Using consumer surveys to determine food sustainability

Wayne Martindale
Sheffield Business School, Sheffield Hallam University, Sheffield, UK

Received 4 September 2013
Revised 12 February 2014
Accepted 20 February 2014

Abstract

Purpose – The purpose of this paper is to define the sustainability attributes of frozen and fresh food consumption in a typical household. The reason for writing this paper is that food preservation is often overlooked when developing sustainability strategies.

Design/methodology/approach – This study uses established carbon footprint data for specific food types and consumer survey data to determine how consumers use fresh and frozen products in the home. Consumption and waste data for 83 households was obtained using a combination of narrative and graphical association questions.

Findings – The results show greenhouse gas emissions associated with a diets containing frozen food are reduced because 47 per cent less frozen foods is wasted as compared to fresh foods with a typical household wasting 10.4 per cent of fresh food and 5.9 per cent frozen food.

Research limitations/implications – This research has highlighted the importance of understanding the waste impacts of catering and food service consumption outside the home.

Practical implications – This research will guide future product development for frozen foods with regard to dietary planning and portion control.

Social implications – The cost and sustainability benefits of meal planning are identified and these will inform policy making and education to improve dietary choices.

Originality/value – This work extends the scope of current consumer surveys that assess quality, value and taste attributes to sustainability criteria and it will enable collaboration between fresh and frozen product categories to deliver sustainable dietary options.

Keywords Sustainability, Consumption, Consumers, Food waste, Frozen foods

Paper type Research paper

Introduction

The development of sustainability criteria associated with food products has been stimulated by the standardisation of the product carbon footprint (British Standards Institute, 2008). The carbon footprint of products can be developed to represent the typical household food consumption using national dietary surveys (Wallén *et al.*, 2004). This approach defines differences in the use of fresh and frozen foods. This is especially challenging because determination of the food use in households that integrates both consumption and sustainability criteria for weekly shopping is often limited by data. Currently, consumer surveys identify taste, value and convenience attributes of different products to define new product development (NPD) in the foods sector. Sustainability research increasingly proposes that increased integration of carbon footprint methods and sustainability measures in manufacturing NPD will occur in future.

The focus on food consumption in this study is of importance because it is a significant proportion of the national greenhouse gas (GHG) emission inventory (ONS, 2012). The UK food and drink system is responsible for 195 million tonnes of CO_2eq (greenhouse gas emission equivalents) per year (Defra, 2012). Thus, using individual

British Food Journal
Vol. 116 No. 7, 2014
pp. 1194-1204
Emerald Group Publishing Limited
0007-070X
DOI 10.1108/BFJ-09-2013-0242

The initial questionnaire design in the research presented here and the APC was funded by Iglo Foods Ltd.

carbon footprints of products to assess the GHG consumption impact of the dietary behaviour of populations will be an important consideration for developing future environmental policy. It is important that future reductions of GHG emission should align with national dietary guidelines and one such action may be a reduction in the waste of food from households.

An important consideration for obtaining meaningful measures of typical consumption in households is what consumer sample size is robust enough to provide extrapolation of results to whole populations. A benchmark for consumer surveys are the macroeconomic indices used by governments to determine purchasing and consumption functions of population such as the consumer price index (CPI). In the UK, the CPI is derived from samples taken from different postal regions and the Office of National Statistics (ONS) use these approaches for the highly relevant Living Costs and Food Survey (LCF). The LCF is the main source of UK government food and beverage purchasing by households. The LCF survey collates data from nearly 5,700 households, the survey itself has close to a 50 per cent response rate (it is sent to nearly 12,000 households). The LCF survey data are utilised with the National Dietary and Nutrition Survey (NDNS) which provides a benchmark for what a typical meal consumed in the UK is[1].

Food consumption surveys themselves show significant variance in the type of survey used to obtain data that will characterise a market including focus groups and convenience sampling. The research reported here uses recall or perception techniques because they obtain a broad understanding of product use in populations. For example, large population samples in excess of $n = 1{,}000$ samples are achievable using recall and perception methodologies and have been reported for fresh and frozen foods successfully by Vanhonacker *et al.* (2013). The total sample size in this study was 3,213 respondents, around 400 from eight European nations. Data acquisition from the head of households increases the number of individuals surveyed because typically a household will have more than one person living in it and this approach is used in this study.

An important recent study that has assessed household food waste production in the UK has been published by WRAP (Quested *et al.*, 2013). This study has surveyed 1,800 households, with nearly 1,000 households collating food diaries, it represents one of the most comprehensive of current studies that's quantifies household food arisings. This WRAP study does account for seasonal variation in food categories and the type of food waste produced. The study reported here does not fully consider this seasonal variation because the sample is assessed for a typical weekly shop and this will be a consideration of future research. Indeed the value of frozen preservation of "out of season" foods reducing the pressure and environmental impact of obtaining "in season" fresh food has not been fully investigated so far. Quested *et al.* (2013) show that reductions in food waste across food categories can be as high as 20-30 per cent when interventions such has clearer labelling and consumer communications are used. The report does not investigate the relationship between fresh and frozen food categories as the reported research here does.

GHG emission reduction has been stimulated by the economic benefits of reducing energy consumption across supply chains and the wider impacts of climate change provide a focus for the sustainable consumption of fast moving consumer goods (de Boer *et al.*, 2007). The development of carbon footprinting standards for products by manufacturers and regulators has enabled measurement of GHG emissions (Hoogland *et al.*, 2007). Our analysis provides a basis for how manufacturers might use

both sustainability criteria and consumer intelligence to further develop products for convenience and sustainability outcomes.

Research methodology

The requirement for a survey that provides a representative and robust sample that defines how we use fresh and frozen foods in the home was discussed with the technical and sustainability function within the Iglo Food Group in June 2012. This resulted in the development of two questionnaires that determine fresh and frozen food use in the home funded by Iglo Food Group and Sheffield Business School. The initial questionnaire was sent to 255 Sheffield, UK residents on-line using the Survey Monkey on-line system[2]. The sample was made up of Sheffield residents who were panellists on food sensory testing programmes at Sheffield Business School and the questionnaire was designed as a series of "tick box" questions so that the demographic, lifestyle and product choice data for households could be determined. The products identified in the questions were selected using the frozen and comparable fresh food product (see Appendix 1 for a questionnaire copy). The number of responses to the questionnaire was 134 (a response of 52 per cent), 100 panellists who used a wide range of frozen and fresh foods were selected to take part in a second survey. The responders to the first survey are shown in Figure 1, and the questionnaire achieved the following objectives:

(1) to determine the range of fresh and frozen food consumed in each household so that selection of respondents who used a broad range of frozen and fresh meat, fish, poultry and vegetable products could be made;

(2) to select households where people lived alone, were 25 years of age and below and those who were 55 years of age and above; and

(3) to select households that included children.

Figure 1 shows the age data from the initial selective questionnaire as a percentage of the $n = 134$ returning sample of $n = 255$ who received the questionnaire. The household sample of $n = 134$ included 21 per cent of households where people lived alone and 24 per cent of households where people lived with dependent and non-dependent children. The respondents represented a typical population sample for Sheffield as compared to National Census population age structure data. The second

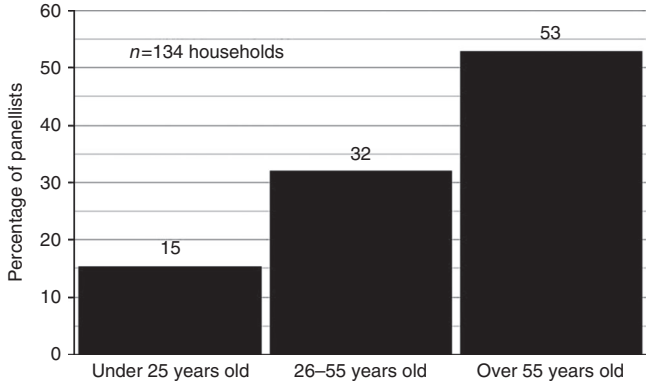


Figure 1.
The respondents to the first questionnaire

questionnaire was sent to 100 respondents who were selected by their use of a wide range of both frozen and fresh food products, these were selected from the $n = 134$ sample shown.

The second (fresh and frozen product use criteria) questionnaire was sent to 100 selected panellists. The percentage of consumers in each of the age groups shown in Figure 1 did not change in response to selecting the 100 panellists for widest product choice across fresh and frozen categories. The second questionnaire was designed as a series of questions that determined how panellists used fresh and frozen food. The questionnaire was developed to obtain a retrospective view of household fresh and frozen food use over one week and the design enabled expedient and accurate determination of amounts and types of food used. It was designed so that the respondents could provide tick box and narrative responses to questions that determined how often they shopped for fresh and frozen foods and what type of fresh and frozen foods were used in the household.

Most importantly, the determination of the amount of fresh and frozen food wasted by the household was determined using a series of graphical associations shown in Appendix 2. These relate to the proportion of meals wasted for fresh and frozen food. The questions were weighted against the use of fresh foods because questions were asked to obtain similar data for fresh food consumption and waste.

Panellists were asked to select and indicate a circular graphic (see Appendix 2) that corresponded to what they perceived as the typical amount of fresh and frozen food waste from each meal they prepared. A typical meal weight based on manufacturer recommendations ranges from 400 to 600 grams of food by weight on a typical plate for a meal. The Eatwell Plate provides a context for the graphics shown in the second questionnaire which corresponded to five parts, ten parts and 20 parts of a typical portion or plate size that equals 100 parts[3]. Using this data a food waste index was developed that related to the amount of food wasted. This was cross referenced with identification of the frequency of wasting food and the types of food wasted. The waste index or percentage waste obtained from the data obtained was cross referenced with answers to questions on the types of foods purchased and home freezing activity.

The self-assessment of food wastes can introduce errors from the population in quantifying food waste produced and alternatives include direct measurement by weight of food wastes and food diaries. Questionnaires are an important method of data collection and this research designed the questions answered so that products used and wasted were cross referenced with measurements and representations of what was wasted. That is the Questionnaire identified which food products were wasted throughout the Questionnaire and asked the respondent to graphically identify the amount of waste produced. The WRAP study produced by Quested *et al.* (2013) identifies the difficulty in obtaining a robust representation of household waste and uses using food diaries, Questionnaire and established statistical census and surveys. This study is limited to the use of Questionnaire and statistical census and surveys, it adds to current understanding by differentiating between fresh and frozen foods.

The aim of the second fresh and frozen product use questionnaire was to achieve the following objectives:

(1) To determine that amount of fresh and frozen food wasted in a household in a typical week. The period of a week was used in this study to provide expedient results from the sample population that were made up of food

sensory panellists accustomed to reporting food portion criteria. This reduced potential errors in mis-reporting because the panellists were trained in reporting both qualitative and quantitative data.

(2) To calculate of the CO_2eq associated with frozen food consumption and waste were made using Carbon Trust and peer review secondary data (British Standards Institute, 2008; Wallén *et al.*, 2004; Nielsen *et al.*, 2009). These existing data sets provided the CO_2eq associated with frozen food consumption with Carbon Trust refrigeration and frozen food data. The CO_2eq associated with frozen food consumption from these data sets includes the supply chain boundary from production, manufacturing, retailing and household use of food products.

(3) To determine how the carbon footprint of the typical weekly use of frozen food in a household relates to that of fresh food. We have used previous research by Martindale and Lucas (2010), which determined the carbon footprint of weekly diets in the UK using the typical NDNS meal data.

Research results

The waste index for the 83 households (83 per cent response rate to the second questionnaire) derived from panellist data was 5.59 for frozen food and 10.46 for fresh food. This means that 47 per cent more fresh food was wasted as compared to frozen food. The waste index provides a measure of food perceived to be wasted by the panellists. The two tailed *t*-test probability (fresh weighted against frozen values) for the mean fresh (10.46) and frozen (5.59) food waste was <1 per cent for the whole sample of 83 households demonstrating the mean values for fresh and frozen food waste were significantly different.

There was variation in the waste index for different types of households, for example people who were over 55 years ($n=9$) and lived alone ($n=15$) had a frozen food waste index between 1.78 and 2.80 and fresh food waste index of 7.11-7.20. Those households who lived with children ($n=26$) had a frozen food waste index of 7.96 and a fresh food waste index of 12.27. Those under 25 years ($n=14$) had a frozen food waste index of 3.5 and a fresh food waste index of 10.36, the two tailed *t*-test probability (fresh weighted against frozen values) returned for the mean values of these sub-groups were not more than 2 per cent, demonstrating the mean values for fresh and frozen food waste were significantly different. While the sub-group data show that people living on their own and older people waste less than younger people and those with children further work would be required to analyse household type and behaviour for a more accurate representation of the household types. The approach does show frozen food waste is less than that in each sub-group.

The carbon footprint of frozen food use in the home

Figure 2, shows the carbon footprint of a typical individual based on NDNS survey data. Previous research carried out by Martindale and Lucas (2010) demonstrated the carbon footprint of a typical diet is 18.23 kg CO_2eq (the carbon footprint) for an individual each week using the published carbon footprint data of the Carbon Trust Footprint Expert (British Standards Institute, 2008; Wallén *et al.*, 2004; Nielsen *et al.*, 2009). These data sets have provided carbon footprint data for each of the products used by respondents of the consumer survey here. The weekly carbon footprint

provides a measurement to compare the frozen food carbon footprint (CO_2eq) using the consumer survey data that has identified what frozen foods are consumed. In this study of 83 households the carbon footprint of frozen food for each household was 12.81 kg CO_2eq, equivalent to 0.70 of a typical individual food consumption carbon footprint. The total food waste in the households' survey contributes 2.52 kg per individual CO_2eq each week to the carbon footprint; this is 14 per cent an individual's food carbon footprint. Figure 2 shows the carbon footprint of frozen food waste is 47 per cent less than that of fresh food waste.

How people purchase and use frozen food results in less food waste and improved value

The survey data showed nearly all of the panellists shop for frozen food at supermarkets (99 per cent). Frozen fish products are rarely wasted with only five panellists (6 per cent) throwing frozen fish away. The reason why 42 (51 per cent) of the panellists throw frozen food away was it was never used, this included home frozen foods. In contrast to the frozen waste behaviours, 66 (80 per cent) of panellists throw away fresh dairy and vegetable products on a weekly basis.

Figure 3 shows that most sampled households shop for frozen food and recall wasting fresh and frozen food on a weekly basis. Importantly, Figure 3 shows 28

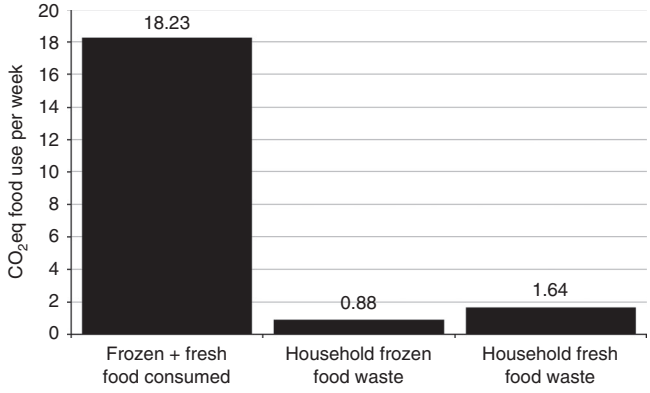


Figure 2.
The carbon footprint of food consumption and waste production for the $n = 83$ households

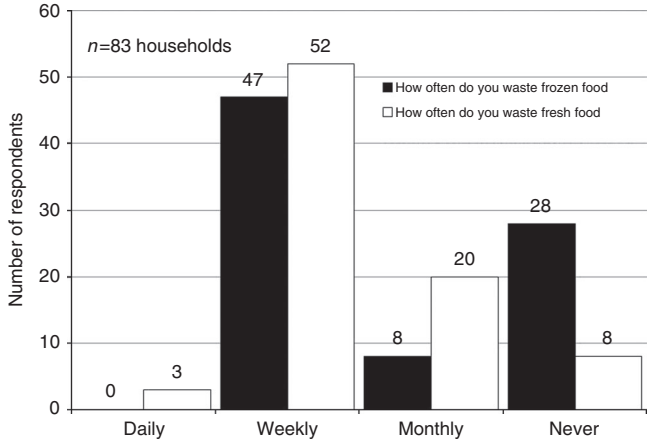


Figure 3.
How frequently fresh and frozen food is wasted in the sampled households

(34 per cent) households never waste frozen food in contrast to fresh food where 8 (9.6 per cent) households never waste.

Validating the research methodology

The research reported in this paper is derived from 83 households and while the 5,700 households sampled for the UK's LCF survey is far in excess of our sample it must be noted that the LCF sample is for the whole UK and it is collected in 150 postal regions or $n = 38$ households per region for 5,700 households. Furthermore, this study has selected a population sample within the Sheffield area that utilises a broad range of fresh and frozen foods in contrast to the LCF that considers some 20,000 products. Thus, the method developed has reduced the variability of data by selecting an appropriate study group who are trained in food sensory techniques ($n = 255$ for the initial screening survey) and utilise a broad range of frozen and fresh category products ($n = 83$ for the final questionnaire). The sample is representative of the National Census age structure for the Sheffield city region so that informed statements on the GHG footprint/waste footprint of frozen food consumption can be made. The panellist population sample was used because the participants were practiced in reporting food categories and product types and they were representative.

The social implications

The results show that 47 per cent more fresh food is wasted than frozen food and extrapolating this waste headline data to a UK population-wide scenario of 61 million consumers should be viewed with caution. However, considering this scenario a 47 per cent reduction in food waste per individual as a consequence of using frozen food as part of their weekly meal planning can conserve up to 0.76 kg CO_2eq which equates to reducing the national GHG inventory by 2.41 million tonnes of GHG each year (i.e. $(0.00076 \times 61{,}000{,}000) \times 52 = 2{,}410{,}720$ tonnes per year). While this extrapolation is taking the current data set to its limit here it can provide useful for providing policy or strategic insight. The 18.23 kg CO_2eq weekly individual consumption footprint in this study which accounts for over one million tonnes of GHG emission per week for the UK's 61 million consumers (i.e. $(0.01823 \times 61{,}000{,}000) \times 52 = 57{,}825{,}560$ tonnes CO_2eq per year). This figure equates well to the 50-60 million tonnes of CO_2eq are associated with consumption of food prepared in the household if we consider 50 per cent of current food consumption may be out of the home with a further significant GHG loading being associated with food imports (Defra, 2012).

Frozen foods are brought in bulk at weekly to monthly intervals; fresh foods are brought according to daily meal planning. The Stock Keeping Units (SKU) for fresh groceries are likely to be lower weight due to perishability and the focus on daily meal planning. This study indicates that this is overlooked in carbon footprint comparisons for fresh and frozen foods. This is important because frozen food is brought for household weekly to monthly meal planning (convenience) and value and results in a reduction in the carbon footprint compared to fresh foods which are brought on a per individual basis. For example, a SKU purchased for frozen green beans is 800-1,000 grams, and it is stored for a month. In contrast a SKU of fresh green beans is 75-120 grams and is stored for a week. This has a large impact on carbon footprint and waste.

Evans (2012) considers a Sunday dinner carbon footprint as an example and developing service-sector and seasonal scenarios that may provide more evidence to further support the sustainability criteria of frozen foods reported here. For example,

the use of frozen out-of-season fruit and vegetables may ameliorate the carbon footprint of imports when integrated into household dietary planning. A possible future development of this research is to develop scenarios for typical meals that contain seafood, beef, vegetables and so on so that "flagship" meals might be compared in terms of waste production and GHG emissions. This type of meal benchmarking might be useful for consumers to observe where avoidable waste might be reduced and where nutritional improvements might be made.

An important outcome of this research is identifying the importance of using frozen food categories to reduce avoidable food waste. Quested *et al.* (2013) identify that this can account for 20-30 per cent of household food waste and the major food categories for avoidable food waste are fresh vegetables which are an important frozen food category. Their research also identifies one of the major reasons for avoidable waste arising is the product was not used in time before it spoiled. Again, the potential for freezing and preservation of food reducing waste is an important aspect of household food management that may not be being fully realised by policy makers. The research reported here represents the first steps in identifying the role of frozen food categories in reducing avoidable food waste in the household.

The use of cars associated with shopping is another external consideration of frozen food use that is highlighted by this Defra data and the interaction between frozen food storage duration and shopping frequency may merit further consideration in future (see Defra, 2012, p. 44). Defra report households generate 7.2 million tonnes of food waste each year of which 4.4 million tonnes is avoidable with 15 per cent of edible food and drink purchases being wasted at a cost of (GBP) £480 per year for an average household (Defra, 2012, pp. 49-50). The research presented here shows nearly half (47 per cent) of this food waste could be avoided if frozen foods were used as part of meal planning representing a saving of (GBP) £240 per year for a typical household. The current statistical reporting for national food consumption does not consider a frozen vs fresh scenario and frozen categories can provide both sustainability and cost incentives.

Research conclusion

The research presented shows that frozen food accounts for 12.8 kg CO_2eq per week for each household in the sample used and this is equivalent to 17.50 million tonnes of GHG per year in the UK). Meal planning with frozen foods can conserve the GHG emissions associated with food waste by 47 per cent compared to fresh food and reduce GHG emissions by 2.41 million tonnes per year in the UK. This represents an innovative approach to applying market intelligence to sustainable metrics associated with new product design and development which will become increasingly important if manufacturers are to develop sustainable consumption policies. Avoidable food waste in the home is an important target for improving sustainability by reducing it and the research reported here shows the efficient use of frozen food in meal and diet planning will achieve this.

Notes

1. Natcen www.natcen.ac.uk/study/national-diet-and-nutrition-survey (accessed 14 August 2013).
2. Survey Monkey, www.surveymonkey.com (accessed 13 August 2013).
3. The Eatwell Plate, www.nhs.uk/Livewell/Goodfood/Pages/eatwell-plate.aspx (accessed 13 August 2013).

References

British Standards Institute (2008), *Guide to PAS 2050; How to Assess the Carbon Footprint of Goods and Services. Specification for the Assessment of the Life Cycle Greenhouse Gas Emissions of Goods and Services*, British Standards Institute, London, available at: http://shop.bsigroup.com/en/forms/PASs/PAS-2050/ (accessed 2 September 2013).

de Boer, J., Hoogland, C.T. and Boersema, J.J. (2007), "Towards more sustainable food choices: value priorities and motivational orientations", *Food Quality and Preference*, Vol. 18 No. 7, pp. 985-996.

Defra (2012), *Food Statistics Pocketbook*, Defra, pp. 42, 44-50, London, available at: www.gov.uk/government/organisations/department-for-environment-food-rural-affairs/series/food-statistics-pocketbook (accessed 14 August 2013).

Evans, J. (2012), "Carbon emissions from chilled and frozen cold chains for a typical UK Sunday roast chicken meal", Refrigeration Developments and Testing (RD&T), Bristol, available at: http://bfff.co.uk/wp-content/uploads/2013/06/Carbon-Emissions-from-Chilled-Frozen-Report-Sept-12.pdf (accessed 2 September 2013).

Hoogland, C.T., de Boer, J. and Boersema, J.J. (2007), "Food and sustainability: do consumers recognize, understand and value on-package information on production standards?", *Appetite*, Vol. 49 No. 1, pp. 47-57.

Martindale, W. and Lucas, K. (2010), "Mapping sustainable diets – testing the MPCR model", available at: www.foodinnovation.org.uk/download/files/MartindaleLucas.pdf (accessed 13 August 2013).

Nielsen, P.H., Nielsen, A.M., Weidema, B.P., Frederiksen, R.H., Dalgaard, R. and Halberg, N. (2009), "The LCA food database", available at: www.lcafood.dk/ (accessed 13 August 2013).

ONS (2012), "Provisional 2011 results for UK greenhouse gas emissions and progress towards targets", available at: www.decc.gov.uk/assets/decc/11/stats/climate-change/4817-2011-uk-greenhouse-gas-emissions-provisional-figur.pdf (accessed 2 September 2013).

Quested, T., Ingle, R. and Parry, A. (2013), *Household Food and Drink Waste in the United Kingdom 2012*, ISBN: 978-1-84405-458-9 WRAP, Banbury, available at: www.wrap.org.uk/content/household-food-and-drink-waste-uk-2012 (accessed 10 February 2014).

Vanhonacker, F., Pieniak, Z. and Verbeke, W. (2013), "European consumer perceptions and barriers for fresh, frozen, preserved and ready-meal fish products", *British Food Journal*, Vol. 115 No. 4, pp. 508-525.

Wallén, A., Brandt, N. and Wennersten, R. (2004), "Does the Swedish consumer's choice of food influence greenhouse gas emissions?", *Environmental Science and Policy*, Vol. 7 No. 4, pp. 525-535.

About the author

Dr Wayne Martindale is a Research Fellow at Sheffield Business School and CSIRO McMaster Fellow directing a diverse folio of environmental sustainability research across the agricultural and food arenas. Dr Wayne Martindale can be contacted at: w.martindale@shu.ac.uk

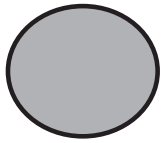
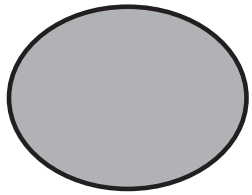
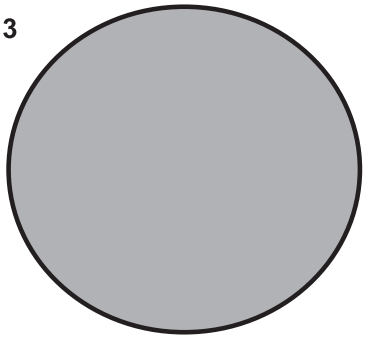
Appendix 1. Selection questionnaire sent to 255 households so that a sample representing a range of product use (fresh and frozen) and lifestyles could be selected for a detailed questionnaire to investigate product use

Category	Product areas	Examples of products in the product area	Do you purchase either or both of the products as fresh or frozen. Please Tick	
			Fresh	Frozen
Meat Fish & Poultry	Beef			
Meat Fish & Poultry	Lamb			
Meat Fish & Poultry	Pork			
Meat Fish & Poultry	Chicken			
Meat Fish & Poultry	Veal			
Meat Fish & Poultry	Burgers			
Meat Fish & Poultry	Sausages			
Meat Fish & Poultry	White fish	Cod, haddock		
Meat Fish & Poultry	Oily fish	Mackerel, fresh tuna, sardines		
Meat Fish & Poultry	Smoked fish	Smoked haddock, smoked mackerel, smoked salmon		
Meat Fish & Poultry	Shellfish	Mussels, prawns, oysters, scallops		
Produce	Root vegetables	Carrots, parsnips		
Produce	Green vegetables	Broccoli, spinach		
Produce	Onions, leeks			
Produce	Berries	Strawberries, blueberries		
Produce	Bananas			
Produce	Exotic fruit/veg	Papaya, okra, pineapple		
Bakery	Sourdough/artisan breads			
Bakery	Continental breads	Baguettes, ciabatta, foccacia		
Bakery	Sliced bread			
Bakery	Cakes			
Bakery	Celebration cakes	Birthday cakes		
Bakery	Croissants			
Bakery	Naans and wraps			
Bakery	Muffins and crumpets			
Bakery	Hot cross buns			
Bakery	Mince pies			
Meal Solutions	Classic ready meals	Lancashire hot pot, chicken casserole		
Meal Solutions	Italian ready meals	Lasagne, spaghetti bolognese		
Meal Solutions	Ethnic ready meals	Curry		
Meal Solutions	Vegetable accompaniments	Mashed potato, prepped roasted vegetables		
Meal Solutions	Fresh pasta			
Meal Solutions	Fresh pasta sauces			
Meal Solutions	Pizza & garlic breads			
Meal Solutions	Pies & quiches			
Meal Solutions	Soup (fresh)			
Frozen	Fresh meat and poultry	Mince, joints		
Frozen	Processed meat and poultry	Sausages, burgers, kievs		
Frozen	Fish	Breaded cod		
Frozen	Frozen vegetables			
Frozen	Ice cream			
Frozen	Frozen fruit			
Frozen	Potato products	Chips, wedges		
Frozen	Ice lollies			
Frozen	Desserts			
Frozen	Meat free			
Frozen	Ready meals			
Frozen	Pizza and garlic bread			
Frozen	Party food			
Canned & Packaged	Cooking sauces	Pasta sauces, curry sauces		
Canned & Packaged	Herbs			
Canned & Packaged	Free from products	Products for customers with gluten, dairy & egg allergies		

Appendix 2. Questionnaire 2

The following exert of the second questionnaire is shown to demonstrate how quantities of food waste produced by consumers were determined. The three shape options corresponded to 5, 10 and 20 per cent of typical meal plates as based on the Eatwell Plate meal size. The graphics have been reduced for typesetting and we aimed to develop a recognition test that helped consumers determine the amount of food waste they produced. These responses were then followed by questions that allowed the responder to describe the food wasted in terms of narratives and tick boxes. This determined whether the food wasted was frozen product, fresh product or home prepared and frozen. The following question was used to graphically associate food waste for fresh and frozen foods identified as wasted by the survey participant. The graphics have been reduced by 50 per cent in scale of the original questionnaire for typesetting.

Using the oval shapes below approximate how much food you threw away for each cooking session. The shapes guide the measurement of how much of the prepared meals are wasted. Please tick the shape that corresponds to how much of a meal is wasted and state what ingredients the 'waste shape' refers to. If no shapes correspond to how much was wasted state the number or fraction of a shape that

Option 1 	• • • •
Option 2 	• • • • • • •
Option 3 	• • • • • • • • • • • • •