BSc Thesis

Food wasted during the Consumption life cycle

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Preface

The topic of food waste is highly active nowadays. An increasing number of campaigns are going on to make people conscious about their waste behaviour and to motivate them to change. Almost everyone is wasting food, including myself. During my research about food waste I got more conscious about my own wasting behaviour. Now I am trying to change my habits and be more creative in cooking with leftovers. I hope other people will also improve their food habits and eventually decrease the large amount of food waste.

This BSc thesis describes the factors that influence the food waste behaviour in the different phases of the consumption life cycle, including differences between countries.

I would like to thank my supervisor Prof. J.C.M. van Trijp for his remarks, advice and for the way he made me think critically about the literature. I also want to thank my second supervisor Dr. E. van Herpen for her remarks and advice.

Danique Wes

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Abstract

This thesis aims to give a review of the existing literature about food waste and focusses particular on the different phases of the consumption life cycle also including country differences. In the first part the concept of food waste is discussed and an overview is given of the amounts of food waste. Nowadays in developed countries food is wasted more easily, consumers in North America and Europe waste about 95-115 kg per capita per year.

In the second part, per consumption life cycle phase reasons and motivations behind food waste behaviour are shown. The consumption life cycle consists of; pre-purchase, purchase, storage, preparation and consumption phase. Furthermore the methods that are used in the reviewed literature are evaluated. Most of the methods used in food waste research use self-reports by respondents, this involves the risk of respondents prefer to present themselves more favourably.

The results of this review showed that food waste starts with the planning behaviour and this will have an influence through the whole life cycle. Guilt is an emotion that also effect food waste for example it is important to have enough food for your family and guests. The differences between countries in relation to motivations and reasons behind food waste are not very visible and therefore it is recommended to research this topic more. A combination of different methods for example diary reports by a third party followed by in-depth interviews would be the best way to investigate this topic.

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1. Introduction

1.1 Background

It is estimated that in the developed countries where the food wastage is the highest, the wastage in Europe and North America is 95-110 kg per capita per year. In comparison, in sub-Saharan Africa and South/Southeast Asia it is only 6-11 kg per capita per year. The food wastage in developed countries occurs mostly in the consumer stage, this is related to consumer behaviour and that consumers can financially afford food losses nowadays, food is wasted more easily. In developing countries the most food is wasted at the early and middle stages of the food supply chain, this is due to for example limited harvesting techniques, inadequate in storing and cooling facilities and the difficult climate conditions (Gustavsson, Cederberg, & Sonesson, 2011) (Grethe, Dembele, & Duman, 2011). There are several reasons why it is important to highlight food waste. There is a moral issue; there are people who do not have enough to eat and at the same time people are throwing away food. Secondly the environment is affected, the natural resources are not endless and throwing food away is unnecessary use of these resources. Third, food waste costs a lot of money. For example people in the UK waste an average amount of £480 per household per year (Koester, 2013) (WRAP, 2009).

A difference in definition can be made between food losses and food waste. Food losses concern the decrease in edible food mass during the food supply chain that specifically leads to edible food for human consumption. Food losses can take place during the whole supply chain from production, postharvest to the processing stages. Food losses that take place in the last stages of the food chain, retail and final consumption, are more often called ''food waste'', which relates to retailers' and consumers' behaviour (Parfitt, Barthel, & Macnaughton, 2010). Food waste in relation with consumers' behaviour can also be defined as 'household food waste'**.** Three categories of household food waste can be defined; avoidable, possibly avoidable and unavoidable.

- Avoidable – food and drink thrown away that was, at some point prior to disposal, edible (e.g. slice of bread, apples, meat).
- Possibly avoidable – food and drink that some people eat and others do not (e.g. bread crusts), or that can be eaten when a food is prepared in one way but not in another (e.g. potato skins).
- Unavoidable – waste arising from food or drink preparation that is not, and has not been, edible under normal circumstances (e.g. meat bones, egg shells, pineapple skin, tea bags).

In this paper the main focus is on avoidable household food waste. The category of avoidable household food waste can be further split into three categories as shown in figure 1 (WRAP, 2009).
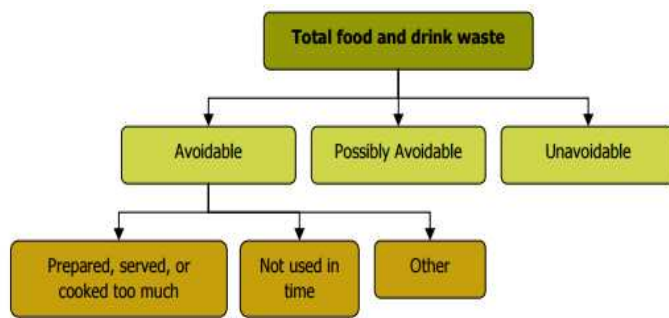
Figure 1: Classification of household food and drink waste from WRAP (WRAP, 2009)

Food waste can occur in all the stages of the consumption life cycle. There are specific behaviours that influence the food waste behaviour in every stage. In figure 2 an overview of the consumption life cycle is given. This figure will serve as the starting point of this literature review.
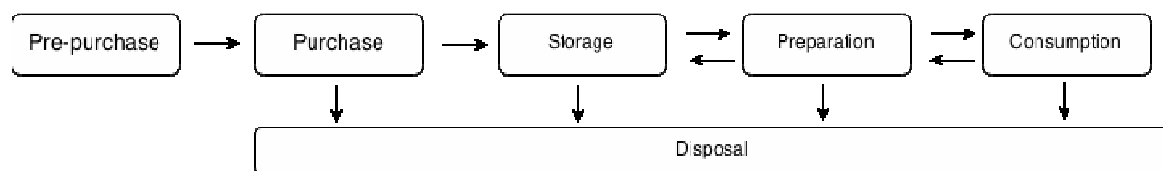
Figure 2 Consumption life cycle

1.2 Problem statement

According to Parfitt (2010) the largest part of the food wasted will continue to be produced by the consumers. The high standards of how the product should look like, for example tomatoes with a soft spot will often be thrown away while it was still edible, the relative low cost of food and the increasing disconnection between the consumers and how the food is produced will contribute to an increasing food waste generation.

A lot of the current research focusses mainly on the amount of food that is wasted. The amount of food wasted per product category is reported and the amount of money that comes along with these losses is shown (e.g. Koester, 2013; Venkat, 2011). The last couple of years there are more and more studies also focusing on the factors of consumer behaviour that influences food waste. To reduce the food waste and to create effective campaigns it is important to find out which determinants influence food waste behaviour. Differences between cultures will possibly also have a major role in waste behaviour, this has not been examined much.

1.3 Goal and research questions

The aim of this literature review is to gain more insight into which determinants influence consumer food waste behaviour. In this review there will be focussed on the phases that influence the household food waste behaviour. The behaviour during the process of food waste is examined and there will be looked at the differences between countries. The following research question is proposed: *What behaviour influences the food waste in the different stages of the consumption life cycle and what are the differences between countries?* In order to answer the research question, the following sub questions are derived:

1. What are the current amounts of food waste in the different countries?

2. What behaviour influences the food waste in the pre-purchase stage?

3. What behaviour influences the food waste in the purchase stage?

4. What behaviour influences the food waste in the storage stage?

5. What behaviour influences the food waste in the preparation stage?

6. What behaviour influences the food waste in the consumption stage?

2. Amounts of food waste in different countries

In this chapter the amounts of consumer food losses are elaborated and some demographic facts are included. The differences between countries are taken into account and facts are shown per product group. Because of the different measurements that are used to measure food waste, the definition of what exactly is considered as food waste it is difficult to compare the numbers from different researches.
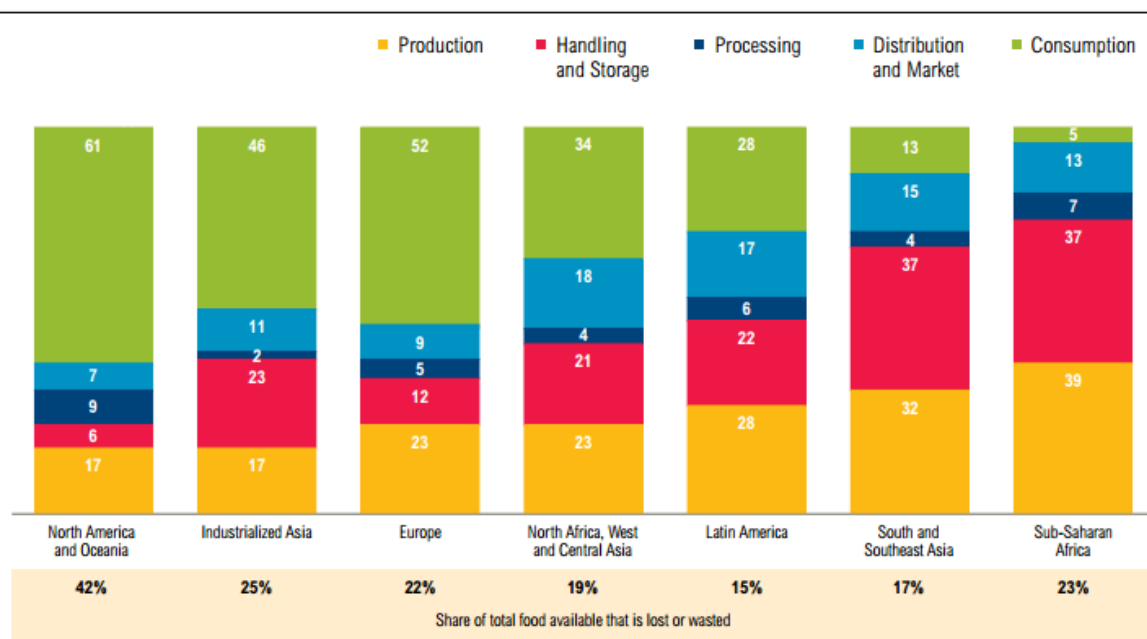
Figure 3 Food lost or wasted by region and stage in 2009 (percent of kcal lost and wasted) (Lipinski et al., 2013)

Figure 3 shows the share of total food loss and waste by region and stage, it shows the percentage of kcal lost and wasted. In North America and Oceania, Industrialized Asia and Europe more than half of the food waste and losses occurs in the consumption stage. The waste at the consumption stage is much lower in Sub-Saharan Africa and South/Southeast Asia (Lipinski et al., 2013). Per capita, consumers in North America and Europe waste about 95-115 kg per year, while this figure in Sub-Saharan Africa and South and Southeast Asia is only 6-11 kg per year (Gustavsson et al., 2011). Data from the European Commission also showed that the largest part of food waste, 42% of the total food losses, is caused by households this accounts for 76 kg per capita. The manufacturing sector waste was estimated at 39% of the total food waste, food Service/Catering 14% and Retail/Wholesale 5% (European Commission, 2010). Comparisons between countries show that countries with similar income levels have large variations in the amounts of food wasted. For example, the Netherlands, Finland, Japan and Sweden waste only about 60% of the amount of food that is wasted in the US, Belgium, Switzerland and Italy (Grethe et al., 2011).

The research by Langley et al. (2010) showed that a main contributor to food waste, 45% of total amount, comes from whole unused and part-consumed products. An example of whole unused product waste is for instance products that are out of date and thrown away without using anything of it. Part-consumed products are for example too large package sizes, some of the product is used and the rest is thrown away. These types of waste mainly occur because of bad shop planning, meal planning, impulse buying, bulk buying and too large

portion sizes. The other categories that contribute to food waste which are mentioned in the article are post-preparation (leftovers), preparation by-product and composite gunge. Lebersorger & Schneider (2011) found the same results, whole unused and part-consumed products contribute for a large part to the food waste, in this research the percentage is almost similar, 46%. The second largest contributor to food waste in this research is preparation residues (44%), which are preparation by products and are categorized as non-avoidable.
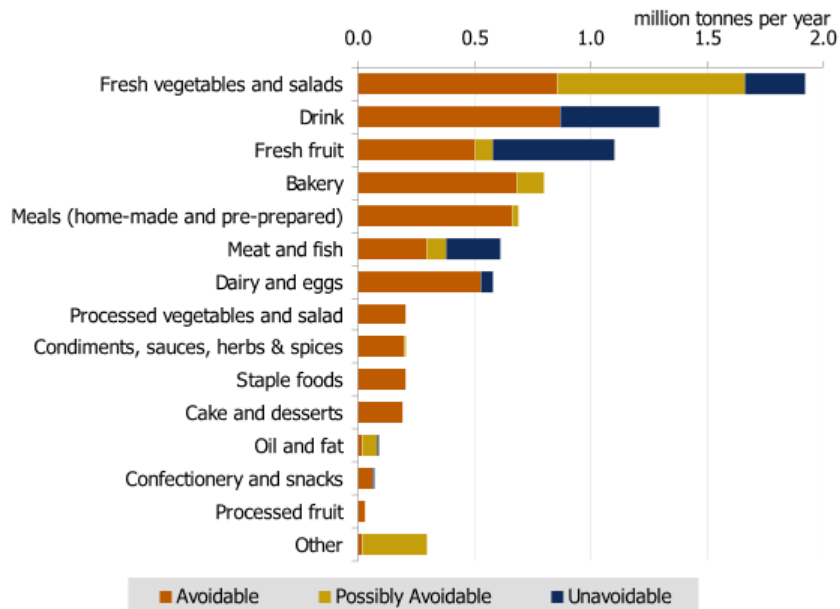

Figure 4 Waste per product group (WRAP, 2009)

A research by WRAP (2009) showed (figure 4) that in the UK the largest product group of food waste are fresh fruit, vegetables and salads. In this product category, 45% of the waste is avoidable, a large part. The bakery product group accounts for 800.000 tonnes of waste, from which 680.000 tonnes is avoidable food waste (WRAP, 2009). Research by Gustavsson et al. (2011) also confirms that the product group fruits and vegetables contributes the most to the total amount of food waste (44%). The research also showed that in developing countries the most food waste takes place at the post-harvest and processing stage. For example in South Africa the post-consumer food waste only contributes 5% to the total. Results of this research are estimated/assumed by using different literature resources and based on mass flow models.

Consumers expect that there is a large variety of choice in different foods and together with the trend of consuming more meat, fruit and vegetables, and other highly perishable foods this will result in an increasing risk of food waste (Priefer, Jörissen, & Bräutigam, 2014). In Japan people have very high standards when it comes to gastronomic food quality. Fresh food products are very deeply entrenched in the Japanese culture. They eat a lot of raw food products like sushi, sashimi and tatiki (raw chicken), these are highly perishable and this increases the risk of being wasted. Japanese people spend a lot of money on good food (especially people in the second largest city, Osaka), they even have a special term for this namely ''Kuidore''; eating until your finances collapse. Even the ready to eat meals in Japan have a much higher quality and freshly made, this leads to a very low shelf life (Stuart, 2009).

Another influence on the amount of food waste is that the amount of the disposable income spent on food by an average household has decreased a lot. People can afford it more to buy food and therefore it is easier to throw food away. The part of the income spent on food is now between less than 10 percent (Luxembourg, Austria, United Kingdom) and up to 20 percent (Estonia, Latvia) across EU-27 (Yaneva & Gerstberger, 2013). For example in Italy the percentage of an average family income spent on food was 30% in 1970 to around 12% in 2009 (Buchner et al., 2012). People with a higher income waste more food, this is because the fact that they have a large budget to buy fresh products and more easily throw old products away (Parfitt et al., 2010).

Per capita, single households waste the highest amount of food, this is due the fact that it is more difficult to prepare a meal for smaller households compared to larger households. Reasons for this are the often large package sizes and single households are more likely to be young and have lifestyles with a less regular pattern of eating at home (Baker, Fear, & Dennis, 2009; Koivupuro et al., 2012; Quested, Marsh, Stunell, & Parry, 2013). Households with young children are wasting more fresh food than other households, but this is just because the fact that more persons waste more (Hamilton, Denniss, & Baker, 2005; WRAP, 2007).

Hamilton et al., (2005) also found that the amount of food waste decreases a lot when people get older. Among 18-24 year olds, 38% wasted more than $30 on fresh food per two weeks, among respondents aged over 70 only 7% showed similar levels of waste. Young people feel less guilty about food waste and how this influences the environment. Tucker & Farrelly (2015) found that elderly, people above 65, waste less because they have different experiences. They had to deal with food shortages and austerity during the Second World War. Also they were told to handle the food carefully because the household income that was spent on groceries was much higher in those times than today. These experiences in difficult (war) times still influence their waste behaviour nowadays. But the immediate post-war generation that was educated to a high respect for food is slowly dying out (Priefer et al., 2014; Tucker & Farrelly, 2015).

Another influence is that if the main shopper of a household is Asian, they generally waste more compared to households where the main shopper is British, they produce least waste. The reason for this fact is that Asian households have a greater tendency to cook from scratch, this result in a large amount of unavoidable food waste (peelings etc.) but also their avoidable food waste is higher. Although this higher amount of food waste is not related to their culture or cooking traditions but rather because of the larger Asian household size compared to for example British households (WRAP, 2008b).

3. What behaviour influences the food waste in the pre-purchase stage?

The pre-purchase stage is mainly about planning and deciding what is needed to create a meal. In this chapter the factors that influence this behaviour and lead to food waste are elaborated.

Planning routines and shopping routines are important predictors of food waste, especially shopping routines have a large influence. Planning routines include having a shopping list, checking inventories before shopping and planning meals in advance. Planning routines are negatively correlated with food waste, respondents that used more planning routines waste less. Shopping routines include buying more food than needed and buying products not intended to buy. The research showed that shopping routines are positively correlated with food waste, it increases the amount of food wasted. Another finding is that moral attitudes and perceived behavioural control influence planning routines positively and influences shopping routines negatively. Especially perceived behavioural control has a large negative influence on shopping routines, this relation is most important in explaining food waste. An outstanding finding is that the intention not to waste food did not significantly influence the amount of food waste. This fact suggests that food waste reduction may not be the result of conscious intentions not to waste food but instead daily routines are the cause of food waste (Stefan, van Herpen, Tudoran, & Lähteenmäki, 2013).

Most food is wasted because people do not adequately plan food purchases. Food is wasted because of it expiring rather than being consumed (Tucker & Farrelly, 2015). Quested et al. (2013) found that there are three closely related planning behaviours that correlate positively: planning meals in advance, checking food levels prior to shopping and making a shopping list. The same planning behaviours are used in the research from Stefan et al. (2013) there they are mentioned as planning routines. Results showed that the respondents who are planning meals for the following week also more often have a 'running' shopping list (a shopping list where people keep adding products, like a white board, not making one complete list at a particular time). Contrary to respondents who plan their meal on the day, they seldom use a shopping list.

Nowadays less people are actually using a shopping list, this results in buying things they already have at home. It is also shown that people who shop without a plan are more likely to buy things they do not need (Stuart, 2009). Another factor is that consumers often do not know what food products they already own. If they would have this information during food purchasing, the chance of purchasing a product they already own will be much lower. Shopping lists will help reducing the chance of ending up with double products (Farr-Wharton, Foth, & Choi, 2014). Temminghof & Damen (2013) found, by using a questionnaire, that only 57% of the respondents always or most of the time uses a shopping list.

A research conducted by Evans (2011) showed that people do not exactly plan every meal, they only have broad idea of which products they would use. The expected use of the products is mostly based on routine and habits. Not exactly planning the meal and the products that are needed can result in a larger chance of mismatch. People end up buying

different products than needed with the actual meal. This could result in throwing away the unnecessary products and increases the chance of food waste. A note has to be made to the study of Evans, only 19 households are included so the representativeness of this study is limited. People do say that planning purchases in advance is important to reduce food waste, but their actual behaviour is different. It is shown that many respondents say they often plan their meals based on what they want to eat rather than on the food that they already have in stock. This way of planning will increase the risk of the older foods not being used and eventually will end up in the trash (Baker et al., 2009; Stefan et al., 2013).

4. What behaviour influences the food waste in the purchase stage?

During the actual shopping trip with or without planning, there are also factors that influence the shopping behaviour that eventually could lead to more or less food waste.

The choice of store where the groceries are bought has an influence on food waste. Most people only shop at large supermarkets, if people exclusively shop at large supermarkets the food waste is higher. People who also shop at other places like specialty stores or the market waste less food, when people grow their own food the amount of waste is the lowest. An explanation for this could be that people who visit different shops and local markets spent more time at doing groceries, they attribute a higher value to food than people who only visit convenient large supermarkets. People who grow their own food attribute even more value to food, they experienced by themselves how the food is grown and therefore respect it more (Priefer et al., 2014). In developed countries the distribution of fresh food products occurs primarily by means of small local markets. These markets favour more frequent purchases because people prefer to have fresh products and therefore they visit the markets more often. Because of the more frequent purchases meal planning can be done more exactly and will decrease the risk of buying too much, this will lower the amount of food wasted (Buchner et al., 2012).

People nowadays have a very busy lifestyle, most time is spend on work and family. People who have a full time job waste more food, they do not have the time to plan their meals carefully and often buy too much. To safe time they purchase all the food at one visit to the supermarket. They buy larger quantities of food that serve for the meals of the whole week. The risk of buying everything at once is that certain food products will not be used and end up in the trash can (Schneider, 2008). If people visit the supermarkets more often a more exact planning can be made of what they actually need for their meals. Other researches confirmed that households who purchase food only once a week produce more food waste compared to purchasing food on a more daily base (Williams, Wikström, Otterbring, Löfgren, & Gustafsson, 2012). Although people who visit the supermarket more often also get confronted with more advertisements and this increases the risk of impulse buying. This fact could outweigh the advantages of the day by day planning when doing groceries more on a frequent base (Cox & Downing, 2007).

Another influence is that people rather stock up food to protect themselves from having to rush to the grocery store because something unplanned or unexpected happened. They prefer to minimize feelings of inconvenience. To save time and decrease the risk of having to go often to the shop, people buy a lot at once and store it at home (Graham-Rowe, Jessop, & Sparks, 2014).

Research by Graham-Rowe, Jessop, & Sparks (2014) found the following motivations to over purchase; being a 'good' provider and make guests feel 'looked after'. Being a 'good' provider is closely related to expressing an identity. For example being a good mother is about purchasing enough healthy food for her children, it is better to have too much than not being able to provide them enough fruits and vegetables. This over-purchasing makes the mother

feel less guilty, even if the children to not eat it at all. People also over-purchase if they have guests to come over, they get a feeling of embarrassment if they have not enough drinks and food.

Food products that have been bought for a special occasion which did not happen is another cause of household food waste (Wansink, 2001). For example with Easter Danish buy 24% more food than normal. The annual cost of edible food waste by Danish is in total €390,-, from this amount €125,- is produced during Christmas. The tendency to over-purchase and to have enough as a sign of a good host leads to a spike in food waste (Halloran, Clement, Kornum, Bucatariu, & Magid, 2014; Landbrug & fødevarer, 2014). Also with recipes that needed special products but eventually were not made result in products that are unused and wasted, this concerns mainly products that are non-versatile. Products that are bought for the first time are also more likely to end up in the trash because there is a higher risk of not being liked compared to products people are already familiar with (Wansink, 2001).

5. What behaviour influences the food waste in the storage stage?

After the groceries are bought, it is important that they are stored well at home to maintain their quality and for food safety. Research by WRAP showed that over two million tonnes of food in the UK is not being stored in the correct way. (WRAP, 2008a).

Most people say they know how to store their products and are therefore not reading the storage guidance. They often take off the package of the products because they think leaving the package on the product will increase the chance of the product to get spoiled. However the opposite is true, the package will increase the time of how long the product lasts (WRAP, 2013). A very interesting study that conducted interviews and a focus group instead of only using quantitative research is that of M. Mikkelsen, although a note has to be made that this study concerns a master thesis. In her thesis she discusses the topic of procrastinating food waste, it is explained as practices to justify wasting food. For example respondents store products as long in the fridge till they mould or discoloured, so they can justify throwing it away. They are rationalizing that they do not throw away food but garbage, this decreases their feelings of guilt (Mikkelsen, 2012).

WRAP estimates that up to 20% of the food waste in the UK can be linked to date labelling confusion (WRAP, 2011). The terminology and applications of date labelling varies widely around the world. The misunderstanding of the different labels is the main cause of food waste in the storage phase. People are very concerned with the food safety and to be sure, they often throw a product away while it is still edible. People highly rely on the dates and have less trust in their own senses to check if a product is still edible. Many people believe that Best-if-used-by or Best-before indicate food safety and throw the product away as it reaches its expiration date. These dates are as mentioned highly linked to food safety by consumers and not to what it actually stands for, namely food quality. It is important to educate people about the different date labels and make a coherence between the existing date labels (Gunders, 2012; Newsome et al., 2014). A research by Priefer et al. (2014) between two different cities, one in Italy and one in Germany, showed a difference in evaluating if a food product is still edible. Respondents in Germany tend to trust more on their senses they cited taste/smells bad and looks mouldy as main reasons to discard food, while respondents in Italy cited ''out of date'' as main reason to discard food. A reason for this difference could be that in Germany an informational campaign has been launched in 2012 about the true meaning of the different food product labels is already showing an effect. Figure 5 shows what the different labels mean.

Sell by or display until	Tells the store how long to display the product
Best-if-used-by or Best before	Recommends the date by when to consume the product in order to experience peak flavour and quality, it does not pertain to the safety of the product.
Use-by	The last date recommended for the use of the product from a food safety perspective.

Figure 5 'Food product dating' fact sheet (USDA, 2011)

6. What behaviour influences the food waste in the preparation stage?

One of the biggest reasons for food being wasted is that households cooked, prepared and served more than could be consumed. In the UK this accounts for 40% of the total food waste (WRAP, 2009). A Dutch research also showed that the most common reason of food waste is that households prepared too much, in this research it accounts for 28% of the total food waste. And most of the time the leftovers are also thrown because people do not like to eat the same dish again (Temminghof & Damen, 2013)

Consumers nowadays are more disconnected from food culture, the production phase and the preparation phase are much further away. This disconnection makes it easier for the consumer to disassociate from the food and view it as less important, this makes it less difficult for them to throw food away (Mikkelsen, 2012). Another factor that influences food waste in the preparation phase is the lack of competence in basic cooking and food management skills, this increases the food waste. People with lower cooking skills often lack the creativity to create a meal from leftovers and only stick to recipes they are familiar with (Priefer et al., 2014; WRAP, 2007). Priefer et al. (2014) found that having poor home home economic skills especially applies to young people. Reasons for this are that young people have less experience with planning and preparing meals, they also eat less often at home. These factors increase the risk of groceries purchased will not be consumed in time.

Being creative with ingredients and trying new recipes shows that you have cooking skills. People rather stick to a well-known recipe instead of using for example a leftover of spinach in a new recipe. The reason for this is that food practices are highly routinized and trying something new is not attractive. Another factor that is important is that the meal should be 'proper', leftovers lead most of the time to a quick meal and this is not really healthy according to the respondents. A meal that is judged as 'proper' by households contains a lot of fresh fruits and vegetables. A characteristic of most of these products is that they are highly perishable and this increases the risk to be wasted (Evans, 2011).

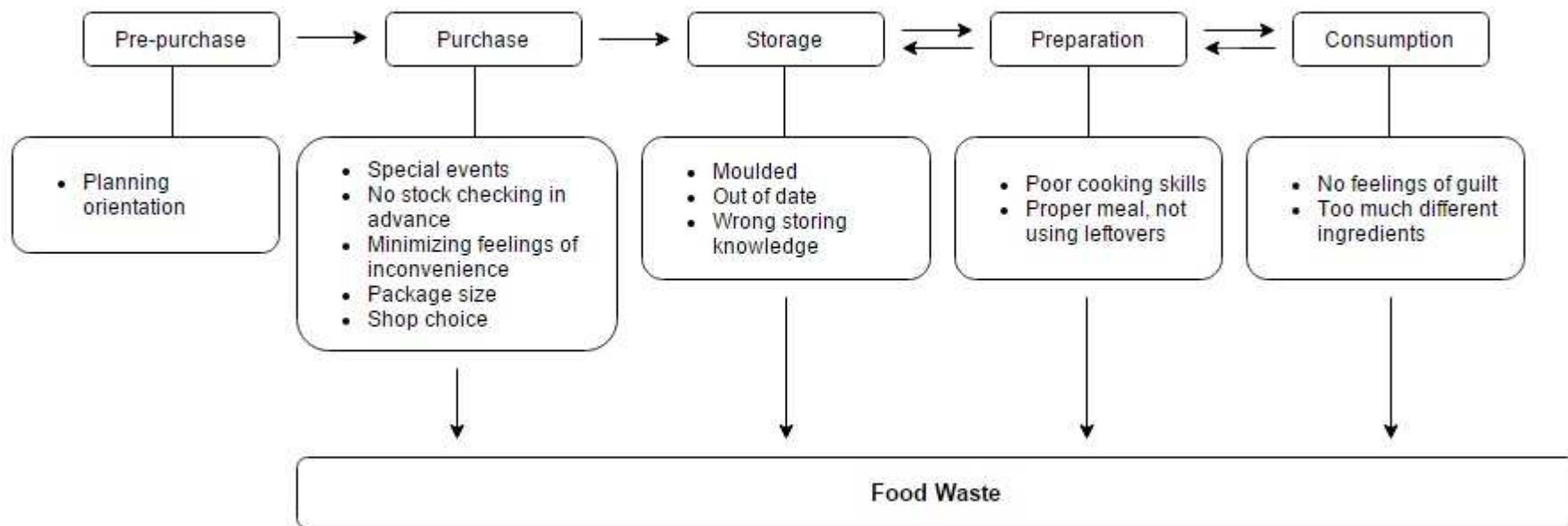# 7. What behaviour influences the food waste in the consumption stage?

In this chapter the behaviour that influences the food waste in the consumption stage is discussed. Not much literature had included specific research about this stage. The preparation stage and the consumption stage are very closely related and it is difficult to separate them.

Research showed that Hispanic households in the USA waste approximately 25% less food compared to non-Hispanics and Hispanic households consume more fresh fruit and vegetables (Parfitt et al., 2010). This can be explained by the *First principle of Food Waste:* the less food use behaviour varies over time, the less food is wasted. For example just normal common sliced bread is wasted at a rate of less than 10% of the purchases, while specialty breads like bagels and croissants are wasted at a rate of more than 35%. Prepared Hispanic foods are very diverse, but their basic ingredients are relatively few compared to the larger variety of foods common in Anglo diets. Using less ingredients makes it easier to incorporate the leftovers into new meals (Buchli & Gavin, 2001).

8. Determinants of food waste

In this chapter there will be looked more in depth to the determinants of food waste. The model is based on the starting model including the different phases of the consumption life cycle mentioned in the introduction

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Pre-purchase  →  Purchase  →  Storage  ⇄  Preparation  ⇄  Consumption
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- Planning orientation

- Special events
- No stock checking in advance
- Minimizing feelings of inconvenience
- Package size
- Shop choice

- Moulded
- Out of date
- Wrong storing knowledge

- Poor cooking skills
- Proper meal, not using leftovers

- No feelings of guilt
- Too much different ingredients

Food Waste

Methods

The methods used to research the amounts of food waste are questionnaires kitchen diaries and waste composition analysis. To uncover the reasons and motivations behind food waste questionnaires and in-depth interviews are used. These methods can be divided into two groups, namely: data collection by a third party or self-reports.

Questionnaires are the most easy and quick option to research a lot of information with a very large sample (Baker et al., 2009; Hamilton et al., 2005; Stefan et al., 2013; Temminghof & Damen, 2013). The disadvantage of this method is that it does not show in depth information about food waste behaviour and the reasons behind it. To investigate important themes relating to how and why households waste food and their perceptions about food waste qualitative research is conducted. In depth interviews are most often used, mainly semi-structured interviews. Pre-prepared interview questions are used as a guide to elicit discussions about the topic of food waste. With face-to-face interviews there is a risk that respondents could get the feeling they should give socially desired answers (Graham-Rowe et al., 2014; Schneider, 2008; Tucker & Farrelly, 2015).

Another research method is keeping kitchen diaries. Respondents are asked to sort and weight their food waste of their household (Koivupuro et al., 2012; Langley et al., 2010; Williams et al., 2012). This method can provide more robust data but it is very time consuming for the respondents. It could also lead to a different behaviour of the respondents in the household because of the conscious participation and could therefore be less realistic. This method is also very expensive and for this reason mostly a small sample size is used. Keeping diary reports can also be executed by a third party for example the researcher themselves (Evans, 2011). Going along with the participants as they shop for and prepare food and looking through cupboard and fridge inventories. A disadvantage of this method is very expensive and takes a lot of time and it is not possible to use a large sample.

Waste composition analysis are executed by a third party, for example local authority, but without the active participation of consumer households (Lebersorger & Schneider, 2011). This is a more obective and accurate way to analyse the amounts and structure of the food that is wasted. A disadvantage of this method is that every research has his own standards and definitions when it comes to food waste. Therefore it is difficult to make a comparison between the results of the different researches. With this method it is also difficult to distinguish if it concerns inedible waste like peelings or edible waste because of decay. Another important weakness of this type of waste analysis is that is does not show the reasons and motvations of consumers behind the food that is wasted.

Every method mentioned above has its strengths and weaknesses, a combination of different methods would be the best choice to uncover the amounts, reasons and motivations behind food waste (Koivupuro et al., 2012; WRAP, 2008b, 2013).

Conclusion and discussion

This study aimed to review the existing literature about food waste in context of the different phases of the consumption lifecycle, also including country differences. In Appendix I an overview is given of the percentages of food waste per life cycle stage. It is difficult to make a comparison between the percentages because the researchers used different definitions. The results by Langley et al. (2010) and Lebersorger & Schneider (2011) can be compared the best because they used almost the same concepts. The percentages in the purchase stage concerns whole unused and partly consumed products, these reasons are probably because people over-purchased or bought products they did not need. In the preparation phase the percentages present residues like peelings. The leftovers are presented in the consumption phase. Their percentages are almost the same for every phase.   The disadvantage of their divisions is that they excluded reasons for food waste in the storage phase. WRAP did not show very detailed information about how much is wasted in which consumption phase. One of their categories was cooked, prepared and served too much, this covers the preparation and consumption phase. The second category was not used in time and includes product that where out of date or got mouldy. In the table this is added to the storage phase. Temminghof & Damen (2013) showed very detailed reasons for wasting food, although in their research respondents could give multiple reasons and therefore the percentages will not sum up to 100%. The most mentioned reason is that respondents cooked too much this is included in the preparation phase, it also includes wrong preparation. The second most mentioned reason is leftovers not used, this is added to the consumption phase, together with the reason: no time to eat the products. In the purchase phase the percentages for the reasons to much in the package and bought to much are included. And finally in the storage phase wrong storage method and out of date are added.

The main question of this literature review was*: What behaviour influences the food waste in the different stages of the consumption life cycle and what are the differences between countries?*

With use of the consumption life cycle mode the following conclusions are drawn. Food behaviour is full of habits and difficult to change. The environment is important when it comes to food waste; frequency of shopping, choice of stores and the choice of products available in relation to the package size all have an effect on food waste. But it all starts with planning behaviour, if people are already conscious about their food waste behaviour in the pre-purchase phase, this will continue to be active and have an influence throughout the whole consumption life cycle. Emotions also play a big role in food waste, people want to be a good provider and feel guilty if they are not able to provide enough (healthy) food for their family or guests. This emotion of guilt is interesting for further research, it could help to set up better campaigns to prevent food waste. Differences between countries are most visible in the amounts especially between developed and developing countries. Differences between the reasons and motivations behind food waste behaviour for a specific country are less clear and only a few outstanding motivations behind food waste are found. This area is very interesting for further research and it is recommended to use the following methods; kitchen diaries by a third party to get an objective image of the food waste and subsequently conduct in-depth interviews with the same respondents to investigate the reasons and

motivations. I realize these methods are very time-consuming and costly but I think the information that could be obtained in this way will be very valuable.

This review clarified the different waste behaviours per food life cycle stage, this information makes it possible for food waste prevention campaigns to aim more precisely per consumption life cycle phase and create a bigger effect. The main limitation of this literature review is that because of the limited information available the differences of motivations and reasons behind food waste between countries are not very visible. Another limitation is that most of the research in the existing literature is based on self-reports by interviews, kitchen diaries and questionnaires. Food behaviour consists of habits and it could be difficult for people to report their behaviour by themselves. There is also a risk of 'sociability bias', people could prefer to present themselves more favourably when it comes to food waste.

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Appendix

I. Overview percentages of food waste per life cycle stage

Study	Pre-purchase	Purchase	Storage (also date labels)	Preparation	Consumption (leftovers not used)	Other
WRAP 2009	-	-	55% (not used in time)	40%		5%
Temminghof & Damen 2013		14%	40%	28%	39%	11%
Langley et al. 2010	45%		-	37% (preparation by-product)	15%	3%
Lebersorger & Schneider 2011	46%		-	44% (preparation residues)	8%	2%