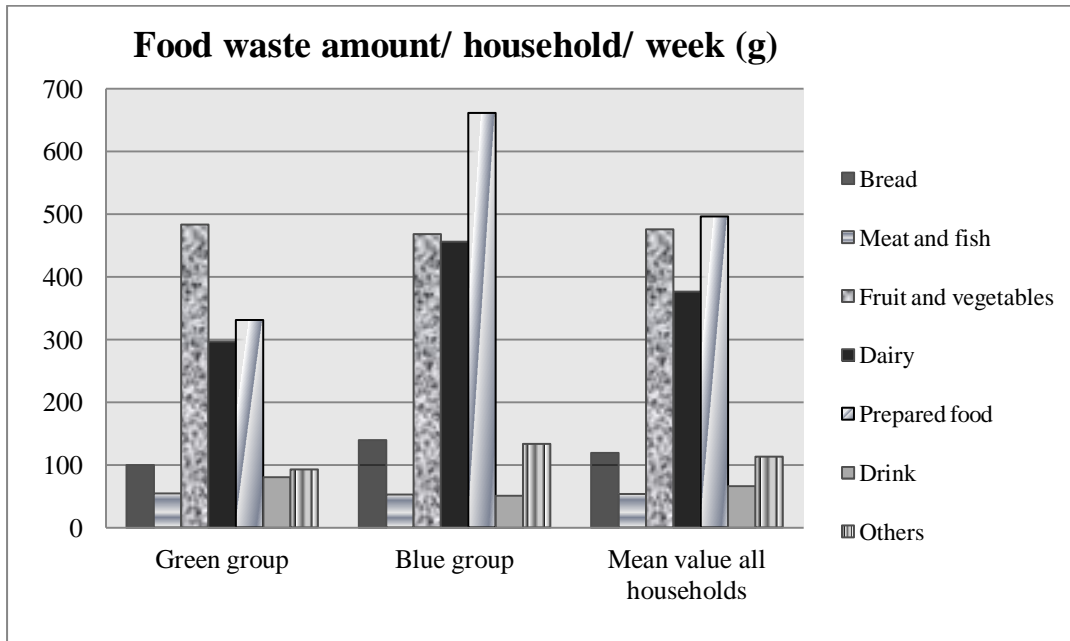
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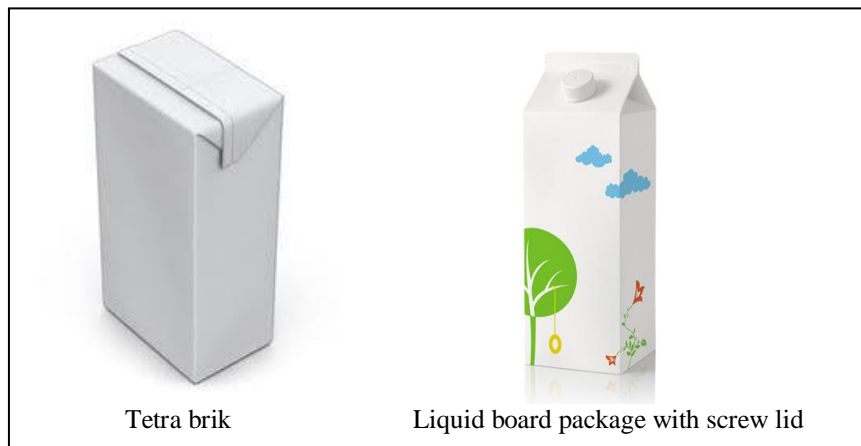
*Figure captions*

<b>Questionnaire</b>							
<b>Questions that were used in the analysis</b>							
<b>1.1 How many people are there in your household? Please give ages and sex for every person.</b>							
<hr/>							
<i>(Note to what extent, rated from 1 to 7, how you agree with the statement below)</i>							
	Do not agree at all			.....Do fully agree			
<b>1.3 How do you feel when you waste food?</b>							
a. It feels like wastage, I/we get a bad conscience.	1	2	3	4	5	6	7
b. It feels good to clean out the refrigerator and freezer.	1	2	3	4	5	6	7
c. It isn't anything I consider.	1	2	3	4	5	6	7
<b>1.4 How do you purchase your everyday commodities?</b>							
a. I/we buy most of our food on one big weekly shopping occasion.	1	2	3	4	5	6	7
b. I/we make several purchases in a week.	1	2	3	4	5	6	7
c. I/we look around and decide a lot based on price/kg.	1	2	3	4	5	6	7
b. I/we purchase food items with discount coupons.	1	2	3	4	5	6	7
e. I/we prepare and purchase food items momentarily.	1	2	3	4	5	6	7
<b>1.6 What is your general opinion about packaging?</b>							
a. They protect the content from the grocery store to my home.	1	2	3	4	5	6	7
b. They protect the content to make the food more durable.	1	2	3	4	5	6	7
c. They make my everyday life easier.	1	2	3	4	5	6	7
d. They are a waste of resources and should be minimised.	1	2	3	4	5	6	7
e. If I/we could choose, the packaging should be removed.	1	2	3	4	5	6	7
<b>1.7 How do you figure the packaging design?</b>							
a. Packaging is well designed for transport.	1	2	3	4	5	6	7
b. Packaging is designed to make my consumption easier.	1	2	3	4	5	6	7
c. Packaging exists in sizes that fit our household.	1	2	3	4	5	6	7
d. Packaging is designed to make it easy to find the right product in the store.	1	2	3	4	5	6	7
e. Packaging is well designed for storage in my home.	1	2	3	4	5	6	7
f. Packaging is designed to be easy to empty.	1	2	3	4	5	6	7
<b>1.9 How large is the household income/month?</b>							
a. < 10 000 SKr (Swedish kronor)							
b. 10 000 - 20 000 SKr							
c. 20 000 - 30 000 SKr							
d. 30 000 - 40 000 SKr							
e. 40 000 - 50 000 SKr							
f. 50 000 - 60 000 SKr							
g. > 60 000 SKr							

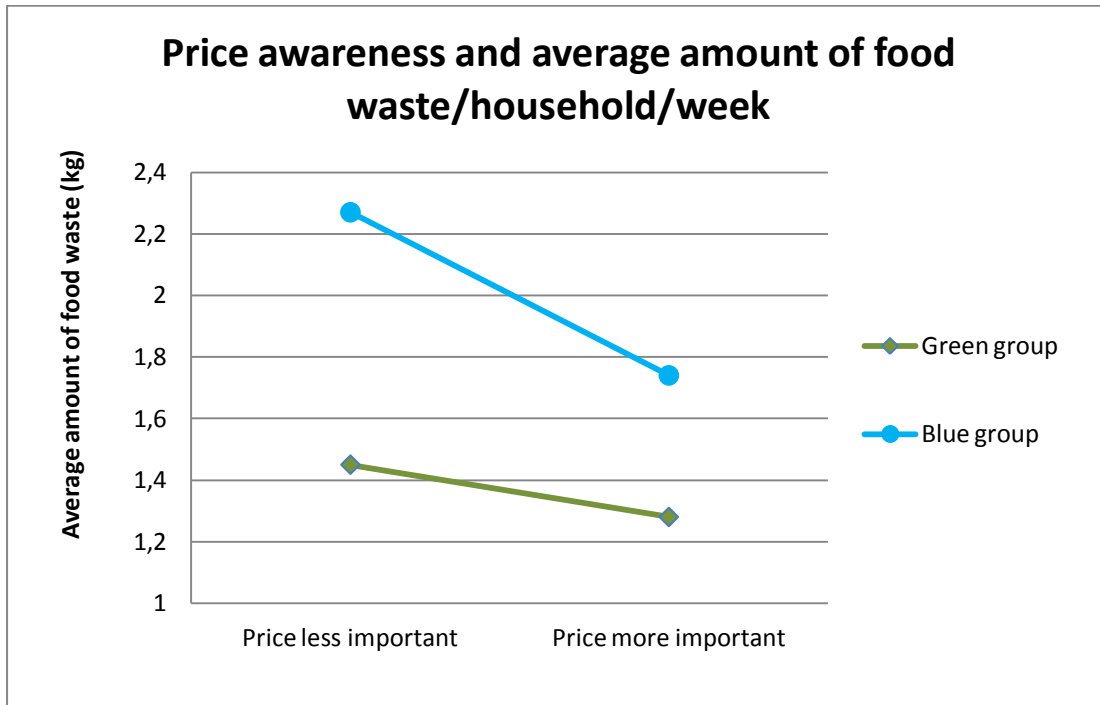
**Figure 1.** *Food waste diary with the questions that were used in the analysis.*



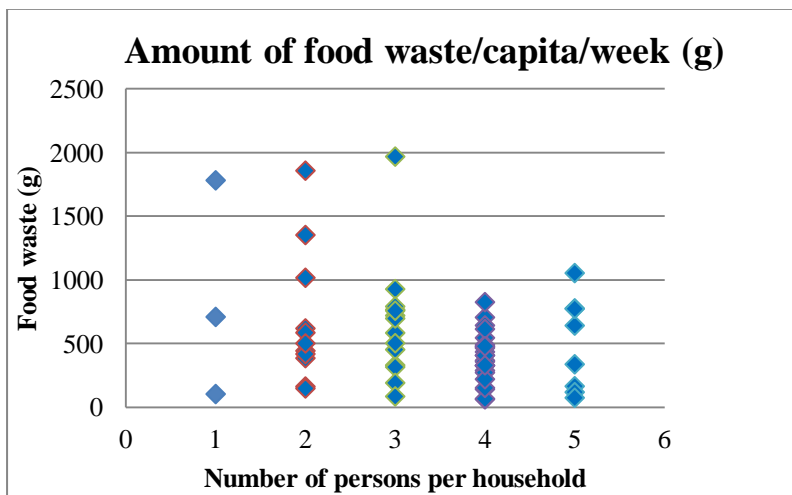
**Figure 2.** Amount of food waste per household and week broken up by food category (the amounts are broken up between the green and blue groups).



**Figure 3.** Pictures of Tetra brik and liquid board package with screw lid. (Photo: [www.tetrapak.com](http://www.tetrapak.com))



**Figure 4.** Price awareness' influence on household weekly food waste. Green group ( $M=1.45$ ,  $SD=0.95$ ;  $M=1.28$ ,  $SD=0.73$ ), blue group ( $M=2.27$ ,  $SD=1.37$ ;  $M=1.74$ ,  $SD= 1.14$ )



**Figure 5.** Amount of food waste per capita and week depending on household size.



**Figure 6.** Purchase habits' influence on the households' weekly food waste. Green group ( $M=1.18$ ,  $SD=0.76$ ;  $M=1.60$ ,  $SD=0.93$ ), blue group ( $M=1.27$ ,  $SD=0.61$ ;  $M=2.45$ ,  $SD=1.37$ )

**Table captions**

**Table 1** Categories of food waste.

Category	Subcategories
Bread	soft and hard bread, pastries
Meat and fish	chicken, ham, bacon, meatballs, sausage, liver paste, fish
Fruit and vegetables	fresh fruits and vegetables, olives, maize
Dairy	milk, cream, yoghurt, sour milk, cheese, egg
Prepared food	vegetarian food and non-vegetarian food, boiled vegetables, mixed dishes.
Drinks	coffee, juice, lemonade
Others	sugar, cake, stewed fruit, sauce,

**Table 2.** Main reasons for food waste in the green and blue groups, how often waste occurs and the total amount of waste per week. The blue group displays a higher number for all of the three 'prepared too much'-reasons. The total amount of food waste from both groups during the week amounted to 104 kg.

	Green Group		Blue Group	
	Number	Amount (kg)	Number	Amount (kg)
<b>Reasons for waste from storage</b>				
Food item gone bad	126	19	108	24
Passed "Best before date"	20	3.6	30	7.9
Packaging (too big, difficult to empty)	63	6.8	30	3.1
Bought too much	8	1.7	4	1.3
<b>Reasons for waste from meals</b>				
Prepared too much (not possible to save leftovers)	26	2.6	52	6.2
Prepared too much (do not want to save leftovers)	17	2.2	37	5.3
Prepared too much (was full, didn't taste well)	21	1.5	30	2.4
Saved leftovers not used in time	17	2.3	20	2.3
Children did not want to finish meal	56	2.6	38	3.4
Mistakes, other	10	0.9	12	0.6



**Table 3.** *A summary of reasons for households' favourite and unfavoured packaging, with the majority of the packaging examples taken from the various categories.*

Why is this a <u>favourite</u> package?	Noted (N°)	Packaging examples (number of times noted)
Easy to empty	20	liquid board (10), table margarine in plastic (3), glass jar (2)
Easy to reseal	13	small plastic bags (6), board packages (3), plastic packages with lid (3),
Easy to recycle	11	liquid board (6), small bags (2), plastic packages for liver paste (2)
Good manageability	10	liquid board without lid (4), liquid board with lid (4)
<b>Why is this an <u>unfavoured</u> package</b>		
Difficult to empty	38	liquid board with lid (29), plastic packaging for ketchup or mustard (4)
Difficult to open	8	liquid board without lid (3)
Difficult to recycle	7	canned food (2), liquid board with lid (2)
Difficult manageability	7	example; tea, cacao, juice, cracker (1)