

# Spaghetti Soup: The Complex World of Food Waste Behaviours

Authors: T.E. Quested, E. Marsh, D. Stunell, A.D. Parry  
Waste & Resources Action Programme (WRAP)

Corresponding author: Tom Quested

Phone: +44 (0) 1295 817890

Fax: +44 (0) 1295 819911

Email: [tom.quested@wrap.org.uk](mailto:tom.quested@wrap.org.uk)

Address: 21 Horse Fair, Banbury, OX16 0AH, UK.

## Notice

This is the authors' version of a work that was accepted for publication in *Resources, Conservation and Recycling*. Changes resulting from the publishing process, such as peer review, editing, corrections, structural formatting, and other quality control mechanisms may not be reflected in this document. Changes may have been made to this work since it was submitted for publication. A definitive version was subsequently published in *Resources, Conservation and Recycling*, Vol. 79, October 2013, pp. 43-51, DOI: 10.1016/j.resconrec.2013.04.011, <http://authors.elsevier.com/sd/article/S0921344913000980>

## Highlights

- The scale of household food waste and its environmental impact is highlighted
- Use of research insights in designing a campaign to reduce food waste is discussed
- Relevant behaviours and practices are found to be more complex than related issues
- This complexity is discussed in light of public engagement and behavioural models



## 1. Introduction

There is increasing awareness of the environmental impact of food waste and the positive consequences of reducing this waste at source, both in the UK (WRAP, 2009) across the EU (Reisinger et al., 2011) and globally (Parfitt et al., 2010; Gustavsson et al., 2011). Reducing food waste is also acknowledged as a key means of addressing both food and water security concerns (WRAP & WWF-UK, 2011). In developed countries, the major contribution to food waste comes from households (Parfitt et al., 2010).

7.2 million tonnes of food and drink waste were generated in UK homes in 2010, of which 4.4 million tonnes was avoidable<sup>1</sup>. This avoidable waste is approximately 160 kg per household per year and equivalent to 12% of the food and drink entering the home. This waste has a large environmental impact: as way of example, avoidable food and drink waste was estimated to contribute the equivalent of 17 million tonnes of CO<sub>2</sub> in greenhouse gas emissions annually and to account for 4.3% of the total water footprint of the UK (WRAP, 2011b). Food waste makes up approximately 30% of the residual (general) waste stream from UK households (WRAP, 2011c).

Given this magnitude, reducing food and drink waste in the home can have a substantial positive environmental effect. For example, an average UK household eliminating their avoidable food and drink waste has the potential to reduce greenhouse gas emissions by a similar amount to installing 270 mm (11 inches) of loft insulation or all household members foregoing an annual return flight from the UK to central Europe (WRAP, 2009).

The choice of how to dispose of food in the home can also have environmental benefits, for example, avoiding landfill by using council food-waste collections where available or home composting food waste. However, the largest environmental benefit comes from preventing food from being wasted in the first place – this has the potential to reduce the energy, water and other resources used to grow, harvest, transport, process and sell the food, as well as emissions associated with storage and cooking in the home. On average, food waste prevention reduces greenhouse gas emissions by around eight times more than diverting the same food waste from landfill to anaerobic digestion (Quested et al., 2011).

Recent years have seen a reduction in the amount of food and drink waste generated from UK homes. Between 2007 and 2010, the amount generated fell by 1.1 million tonnes, from 8.3 million tonnes to 7.2 million tonnes, with the vast majority of this reduction associated with avoidable waste (WRAP, 2011b). This decrease in waste coincided with a programme of waste prevention co-ordinated by WRAP and involving multiple partners including supermarkets, food and drink manufacturers, local authorities, community groups and NGOs (see section 7 for details of this engagement). This time period also corresponded with increases in food prices and testing economic conditions.

This paper explores insights about food waste in the home, which has largely emanated from work funded by the Waste & Resources Action Programme (WRAP), the UK's main delivery body for government policy on waste and resource efficiency, which has been running a programme to reduce household food waste since 2006<sup>2</sup>. Alongside this delivery, WRAP has undertaken and commissioned extensive research relating to this issue, including measurement of the physical flow of material into and within the home, and social research to understand the many aspects of the waste generation and prevention. As such, this paper draws on six years' worth of social research including in-depth qualitative research, large scale quantitative studies, and on-going quantitative tracking.

The behaviours and practices associated with waste generation and waste prevention are discussed, highlighting a complex interrelationship between multiple activities and the context in which they are performed (sections 2 & 3). This context includes factors outside of people's control (such as food prices and changes to packaging of food products) in addition to backdrop of everyday life that impacts food waste (e.g. work patterns, family structure, household traditions around meals). Attitudes, values and other factors that have the potential to influence these actions are discussed in section 5.

---

<sup>1</sup> i.e. food and drink thrown away that was, at some point prior to disposal, edible (e.g. slice of bread, apples, meat). The remaining food and drink waste is mostly the inedible fraction of food – egg shells, banana skins, animal bones, etc.

<sup>2</sup> WRAP also delivers programmes of work to reduce food waste in other sectors: hospitality and food service, food manufacturing and grocery retail. This work is not detailed in this paper.

It has been found that people over 65 years old waste less food on average than the rest of the population. Given this marked difference, this group is used as a case study to understand some of the antecedents of food waste, further illustrating the complexities of this issue (section 4).

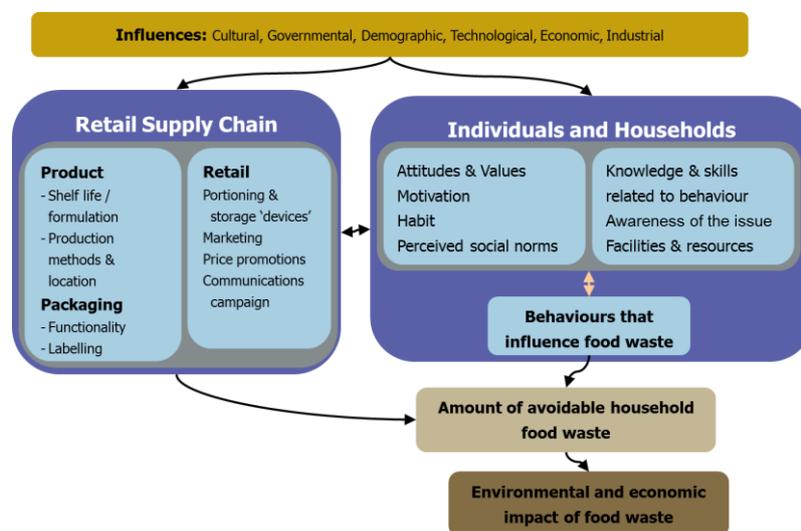
The issue of household food waste is discussed in light of commonly used behavioural models (section 6). The purpose of this section is not to review the literature on behavioural and behaviour-change models, but to discuss their use and relevance for those involved in the delivery of behaviour change programmes.

Finally, the ramifications of these insights are explored for other pro-environmental behaviours (section 8). In particular, how these relate to other waste-reduction activities (i.e. those not relating to food) is discussed. Although the insights described in this paper pertain to the UK, many of them will be applicable to other developed nations with similar patterns of shopping, food preparation and consumption.

## 2. Conceptualising Household Food Waste

Food plays a central role in our lives, not only providing fuel, nutrients and sustenance, nor merely being central to many of our social interactions, but also feeding into our sense of identity (Defra, 2009). Against this backdrop, food is purchased, prepared, consumed and, in many cases, wasted. Figure 1 is a conceptual framework developed by WRAP that illustrates these interactions. This draws on the extensive research by WRAP and other organisations on this issue. It indicates that there are two main ways of reducing the amount of food wasted in homes – by influencing people’s actions or by making changes to the food that is sold (for example, by extending its shelf life) and the way it is packaged and sold. This has shaped the delivery of household food waste prevention (as described in section 7). Although the remainder of this paper largely focuses on the interactions associated with the ‘individuals and household’ box, WRAP also has a programme to engage and influence the retail supply chain (section 7).

**Figure 1:** ‘Conceptual Framework’ to understand prevention of food waste in the home



WRAP research has demonstrated that there are many reasons why food is wasted and multiple behaviours that lead to this waste (e.g. WRAP, 2011d). Given this, the generation of food waste is best viewed not as a single behaviour but as the result of multiple behaviours that can increase the likelihood or amount of food being wasted. These behaviours relate to many different aspects of food’s journey into and through the home: planning, shopping, storage, preparation and consumption of food (entitled ‘behaviours that influence food waste’ in Figure 1 and explored in more detail in section 3). This means that by the time an item of food is thrown away, the opportunity to prevent that food from becoming waste has usually passed, i.e. the action (or actions) leading to the waste may have been some time, often many days, in the past.

In addition to this separation in time, there is often a conceptual disconnect between the behaviours relevant to waste generation (or waste prevention) and the outcome of these actions. This means that

other concerns – for example relating to other aspects of food, health, or family expectations of meals – are likely to be at the top of people’s minds at the time actions that result in food waste are undertaken.

This contrasts with many other activities commonly referred to under the banner ‘pro-environmental behaviours’ (Defra, 2011). For example, these elements of separation do not exist to the same extent between the act of turning off lights and the outcome of this action. Although recycling (e.g. of grocery packaging) comprises multiple actions – washing out packaging, placing it in the correct recycling receptacle, and setting the receptacle out for collection – these different stages are all directly linked to the act of ‘discarding’, in that they relate primarily to the final part of an item’s journey through the home, when the prime consideration is how to effectively remove it. The environmental benefits of recycling are also more intuitive as these occur ‘downstream’ of the discarding of an object: from avoided landfill emissions or substitution of virgin material in future production.

The next section examines some of the behaviours relating to household food waste in more detail.

### 3. The Multiple Behaviours and Practices of Food Waste

It can be helpful to break down the complex behavioural relationships described in the previous section into individual actions or behaviours that can help reduce either the amount of waste produced or the likelihood of waste arising. This is necessary to be able to study the inter-relationship between these behaviours and their trends over time. There are dozens of these individual actions and the effectiveness of each to reduce food waste in the home varies depending upon the context in which it is performed. For instance, storing fruit and vegetables in conditions that maximise their shelf life will have a greater potential to reduce waste where people buy large amounts of fresh produce at widely spaced intervals.

WRAP track nine individual behaviours that contribute to food waste reduction and have the potential to be monitored via a questionnaire. The choice of these behaviours was based on many pieces of research exploring the link between behaviours and food waste including WRAP (2007a, 2009, 2011d). These behaviours cover a large proportion of the activities that could reduce food waste in the home and are broadly applicable to the majority of homes in the UK; however, they are by no means exhaustive and there are many other activities that could reduce the amount of food waste. In approximate order in which they occur in the cycle of food preparation and consumption, these are:

- Planning meals in advance
- Checking levels of food in cupboards and fridge prior to shopping
- Making a shopping list
- Storing meat and cheese in appropriate packaging or wrapping
- Storing apples and carrots in the fridge
- Using the freezer to extend the shelf-life of food
- Portioning rice and pasta
- Using up leftovers
- Using date-labels on food

Many of these behaviours are proxies for a wider range of behaviours; for example, storing apples and carrots in the fridge – and thereby increasing their shelf-lives considerably – is used as a proxy for a wider range of behaviours of storing fruit and vegetables in the fridge. Given this and the fact that the list is not exhaustive, tracking these behaviours over time gives an indication of behaviour change, rather than an absolute measure. As these behaviours span a wide range of activities, the factors that influence whether they are performed are also varied. Table 1 gives some examples of factors influencing some of these behaviours drawn from WRAP’s research. These illustrate that there is little overlap in the factors influencing many of the food waste reduction behaviours.

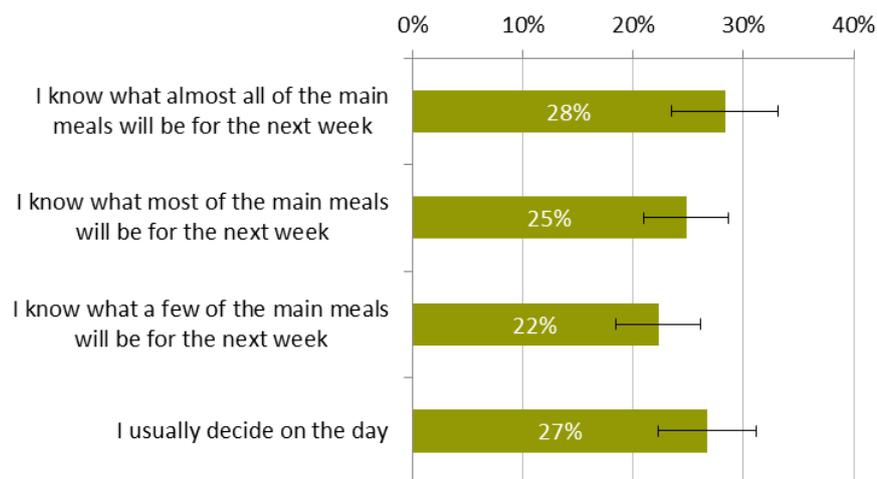
**Table 1:** Influencing factors for a selection of food waste reducing behaviours

Activity / behaviour	Potential Influences
Planning meals in advance	<ul style="list-style-type: none"> <li>▪ Good communications within household</li> <li>▪ Time available to plan</li> </ul>

	<ul style="list-style-type: none"> <li>▪ Frequency of shopping</li> <li>▪ Variability in food-related routines</li> </ul>
Portioning rice and pasta	<ul style="list-style-type: none"> <li>▪ Knowledge of the correct amount</li> <li>▪ Possessing measuring implements</li> <li>▪ Social conventions around provisioning</li> </ul>
Storing fruit in the fridge	<ul style="list-style-type: none"> <li>▪ Capacity in fridge</li> <li>▪ Knowledge that fridge prolongs shelf life</li> <li>▪ Encouraging consumption of fruit by making it visible (e.g. in bowl)</li> </ul>

Given the above, we would expect relative low associations between behaviours with markedly different influences and this has indeed been observed in WRAP research (detailed below). For most behaviours there were only weak correlations: the example in Figure 2 shows that there is no significant difference (at the 95% confidence level) between the proportion of people storing apples in the fridge and degree of meal planning. Of those who state they usually decide what to eat on the day, 27% stored apples in the fridge. This compares to 28% of people who state that they know what almost all of their main meals will be for the next week storing apples in the fridge.

**Figure 2:** Percentages of respondents keeping apples in the fridge for each of the options relating to meal-planning behaviour\* (Source: previously unpublished analysis of WRAP’s regular questionnaire survey<sup>3</sup>; error bars represent 95% confidence interval of mean value).

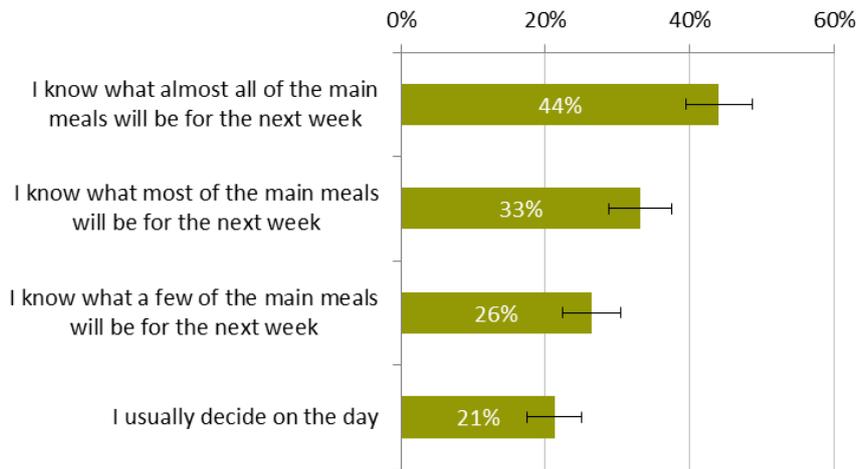


\*For respondents selecting a given option for meal-planning behaviour, the percentage of this sub-population storing apples in the fridge is shown

However, there are strong, positive correlations between some closely related behaviours, in particular the three planning behaviours: planning meals in advance, checking food levels prior to shopping and making a shopping list. For example, people who plan meals for the following week are more likely to keep a ‘running’ shopping list (Figure 3). 44% of those who state that they know what almost all of their main meals will be for the following week also keep a running shopping list, compared to 21% of those who decide what their main meals are on the day. These planning behaviours also correlate positively with using the freezer to extend the shelf-life of food and using leftovers.

<sup>3</sup> Unless otherwise stated, results shown in this paper were from a single wave of the questionnaire, asked in March 2011 to a representative sample of 1,812 adults in Great Britain who had some responsibility for shopping and food preparation.

**Figure 3:** Percentage of people keeping a running shopping list during the week split by meal-planning behaviour\* (Source: previously unpublished analysis of WRAP’s regular questionnaire survey; error bars represent 95% confidence interval of mean value).



\*For respondents selecting a given option for meal-planning behaviour, the percentage of this sub-population keeping a running shopping list is shown

There are also some relatively strong, negative correlations: for example, between portioning rice and pasta and use of the freezer (Figure 4) – those people who portion rice and pasta used the freezer for an average of 3.8 items over the previous week, compared to 4.8 items for those who portion neither rice nor pasta correctly. This result makes intuitive sense – those people who cook the right amount of food for their needs are likely to have less need of the freezer to store leftover food.

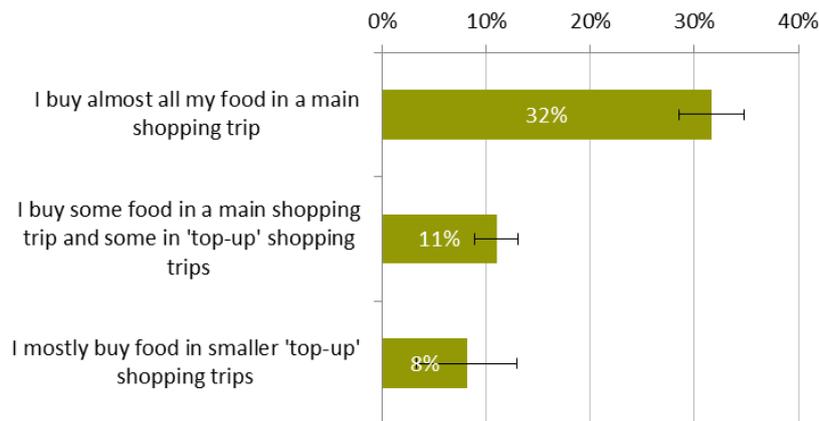
**Figure 4:** Number of items placed in the freezer in the past week split by whether rice and pasta are portioned correctly (Source: previously unpublished analysis of WRAP’s regular questionnaire survey; error bars represent 95% confidence interval of mean value).



\*For respondents selecting the given options for portioning rice and pasta, the average number of items placed in this freezer for this sub-population is shown

The context of food purchasing and consumption is extremely important to whether – and the extent to which – they are performed. For example, the research of Evans (2011, 2012) suggests that food waste results from households negotiating the complex and contradictory demands of everyday life. Furthermore, it indicates that the behaviours that give rise to waste are not necessarily waste-related, in that they are more closely related to provisioning of the home. The effect of context has been found with other pro-environmental behaviours (e.g. Barr, 2011). Such relationships have been found by WRAP in responses to their questionnaires: for instance, the propensity to plan meals is very strongly correlated to how people shop – those who usually purchase food in small, frequent ‘top-up’ shops are unlikely to plan their meals for the following week (Figure 5). In this particular context, a lack of meal planning is unlikely – in itself – to be a strong driver for food waste. It is not only shopping that has an impact on people’s action in the home: other contextual aspects of food preparation and consumption are also likely to impact on the quantities and types of food wasted.

**Figure 5:** Percentage of people who plan meals for the following week split by whether they purchase food in main or top-up shops (Source: previously unpublished analysis of WRAP’s regular questionnaire survey; error bars represent 95% confidence interval of mean value).



\*For respondents selecting a given option for type of shopping, the percentage of this sub-population who 'know what almost all of the main meals will be for the next week' is shown

The impact of other contextual factors can also be discerned from quantitative data: for instance, the amount of food and drink waste generated per capita decreases within increasing household size; people in four-person households generated approximately half the amount of food waste per capita compared to single-occupancy households (WRAP, 2009). There are many factors which make efficient provisioning of a smaller household more problematic than for larger households: food is often only available (or cheaper) in larger quantities (WRAP, 2008a, 2010), recipes usually cater for groups of people rather than individuals and variability in consumption has a greater impact in smaller households (WRAP, 2013).

This marked relationship between the context and behaviours is consistent with ideas propounded in the 'theories of practice' emanating from sociology: e.g. Shove (2010) and Southerton, McMeekin and Evans (2011). This set of theories – and the evidence presented above – suggests that failure to appreciate the context in which food is purchased, stored, cooked and consumed will lead to sub-optimal attempts to influence behaviour.

As discussed by Tucker and Douglas (2006a), the generation of food waste in the household is often a private matter with the practices involved and their result less visible to friends, family and neighbours than, say, recycling, car use or reuse of carrier bags. This reduced visibility is also a feature of waste generation of other materials in the home with the consequence that the ability of social norms to influence practices may not be as strong as some more 'visible' behaviours.

Habit is likely to play an important role in practices and behaviours relating to household food waste. As highlighted by Darnton et al. (2011), both waste behaviours and food choice have a strong habitual element, given their frequency and automaticity. The habitual component of these practices implies that the associated behaviours are being performed with less conscious thought and therefore this adds to the challenges of eliciting behaviour change. Behaviour change is also problematic as a large proportion of the population underestimate the amount of food they waste (Quested et al., 2011).

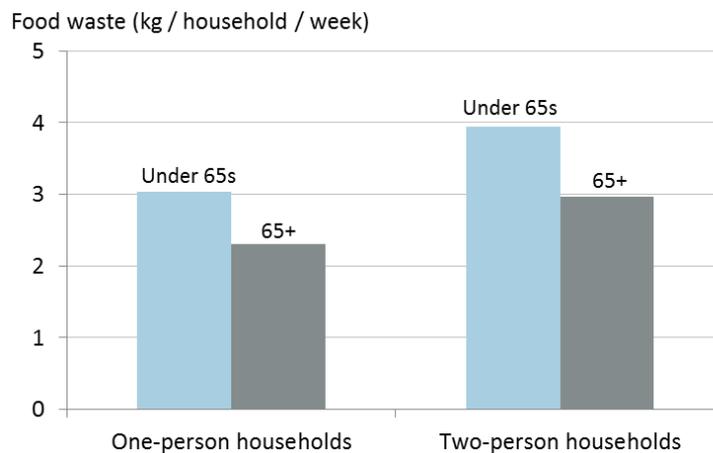
There are many challenges arising from the high degree of complexity around food waste. In designing initiatives to engage the public on this issue, there are many potential ways to approach the issue and consequently many different types of messages. If multiple approaches can be used to target different parts of the population, this gives the opportunity to engage a large proportion of the population. This requires a good understanding of who is doing what, in what situations and the motivations behind these actions – requirements that necessitate a range of research techniques covering compositional analysis of the waste, questionnaire surveys, focus groups, diary research and ethnographic studies. The flip side of this is that many messages will not be relevant to all parts of the population and poor targeting could lead to many people not engaging with the issue or even being turned off the whole campaign.

The next section explores one group within the UK population who exhibit markedly different behaviours around food waste compared to the rest of the population.

#### 4. Case study: Food waste and the over 65s

One segment of the population that warrants further investigation is people over 65 years in age. Between most other groups of the population, there are only slight differences in the amount of food waste generated, and these can mostly be attributed to the number of people residing in a household. However, the over 65s generate measurably less food waste than the rest of the population – approximately 25% less when household size is controlled for (Figure 6).

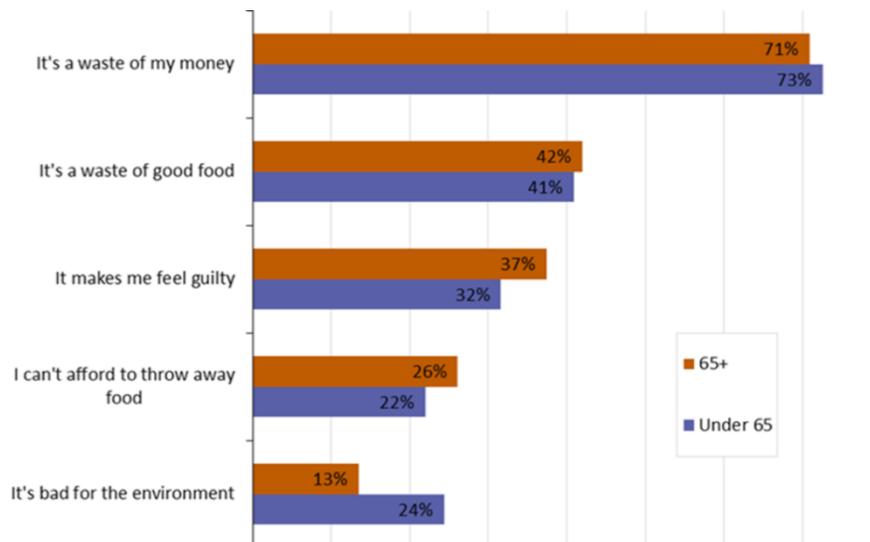
**Figure 6:** Comparison of the amount of food waste collected from homes by local authorities between over 65s and the rest of the population for households containing one and two people (Source: unpublished analysis from *The Food We Waste*, WRAP, 2008b)



This lower level of waste is reflected in the level of behavioural engagement: of the nine behaviours that are associated with lower waste levels (highlighted in section 3), older people are more likely to be performing seven of these, with one showing no significant difference at the 95% confidence level (storing meat and cheese in appropriate packaging or wrapping) and one (planning meals) showing a higher level of engagement in the under 65s (unpublished analysis of WRAP's food waste regular questionnaire). This suggests that reduced amount of food waste (Figure 6) is – in part at least – the result of older people managing food in the home differently from the rest of the population.

It appears that these differences in behaviour are not motivated by a concern for the environment; indeed, the over 65s are relatively disengaged with global environmental concerns (e.g. British Social Attitudes 28, 2011). This is also seen in WRAP research – for example, the response to questions asked about the link between food waste and environment (Figure 7): of those people bothered by food waste, over 65s were less likely to cite environmental reasons (13%) than the rest of the population (24%).

**Figure 7:** Response to question: 'Why does throwing away food bother you?' asked to those bothered by throwing away food, split by age (Source: WRAP household food waste questionnaire, September 2008, base size: under 65 = 1,045; 65+ = 225).



From focus groups and other qualitative research (e.g. WRAP, 2007b), it appears that the over 65 age group is more likely to hold the view that wasting food is just wrong, and that this attitude may extend to 'wastefulness' in general. One hypothesis for these observations is that the over 65s have been influenced by different experiences compared to the rest of the population: these influences could include austerity and food rationing around the time of the Second World War (with rationing being phased out from the end of the war through to the early 1950s), and education relating to cooking and food management in the home, either informally built up over time or resulting from more traditional teaching of these topics during their formative years.

What is important for delivery of public-engagement campaigns is that the over 65s do not appear to be strongly motivated by environmental concern. Indeed, a general finding from the body of research in this area is that the generation of food waste is very closely associated with food practices in the home. To a lesser degree it is also perceived as an issue of waste and wastefulness, but this is not necessarily related to the environment in people's minds. This is further illustrated in the next section which looks at motivations to reduce food waste.

### 5. Motivations, attitudes and values

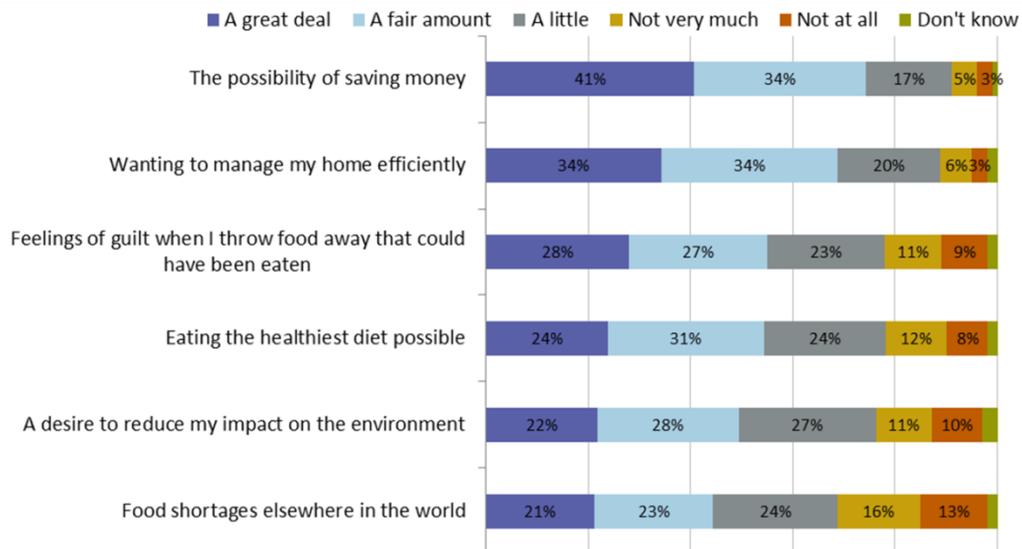
The previous three sections have described some of the characteristics of behaviours connected to food waste prevention in the home and the context in which they are played out. Given that the relationship between these behaviours and the resulting food waste is not straight-forward and these behaviours have a strong habitual element, it is perhaps not surprising that the factors that encourage people to reduce food waste are varied and cover a range of themes and motivations.

The concept of saving money has been found in both qualitative and quantitative research to be a powerful motivating factor. For example, in WRAP's regular questionnaire survey, more respondents state this as a motivating factor than any other reason (Figure 8) – 41% of the population stated it influenced them 'a great deal', with a further 34% stating it influenced 'a fair amount'.

However, even a simple concept such as saving money may well be multi-faceted and open to interpretation: saving money may appeal to ideas of thrift and avoiding wastefulness, as illustrated in the case study of over 65s in section 4; alternatively it may be motivated by an underlying desire to have greater spending power elsewhere in the household budget. To successfully utilise this motivating factor in public-engagement initiatives, understanding these nuances and where the balance lies for different parts of the population is crucial.

'Guilt' is also found to play an important part in food waste reduction, as illustrated in Figure 8 – WRAP's qualitative research has also found that the vast majority of people do not like wasting food and, when food is wasted, this frequently leads to feelings of guilt.

**Figure 8:** Responses to question: 'To what extent do any of the following encourage you to try to minimise the amount of food that your household throws away?' (Source: previously unpublished analysis of WRAP's regular questionnaire survey).



For those approaching the issue of food waste from an environmental or waste-related perspective, it may be somewhat surprising to see that many people relate eating a healthy diet to reducing food waste. Indeed, for the question asked in WRAP's regular questionnaire, more people cite eating a healthy diet as an encouraging factor than wanted to reduce their environmental impact (Figure 8).

A possible explanation for this result is that food plays a central role in both nutrition and food waste in the home, even though the outcomes of eating a healthy diet (e.g. less diet-related disease) are very different to those related to reducing food waste (e.g. lower environmental impact, saving money). In certain situations, this overlap extends to changes in knowledge and behaviours – increasing one's food planning skills or cooking the right amount of food are both positive steps towards a healthy diet and cutting down on food waste.

This suggests that there is a conceptual link between different food-related outcomes, as well as a practical link for some behaviours. These links were exploited as part of a *Love Food Hate Waste* initiative in Worcestershire during 2011 which used nutrition and healthy eating as a method of engaging people on the issue of food waste (WRAP, 2011e).

The fact that environmental concerns and those associated with food shortages elsewhere in the world have less weight placed on them (Figure 8) indicates that the link between food waste and environmental impact is not firmly established in people's minds, even though the impact on the environment and the world's resources is considerable (section 1). This suggests that solely engaging the public's values associated with the environment – and other pro-social values – as described in the Common Cause (<http://valuesandframes.org/>) is likely to have limited impact as a single intervention measure without first strengthening this conceptual link between food waste and its environmental impact. This link could be strengthened by increasing the public understanding of the environmental impacts food – rather than food *waste per se* – something which initiatives such as Live Well (WWF, 2011) and the *Cooking Up A Storm* report (Garnett, 2008) focus on achieving. Further research into the link between people's values would be beneficial and may present further opportunities for engaging the public on food waste and related issues.

This discussion illustrates an important point about food waste prevention specifically, which may also be applicable to pro-environmental behaviours more generally: although performing certain behaviours may have beneficial environmental impacts, this does not mean that the behaviours are necessarily perceived as 'environmental' or 'sustainable' behaviours by those people performing them. This may be at the heart of the weak association between waste prevention attitudes and behaviours that have been found by Lober (1996) and Barr et al. (2001), and summarised by Tucker and Douglas (2006b):

*"... it is clear from the literature that many people do not associate their activities as having anything to do with waste prevention."*

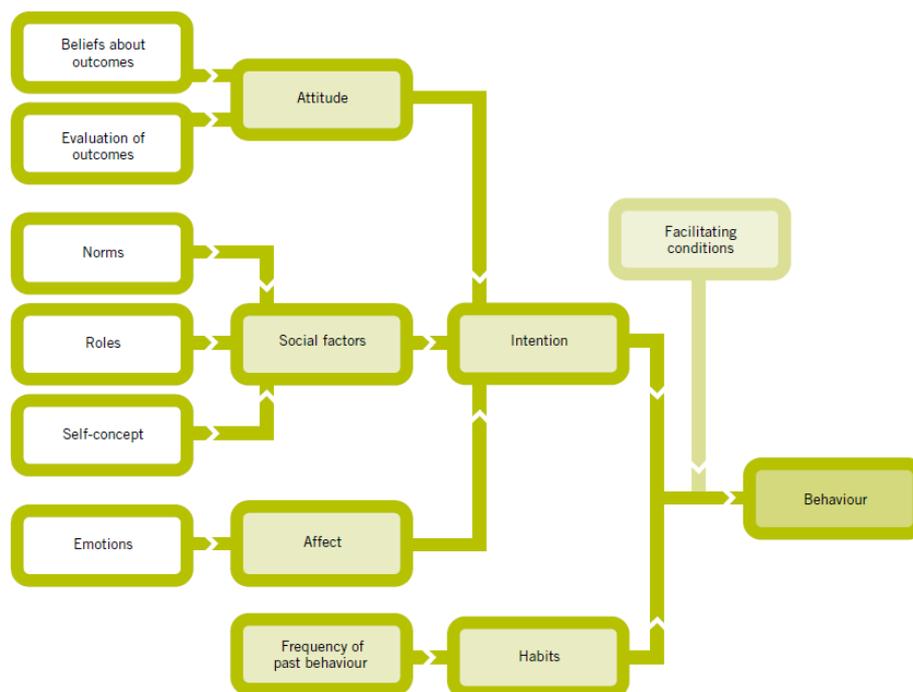
For this reason, the *Love Food Hate Waste* campaign has mainly focused on encouraging the use of food rather than a reduction in waste: a subtle but important distinction.

## 6. Application of behavioural models

This section seeks to explore some of the challenges in applying behavioural models to aid the delivery and evaluation of the household food waste reduction programme. It is not the purpose of this section to review the literature on behavioural models and behaviour change – many excellent reviews already exist (e.g. Darnton, 2008; Chatterton, 2011) – but to draw on how these models have proved useful and where there is scope for theoretical development.

There are a suite of psychological models that look at explaining a behaviour through various antecedents, for example the Theory of Interpersonal Behaviour (Triandis, 1977), illustrated schematically in Figure 9. This covers a wide range of antecedents including – importantly for household food waste – the role of habit. However, applying this model to household food waste quickly leads to a key difficulty: the ‘behaviour’ in the model could be either i) the generation of food waste (i.e. a general behavioural concept around wasting food), or ii) an individual behaviour associated with food waste, such as making a shopping list.

**Figure 9:** Schematic representation of Triandis’ theory of interpersonal behaviour (TIB) (diagram from Communications and behaviour change, COI, 2009)



Either option leads to difficulties as some antecedents relate to the general concept of reducing food waste (e.g. attitudes, norms) whilst other antecedents relate to specific behaviours, such as habit and the facilitating conditions; some antecedents could be applied at both levels. Similar problems are encountered in the application of other similar models, i.e. those seeking to explain a single behaviour such as the Theory of Planned Behaviour (Ajzen, 1991) and the Needs Opportunities Abilities (Gatersleben and Vlek, 1997). This is a direct result of household food waste emanating from multiple behaviours, rather than a single behaviour.

This does not, however, mean that these models have no use; they provide a list of factors (norms, roles, emotions, habit, etc.) which are useful to consider in relation to food waste generation and prevention. Given the preceding discussion, it would suggest that for a model to be of practical use it must incorporate the context of behaviours, the role of habit (and its different facets – stability of context, automaticity and frequency), the disconnect between attitudes and behaviour, and the complexity implied by multiple behaviours.

The useful elements taken from the above models can be supplemented by other behavioural (and behaviour change) models. For example, the application of behavioural economics, specifically the elements identified in the MINDSPACE report (Dolan et al., 2010) and the 4Es model (Defra, 2005) both provide a series of lenses through which the issue can be viewed, informing the design of food waste reduction initiatives. For instance, WRAP's qualitative research reveals that some people who disengage with the issue of food waste prevention do so due to a perception that no one else is acting on this issue; therefore, exemplification is required by prominent organisations and companies has the potential to remove an important barrier to action for this group. Consideration of exemplification was fundamental in embedding reduction of food waste in voluntary agreements with supermarkets and food manufacturers (through the Courtauld Commitment: [www.wrap.org.uk/courtauld](http://www.wrap.org.uk/courtauld)) and the hospitality sector ([www.wrap.org.uk/hospitality/](http://www.wrap.org.uk/hospitality/)).

In conclusion, it has been useful to look at the issue of food waste from a number of different angles and drawing on a number of disciplines, including various branches of social research, economics, and system-think approaches from within operational research.

## **7. Influencing the nation's food waste**

There has been a significant government-funded programme of work to reduce household food waste delivered by WRAP since 2006. Consistent with the conceptual framework (Figure 1) and behavioural economics, this has followed a twin-track approach comprising public engagement and also changes to the way food is packaged, labelled, sold and its shelf-life (i.e. thereby subtly altering the context in which food is purchased and consumed). This concerted approach has meant that it is easier for people to waste less food, whilst at the same time building momentum around the issue.

The *Love Food Hate Waste* (LFHW) campaign was launched in 2007 by WRAP to engage the public on the issue of food waste and now operates in all four nations of the UK. At the start of the campaign, awareness of food waste as an issue was relatively low, as indicated by a low number of mentions of food waste in the media and a low awareness by many households of how much food they threw away (Quested et al., 2011). Therefore much of the focus of the early part of the campaign was to raise awareness, highlight the benefits of reducing the amount thrown away and to create the personal conviction to act. Raising (and maintaining) awareness can be effectively achieved through channels that reach a large number of people: e.g. press exposure and advertising. Tools, hints, tips, recipes, and ideas to help people waste less have also been available via numerous channels (e.g. websites, recipe cards in supermarkets). However, raising awareness and provision of information alone are unlikely to be sufficient to elicit a substantial change in behaviour and practice across the whole population, so other methods of engagement have also been used.

Engaging with people on a one-to-one basis can be extremely effective, as people have different barrier to overcome and this type of engagement allows advice to be highly tailored to the individual. However, the key challenge is influencing sufficient numbers of people to make a sizeable difference on the population as a whole. To address this challenge, Love Food Hate Waste has been delivered via partner organisations (see below) and using approaches such as 'cascade training', i.e. WRAP train a group of people who then pass on messages about food waste and train further people. Our research suggests that this is a cost-effective way of reaching a large number of people while still providing one-to-one advice. The success of individual engagement can also be seen in the case study of a Love Food Hate Waste initiative in Worcestershire (WRAP, 2011e).

The campaign has been delivered by WRAP directly to the public, but also through a wide range of partner organisations – grocery retailers, food manufacturers, local authorities and community groups (more information is available in Quested et al. (2011) and on the WRAP website). The design of the campaign has been informed by the insights from the wide range of research, detailed in earlier sections of this paper.

Opportunities to break habits have also been utilised: in addition to moments in people's lives where they are more amenable to change, such as retirement (e.g. Thompson et al., 2011), increased visibility of food waste in the home is also a good opportunity to change behaviour. Examples include completing a food diary or placing all food waste generated over a week in a separate receptacle. The latter formed an important part of a joint project between the Women's Institute and Love Food Hate Waste (<http://www.thewi.org.uk/viewNews.aspx?id=13191>) and is integral to the Kitchen Canny initiative: (<http://www.kitchencanny.co.uk/>). WRAP has also engaged people during their time at university when

they are forming habits that could persist through adulthood: for instance in Greater Manchester, a student 'Master Chef' competition was run focusing on practical tips to reduce food waste.

WRAP has also been working with partner companies and organisations to make technical changes to the retail environment. Changes to packaging, labelling and merchandising can reinforce, complement, or even negate the need for behaviour change and, broadly, fall into three areas (again, more details can be found in Quested et al. 2011):

- **Buying the right amount:** this can be achieved by offering the right size of pack and using promotional mechanics in a way that reduces the risk of food being wasted (e.g. price reductions – for example, 25% off – as opposed to volume offers, such as '4 for £3' or 'buy 2 for the price of 3')
- **Keeping what people buy at its best:** for example, packaging can play an important role in keeping food fresh and, in many instances, the environmental impact of increased functionality such as allowing a pack of cheese to be re-closed is more than offset by the ensuing reduction in food waste.
- **Helping people use what they buy:** for example, by extending shelf life of products, providing clear and consistent date labels, improving freezing guidance (e.g. moving away from "freeze on day of purchase" to "freeze up to the date") and also providing recipe ideas for using up leftover foods.

There is strong evidence to suggest that this activity has contributed to the recent reduction in UK household food waste of 1.1 million, as detailed in section 1. There have also been positive changes in behaviours relating to food waste in the home over this time period: e.g. planning meals and making lists (Quested et al., 2011). Some of these changes are likely to be linked to food-price inflation rises and the recent squeeze of incomes. Although there are many difficulties in separating out the effects of these factors (WRAP, 2011b), econometric modelling commissioned by WRAP suggests that a sizeable proportion of the reduction is closely associated with the increased awareness of food waste and other engagement work in this area. Further research is on-going in this area and publication of econometric research is planned during 2013.

## **8. Conclusions and ramifications for other pro-environmental behaviours**

There are many important characteristics of food waste reduction, elucidated within this paper. There is a high level of complexity associated with the behaviours and practices relating to food waste in the home, which is the result of:

- Multiple, interacting activities that can increase the likelihood or amount of food that is wasted; and
- A separation in time, location and conceptually between these activities, the waste that is generated as a result and the environmental impact.

In addition, other pronounced effects include:

- A marked habitual element to these activities due to frequent repetition;
- A strong interaction with the context in which these activities are undertaken, spanning shopping, food preparation and consumption and people's social life;
- A noticeable (and possibly surprising) conceptual link between food waste and other food related issues such as nutrition and food safety; and
- Initially low awareness of the quantity and value of food being wasted.

There are some parallels between these characteristics and other waste-reduction activities (specifically reducing the quantity of waste generated at source, rather than re-use and other activities that divert material from the waste stream). For example, the separation between action and impact is likely to be present for many other items and materials – indeed for items with longer lifetimes (such as clothes and electronics), the impact on waste of purchasing habits may be separated by months or even years.

Furthermore, waste generation is often associated with the 'in-use' phase of objects and materials. Therefore, initiatives that reduce waste at source commonly have to target this phase, which is conceptually different from the process of 'discarding' an item, which is relevant to recycling and aspects

of reuse such as donation. In general, these 'in-use' practices are operating further up the waste hierarchy and consequently offer greater potential environmental benefits, but, as we have seen, are generally associated with greater levels of behavioural complexity.

The separation between actions and the generation of waste also suggests that it is not just organisations responsible for waste collection or treatment that are well placed to promote waste prevention, even though they may benefit from the reduction that does occur. Companies that manufacture, sell or are otherwise connected with the use of goods also have the opportunity to affect waste reduction. Public engagement by these companies could be crucial to the success of waste-reduction initiatives.

In a similar vein, experience with food-waste reduction has shown that there is merit in working with organisations that focus on other food-related issues. The fact that the way food is purchased, prepared and consumed can deliver multiple positive outcomes (relating to health, food-borne disease and the environment) means that it may be productive to join up messages and engaging with the public on these issues. This approach could prove useful for other waste-reduction and pro-environmental behaviours. The holistic approach also helps to avoid contradictory or confusing messages relating to food being given out by different organisations.

Despite the advice above, there may be fewer similarities than differences between waste-reduction activities of different items and materials. The cycle of food purchasing – often occurring on a weekly basis – is not replicated for many other items, such as electronic goods or clothing. Furthermore, these items have markedly different roles in our social interactions and elicit dissimilar emotional responses during their use or consumption. Given these prominent differences, it is important to understand how the items or materials in question are purchased, used, lent and discarded, rather than basing assumptions on items that are well-researched but dissimilar: 'carry-over' of knowledge between waste-reduction activities may be therefore somewhat limited.

This limited 'carry-over' also applies to other pro-environmental behaviours – for example, the use of energy within the home has only a few parallels with the use of food, and therefore there will be limited overlap in the knowledge base underpinning energy-reduction programmes and food-waste-reduction initiatives. It may be a useful to categorise behaviours into those that are 'simple', i.e. with consequences that are perceived to be direct and logical, and 'complex', where consequences are indirect, and unlikely to be uppermost in people's minds when the causal behaviour is practised.

A number of key challenges emerge from this discussion of household food waste. Firstly, following the comments in section 5, there could be substantial benefit from increased understanding of the relationship between complex pro-environmental behaviours – such as those associated with food waste – and values. Similar benefits may ensue from further exploration of the role of contextual factors in waste generation and some of the more nuanced drivers, such as the role of guilt and a desire to run an efficient home. These developments could be used to adapt existing behavioural models and conceptual understanding, aiding delivery of public-engagement programmes in the future. These challenges could be met through partnership of those delivering public-engagement programmes, contractors researching this issue, and the academic community.

## **9. Acknowledgements**

WRAP is grateful to all of its funders on household food waste (the four national governments of the UK) for financially supporting time spent on the preparation of this paper. The views expressed in this paper are those of the authors alone, and the funders have not been involved in writing or shaping any of the contents.

The authors would like to thank colleagues in WRAP, their contractors, and partners from central and local governments, retailers, food manufacturers, the media, academia and charities who have worked together to understand and deliver reductions in household food, with a special mention to those people and organisations who have undertaken the research funded by WRAP that underpins the discussion in this paper.

The authors would also like to thank the anonymous reviewers of this paper for helpful suggestions that have improved the paper.

## References

Ajzen I. The Theory of Planned Behavior. *Organizational Behavior and Human Decision Processes* 1991;50:179-211.

Barr S, Gilg A, Ford NJ. Difference between Household Waste Reduction, Reuse and Recycling Behaviour: A Study of Reported Behaviours, Intentions and Explanatory Variables. *Environ. Waste Management* 2001;4:69-79.

Barr S. Times for (Un)sustainability? Challenges and opportunities for developing behaviour change policy: A case-study of consumers at home and away. *Glob. Environ. Change* 2011;21:1234-44.

British Social Attitudes 28, 2011: <http://www.natcen.ac.uk/study/british-social-attitudes-28th-report>. Accessed 30<sup>th</sup> April 2012.

Chatterton T. An introduction to Thinking about 'Energy Behaviour': a Multi Model Approach. 2011: [http://www.decc.gov.uk/en/content/cms/about/ec\\_social\\_res/sr\\_cus\\_insight/sr\\_cus\\_insight.aspx](http://www.decc.gov.uk/en/content/cms/about/ec_social_res/sr_cus_insight/sr_cus_insight.aspx)

Darnton A. Practical Guide: An overview of behaviour change models and their uses. 2008: [http://www.civilservice.gov.uk/wp-content/uploads/2011/09/Behaviour-change\\_practical\\_guide\\_tcm6-9696.pdf](http://www.civilservice.gov.uk/wp-content/uploads/2011/09/Behaviour-change_practical_guide_tcm6-9696.pdf). Accessed 30<sup>th</sup> April 2012.

Darnton A, Verplanken B, White P, Whitmarsh L. Habits, Routines and Sustainable Lifestyles: A summary report to the Department for Environment, Food and Rural Affairs. 2011: <http://randd.defra.gov.uk/Default.aspx?Menu=Menu&Module=More&Location=None&Completed=0&ProjectID=16189>. Accessed 30<sup>th</sup> April 2012.

Defra. Food Synthesis Review. 2009: [http://randd.defra.gov.uk/Document.aspx?Document=EV0510\\_8632\\_FRP.pdf](http://randd.defra.gov.uk/Document.aspx?Document=EV0510_8632_FRP.pdf). Accessed 7<sup>th</sup> November 2012.

Defra. A Framework for Sustainable Lifestyles. 2011: <http://www.defra.gov.uk/environment/economy/products-consumers/influencing-behaviour/>. Accessed 7<sup>th</sup> November 2012.

Defra. Securing the future – delivering UK sustainable development strategy. 2005: <http://www.defra.gov.uk/publications/files/pb10589-securing-the-future-050307.pdf> Accessed 7<sup>th</sup> November 2012.

Doland P, Hallsworth M, Halpern D, King D, Vlaev, I. Mindspace: Influencing behaviour through public policy. 2010: <http://www.instituteforgovernment.org.uk/publications/mindspace>. Accessed 30<sup>th</sup> April 2012.

Evans D, Beyond the Throwaway Society: Ordinary Domestic Practice and a Sociological Approach to Household Food Waste. *Sociology* 2012;46:41-56

Evans D, Blaming the consumer – once again: the social and material contexts of everyday food waste practices in some English households. *Critical Public Health* 2011;21:429-40.

Garnett T. Cooking Up a Storm. 2008: <http://www.fcrn.org.uk/fcrn/publications/cooking-up-a-storm> Accessed 30<sup>th</sup> April 2012.

Gatersleben B, and Vlek C, Household Consumption, Quality of Life and Environmental Impacts. In: Noorman KJ, Schoot-Uiterkamp AJM, editors. *Green Households? Domestic Consumers, Environment and Sustainability*. London: Earthscan, 1998. p. 141-83.

Gustavsson J, Cederberg C, Sonesson U, van Otterdijk R, Meybeck A. Global food losses and food waste, extent, causes and prevention. Food and Agriculture Organization of the United Nations (FAO). 2011 [http://www.fao.org/fileadmin/user\\_upload/ags/publications/GFL\\_web.pdf](http://www.fao.org/fileadmin/user_upload/ags/publications/GFL_web.pdf). Accessed 30<sup>th</sup> April 2012.

Lober DJ. Municipal Solid Waste Policy and Public Participation in Household Source Reduction. *Waste Management and Res* 1996;14:125-43.

Southerton D, McMeekin A, Evans A. International Review of Behaviour Change Initiatives; Scottish Government Social Research. 2011. <http://www.scotland.gov.uk/Resource/Doc/340440/0112767.pdf>. Accessed 7<sup>th</sup> November 2012.

Parfitt J, Barthel M, MacNaughton S. Food waste within food supply chains: quantification and potential for change to 2050. *Phil. Trans. R. Soc. B* 2010;365:3065-81.

Quested TE, Parry AD, Eastal S, Swannell R. Food and drink waste from households in the UK. *Nutrition Bull* 2011;36:460-7.

Reisinger H, van Acoleyen M, O'Connor C, Hestin M, Laureysens I, Morton G et al. Evolution of (bio-) waste generation/prevention and (bio-) waste prevention indicators, Final Report (2011). [http://ec.europa.eu/environment/waste/prevention/pdf/SR1008\\_FinalReport.pdf](http://ec.europa.eu/environment/waste/prevention/pdf/SR1008_FinalReport.pdf). Accessed 30<sup>th</sup> April 2012.

Shove E. Beyond the ABC climate change policy and theories of social change. *Environment and Planning A* 2010;42,1273-85.

Thompson S, Michaelson J, Abdallah S, Johnson V, Morris D, Riley K, & Simms A. "Moments of change" as opportunities for influencing behaviour. 2011. <http://randd.defra.gov.uk/Default.aspx?Menu=Menu&Module=More&Location=None&Completed=0&ProjectID=16193>. Accessed 30<sup>th</sup> April 2012.

Triandis H. *Interpersonal behaviour*. Monterey, CA: Brooks/Cole; 1977.

Tucker P, Douglas P. Understanding household waste prevention behaviour, Technical report no. 2: Results of a household attitude/ behaviour survey. 2006a. <http://randd.defra.gov.uk/Default.aspx?Menu=Menu&Module=More&Location=None&Completed=0&ProjectID=14681>. Accessed 30<sup>th</sup> April 2012.

Tucker P, Douglas P. Understanding household waste prevention behaviour, Technical report no. 1: A critical review of the literature. 2006b. <http://randd.defra.gov.uk/Default.aspx?Menu=Menu&Module=More&Location=None&Completed=0&ProjectID=14681>. Accessed 30<sup>th</sup> April 2012.

WRAP. Food behaviour consumer research: quantitative phase. 2007a. <http://www.wrap.org.uk/content/food-behaviour-consumer-research-quantitative-phase>. Accessed 30<sup>th</sup> April 2012.

WRAP. Understanding Consumer Food Management Behaviour. 2007b. <http://www.wrap.org.uk/content/understanding-consumer-food-management-behaviour-0> Accessed 18th May 2012.

WRAP. Consumer behaviour food dates, portion sizes. 2008a. <http://www.wrap.org.uk/content/research-consumer-behaviour-relation-food-dates-and-portion-sizes>. Accessed 30<sup>th</sup> April 2012.

WRAP. The Food We Waste. 2008b. (available on request from WRAP)

WRAP. Household Food and Drink Waste in the UK. 2009. <http://www.wrap.org.uk/content/report-household-food-and-drink-waste-uk>. Accessed 30<sup>th</sup> April 2012.

WRAP. Helping consumers reduce food waste - a retail survey. 2010.  
<http://www.wrap.org.uk/content/helping-consumers-reduce-food-waste-retail-survey>. Accessed 30<sup>th</sup> April 2012.

WRAP and WWF-UK. Water and Carbon Footprint of Household Food and Drink Waste. 2011a.  
<http://www.wrap.org.uk/content/water-and-carbon-footprint-household-food-and-drink-waste-uk-1>. Accessed 30<sup>th</sup> April 2012.

WRAP. New estimates for household food and drink waste in the UK. 2011b.  
<http://www.wrap.org.uk/content/new-estimates-household-food-and-drink-waste-uk>. Accessed 30<sup>th</sup> April 2012.

WRAP. Synthesis of Food Waste Compositional Data 2010. 2011c.  
<http://www.wrap.org.uk/sites/files/wrap/Synthesis%20of%20Food%20Waste%20Compositional%20Data%202010%20FINAL.pdf>. Accessed 7<sup>th</sup> November 2012.

WRAP. Consumer insight: date labels and storage guidance. 2011d.  
[http://www.wrap.org.uk/sites/files/wrap/Technical\\_report\\_dates.pdf](http://www.wrap.org.uk/sites/files/wrap/Technical_report_dates.pdf). Accessed 30<sup>th</sup> April 2012.

WRAP. Love Food Hate Waste case study: Worcestershire County Council and the University of Worcester. Reducing food waste through community focussed initiatives. 2011e.  
<http://www.sustainablegov.co.uk/wp-content/uploads/2012/02/Worcestershire-CC-LFHW-2011-case-study.pdf>. Accessed 30<sup>th</sup> April 2012.

WRAP. The milk model: simulating food waste in the home; 2013, <http://www.wrap.org.uk/content/milk-model-simulating-food-waste-home-0> [accessed 13.05.2013].

WWF-UK. Livewell: a balance of healthy and sustainable food choices. 2011.  
[http://assets.wwf.org.uk/downloads/livewell\\_report\\_jan11.pdf](http://assets.wwf.org.uk/downloads/livewell_report_jan11.pdf). Accessed 30<sup>th</sup> April 2012.