CCF-2708 Final Report Appendix I:

Approaches to Surveying Diets and Food Waste as Part of Carbon-Saving Initiatives

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1 INTRODUCTION

1.1 THE PURPOSE OF THIS DOCUMENT

This document explains what factors we considered when deciding on our approach to surveying diet- and food waste-related behaviour and sets out some of the lessons we learned from CCF projects 3914 and 2708. We hope that it will be useful for others working in this field.

1.2 BACKGROUND INFORMATION

Key points:

- Getting people to change their diets by reducing the consumption of red meat makes sense from both environmental (climate change) and health perspectives.
- Reducing food waste and diverting food waste from landfill to compost is also an important means of reducing greenhouse gas emissions.

1.2.1 Food, Environment and Health – Changing Diets Makes Sense

The average annual greenhouse gas (GHG) emissions associated with the supply of food and drink for the UK have been estimated as 152 $MtCO_2e$ (Audsley et al., 2009), which means that the average annual food-related GHG emissions per person are approximately 2,390 $kgCO_2e$. Food is responsible for around one-fifth of all GHG emissions from products consumed in the UK, the largest contributors to which are meat and dairy (Scarborough et al., 2012). Indeed, while, according to Keep Scotland Beautiful (KSB), the average embodied emissions for food and drink are 4.060 $kgCO_2e$/kg, the range of CO_2e values for particular food items is enormous, stretching from, for example, 39.20 $kgCO_2e$/kg for lamb (Environmental Working Group, 2011) to an average of 0.540 $kgCO_2e$/kg for allotment-grown fruit and vegetable produce (KSB).

In addition, average meat consumption in Scotland is higher than is recommended for a healthy diet (Frey and Barrett, 2006; Eating Better, 2014) and the UK government's scientific advisers (the Scientific Advisory Committee on Nutrition) have suggested that people should limit their consumption of red and processed meat to 70 g/day for health reasons (Hennessy and Donnelly, 2011). Rohrmann et al. (2013) found, from an analysis of 448,568 men and women, that 3.3% of deaths could be prevented if all participants had, specifically, a processed meat consumption of less than 20 g/day, and that processed meat intake is significantly associated with cardiovascular diseases, cancer, and other causes of death. Wang and Beydoun (2009) found that meat consumption was correlated with obesity. The World Cancer Research fund recommends a maximum of 43 g meat/day, which contrasts with the figure of 58.7 g, which the average Scot was consuming in 2006 (Barton et al., 2011). Despite the dual health and environmental benefits of reducing meat consumption (Scarborough et al., 2012), and the fact that it is not necessary to drastically change one's diet to reduce its environmental impact (MacDiarmid et al., 2012), to date 'efforts by non-governmental organizations to encourage reduced meat consumption in light of climate change have been quite limited, particularly among environmental non-governmental organizations' (Laestadius et al., 2014).

The synergy between reducing meat consumption for environmental reasons and reducing it for health reasons is not perfect. This is implied not only by the fact that health-motivated recommendations with regard to meat consumption do not argue for zero meat consumption, but also by the fact that meat options that may be relatively benign environmentally may be worse for health. For example, bacon falls into the category of processed meat, so the work of Rohrmann et al. (2013) suggests that it would be worse for health than unprocessed beef or lamb. However, Berners-Lee et al. (2012) rate the GHG impact of bacon (<10 $kgCO_2e$/kg at the checkout) as much lower than that of [supermarket] 'counter raw meats' (>16 $kgCO_2e$/kg at the checkout) and lower than that of all the other pure meat products they list, and the Environmental Working Group (2011)

lists the full life cycle GHG emissions of lamb as 39.2 kgCO_2e/kg and (undifferentiated) pork products as only 12.1. These figures, and the relative health impacts of the meats, imply that by maintaining the same total meat consumption but shifting from lamb to bacon one could increase one's health risk but decrease one's GHG impact, and vice versa.

1.2.2 Food Waste and Composting

According to Love Food, Hate Waste Scotland about 15 million tonnes of food is thrown away every year in the UK, almost 50% of this comes from our homes, and people in Scotland annually throw away about 78 kg each. The site implies that this is avoidable. KSB recommends a coefficient of 4.060 kgCO_2e/kg waste to calculate the embodied GHG of undifferentiated food and drink waste so, without even considering the consequences of landfilling some of this (which generates methane, a potent GHG), UK-wide food waste represents over 50 MtCO_2e/year and domestic food waste in Scotland over 300 kgCO_2e/person/year. In fact, because much waste goes to landfill, it represents significantly more. Ideally, then, one would eliminate avoidable food waste and divert unavoidable food waste from landfill to compost. (KSB provides GHG coefficients for these: 0.723 and 0.006 kgCO_2e/kg respectively.)

2 PRACTICAL CONSIDERATIONS: ESTIMATING THE GHG (CO_2e) IMPACTS OF DIETS

In order to estimate the GHG impacts of diets (and inform policy on changing them), one needs to identify practical and coherent dietary components (which, for the sake of brevity, we call 'categories'), identify appropriate CO_2e coefficients for these, and then quantify them. A category for measurement (and potentially as a target for change) might be made up of several elements. For example, one might decide to lump processed and unprocessed beef, mutton, lamb and venison into a single 'red meat' category.

Decisions about what and how many dietary elements to group into what and how many categories will be influenced by the common-sense similarity of the elements, by the practicality of individually quantifying elements, and by the closeness of these elements' individual CO_2e coefficients. The first factor (common sense) requires little explanation – categories influenced by common sense would generally be those already recognised by the language, e.g. 'red meat' and 'fruit'. The second and third influencing factors are discussed below, in reverse order.

2.1 ESTIMATING THE CO_2e COEFFICIENTS OF DIETARY ELEMENTS AND CATEGORIES

Many things influence the GHG impacts of dietary elements, including production, transportation, storage and processing. An organic allotment-grown pea eaten raw immediately after being picked will have a far lower impact than one flown in from Kenya and then driven from a supermarket to spend months in a freezer before being boiled on a gas stove.

Complicating this, the literature gives a range of values even for apparently similar, identically produced, transported, stored and processed food items (or is unclear about what production, transportation, storage and processing has been taken into account), and some figures are controversial – should one consider the potential ancillary benefits of particular farming methods? If so, how would one do so? For example, some argue that the production of grass-fed, free-range and organically produced beef is associated with the maintenance of healthy grassland ecosystems, which may sequester carbon and have other environmental benefits, and therefore that it has a far lower GHG (and general environmental) impact than feedlot-produced beef. (See, for example, Abberton et al., 2010, and Ritchie, 2014.) How could one quantify this?

Fortunately, even though it is virtually impossible to establish indisputably accurate CO_2e coefficients for most (if not all) dietary elements, there is a huge difference between the ranges of values of many of them. For

example, according to every source the author of this document could find, chicken has a significantly lower CO_2e coefficient than beef or lamb. (And even if one accepts that the grass-fed, free-range organic beef referred to above should be assigned a low coefficient, this item is unlikely to be a significant element in most survey populations' diets.) Therefore, if one is attempting to influence dietary change for environmental reasons, exact values are not essential. When considering two possible alternative elements in a diet, if the lowest suggested CO_2e coefficient for one is higher than the highest suggested CO_2e coefficient for the other, one should encourage people to shift from the former to the latter. One will not, of course, be able to calculate the precise CO_2e saving associated with any diet, but one can at least be reasonably certain that some dietary changes have CO_2e benefits, and one can come up with an approximation of what this will be.

2.2 WHAT AND HOW MANY CATEGORIES TO USE

Whether one can establish accurate CO_2e coefficients for every narrowly defined dietary element or not, it would be unrealistic to expect to get many people to supply detailed and precise information on their diets. Even if an individual could theoretically provide a detailed qualitative and quantitative breakdown of his/her diet, there is a trade-off between the comprehensiveness of information requested and the onerousness of providing it and therefore the likelihood of compliance. The amount of work involved in analysis is also a consideration. These considerations are illustrated on the y-axis on Figure 2, below.

It seems sensible at least to group elements which have a common-sense category identity and for which the potential CO_2e coefficients have significantly overlapping ranges (or which have ranges that are narrow and close to each other compared to the range of all coefficients for the elements of a diet).

2.3 OPTIONS FOR DATA COLLECTION

With regard to the collection of data, considerations include:

1. how often data are to be collected from participants,
2. over what periods the data will be collected (e.g. over a day or a week), and
3. how elements/components of participants' diets are to be quantified (weight, volume or portions, objective measurement or participants' estimates).

2.3.1 Frequency of data collection

If one is only interested in measuring the impact of a particular intervention on dietary choice (the difference it makes), and if one could assume that participants (or experimental subjects, in this case) were honest and had perfect recall and ability to estimate what they consume, then it would be sufficient to ask them merely how their diets had changed since before the intervention (in other words, a single collection of data). This is represented by the extreme right position on the x-axis in Figure 2, below, indicated by the pink box. While this approach involves the least work for researchers, and is arguably the least onerous for participants, and therefore would make it relatively easy to have a large sample size (and therefore might lead to high statistical significance/representativeness), the data may be unreliable as the assumptions are unlikely to be correct. It also does not allow for the social norms-style feeding back of the results of the initial survey as part of an intervention.

Collecting data both before and after an intervention allows one to calculate the difference between the two. This is illustrated in Figure 2, below, by the range on the x-axis indicated by the orange box. This dual collection is more onerous for both researchers and participants (and therefore may result in a small sample size and statistical significance/representativeness) but is likely to be more accurate, assuming the second collection of data uses the same methodology as the first and does not merely ask for participants to report themselves

how their diets have changed. Furthermore, it allows for the use of the data collected in the first survey as part of a social norms-style intervention.

Of course one may collect data more than twice, to facilitate ongoing social norms-style feeding back of results, to assess the effects of other interventions, or to assess the persistence of apparent change in the absence of further intervention. The considerations discussed above relating to the burden on participants, and therefore the likely number of them, would apply here too.

A further consideration is what the intervals between periods of data collection should be. If this is too long, but not a year or a multiple thereof, then seasonal effects may influence findings. If it is too short, then one may annoy participants (and so reduce their number), and also fail to allow enough time for interventions to be effective. The two main surveys we carried out were separated by approximately a year.

2.3.2 Length of periods over which data collected

Dietary information could be collected from single meals, over a full day, over a week, etc. Most people's diets probably vary significantly from day to day, and significantly less from week to week or month to month (with the caveat that seasonal factors may affect diet). Another way to put it is to say that what people eat on any one day is far less likely to represent their long-term dietary habits than their diet over a week. This means that in order to assess the effectiveness of an intervention on the diet of a population one would need many more participants if one were only measuring what people eat on a particular day, in order to eliminate the effects of day-to-day variation. Of course, long periods of data collection are more onerous for researchers and participants, so there is a happy medium to be found. We opted for surveying behaviour over the course of a week.

In order not to overcomplicate Figure 2, below, these considerations have been omitted.

2.3.3 Quantification of dietary elements/components: weight, volume or portions, objective measurement or participants' estimates?

There are two main things to consider here: what type of unit to use for quantifying dietary elements/components and whether to quantify these objectively or to rely on participants' estimates. In order not to overcomplicate Figure 2 ('Advantages and disadvantages of various approaches to dietary surveys'), below, options with regard to both of these have been rationalised (reduced and simplified) and displayed along the x-axis, but more detailed consideration is given in Figure 1.

Figure 1: Advantages and Disadvantages of Quantifying Dietary Items by Weight, Volume or Portions, and of Using Objective Measurement or Participants' Estimates.

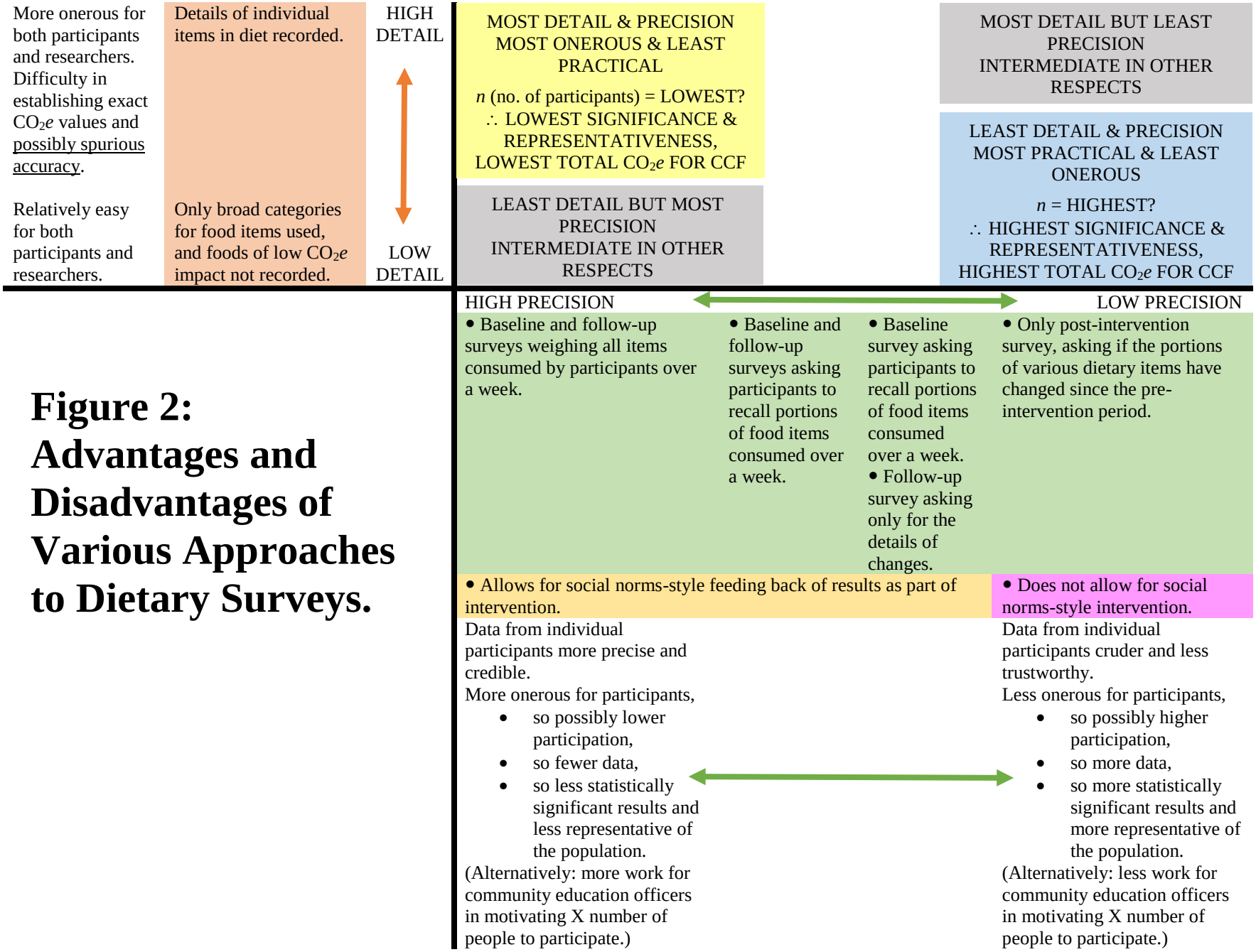
	Weight	Volume	Portions
Direct measurement	Most accurate means of assessing CO_2e values of diets as coefficients are calculated on a per kg basis.	Moderately accurate as long as densities of food items are known.	There is a degree in subjectivity in deciding how much of a food item constitutes a portion.
	Most onerous for participants.	Significantly less onerous than weighing for participants – they could use a small measuring vessel and determine how many of these are filled with each dietary item. Onerous for researchers as need to establish densities and to convert volume to mass.	Possibly less onerous than measuring weight or volume as people are more used to thinking of food in terms of portions.
Participants' estimates at the time of each meal	Unlikely to be accurate as people generally don't think of what they eat in terms of weight, but likely to be more accurate than retrospective estimates.	Possibly slightly less inaccurate than estimates of weight, as long as densities of food items are known. Likely to be more accurate than retrospective estimates.	Possibly not different from *measuring* the number of portions consumed.
	Moderately onerous.	Estimation possibly more difficult and onerous than *measuring* volumes, as people do not tend to think of their food in terms of volumes.	Not very onerous, as people tend to think of food in terms of portions.
Participants' retrospective estimates at the end of a week	Unlikely to be accurate.	Unlikely to be accurate.	Not very accurate, but possibly more accurate than estimating by weight or volume.
	Estimation possibly more difficult and onerous than *measuring* weights, as people do not tend to think of their food in terms of weight.	Estimation possibly more difficult and onerous than *measuring* volumes, as people do not tend to think of their food in terms of volumes.	Possibly least onerous, as people tend to think of food in terms of portions, and if prompted with regard to the elements/categories of their diet they may have some idea of what they ate in the last week.

Notes:

- The red box represents the ideal, but will not produce useful results if sample sizes are tiny due to the reluctance of people to commit to such an onerous procedure. In statistical terms, there is a likelihood that while individual results may be accurate, *n* will be low and therefore, when statistically assessing the effects of any interventions, *p* may well be greater than 0.05 (i.e. results will not be significant or representative), even if interventions are effective.

- The black box represents the ultimate 'quick and dirty' approach, which may maximise compliance (participation) but arguably will not produce accurate results as people may neither recall accurately what they consumed, nor be entirely honest. Estimating weights and volumes would not come naturally to most people, so if estimation is to be used this should arguably be in the form of portions. However, there is another level of subjectivity here as what people imagine portions to be may vary. In statistical terms, while *n* may be high and *p* may be far less than 0.05 (i.e. results may be highly significant), results may be challenged as being inaccurate.

Figure 2: Advantages and Disadvantages of Various Approaches to Dietary Surveys.



4 DECISIONS MADE BY LEITH COMMUNITY CROPS IN POTS REGARDING THE ESTIMATION OF THE CLIMATE CHANGE IMPACT OF DIETS, FOOD WASTE AND COMPOSTING

4.1 OUR EXPERIENCE WITH REGARD TO FOOD WASTE AND COMPOSTING

Our community education officers found it difficult to get individuals to report food waste. They have three hypotheses:

1. Leith is a poor area and so people waste very little food.
2. People are ashamed of wasting food, and so don't want to admit to it.
3. People are reluctant to go to the effort of measuring avoidable food waste.

We are inclined to think that a combination of the last two may be the most likely explanation. By contrast, our community education officers' experience with an organisation which provides meals on its premises (Little Leithers), albeit only with regard to composting, suggests that it may be easier to persuade people to measure and tackle waste at the organisational level. Apart from the fact that there is less of a personal embarrassment factor, organisations might feel under more pressure than individuals to do something about the problem, and there could even be a certain prestige associated with doing so. Furthermore, in terms of the ratio of effort to quantities of food waste/compost material recorded and managed, working with organisations is vastly more efficient than working with individuals.

It seems easier to get individuals to record total food waste (as opposed to avoidable food waste), perhaps both because this is easier to do than to separately record avoidable food waste and because there is less shame attached to it. This is, of course, material that can be composted.

4.2 WHAT WE DID, AND OUR EXPERIENCE, WITH REGARD TO DIETARY CHOICES ('RESPONSIBLE SHOPPING')

In the course of projects CCF-3914 and -2708, we developed a 'middle way'. This involved:

1) Deciding not to quantify the consumption of fruit and vegetables. While some items in this category may have high CO_2e values, the vast majority have very low ones compared to animal-source foodstuffs, so most changes in this component of the diet will have a relatively small impact on dietary carbon footprints. Furthermore, we are in any case quantifying the fruit and vegetables produced from our various growing projects, which displace shop-bought products from people's diets, allowing us to estimate the CO_2e impact of this displacement.

2) Creating broad categories for other dietary items and using approximate coefficients for these.

3) Asking individuals/households for baseline consumption data for the above categories in the form of estimated portions consumed per week (making assumptions about the size of portions). This made baseline surveys relatively short and undemanding for respondents to complete.

4) Unfortunately, although we stressed that individuals would be expected to complete follow-up surveys, fewer than half responded when prompted by email to complete an online survey. Our community education officers decided to make this as easy as possible for participants by phoning them and simply asking them whether/how, and by how much, their diets had changed. This was more successful, but clearly labour-intensive. For the main follow-up survey described in the Final Report for CCF Project 2708 we did, however, simply repeat the initial online survey, with the omission of a single question on the frequency of fruit and vegetable consumption and ready/microwaveable meals. Eleven of the 23 original respondents attempted this follow-up survey, but not all of them answered all questions.

4.3 SUGGESTIONS FOR FUTURE WORK (TAKING INTO ACCOUNT INPUT FROM KEEP SCOTLAND BEAUTIFUL)

4.3.1 Summary of KSB Guidance

We understand that KSB does not favour simply asking people retrospectively (after an intervention) what changes they made in their diets (or regarding food waste/composting), but that KSB strongly recommends measuring both pre- and post-intervention diet/food waste/composting figures. KSB is happy for undifferentiated (total) food waste to be quantified by weight or volume (and the weight estimated from volume). KSB has not dictated how the elements/categories in diets should be defined.

4.3.2 Approach to Avoidable Food Waste

While we found avoidable food waste difficult to tackle, this is such an important issue that further work is surely justified. Because our experience suggests that gaining 'hard' data from individuals (in a form acceptable to KSB) is so challenging, we suggest that it might be more efficient to concentrate efforts at an organisational level, and it should also then be possible to use pre- and post-intervention measures of weight and/or volume (converted to weight) and not estimates. A preliminary survey of potential local organisations suggests that this would be feasible, at least in Leith.

Although 'avoidable food waste' efforts could be focused on organisations, it might be practical to engage with individuals contacted through these organisations, as they will potentially be amenable given the organisations' example. However, in order to maintain the cooperation of individuals one might have to compromise on the quality of data, opting for more subjective data (estimates).

4.3.3 Approach to Dietary Choices (Responsible Shopping)

As with avoidable food waste, we found it difficult to get hard data for dietary change, but in this case, as implied above, it was simply because people found responding to surveys onerous (even if we were merely asking for estimates in terms of portions of various dietary elements/categories). We feel, however, that this too is such an important issue that one should persevere.

As with avoidable food waste, we suggest it might be more efficient to concentrate on organisations with regard to obtaining hard data relating to dietary choices, using approaches tailored to individual organisations. For example, with one organisation it might be appropriate to review menus and make recommendations, and check pre- and post-intervention menus and pre- and post-intervention food purchases. With another it might be better to quantify food as it is served (pre- and post-intervention). The length of monitoring periods would depend on the variability of menus and number of diners from day to day. With a third organisation it might be more practical to simply review receipts from food purchases.

As with 'avoidable food waste', one could also endeavour to engage with individuals met through these organisations. While one could encourage them to gather 'hard data', if it became clear that they will not comply one could accept more subjective data rather than lose these individuals altogether.

4.3.4 *Approach to Composting Data*

Material composted can be measured either by weight or by volume (and converted to approximate weight). With clear directions and appropriate equipment our experience suggests that individuals are generally willing to do this.

5 NOTE: THE USE OF SOCIAL NORMS METHODOLOGY

This topic is dealt with at more length, and referenced, in the main body of the final report for CCF project 2718, but a short summary is included here to set the rest of this document in context.

Social norms methodology is based on the fact that people are influenced by what they perceive their peers' behaviour to be. Such perceptions are often inaccurate, and lean towards perceiving undesirable behaviour to be more common than it is. When the true nature of peers' behaviour is credibly surveyed and conveyed to people, their behaviour is shifted in a positive direction. Further surveys can be used on peer groups, and the results fed back serially, entraining a virtuous circle.

While others have suggested its use in motivating food-related behaviour change for environmental reasons, as far as we are aware we were pioneering this. We were keen to develop and document our use of the social norms approach to food-related behaviour change, with a view to encouraging and helping others to follow suit. Our Leith Lunches provided a milieu conducive to this approach, and you may view online an example of how we used the social norms approach in reporting the results of our first major survey, emphasising the fact that 'most' or 'many' people act in such-and-such an environmentally responsible way (https://www.youtube.com/watch?v=LJEvB4ipvQE and http://tiny.cc/surv2015).

6 ADDITIONAL NOTE: DELIBERATE OMISSIONS

To keep this document to a reasonable length, the dietary elements and categories and the associated GHG coefficients used in our work to date have not been discussed or listed. This is done in the main body of the final report for CCF-2708.

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