

**A COMPARATIVE ANALYSIS OF COMMUNITY  
SUPPORTED AGRICULTURE AND UK SUPERMARKETS AS  
FOOD SYSTEMS WITH SPECIFIC REFERENCE TO FOOD  
WASTE**

**By**

**Nigel Baker**

**August 2014**



**A report submitted to the Department of Geography,  
Environment and Disaster Management, Faculty of  
Business, Environment and Society, Coventry University  
in partial fulfillment of the requirements for an MSc in  
Food Security Management**

## RESEARCH DECLARATION

I declare that this report is entirely my own work and that any use of the work of others has been appropriately acknowledged as in-text citations and compiled in the reference list. I also confirm that the project has been conducted in compliance with the University's research ethics policy and evidence of this has been included in my thesis.

I agree that the project report can be made available as a Reference Document for other students in the Department of Geography, Environment and Disaster Management Information Room/Map Library.

Signed: Nigel Baker

Date: 18/8/14

## Abstract

Food security is rightly high on the global agenda. Two factors make it particularly pressing: the continuing rise in the global population and the failure to adequately feed the current one. An area that has been the focus of much recent attention has been food waste; with the FAO currently estimating that as much as a third of all food is lost or wasted (FLW). The study compared levels of fresh vegetable waste in the UK supermarket controlled food system and that of an agroecological micro-food system, exemplified by a Community Supported Agriculture (CSA) scheme. The study found that when all stages of the food system were measured for waste, the CSA system dramatically out-performed the supermarket system, wasting only 6.71% compared to 55.2%. Even giving considerable allowance for estimation (as in all FLW studies) the results are very significant. Two further aspects were investigated during the study. 1) From the study data, fresh vegetable consumption amongst CSA scheme members was estimated to be 3 times the national average at 230g per day compared to 74g per day. 2) The study report uses the term '*net yield efficiency*' [NYE] as a measure of the entire productivity of a food system i.e. accounting for crop yield, supply chain losses and consumer losses. The agroecological system was found to be 40% more efficient than the conventional farming/supermarket system. No statistical accuracy can be attributed to the study, as no direct data comparisons were possible. In conclusion, it is suggested that this report prompts detailed investigation of food waste, diet and health in CSA members and that agroecological organisations re-evaluate the importance of FLW as well as fully assessing the NYE of agroecological food systems.

## Contents

<b>1.0</b>	<b>FOOD SECURITY, FOOD SYSTEMS AND WASTE</b>	
8		
<b>1.1</b>	<b>INTRODUCTION</b>	<b>8</b>
<b>1.1.1</b>	<b>Food Security</b>	<b>8</b>
<b>1.1.2</b>	<b>Food Systems</b>	<b>9</b>
<b>1.1.3</b>	<b>Food Waste</b>	<b>10</b>
<b>1.1.4</b>	<b>Agroecological Production Systems</b>	<b>10</b>
<b>1.1.5</b>	<b>Community Supported Agriculture (CSA) – Overview</b>	<b>11</b>
<b>1.2</b>	<b>FOOD SYSTEMS, DIET AND PUBLIC HEALTH</b>	
12		
<b>1.2.1</b>	<b>Farming and Diet</b>	<b>12</b>
<b>1.3</b>	<b>MEASURING FOOD WASTE</b>	
13		
<b>1.3.1</b>	<b>Definitions</b>	<b>14</b>
<b>1.3.2</b>	<b>A Wider View on Food Waste, Wasted Production and Wasted Consumption</b>	
14		
<b>1.3.3</b>	<b>Methods of Measuring Food Waste</b>	<b>17</b>
1.3.3.1	Nutritional Deterioration	17
1.3.3.2	Measuring Food Waste in a Developed World Context	18
1.3.3.3	UK Household Food Waste Data	19
1.3.3.4	UK Household Vegetable and Salad Waste (VSW)	20
<b>1.4</b>	<b>THE UK SUPERMARKET FOOD SYSTEM</b>	
21		
<b>1.4.1</b>	<b>How Supermarkets Contribute to and/or Create Wasteful Consumer Habits</b>	<b>22</b>
<b>1.4.2</b>	<b>How Supermarkets Contribute to and/or Create Waste in the Supply Chain</b>	<b>27</b>
<b>1.5</b>	<b>COMMUNITY SUPPORTED AGRICULTURE</b>	<b>29</b>
<b>1.5.1</b>	<b>Canalside Community Food/CSA</b>	
32		
<b>2.0</b>	<b>METHODOLOGY</b>	
33		
<b>2.1</b>	<b>HOUSEHOLD VEGETABLE AND SALAD WASTE STUDY</b>	<b>33</b>

2.1.1	Calculating edible portion of shares	34
2.1.2	Arriving at a WRAP comparative AFW figure for VSW	35
2.2	WASTE AT CANALSIDE AS A MICRO-FOOD SYSTEM	36
2.3	FRESH VEGETABLE CONSUMPTION ASSESSMENT	36
2.3.1	Family Food Survey Data and '5 a day'	36
<b>3.0</b>	<b>RESULTS AND DISCUSSION</b>	<b>37</b>
3.1	ISSUES OF METHODOLOGY	37
3.1.1	Estimations	37
3.1.2	Comparators	38
3.1.3	Background of Canalside Members	38
3.2	HOUSEHOLD AFW	38
3.3	SUPPLY CHAIN WASTE/ON FARM WASTE	39
3.4	COMPARING FV WASTE IN CANALSIDE MICRO-FOOD SYSTEM AND THE UK SUPERMARKET FOOD SYSTEM	39
3.5	FRESH VEGETABLE CONSUMPTION AND '5 A DAY' PORTIONS	40
3.6	NET YIELD EFFICIENCY (NYE)	42
<b>4.0</b>	<b>CONCLUSIONS AND RECOMMENDATIONS</b>	<b>43</b>
4.1	CONCLUSION	43
4.2	RECOMMENDATIONS	44
<b>5.0</b>	<b>REFERENCES</b>	<b>45</b>
<b>6.0</b>	<b>APPENDICES</b>	<b>51</b>
<b>Ax 1</b>	<b>HOUSEHOLD WASTE STUDY RESULTS</b>	<b>51</b>
Ax 1.1	VEGETABLE SHARE SIZES	51
Ax 1.2	STUDY GROUP 1	51
Ax 1.2.1	Group 1 Estimated Edible Portion	52
Ax 1.2.2	Group 1 Waste	52
Ax 1.3	STUDY GROUP 2	53
Ax 1.3.1	Group 2 Estimated Edible Portion	53

Ax 1.3.2	Group 2 Waste	54
Ax 1.4	WASTE, ALL PARTICIPANTS	55
Ax 1.5	EXIT INTERVIEW DATA	55
Ax 2	TOTAL CONSUMABLE FOOD CHAIN WASTE	
56		
Ax 2.1	ON FARM WASTE	56
Ax 2.2	TOTAL HARVESTABLE CROP	56
Ax 2.3	CANALSIDE MICRO-FOOD SYSTEM TOTAL WASTE	
57		
Ax 3	FRESH VEGETABLE (FV) CONSUMPTION	57
Ax 3.1	AVERAGE WEEKLY HOUSEHOLD FV AND LEAFY GREEN VEGETABLES (LGV) CONSUMPTION CALCULATION PROCESS	57
Ax 3.1.1	Edible Large Shares (ELS)	
57		
Ax 3.1.2	Edible Medium Shares (EMS)	57
Ax 3.1.3	Edible Small Shares (ESS)	
57		
Ax 3.1.4	Average FV Consumption For All Canalside Households	
58		
Ax 3.1.5	Household to Person Conversion	
58		
Ax 3.1.6	Average Daily Amount of FV and LGV and '5 a day' Portions	59
Ax 3.1.7	Adjusting FV Consumption for Seasonal Variations in Size of Share	59
Ax 4	TABLE FOR CONVERTING 'AS PURCHASED' PORTIONS OF VEGETABLES TO 'EDIBLE' PORTIONS	
60		
Ax 5	INFORMED CONSENT FORM	
61		
Ax 6	FOOD WASTE STUDY BRIEF	
62		
Ax 7	ETHICS APPROVAL	
64		
Ax8	RISK ASSESSMENT	65

## **TABLES AND FIGURES**

### **TABLES**

1	Global per capita food waste pre and post-consumer	10
2	Hypothetical scenario comparing net yield efficiencies	12

<b>3</b>	<b>Terminology and definitions</b>	<b>14</b>
<b>4</b>	<b>Definitions of household food waste</b>	<b>18</b>
<b>5</b>	<b>UK food waste by avoidability</b>	<b>19</b>
<b>6</b>	<b>Examples of losses in the UK fruit and vegetable supply chain</b>	<b>28</b>
<b>7</b>	<b>Examples of crop yields Canalside CSA 2013</b>	<b>30</b>
<b>8</b>	<b>Price comparison Canalside CSA medium share v supermarket average</b>	<b>31</b>
<b>9</b>	<b>Explanation of VSW included and not included</b>	<b>34</b>
<b>10</b>	<b>Proportion of salad in medium share over study period</b>	<b>35</b>
<b>11</b>	<b>CFC comparison of FLW</b>	<b>39</b>
<b>12</b>	<b>Estimations of overall levels of F &amp; V consumption from three different studies</b>	<b>42</b>
<b>13</b>	<b>Hypothetical scenario comparing net yield efficiencies – updated</b>	<b>42</b>
<b>14</b>	<b>Canalside households and share size July 2014</b>	<b>51</b>
<b>15</b>	<b>Size and make up of veg shares Group 1 – medium shares</b>	<b>51</b>
<b>16</b>	<b>Size and make up of veg shares Group 1 – small size</b>	<b>51</b>
<b>17</b>	<b>Estimated edible portion of weekly veg shares Group 1</b>	<b>52</b>
<b>18</b>	<b>Group 1 participants – medium shares waste record</b>	<b>52</b>
<b>19</b>	<b>Group 1 participants – small shares waste record</b>	<b>52</b>
<b>20</b>	<b>Group 1 – combined total of all waste as % of combined total share</b>	<b>52</b>
<b>21</b>	<b>Group 1 – combined estimated edible waste as % of combined edible food</b>	<b>53</b>
<b>22a</b>	<b>Large veg share Group 2</b>	<b>53</b>
<b>22b</b>	<b>Size and make up of veg shares Group 2 – medium share</b>	<b>53</b>
<b>23</b>	<b>Size and make up of veg shares Group 2 – small share</b>	<b>53</b>
<b>24</b>	<b>Estimated edible portion of weekly veg shares Group 2</b>	<b>53</b>
<b>25</b>	<b>Group 2 – large and medium shares waste record</b>	<b>53</b>
<b>26</b>	<b>Group 2 – small shares waste record</b>	<b>54</b>
<b>27</b>	<b>Group 2 – combined total waste as % of combined total share</b>	<b>54</b>
<b>28</b>	<b>Group 2 – combined estimated edible waste as % of combined</b>	

	<b>edible food</b>	
<b>54</b>		
<b>29</b>	<b>All participants – combined totals waste and AFW as %</b>	
	<b>55</b>	
<b>30</b>	<b>Exit interview responses</b>	
	<b>55</b>	
<b>31</b>	<b>On farm waste</b>	<b>56</b>
<b>32a</b>	<b>Total harvestable crop during four week study period</b>	<b>56</b>
<b>32b</b>	<b>Farm waste as % of total produce</b>	<b>56</b>
<b>33</b>	<b>Canalside food system waste</b>	<b>57</b>
<b>34</b>	<b>Estimated annual average weight of weekly medium shares</b>	<b>59</b>
<b>FIGURES</b>		
<b>1</b>	<b>Losses in global food supply</b>	<b>15</b>
<b>2</b>	<b>Schematic of wastage of UK harvestable edible produce and imported foodstuffs</b>	<b>16</b>
<b>3</b>	<b>Proportion of each food category wasted by weight</b>	
	<b>19</b>	
<b>4</b>	<b>Proportion of each food category wasted by cost</b>	
	<b>20</b>	
<b>5</b>	<b>Breakdown of avoidability of household food waste by food type</b>	
	<b>20</b>	
<b>6</b>	<b>FV and LGV consumption</b>	
	<b>40</b>	

## **Acknowledgements**

**I would like to thank all the participants in the study and in particular the invaluable support of Will and Ali from Canalside. I would also like to thank James Bennett for his guidance and Helen Salisbury for her practical assistance and especially Dottie the dog for not jumping on the keyboard too much!**

# **A COMPARATIVE ANALYSIS OF COMMUNITY SUPPORTED AGRICULTURE AND UK SUPERMARKETS AS FOOD SYSTEMS WITH SPECIFIC REFERENCE TO FOOD WASTE**

*925 million people experience hunger: they lack access to sufficient of the major macronutrients (carbohydrates, fats and protein). Perhaps another billion are thought to suffer from 'hidden hunger', in which important micronutrients (such as vitamins and minerals) are missing from their diet, with consequent risks of physical and mental impairment. In contrast, a billion people are substantially over-consuming, spawning a new public health epidemic involving chronic conditions such as type 2 diabetes and cardiovascular disease. Much of the responsibility for these three billion people having suboptimal diets lies within the global food system. [Foresight 2011, p12]*

## **1.0 FOOD SECURITY, FOOD SYSTEMS AND WASTE**

### **1.1 INTRODUCTION**

Global food security is under constant discussion, not just amongst food and agriculture experts but also across the world's governments, politicians and media. [FIAN, 2014; Guardian, 2014] The debate is fuelled by misconceptions, misinformation and the self-interest of different lobbies. This paper aims to make a contribution to that debate in a developed world context, by comparing food waste within a Community Supported Agriculture [CSA] scheme and the supermarket food system. It will also seek to see how CSA could assist in key public health goals linked to the consumption of fruit and vegetables. CSA is a form of food production that the author believes could play a significant role in transforming our relationship with food and

through that transformation reduce waste and improve nutritional outcomes.

### **1.1.1 Food Security**

The United Nations [UN] definition of food security is: “*when all people at all times have access to sufficient, safe, nutritious food to maintain a healthy and active life*” [WHO 1996]. Unfortunately as the Foresight Report quote illustrates we are very far from meeting this definition. When one considers that this situation exists despite the fact that we are already capable of producing sufficient calories to feed 12 – 14 billion [UNCTAD 2013] questions must be asked about the efficacy of the global food supply chain.

Clearly, food security is at least as much a function of markets and logistics as it is about supply – in other words the food system. A very significant element of the failure of the global food system is the level of wastage all along the food chain. The Food and Agriculture Organisation (FAO) suggest that one-third of food produced for human consumption is lost or wasted annually. [FAO, 2011]

Such levels of food losses and waste [FLW] mean far more than the lost food itself and the people that it could feed, it also represents many other wasted resources in terms of land, water and energy as well as a major contribution to greenhouse gas emissions [GHG]. Estimating FLW of around 25%, (lower than the FAO estimate) it has been calculated that this represents: 24% of total freshwater resources used in food crop production, 23% of total global cropland area and 23% of total global fertilizer use. [Kummu, 2013] In addition to the GHG linked to powering irrigation, farm machinery and fertilizer production, as the food that is ultimately wasted moves further down the supply chain, it continues to waste energy in transportation, processing, and refrigeration. With most waste going to landfill or entering the sewage system [WRAP, 2009] further energy is wasted and, especially regarding landfill, further GHG emissions are produced.

### **1.1.2 Food Systems**

*The very extent of food losses and waste invites us to consider them not as an accident but as an integral part of food systems. Food losses and waste are consequences of the way food systems function, technically, culturally and economically. (HLPE, 2014 P11)*

The term ‘system’ suggests complexity and that is certainly true of the corporation and supermarket controlled structures that dominate the developed world and increasingly much of the developing world. The HLPE define it thus: *A food system gathers all the elements (environmental, people, inputs, processes, infrastructures, institutions etc.) and activities that relate to the production, processing, distribution, preparation and consumption of food, and the outputs of these activities, including socio-economic and*

*environmental outcomes.* [HLPE, 2014, p12]

It is important to grasp that there is both a *'the'* and an *'a'* food system. *The* food system refers to that overarching global industry with highly concentrated sources of power and control that influence all aspects of the system. *A* food system – perhaps better termed a micro-food system is one that sits wholly or partly outside *the food system* – for example traditional and small scale, low input systems characteristic still of much of the developing world (but increasingly vulnerable to *the food system*). In the developed world, alternative food systems are springing up almost organically reflecting in part dissatisfaction with *the food system* and its dominant forces. Examples of this include farmer's markets, organic box schemes, community growing schemes and CSAs.

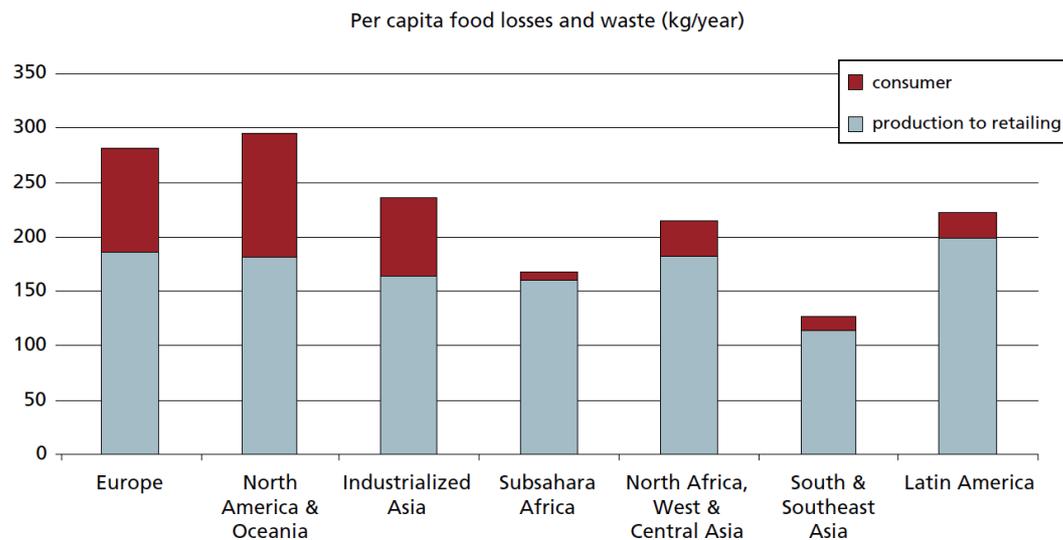
This paper will argue that, in the UK context at least, the supermarkets are the dominant players who, whilst being more than efficient at generating vast profit margins and relatively cheap food, are rather less efficient at minimising food waste or enabling efficient and sustainable farming practices.

### **1.1.3 Food Waste**

There is significant waste all along the food chain in all parts of the world. Table 1 illustrates the estimated scale of FLW by global region and shows the marked difference in levels of consumer waste, which at its most extreme (North America at 115kg/year v Sub-Saharan Africa at 6kg/year) is a 20-fold difference. [FAO, 2011 p6] The very similar rates of pre-consumer waste/losses that table 1 illustrates masks a very different range of causes. In Europe and North America there is very little genuinely unavoidable waste – it is overwhelmingly linked to retailer and processor imposed standards and practices. In the developing world harvesting storage, infrastructural and technical failings are the main causes of food losses.

In the UK much is lost through the supply chain and through supermarket practices and this is particularly true with vegetables. Up to 30% of our vegetables are not harvested because they fail to meet supermarket standards. [IMECHE, 2013, p3] UK Manufacturing, retailing and wholesaling food waste is estimated to total around 4.3 million tons per year [WRAP, 2011, p4]

Table 1: Global per capita food waste pre and post-consumer (FAO, 2011 p5)



The Fabian Society estimated the monetary value of UK household food waste alone to be £12 billion [Doron 2012] representing about 20% of all food bought. [Bond, 2013] Combining all the incidences of food waste from field to plate, it is not unreasonable to estimate that up to 50% of vegetables grown for the UK market are never eaten by humans. Factoring in these levels of wastage, it may well be the case that alternative food systems could compete very favourably with *the* dominant food system in terms of how much of what was originally grown actually gets eaten.

### 1.1.4 Agroecological Production Systems

The manner in which we produce food is critically important, given global population increase, environmental constraints – notably climate change, widespread soil degradation and the pressure from agri-business for genetically modified [GM] crops. UN bodies such as the United Nations Conference on Trade and Development [UNCTAD] and the International Assessment of Agricultural Knowledge, Science and Technology for Development [IAASTD] have given a clear steer that an agroecological approach to agriculture offers the most sustainable path to global food security in the 21<sup>st</sup> Century. [UNCTAD 2013, IAASTD, 2009]

Agroecology is a form of farming that seeks to minimise external inputs and instead to work with and reflect natural eco-systems not compete with and degrade them. One definition describes agroecology as *'the science of applying ecological concepts and principles to the design and management of sustainable food systems'* [Gliessman, 2007 p18]

In a UK context agroecology best approximates to organic agriculture. The following definition clearly illustrates the strong parallels between the two approaches: *"Organic Agriculture is a production system that sustains the health of soils, ecosystems and people. It relies on ecological processes, biodiversity and cycles adapted to local conditions, rather than the use of*

*inputs with adverse effects. Organic Agriculture combines tradition, innovation and science to benefit the shared environment and promote fair relationships and a good quality of life for all involved.”[IFOAM 2014]*

Conventional farmers will argue, with good evidence that in terms of yield organic crops generally perform less well than conventional crops. An authoritative extensive meta-analysis of recent research by de Ponti et al suggests that organic agriculture is typically 80% as productive in yield terms as conventional farming. Coincidentally this was also the specific average gap for organic vegetables. [de Ponti, 2012] However, to look at only one variable is extremely misleading; any serious examination of global food security cannot be undertaken without assessing all the links in the chain, all the interactions and knock-on effects. This paper will compare and contrast the *net yield efficiency* of the current food system and an agroecological system in a developed world context using CSA as an exemplar. The term net yield efficiency being a measure of the total amount of planted produce actually consumed – not simply what is grown [see table 2].

### **1.1.5 Community Supported Agriculture (CSA)**

CSA is a radically simplified, alternative food system. There are a variety of forms of CSA, but the common thread is that the consumers of the produce are also members with a commitment to and an embedded relationship with, the farm - often helping out, but always a financial commitment beyond the transactionary. Almost all CSAs in the UK operate agro-ecologically, for example:

- 56% have increased the amount of land managed according to organic principles;
- 55% have planted more hedges and trees;
- 61% have introduced new wildlife areas.
- Cultivation of an unusually wide range of crops and raising rare breeds of livestock: 77% [Soil Association 2011, p27]

CSAs also have a number of other characteristics that suggest they can play an important role in a re-framed food system. The Soil Association report, which is the only detailed UK study on the impact of CSAs, showed significant positive outcomes for members, including:

- 70% an improved quality of life
- 46% improved health
- 32% new skills
- 49% named other personal benefits
- 45% a positive impact on the local community

[Soil Association, 2011, p5-6]

There hasn't so far been a study looking at the aspect of food waste or the relationship with dietary outcomes. However, an interesting additional finding of the Soil Association report, in terms of the food system comparison, is that

after joining a CSA there had been a 30% reduction in those who regularly shopped at supermarkets and for most, cooking and eating habits had changed too. [Soil Association, 2011 p5]

In a CSA there are no middlemen and therefore no supply chain losses; the only waste is on the farm and by consumers. The author theorises that CSA consumers are likely to waste significantly less than average, given the much stronger relationship they have with the source of their food.

Table 2 gives a set of hypothetical losses factoring lower organic yield for the CSA compared to conventional farming. The term 'Net Yield Efficiency' is used.

Table 2 hypothetical scenario comparing net yield efficiencies

Farm type	Field yield (t)	Field losses (t)		Supermarket supply chain losses (t)		Consumer waste (t)	Net yield
		%	and crop left				
Organic CSA	800 (a)	5%	760	0%	760	10%	684
Convention grower – good year with supermarket demands	1000	5%	950	15% (b)	807.5	30%	565.25
Conventional grower – bad year with supermarket demands	1000	5%	950	30% (c)	665.0	30%	465.5

(a) de Ponti [2012] (b and c) based on IMECHE, [2013, p3]

## 1.2 FOOD SYSTEMS, DIET AND PUBLIC HEALTH

### 1.2.1 Farming and Diet

Diet and health outcomes have never been an element in UK farming policy. This situation reflects a global policy failure which has contributed to the dysfunctional food and farming system described in the introduction. Farming in industrialised countries, has long been heavily dependent on subsidy. With the onset of industrialised farming and monocultural production systems, an uncapped subsidy system has disproportionately rewarded large-scale farming and food processing corporations. The net impact of that is that agricultural production is skewed towards cheap, nutritionally poor ingredients for processed foods and animal feed – not healthy food for humans. Supporting alternative farming systems, such as CSAs, could dramatically change the nation's diet and as a result help to achieve public health goals.

### 1.2.2 Micronutrient Deficiency and Fruit and Vegetable (F&V) Consumption

Low consumption of fruit and vegetables is linked to incidences of micronutrient deficiencies such as iron, zinc, magnesium, folate, and vitamins B2, C, D and E.

Consumption of fruit and vegetables in the UK is below recommended levels, and for certain groups, significantly below.

The UK government, through the National Health Service (NHS) promoted F&V consumption through its '5-a-day' campaign. [NHS, 2010] The '5' represents five 80g portion of F&V. Research suggests that the average portions range from 3.4 to 4.1 for adults, significantly less for teenagers. [Family Food Survey (FFS), 2012, National Diet and Nutrition Survey (NDNS), 2013] Given the strong likelihood of over-reporting and the inclusion of such items as fruit juices from concentrates, baked beans and other processed foods; the actual levels are certainly much less.

Household purchases of fresh and processed vegetables (excluding potatoes) have generally been declining since 2005, with a 6.1 per cent fall from 1,156g to 1,086g average per person weekly consumption. [FFS, 2012] This has mainly been due to a decrease in purchases of fresh vegetables, which account for roughly 70 per cent of all vegetable purchases i.e. just 760g per person [FFS 2012]. Assuming an average level of waste of 30% [Brook, 2007], this leaves the average weekly consumption of fresh vegetables at 532g or less than a single '5 a day' 80g portion per day.

This study will provide evidence of the level of fresh vegetable consumption amongst CSA members and whether there is potentially a link between CSA membership and a healthier diet.

### **1.3 MEASURING FOOD WASTE**

To term the measurement of food waste a science may be a little generous, and even if it can be so termed, it is very much in its infancy. The term 'post-harvest losses' when searched in Agricola, the world's largest agricultural electronic data base, produced just 20 articles for the decade beginning 1990 – compared to tens of thousands on increasing crop yield. [Smil 2010] There are issues of what to include, methods of measurement, liability to error and inter-relationships of causes to consider. The HLPE report concluded that 'it was 'difficult and sometimes impossible to compare studies, systems and countries.' [HLPE 2014, p 11] Nevertheless there is a widespread acceptance that there is very substantial food waste, the tackling of which can contribute significantly to food security at all levels.

#### **1.3.1 Definitions**

HLPE uses the following definition of food losses and waste [FLW]: 'A decrease at all stages of the food chain from harvest to consumption, in mass, of food that was originally intended for human consumption, regardless of the cause' [HLPE 2014, p11] It is important to be clear that considerations of FLW excludes whole or partial crop failure, whatever the reason. Though these can certainly be regarded as 'losses' in terms of lost production potential and clearly very important, they fall outside the definition of FLW,

which is concerned with harvestable crops and their route through the supply chain. A consensus of opinion further delimitates FLW into 'losses' and 'waste' as described in table 3.

Table 3: Terminology and definitions (from Kummu, 2012; FAO, 2011)

FLW term	Alternative term or description	Food Loss [FL] or Food Waste [FW]	Examples
Production	On-farm / harvest or immediately post-harvest / agricultural	FL	Spillage, crop sorting
Post- harvest handling and storage		FL	Transit losses, in storage, poor handling
Processing		FL	Losses in processing / grading out for quality
Distribution	Retail	FW	Final transit/ in store
Consumption	Household / Consumer	FW	Surplus food/ past use by date/ plate waste

The linear model described in table 3 simplifies to some extent the methodology of calculating FLW but does little to explain causes and at face value can be very misleading in that regard. *'It is important not to confuse "where" a specific loss or waste is occurring with its cause.'* [HLPE, 2014 p12] This paper will argue that the causes of FLW is inextricably linked to the industrialised food system and within the UK specifically to the monopolistic practices of the major retailers.

### **1.3.2 A Wider View on Food Waste, Wasted Production and Wasted Consumption**

There are those who would propose a wider definition, for example by including the calorific differential between crops grown to feed livestock and the meat and dairy indirectly produced. Figure 1 illustrates the net global loss incurred if this is taken into account – an estimated 1200kcal/per person/ per day.

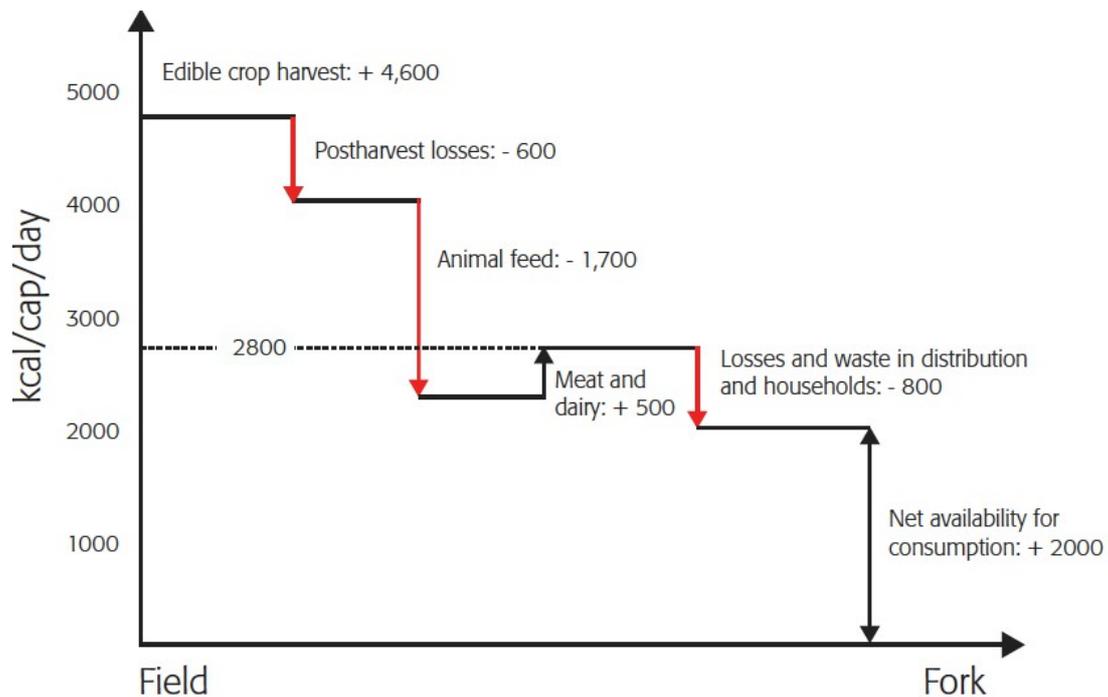


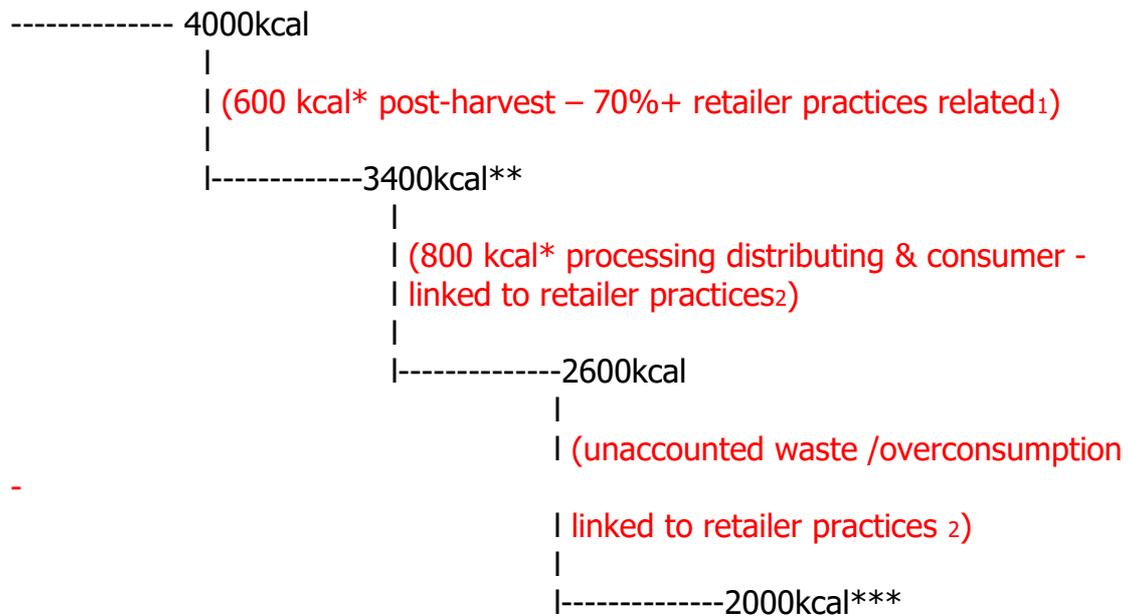
Figure 1: Losses in Global food supply [Lundqvist, 2008 taken from Smil, 2000]

A more radical approach still might be to consider that portion of global food production that makes it all the way through the food chain but is eaten surplus to individual calorific needs i.e. that portion of over-consumption that leads to obesity. One could go further and propose regarding as food waste much of our increasingly highly processed foods, particularly those high in fat and/or sugar [HFS], that are to all intents and purposes nutritionally valueless. These are the products most associated with the global obesity crisis. How much agricultural production is turned into HFS products and how it would reconfigure Lundqvist’s diagram is an interesting question.

Any food system needs to aim to produce more than the precise nutritional needs of its population; that is simply good planning – it buffers against natural and other external impacts. As in all systems, but perhaps more so with food – given the perishability of the product – there will be losses and wastage that can never entirely be eliminated. Simply to ensure food security, a calorific supply that is approximately 130% of a population’s requirements is generally considered necessary by agronomists. [Smil 2010, Stuart, 2009] Even allowing for a 30% buffer, the differential between available food and nutritional requirement in most of the developed world is huge.

The FAO recommended estimates the minimum energy requirements for adults in the developed world to be 1900 – 2000kcal per person per day. [Stuart, 2009 p174] In the UK dietary guidance, in broad terms recommends 2000 calories for women and 2500 for men. [NHS, 2014] However, allowing for factors such as children under 11, the high percentage of elderly and our increasingly sedentary lifestyle the overall average is very likely to reflect the FAO figure.

The data on food available for consumption in the UK shows that there is a supply of 3414Kcal per person/per day. [FAO, 2014] This figure does not include food waste along the food supply chain, which can be estimated at 600kcal (fig.1) – suggesting that the UK produces or imports over 4000kcal per person/per day or twice nutritional requirement. Figure 2 shows the data as interpreted; it illustrates a further 'gap' between accounted for waste and nutritional need of some 600kcal.



\*from figure 1; \*\* from FAO, 2014, \*\*\*from Stuart, 2009 (1 see section 1.4.2; 2 see section

#### 1.4.1)

Figure 2: Schematic of wastage (kcal) of UK harvestable edible produce and imported foodstuffs (figures approximated)

A significant element of the gap will be through over-consumption, though there is currently no clarity on actual levels of calorie intake. However, given that 66% of men and 57% of women in England are obese or overweight [HSCIC, 2014, p11] this must make up a significant part of the gap. One explanation for the lack of knowledge about actual calorie intake may lie in the repeated findings of dietary studies that participants consistently under-report how much they eat. One study of obese subjects on a self-reported controlled diet concluded: *'The failure of some obese subjects to lose weight while eating a diet they report as low in calories is due to an energy intake substantially higher than reported and an overestimation of physical activity.'* [Littman, 1992 p1] The other explanation is that we are still not getting a full measure of consumer waste: *'90% of us claim that little food ("some", "a small amount", "hardly any" or "none") is wasted in their household. But the figures don't stack up. If that's true, the other 10% of us must be wasting almost all the food we buy...'* [WRAP<sub>1</sub>, 2007 p7]

### 1.3.3 Methods of Measuring Food Waste

*'Fruits can be left in the field because of a retailer's decision to lower its buying price or interrupt a contract. [HLPE 2014, p12]*

Most organisations that have endeavored to measure food waste would begin with all food grown or raised with the intention of being eaten directly by humans. Tracking down such data is complex, at its most basic level it involves knowing what is grown, how much leaves the farm, how much reaches the food processor, how much reaches the market and how much is wasted by consumers.

In measuring food losses along the chain a major complicating factor is to avoid counting in that part which is inedible. Sometimes that is straightforward - cereal stalks left as stubble or entering the livestock food chain can easily be eliminated from the figures. However, perfectly edible crops left in the field because of various economic/logistical/retailing reasons are not so easily accounted for. Furthermore how does one decide when a carrot or swede is too small or damaged to be part of the human food chain and do we accept that the definition should be economically, culturally or socially determined?

Finding out the cause of the food waste/losses is what matters not the location – for example the grading out of vegetables because they do not meet supermarket specifications can happen in the field, elsewhere on the farm or in the packing house - but the cause is the stringent specifications not the weather, pests, disease or farmer inefficiency. [IMECH 2011, WRAP 2009, Stuart 2009]

#### 1.3.3.1 Nutritional Deterioration

An aspect of food waste that is not often taken into consideration relates to deterioration in food quality. One reason for this is certainly the difficulty of quantifying it. Nevertheless, to eat a product that has lost, for example 50% of its nutritional value could, not unreasonably, be argued as 50% food waste. The HLPE report is the first to highlight this important aspect of food waste and it proposes a definition as: *'Food quality loss or waste [FQLW] refers to the decrease of a quality attribute (nutrition, aspect etc.), linked to the degradation of the product, at all stages of the food chain from harvest to consumption'* [HLPE, 2014, p22] At this stage in the debate, it is impossible to make any sort of estimation of the scale of FQLW. However, given the importance of fresh fruit and vegetables (FFV) to human nutrition and their limited availability in the diet of huge swathes of the global population, (in

both developed and developing countries), the management of FFV perishability is not only a matter of preventing absolute waste but also its nutritional deterioration. For virtually all FFV nutritional decline begins from the moment of picking.

Much processing in industrialised food systems degrades the produce far more than might be considered reasonable if one was concerned primarily with medium to long-term food preservation; which is clearly a critical aspect in any food system. The seasonality of nature has long required human ingenuity to manage times of feast and famine from migrating with the herds, to pickling, salting, refrigeration and dehydrating. However, the fact is that food has quite deliberately been nutritionally degraded to suit powerful interests in food systems over time. Whilst practices of adulteration go back millennia, the late 20<sup>th</sup> Century has seen a monumental step backwards in key aspects of food quality. The advent of industrialised food and farming systems is perhaps more than anything else, associated with a global micronutrient decline and an explosion in refined grains, sugar, fat and salt. As a result, the UK not only boasts a high numbers of obese and overweight citizens it also has significant micronutrient deficiency especially in its teenage population, e.g. 39% of young females from low income families have iron levels below the absolute minimum recommended levels [Bates 2010]. It is arguable that much of food processing is not only wasting food directly but also actively creating FQLW.

### 1.3.3.2 Measuring Food Waste in a Developed World Context

This study is concerned with food waste within a developed world context and specifically the UK. The UK has in many ways led the world in assessing and beginning to act on food waste – particularly regarding household waste with the Waste and Resources Action Programme [WRAP] producing increasingly detailed and well-evidenced data throughout the UK food chain.

The difficulties of accurate data collection and, not least analysis, is well illustrated by a comparison between the United States Department of Agriculture’s [USDA] 1997 study on food waste and its own Economic Research Service data sheets published annually since. For example, the study suggested that 1% of red meat was wasted by retailers and 16% by consumers; but the data sheets put the figure at 7% and 30% respectively. [Stuart, 2009 p186] WRAP’s own studies have grown in sophistication, as illustrated by their terminology since 2009 of unavoidable, possibly avoidable and avoidable waste (see table 4). [WRAP, 2009] These terms are also broadly applicable at earlier stages in the food chain.

Table 4: Definitions of household food waste [from WRAP, 2009 p4]

Terms	Definition	examples
Avoidable [AFW]	Food and drink thrown away that was, at some point prior to disposal, edible.	Bread, apples, meat

Possibly Avoidable [PAFW]	Food and drink that some people eat and others do not or that can be eaten when a food is prepared in one way but not in another	Bread crusts, potato skins
Unavoidable [UFW]	Waste arising from food or drink preparation that is not, and has not been, edible under normal circumstances	Meat bones, egg shells, pineapple skin, tea bags

By definition, the term 'possibly avoidable' leaves considerable scope for disagreement, especially with regard to fresh vegetable produce. Many perfectly edible parts are routinely discarded because they are simply considered or perceived to be distasteful, not traditionally eaten, not eaten by some family members, not knowing they can be eaten or not knowing how to cook them etc.

Examples include: brassica leaves and stems, celery leaves, nearly all root vegetable skins if washed, bean pod trimmings and mushroom stalks.

### 1.3.3.3 UK Household Food Waste Data

Virtually all examinations of food waste in the UK have been carried out by WRAP, which has produced numerous detailed reports in recent years. Most of WRAP's work has focused on household waste and is amongst the most authoritative in global terms. Much international data quotes and extrapolated from WRAP studies. [FAO, 2011, IMECHE, 3013, Foresight, 2011]

According to WRAP we waste 6.7 million tons of food every year only a fifth of which is entirely unavoidable – essentially the parts of plants and animals humans consider inedible (table 5).

Table 5: UK Food Waste by avoidability [WRAP 2008, p4]

Category	Tons	% of total
Avoidable	4.1m	61%
Possibly Avoidable	1.3m	19.5%
Unavoidable	1.3m	19.5%

The most prominent items were potatoes and bread – both over 300,000 tons. By proportion of the amount purchased, salad vegetables came out highest at 45%, followed by bakery (31%) and fruit (26%). [WRAP, 2008]

Financially, the value of this waste is estimated to be £12 billion, which works out at £480 per household. [WRAP, 2009 p28]

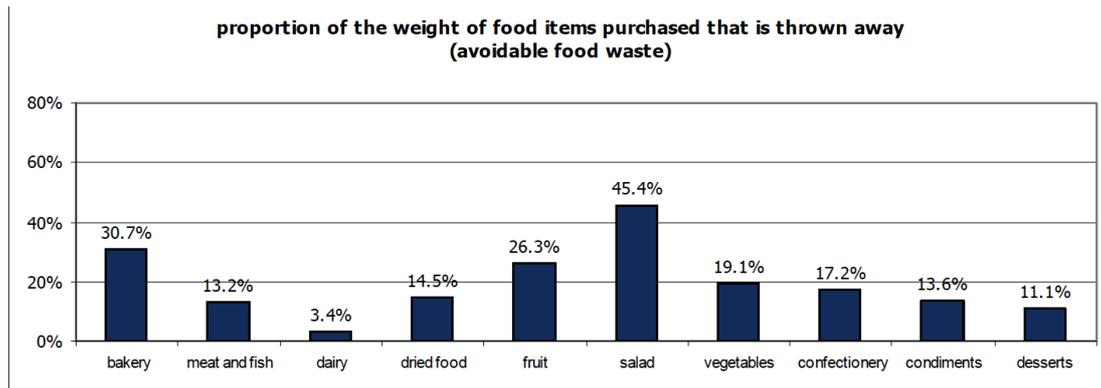


Figure 3: Proportion of each food category wasted by weight [WRAP, 2008 p33]

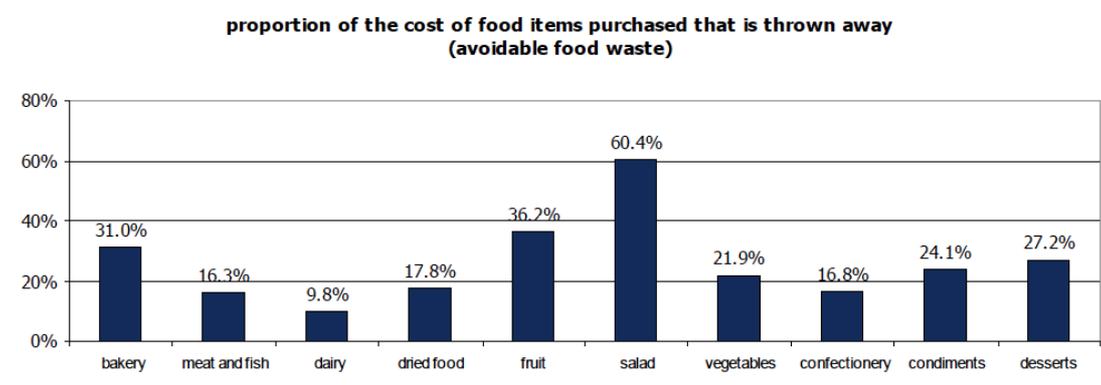


Figure 4: Proportion of each food category wasted by cost [WRAP, 2008 p34]

Strikingly three of the top 4 most wasted foods by weight and three of the top five by cost are foods that are also foods that the majority of Britons need to eat more of: fruit, vegetables and salad (figures 3 and 4). Figure 5 further demonstrates how the same foods dominate household waste overall and in particular how big a part of the 'possibly avoidable' element is with fresh produce.

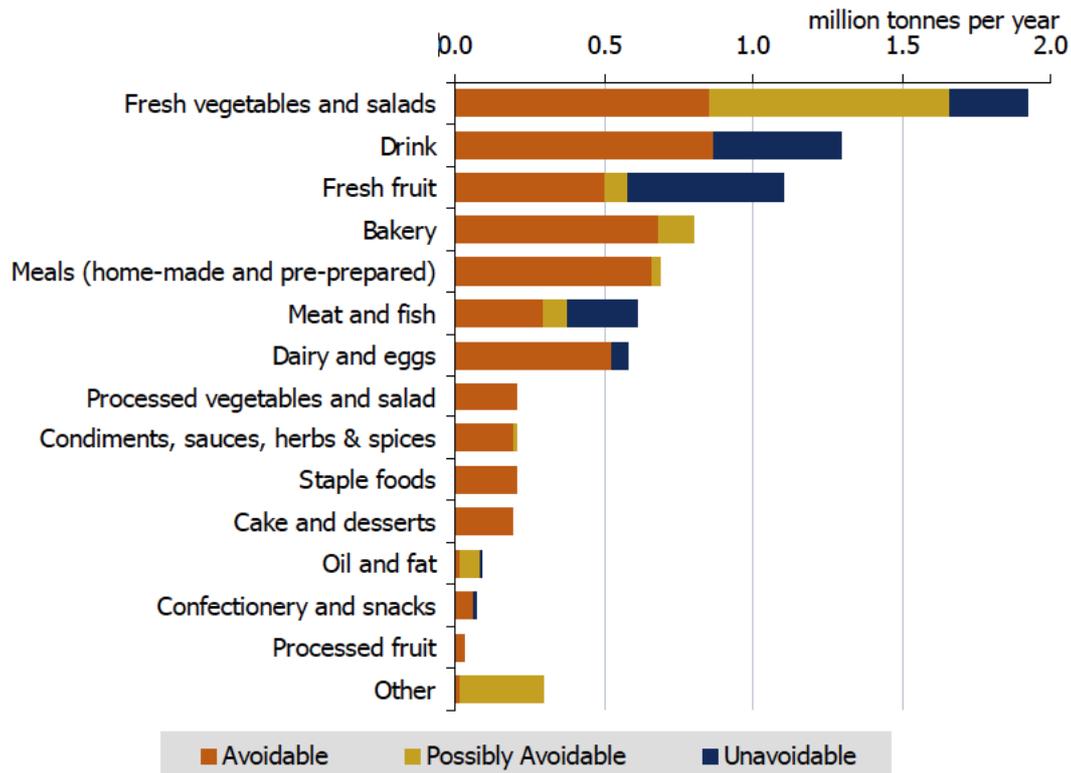


Figure 5: Breakdown of avoidability of household food waste by food type [WRAP, 2009, p31]

### 1.3.3.4 UK Household vegetable and salad waste (VSW)

The WRAP data provides an opportunity to make comparisons between average household vegetable and salad waste [VSW] and that wasted by Canalside CSA study participants. Although the methodology is different there should be sufficient similarities to make comparisons valid, if not in a formal statistical way. The WRAP 2008 report: 'The Food We Waste' is the most comprehensive UK study of household food waste. The study took one week's household waste of 2138 households and had it analysed in detail for food type and 'avoidability'. The study did not relate the food waste to the actual household food purchases but extrapolated from national data such as provided by the Family Food Survey. Whilst the food analysis can be regarded as highly accurate (+/- 2.1%), [WRAP, 2008 p 16], there is obviously considerable room for error when that data is not related to actual purchases. However, like all FLW studies the practical limitations are a severe test.

As figure 5 shows, an important consideration with VSW is the significant proportion of PAFW; the total amount of which is equal to that of AFW. As discussed, this increases the risk of inaccuracy and would suggest that calculating on the basis of AFW alone is likely to underestimate true levels of VSW waste.

## 1.4 THE UK SUPERMARKET FOOD SYSTEM

The UK food system is possibly the most supermarket dominated of any country. Despite recent growth in the discount supermarket chains eating a little into the share of the 'big four' (Tesco, Asda, Sainsbury's and Morrisons), these still hold 66% of the £150 billion grocery market. [UK Statistics 2014] Including the smaller chains (small being a relative term] supermarkets now account for well over 90% of the fresh fruit and vegetables (FFV) market. The entire revenue of the 3,000 or so independent greengrocers stands at just £1 billion. [IBIS 2014] Sainsbury's alone sold one fifth of all FFV sales. [Sainsbury's 2013 p13]

There are many consequences to this phenomenon beyond the scope of this paper, including the impact on town centres, access to healthy food in poorer neighbourhoods and net loss of employment [Blythman 2004, p6]. However, the overwhelming element is the power over the entire food chain that these giant retailers exert, one consequence of which is the level of waste throughout the system including by households.

Like all enterprises, big and small, supermarkets exist to make profits. Whatever, their PR might say, they are not in the business of creating healthy citizens or a sustainable environment – nor should that be a criticism, it is the nature of capitalism in its unregulated form. The supermarket food system operates like any other corporate dominated system seeking out every conceivable angle to cut costs and improve margins. Amongst the consequences of this are squeezed suppliers – growers and wholesalers (where they still exist), a complex global supply chain and a preference for food with long shelf lives, cheap ingredients and added value. Though supermarkets have obligations under corporate social responsibility and under planning regulations (S106) these do not impede on core business activities in any way and often are just another way of 'appearing' to be concerned about local communities by implying that actions under these rules were selfless and unprompted.

#### **1.4.1 How supermarkets contribute to and/or create wasteful consumer habits**

*The standardization of the products offered to consumers is a major cause of food losses and waste in modern retailing systems' [HLPE, 2014 p15]*

It is critical to remember that the job of supermarkets is to *sell* as much food as possible, with the best possible mark-up. What customers do with the food they buy is theoretically of no concern to the supermarkets. However, like all industries, maximising repeat business is also essential. Operating on policies of cheap prices, narrow margins and high turnover, as most supermarkets do, consumer wastefulness is extremely beneficial to the industry. For example, Sainsbury's operating margin between 2008 and 2013 ranged from just 3.26 to 3.56% with a turnover for 2012/13 of £25.6 billion [Sainsbury's, 2013 p 1 & 8]

Throwing food away simply accelerates a return visit. Household food waste of 25% [WRAP, 2009] actually means 25% more sales. Food never eaten thus contributes massively to supermarket income and profit!

Supermarkets always claim that what they stock is simply a response to customer demand – but the truth is that they have an overwhelming influence on what customers 'choose' to buy. In its relationships with both suppliers and consumers supermarket practices are by far the biggest driver of food waste in the UK. [Stuart, 2009]

The supermarket food system is analogous to an industrial process, characterized by uniformity, standardization and long, often complex, supply chains. In such a world, fresh fruit and vegetables play an interesting role – not least because they are not naturally uniform, standardized or suited to a long supply chain. In fact they are just the sorts of food product a supermarket doesn't want to sell – not just for these reasons but even more because they offer little opportunity for added value, have a relatively short shelf life and a potentially unpredictable supply.

For the other major player in the UK food market; the brand name producers, such as Kellogg's, Walkers, Coca Cola and Heinz; added value is their modus operandus. Put simply: *'the basic question for many food companies is how to turn a cheap product, like wheat, potatoes or peanuts into a profitable item that people want to buy from them.'* [Tansey 1995, p118]

Given their inconvenient characteristics, it is perhaps a little bit surprising that supermarkets continue to stock vegetables at all! In fact, Blythman quotes one supplier saying just that: *'...supermarkets would stop selling fresh unprocessed food entirely if they thought they could get away with it. "Whether it's melons, milk or mince, fresh unprocessed food is full of hassle... the less fresh food they can do the better as far as they are concerned. They stock it because they have to, because people expect it."* [Blythman 2004, p69]

The fact that 'they have to' sell fresh fruit and vegetables is partly a testament to health lobbyists pressure, for example campaigning by Sustain, British Heart Foundation and the NHS '5 a day' initiative, but it is much more to do with image and display. Virtually all supermarkets place their fresh vegetables as close as possible to their entrances and, even in their relative uniformity they will always at least make a colourful and aesthetically pleasing display. Added to this, supermarkets have many tie-ins with TV celebrity chefs whose use of fresh ingredients, alongside their branded sauces and ready meals, requires catering for. Accepting the need to sell fresh produce, the issue of standardization becomes paramount and this, more than anything else, drives waste.

Industrialised food and farming deals in bulk: huge sales, huge suppliers and easy transportability. Fresh fruit and vegetables [FFV] don't travel well, but

much ingenuity and expense has gone into packaging systems and temperature controlled supply chains that have doubled shelf life for many vegetables in recent years. Tesco's fresh vegetable shelf life went from 5 days in 1987 to 11 days in 2002. [Gustafsson 2009, p63-4] Whilst such processes in themselves ought to reduce waste, the strictures on size and shape that come with them do not. Shelf- life is not only enhanced by technology but also by choice of variety and the strictest control of quality. The first quality of any fruit or vegetable variety is durability – measured by its ability to withstand a series of supply chain processes and, when not cellophane wrapped, handling by customers. [Gustafsson, 2009] There is no room for any blemishing or bruising as this not only reduce the shelf life of the individual item, but can spread to others too. FFV need to arrive on the supermarket shelves firm and immature, yet on the cusp of maturation – a state of perpetual puberty without the spots (they're not allowed)! The second quality is size and shape. For example, supermarkets expect tomatoes to fit within a 10mm size range, originally to suit packaging needs. The inevitability of the limitations created by economic efficiencies is the need to tailor customer demand to the sort of FFV supermarkets want to sell. A set of expectations around what a fruit or vegetable 'should' look like was, by a combination of accident and design created. A notional 'perfect' potato, carrot or apple was created – not based on the quality that actually matters – taste –but on appearance. An example of the sort strictures this created is in Box 1. Such criteria are the norm in all UK supermarkets.

Box 1: Tomato rejection criteria from Blythman, 2004 p211

Consumers have, over the last 30 years learnt to expect and then demand the same set of criteria – or as Nick Twell of the British Potato Council put it, the supermarkets 'educated the public to expect perfect potatoes.' [Stuart 2009, p116] WRAP's detailed report on the fruit and vegetable supply chain stated:

*'Part of the perceived problem by many throughout this research is that consumer expectations of quality are viewed as having increased continually. It is inevitable that once customers are offered better quality then they will expect this quality as standard. It could be argued that this perpetual feedback loop needs to be reviewed so that mechanisms can be considered to halt, or at least suppress, the ever-increasing quality demands'* [WRAP, 2011 p81]

Supermarket shopping, in all respects is 'sanitized shopping' – most notably in terms of the presentation of meat and meat products. But the FFV aisles have the same characteristics – no dirt, no sign of insects (let alone an actual one!), no bruising, no blemishes – no potatoes with eyes, no apple with a scab, no leaves on a cauliflower. Much 'fresh' produce is pre-wrapped with only the most tender, sweetest possible bits remaining –broccoli florets, baby carrots and even little baby bite size chunks of apple. Many perfectly edible –

and often the most nutritious parts of FFV are removed before the consumer has a chance to taste them. This practice further reinforces consumers' perceptions of what should and shouldn't be eaten – if one is used to buying broccoli florets, the chances are if presented with a whole broccoli the leaves and stem will be discarded.

This all leads inevitably to huge amounts of waste – most particularly in the supply chain – where growers struggle to produce to the supermarkets' exacting standards. But for the consumer the expectations of perfection mean that once they purchase FFV they have little tolerance once it begins to lose some of its superficial lustre. They are also extremely unlikely to purchase 'sub-standard' looking vegetables from other sources – making these unmarketable.

Examining research in to UK consumer behaviour that generates food waste, the influence of the supermarket is writ large. Some of the behaviors are the inevitable outcome of buying more than one needs. It is simply a repetition of the obvious that supermarkets want people to buy as much as possible. With food so cheap, at least in relative terms, the consequence will be high levels of waste: either the wastefulness of throwing away food or the even more serious waste of over-consumption with its further impacts on health and the economy. Box 2 outlines the key underlying drivers of consumer food waste.

Box 2: Underlying behaviours leading to food waste by UK households [sources: Brook Lyndhurst, 2007 p4; WRAP, 2007 p9\*]

Special offers of various sorts such as 'buy one get one free' (BOGOFs), three for two or 33% extra alongside the inevitable cost saving of multipacks and larger sizes all encourage consumers to buy more than they need. With perishables in particular this can lead to considerable waste. To a limited extent this can help move seasonal gluts however, as the supermarkets have largely dispensed with the notion of seasonality through their global supply chains, there is little relationship between special offers and the seasons except where it reflects consumers' seasonal preferences. Smaller households, who are proportionately more wasteful [Parfitt 2010, p5 re: single person households; Brook Lyndhurst, 2007 p13 re: young professionals] are caught in the dilemma of 'missing out' on the apparent bargains of special offers or buying what they will actually get round to eating.

The growing awareness of the need to eat more healthily through public health initiatives such as '5 a day' is encouraging and certainly supermarkets will exploit that message to push FFV sales. However, it is telling that supermarket and brand pressure is almost certainly responsible for the inclusion of sugar/fat and/or salt laden items such as baked beans, tinned fruit in syrup and other processed foods in the '5 a day' list. Furthermore, several supermarkets refused to even use the official '5 a day logo' and created their own because it only applied to FFV. [Blythman 2004, p67] A strategic analysis of the role of supermarkets will very quickly show that the foods they really want to sell are by and large the least healthy. A big seller in this regard are 'ready meals' of which there are endless varieties – in short supermarkets don't want you to cook for yourself, it's not where the money is made. Supermarkets don't just regard FFV as window dressing – they want customers to treat it as window dressing too.

Encouraging spontaneous purchases – or impulse buying, is something the supermarkets are past masters at, generating effectively 'unintended' purchases adds greatly to overall sales but leaves consumers with conflicting choices back at home. Human nature will push the consumer to eat what they have just bought – it caught their eye, is newer and probably looks better – so will most likely be eaten before something that's been in the fridge a few days or the cupboard a few weeks. The inevitable consequence is that FFV not eaten within a day or two are very often not eaten at all. And of course in the 'no time' 21<sup>st</sup> century lifestyle it's always easier to bung something ready made in the oven or ring up the local take away than prepare a meal from scratch. The strapline message of one fast food website – '*Don't cook, eat*' could equally apply to supermarkets. One further logical consequence of over-buying and the general 'cheapness' of food is that when we construct a meal, whether from scratch or ready-made, we often make too much further fuelling our over-eating or wastefulness habits.

The 'sanitation' of food that is fundamental to supermarket retailing is reinforced by a near national obsession with food hygiene. Our fear of the world's commonest living organisms – bacteria – knows no bounds. This is not to belittle the importance of good food hygiene practices, the trouble is we don't really know what they are and one consequence is to take caution to the extreme. For the supermarkets taking caution to the extreme is both practical and profitable – but also a major cause of food waste. Food labelling confusion has resulted in millions of tons of perfectly edible food being binned. 34% of consumers '*attributed food waste to food going past the date on the label and 21% will not take a risk with a product close to its date, even if it appears fine*' [Brook Lyndhurst 2007, p15] The Food Standards Agency [FSA] found that only 51% and 55% respectively of people knew what 'best before' and 'use by' labels meant. [FSA, 2008, p34] Supermarkets are naturally risk averse and that, to some extent explains their labelling practices – however the fact that the terms 'best before', 'sell by' and 'use by' do not mean the same thing is very often lost on the consumer, prompting the sort of knee jerk response found by Brook Lyndhurst [2007]. No product,

unless stored, prepared or cooked completely inappropriately could possibly need throwing away because it had reached or was approaching its 'best before' or 'sell by' date and the same would very often apply to a 'use by' date –given supermarket caution. The safety margin on much date labelling is often huge and as such difficult to justify in consumer protection terms. [HLPE, 2014 p14] Despite not being legally required, date labels are frequently appended to packaged fruit and vegetables [Stuart, 2009, p61]. Whilst the nutritional quality clock may begin ticking the moment a vegetable is harvested, that doesn't mean that FFV a week or more old isn't perfectly edible and at least reasonably nutritious (certainly in comparison to the vast majority of processed foods) –what matters is that consumers endeavour to eat things at their freshest whilst ensuring produce doesn't get left so long that it does *actually* go off. Much labelling is designed to help stock management by the stores rather to inform customers

Dissatisfaction with the taste of food, especially FFV is unquestionably a significant cause of waste. Nearly half of families with young children throw away food left on the plate compared with 32% of households in general. [WRAP, 2007 p 17] The fact that children are the biggest culprits is no surprise. But here again there is a powerful case for putting the lion's share of the blame for this at the door of the supermarkets and the processed food/junk food brand leaders. For decades children have been the target of junk food marketing, subject to the creation of children's menus and generally bombarded with food products high in fat sugar and salt - especially sugar or some other form of sweetener. The net result is that children develop a taste for sweet and artificially enhanced flavours –the very antithesis of many FFV. Whilst there are other factors at play (and beleaguered parents are not immune from responsibility), in waste terms alone the joint brand/supermarket selling strategy towards children is probably the biggest single cause.

There have clearly been significant lifestyle changes in recent decades and in general they have led to a breakdown of formal eating habits in the home; TV dinners, separate children's food and eating times, all day snacking and a blurring of work/domestic and social activities. Between 1994 and 2004 average meal preparation time fell from 30 minutes to just 19 minutes, whilst the number of times families ate together fell from 54% to 34%. [WRAP, 2007 p13] Many people work long hours and are simply too tired to cook or, at least, the option of a take-away or ready meal is just so much easier. It is not surprising that one consequence is high levels of food waste strongly linked to a lack of planning in food purchasing and in when, what and how we eat. The 'casualisation' of mealtimes contributes to increased plate waste, especially from children if parents are not eating with them as often. There will be less eating-up of others' leftovers (worsened by the sanitisation of food) and in general no coordinated approach to the saving and use of leftovers. For supermarkets these lifestyle changes have proved very profitable not only creating new forms of food, such as the ready-meal, but also carrying the bonus of 'added value'. Supermarkets' ever longer opening

times reinforce our fluid lifestyles adding to opportunities for 'grabbing something at the last minute' and other impulsive buying decisions known to contribute to food waste.

#### **1.4.2 How supermarkets contribute to and/or create waste in the supply chain**

*Although mature, developed societies have substantially more efficient, effective and well-engineered market logistics, 30% of what is harvested from the field never actually reaches the marketplace (primarily the supermarket) due to trimming, quality selection and failure to conform to purely cosmetic criteria. [IMECHE, 2011 p23]*

The many strictures on FFVs appearance discussed in the previous section inevitably put huge pressure on growers. Even the most technologically aware grower cannot yet create near identical tomatoes or cauliflowers on demand. The complete control that supermarkets hold over growers enables them to impose severe contractual terms. Thus in order to attempt to meet supermarket demands, the first thing a grower will do is overproduce. *No supplier wishes to be "short" and will trade off delivery to their customers "in full" (as well as on time) for high levels of field waste. [WRAP, 2011 p36]* According to one National Farmers Union [NFU] official, planting 140% of the contracted amount was *'not an unstandard example of the industry being inefficient to avoid shortfall.'* [Stuart, 2009, p109] Occasionally excess crop can be sold on to wholesalers at a knock down price, but it is more than likely that the contract will debar such an arrangement – the majority will be ploughed back in or go to animal fodder.

The main supply chain factors (excluding losses related to natural causes) causing food waste almost all lie within the contractual terms between supermarkets or large-scale processors (such as Bird's Eye):

- Exacting product quality standards
- Over-production to meet contracts
- Take-back clauses allowing retailers to return products to suppliers
- Poor demand forecasting by retailers

It has to be conceded that much of the evidence for contract related waste is anecdotal or the result of relatively small-scale surveys. However, virtually all authoritative reports consistently accept their importance. [HLPE, 2014; IMECH, 2013, FAO 2011, Parfitt 2010] However, as Blythman's and Friends of the Earth [FoE 2002] research suggests even growers giving evidence to the UK Government's Competition Committee were reluctant to go into details; she quotes one supplier: *"It would be commercial suicide for any supplier to give a true and honest account of all aspects of relationships with retailers"* [Blythman 2004, p139]

Meeting supermarket quality standards is consistently reported as a, if not

the, dominant factor in supply chain waste in the UK. Table 6 illustrates recent detailed studies of UK FFV supply chain waste. Whilst there is no clear consistency between crop and the amount of waste (15-57%), the waste due to grading – largely but not entirely a matter of supermarket standards – is very consistent, (66 -79%). Other estimates of supply chain losses are comparable to the 36% average in table 6 with figures for FFV supply chain waste of 33% [FAO, 2011 p7] and 39% [Kummu, 2012 fig.5A].

Table: 6 Examples of losses in the UK fruit and vegetable supply chain (S/C)

	Field losses	Initial grading	Storage	Grading at packing stage	Retail	Average S/C losses	Av. % loss due to grading
Onion <sup>1</sup>	3-5%	9-20%	3-10%	2-3%	0.5-1%	<b>28%</b>	<b>61%</b>
Potato <sup>1</sup>	6%	11%	4%	18.5%	1.7%	<b>42%</b>	<b>70%</b>
Potato <sup>2</sup>	1-2%	3-13%	3-5%	20-25%	1.5-3%	<b>38%</b>	<b>79%</b>
Apple <sup>1</sup>	5-25%	5-25%	3-4%	20-25%	1.5-3%	<b>57%</b>	<b>66%</b>
Broccoli <sup>1</sup>	3%*	10%*	0%	0%	1.5-3%	<b>15%</b>	<b>66%</b>
<b>Average</b>	<b>5.8%</b>	<b>11.6%</b>	<b>3.6%</b>	<b>13.2%</b>	<b>1.8%</b>	<b>36%</b>	<b>69%</b>

<sup>1</sup> Adapted from WRAP 2011, p74 using UK grown FFV where all supply chain figures were available <sup>2</sup> Adapted from Bowen 2012 \* WRAP data put figures other way round but notes stated: 'grading is primarily done at picking; hence, there is a high proportion of field waste' [p57] – a high proportion has been taken as 7/10.

An illuminating snapshot is provided in Box 3. It reflects the practice of a large, established U.K. grower, which almost certainly reflects standard practice.

Box 3 Carrot supplier wastage adapted from FAO, 2011 p10 – information from Stuart, 2009

Carrot quality standards, by the supermarket chain Asda

Stuart visited M.H. Poskitt Carrots in Yorkshire, a major supplier to the supermarket. At the farm, the author was shown large quantities of out-graded carrots, which, having a slight bend, were sent off as animal feed. In the packinghouse, all carrots passed through photographic sensor machines, searching for aesthetic defects. Carrots that were not bright orange, had a bend or blemish or were broken were swept off into a livestock feed container. As staff at the farm put it: "Asda insist that all carrots should be straight, so customers can peel the full length in one easy stroke." In total, 25-30% of all carrots handled by M.H. Poskitt Carrots were out-graded. About half of these were rejected due to physical or aesthetic defects, such as being the wrong shape or size; being broken or having a cleft or a blemish.

It is important to note that as Box 4 illustrates EU standards provide an unhelpful backdrop to supermarket practices, and these too are largely based on size and appearance.

Box 4: UN/EU standard for 'extra' class carrots

"Extra" Class Carrots

Carrots in this class must be of superior quality and washed. They must be characteristic of the variety or the varietal type.

The roots must be: • smooth • fresh in appearance • regular in shape • free of fissures • free of bruises and cracks • free of damage due to frost • free of green or violet/purple tops.

If presented with leaves, leaves must be fresh in appearance.

They must be free from defects with the exception of very slight superficial defects, provided these do not

affect the general appearance of the produce, the quality, the keeping.  
To ensure uniformity in size, the range in size between produce in the same package shall not exceed: 20 mm or 150g

However, as UK supermarkets rarely deal in anything other than the highest two grades – ‘extra’ and ‘grade 1’, leaving ‘grade 2’ to the fringe retailers – the impact of these standards is much exaggerated – like tales of ‘straight bananas’ in EU sceptic tabloids. The leading supermarkets set their own standards that are often even more stringent than EU ones [WRAP, 2011; FoE 2002; Stuart, 2009]. This fact is particularly well illustrated following the EU’s decision in 2009 to drop its classification standards for 26 of the 36 types of FFV that they had previously applied to – with, as it admitted itself, little or no effect; stating: *Despite the fact that it is not longer legally obligated, odd shaped fruit and vegetables are not that much spotted in ordinary EU supermarkets.* [EU 2012 p4]

Using cucumbers as an example, the EU gave the reasons as: straight cucumbers pack in boxes better, process better and are what customers have come to expect. [EU, 2012] Confirmation of the stringency of supermarket standards is given by WRAP: ‘*Without exception in this research, retail specifications exceeded the minimum set by EU Regulation and covered such things as size, shape, skin blemish and colour.*’ [WRAP, 2011, p81] the same also reported that even cut-price ‘basic’ ranges had specifications ‘well above’ the EU floor. [WRAP, 2011 p82]

## **1.5 COMMUNITY SUPPORTED AGRICULTURE (CSA\*)**

*CSA is a partnership between farmers and the local community, providing mutual benefits and reconnecting people to the land where their food is grown. [Soil Association website, 2014].*

[\* The acronym CSA can refer to the form of agriculture or to an individual scheme e.g. Canalside CSA]

CSA schemes exist in many forms, but their essence is that there is an element of risk sharing between producer and consumer as well as the creation of direct connectivity between consumers and how and where their food is grown. They are overwhelmingly products of post-industrial societies reflecting both consumer and producer dissatisfaction with the dominant food production paradigm. For farmers and growers, CSAs can offer greater financial security because of the commitment given by the CSA members, they also offer an escape from the vagaries of the supermarket supply chain and very often the chance to farm without damaging the sustainability of soil and environment. For consumers, membership of a CSA is about re-connecting with food, knowing where it came from, how it was grown and that the food is healthy and usually organic.

In 2011 the number of CSAs in England stood at 80, providing fresh food (overwhelmingly vegetable and salad crops) to 5000 households. The total acreage is around 3,200 acres and annual turnover of £7 million. [Soil

Association, 2011] There are greater numbers in countries like France and the USA, but the greatest density is in Japan with over 600. [Hall, 2006] Dividing turnover by acreage suggests an average value of £2187 per acre, however the best run schemes show returns 4 or 5 times that figure by using intensive and protective cropping – Hall suggests under such systems £9000+ per acre (at 2006 prices). [Hall, 2006, p303] Even the lower figure represents a far greater return per acre than any arable field. An example of the sheer productivity of a CSA growing organically, using intensive and protective cropping is shown in table 7.

Table 7: example of crop yields Canalside CSA 2013

Crop	Planted area (m2)	Total yield	Equivalent per hectare
Squash	840	3000kg	36 tons
Beetroot	580	2500kg	43 tons
Celeriac	360	600kg	17 tons
Carrot	1000	3600kg	36 tons

The CSA movement is perhaps the ultimate consumer reaction to the ills, real or perceived of the industrialised food system. In recent years the UK has seen a significant growth in people growing their own food, farmer’s markets, organic, local, artisan and fairly traded food. A CSA scheme ticks all of those boxes in one go, but as such can be too big a jump for many still weaning themselves of a supermarket’s interpretation of food.

The depth of the relationship between the consumer and the producer, the crop and the land is clearly on an entirely different level to that between a supermarket shopper and the source of his or her basket of goods. This is eloquently summed up by Kneafsey: *‘The qualities of food – both aspects such as taste and the meanings that it carries such as a commitment to community –shape how foods will be treated; the care with which they will be cooked, whether they will be thoughtlessly wasted or whether they will be shared, lovingly, with others.’ [Kneafsey 2008]*

Canalside Community Food lists the benefits of CSAs as:

*For the consumer:*

- *Receiving fresh, locally grown, typically organic produce on a regular basis*
- *Direct participation in the growing process*
- *Cheaper food due to direct relationship with the grower*
- *Access to land where their food is grown*
- *Opportunities to meet other like-minded people in community through open days, farm walks, and social events*
- *Understanding about where their food comes from and an opportunity to have a say in the future shape of the countryside through directly supporting local food production*

*For the producer:*

- *A fair return on their work and products*

- *A guaranteed market*
- *Links to the surrounding community so they are no longer feel isolated*

*Other benefits:*

- *Stimulation the local economy by supporting local business*
- *A feeling of community cohesion [Canalside website, 2014]*

Perhaps surprisingly, on top of all the other benefits, CSA prices are very often more than competitive [Pinkerton, 2009 p103]. As part of this study a price comparison was made between the cost of a 'medium' share at Canalside and the equivalent supermarket average. The cost was not only much cheaper than organic like for like but even beat conventionally grown equivalents (table 8).

Table 8: Price comparison Canalside CSA 'medium share' v supermarket (July 2014)

Produce July 19th	Weight (g)	Supermarket organic average £	Supermarket conventional av.£
Potatoes	600	£1.80	£1.20
Onions	400	£0.60	0.28p
Cucumber	1200	£2.50	£1.20
Broad Beans	600	£3.20	£1.50
Tomatoes	150	£0.98	£0.53
Chard	200	£1.75	£1.30
Coriander	100	£2.00**	£2.00
Kale	300	£2.50	£1.95
Lettuce	300	£1.50	£0.60
Calabrese/Broccoli	500	£2.00	£1.00
Fennel	100	£0.37	£0.30
Total cost	£12.00*	£19.20	£13.86

\*£2 monthly membership fee + £11.50 per week; no organic coriander available in any leading supermarket that week.

This study would predict that CSA members would be less wasteful than the supermarket shopper – even though they have no real control over the amount or range of produce they will receive – other than, in the case of Canalside – to opt for a small, medium or large share.

In terms of overall FLW, what is potentially more significant is the absence of a complex, retailer dictated supply chain. There simply is no supply chain; there is the producer(s) and the consumers, some of whom are one and the same. What is harvested is given to the members, nothing is discarded because of shape or colour or ripeness. In general all that doesn't reach the consumer would be the very lowest quality small or badly damaged produce and the occasional perishable leafy vegetables at times of peak supply.

### **1.5.1 Canalside Community Food/CSA**

Canalside Community Food is a CSA scheme situated just outside Leamington Spa in Warwickshire. The scheme provides vegetable shares for around 150 households. The scheme began in 2007 and uses land leased from Leasowes Farm – both the farm and the CSA are registered as organic with the Soil Association.

All produce that goes into the vegetable shares is grown at Canalside – no produce is brought in to supplement the shares. The produce is therefore overwhelmingly seasonal, supplemented by produce that can be stored for a period of time, usually root vegetables. Inevitably therefore the amount of produce varies quite significantly throughout the year both in type and quantity. At seasonal peaks, members can receive considerable quantities of certain vegetables that may require imaginative uses; it is not uncommon for members to give surplus produce to friends and family at such times. Members also understand that there are times when the size of the share will be relatively small.

Canalside is very much a community venture, taking every opportunity to involve members with regular events throughout the year. All members are expected to contribute around 9 hours labour per year in addition to the cost of their share. In addition to employing full-time and part time staff, there are 'work-share' places where members receive a complementary share in return for a 3 or 4 hours shift.

Most scheme members pick up their vegetable shares directly, others collect pre-bagged shares from a shop in the centre of Leamington. Members collecting from the site will select and bag up their own share, weighing out that week's amount for each crop according to the size of their share: small, medium or large. The very act of handling and weighing out the produce – especially root vegetables with mud and earth on – enhances the sense of connection. Most of the produce will have been picked that day, though produce in winter and spring often has a significant amount of stored late autumn harvest.

## **2.0 METHODOLOGY**

The three elements of the study were:

1. Household Vegetable and Salad Waste Study
2. Entire food chain waste at Canalside regarding it as an enclosed independent micro food system
3. Fresh Vegetable Consumption Assessment

### **2.1 HOUSEHOLD VEGETABLE AND SALAD WASTE [VSW\*] STUDY**

[\*VSW is used to allow comparison with WRAP studies]

The study sought to calculate the percentage of participants' VSW over two separate periods of two weeks. Twenty kitchen caddies were purchased to give to participants to put their Canalside waste in and, in order to maximise sample size, the caddies were returned for a second study period to be used by different participants.

The Canalside share scheme involves members collecting a weekly share from the CSA site (or farm). Each week the contents of the share would vary according to the type and amount of produce harvested or allocated from storage. Each share is broken down into specific weights per produce (see tables 15-16 as examples). Occasionally an item would simply be '*one or two of*' or one from crate A, B or C – this was the case with cucumbers, fennel and calabrese during the study. For these crops a number average sized examples were weighed to give a fair weight-value.

Throughout the period of the study, the exact size of participants' share was known. This would provide a figure from which to calculate the amount of waste as a percentage.

Canalside members who agreed to take part in the study were given a participant information sheet [appendix 5] and a consent form [appendix 6]. Additionally each participant had the nature and purpose of the study explained in full. The participants were given a caddy to be used exclusively for all waste from their Canalside share (i.e. using WRAP terminology AFW, PAFW and UFW). They were not asked to self-sort the waste. Participants were asked to bring back their caddy for the waste to be weighed and analysed after the first week and again after the second week of the study.

Allowance needed to be made for the fact that VSW generated from the weighed study period could occur after the end of the second week and thus would not be measured. Participants were asked to include any Canalside VSW from shares collected in previous weeks. By including anything still left from the week or two before the study period, it was hoped this would 'offset' carry-over waste beyond the study period and provide a fairer full representation of waste (see table 9).

Table 9: Explanation of VSW included and not included

Week(s) before study period	Study period week 1	Study period week 2	Week(s) after study period
VSW from these weeks occurring during study period included	All VSW included	All VSW included	VSW from study period not included

The total amount of waste was measured at the end of each of the two study weeks. To enable the best possible comparison with WRAP studies and to focus in on 'true' waste, rather than inedible matter, it was necessary to estimate the amount of waste that would come within WRAP's category of AFW. The first part of this calculation was to estimate what portion of the weekly share was edible. This was especially important as, unlike supermarket vegetables, the Canalside shares were not pre-washed or trimmed so the total weight would certainly be far from entirely edible. The second element was to estimate from the actual VSW what was and wasn't edible.

### **2.1.1 Calculating edible portion of shares**

A figure of 80% of each share being edible was derived. This was done in two ways:

Firstly, a medium share was chosen from week 1 and all 'inedible' and generally considered inedible elements [UFW and PAFW] were saved and weighed. The inclusion of PAFW meant that the study was erring on the cautious side because it effectively reduced the size of the edible share, thus potentially increasing waste proportionately. It was predicted, and proved to be the case, that many participants would consume elements of PAFW –such as not peeling carrots and beetroots, not taking ends off sugar snap peas etc.

The UFW and PAFW from the sample share comprised:

- Carrot tops 1-2 cm, peelings
- Coriander lower stalks,
- Russian Chard where stalks were tough,
- Cucumber ends – 1-2cm off each,
- Lettuce cores – though there was little as most was leaves,
- Spring onion roots and top ends of stalks,
- Beetroot skin and 1cm off tops and bottoms
- Broad bean empty pods – approx. 65% of entire bean weight\*
- Onion skins an 1cm off top and bottom
- Sugar snap peas 1cm off ends in total

\*The broad bean pods were easily the most significant part of the inedible waste.

The weight of UFW and PAFW came to approximately 20% of the total share.

Secondly, information derived from a table for converting whole vegetables into weighted amounts for recipe specifications confirmed that the estimates were reasonably accurate [see appendix 4). An average of all 45 vegetables on the table, (except celery leaves, which were clearly out of range), was calculated. The average differential between 'as purchased' and 'edible' portions was 16%. Given that broad beans were not on the list of 45 vegetables, but were so significant in the study, to take a figure of 20%

seemed appropriate.

This estimate of 80% was used for all 4 weeks and taken to be reasonably representative, as the shares did not change greatly, except in total size.

Participants' kitchen caddy contents were weighed to give individual household total waste figures (tables 18,19, 25 and 26). Edible waste [AFW] figures were based on the examination of each caddy, separating out edible waste from inedible waste in line with the criteria described. Samples from week 1 were weighed, but later estimations were made based on knowledge gained from the samples, therefore the AFW figures cannot be regarded as wholly accurate and should be treated appropriately. However, the researcher again erred on the cautious side and would consider the estimates of edible waste more likely *over-estimates*.

The caddy waste was composted on the farm with other farm waste.

### 2.1.2 Arriving at a WRAP comparative AFW figure for VSW

As the WRAP data shows, there is considerable variation between waste levels for different food categories. Figures 3 and 4 show that both salad (45.4%) and vegetables (19.1%) have amongst the highest levels of AFW – salad being the most wasted category of all. The vegetable shares during the study period were a mixture of the two, but for practicability, the waste was measured together.

Taking the list of produce in tables 14 and 22 and referencing the WRAP list of salad items, [WRAP, 2008 p 59-62]; it was possible to calculate the % of 'salad' and of 'vegetables' in each category (see table 10).

Table 10: Proportion of salad in medium share over study period

Salad	cucumber	lettuce	spring onion	beetroot	tomato	fennel	All salad	Total share	Salad as %
Week 1	500	300	150	300	0	0	1250	2860	40%
Week 2	650	300	150	500	0	0	1600	3610	44%
Week 3	1200	300	0	0	150	100	1750	4350	38%
Week 4	1200	300	0	0	150	0	1650	3880	43%
Totals							6250	14700	42.5%

Calculating mean rate of VSW waste:

Salad = 42.5% x 45.4 = 1929.5

Vegetables = 57.5% x 19.1 = 1098.25

VSW = 1929.5 + 1098.25 = 3027.75/100 = 30.27%

A figure of 30% was therefore used as the average national rate of avoidable VSW.

## **2.2 WASTE AT CANALSIDE AS A MICRO-FOOD SYSTEM**

Unlike the supermarket food chain – the Canalside food chain is very simple, comprising on farm waste and household waste only.

Using the HLPE definition of FLW '*A decrease at all stages of the food chain from harvest to consumption, in mass, of food that was originally intended for human consumption, regardless of the cause*' [HLPE 2014, p11], the on-farm FLW is therefore comprised all harvestable crop not distributed to members.

Like all farmers and growers, Canalside has crop residues and a margin of very poor quality pest damaged or undersized produce that is ploughed back in to increase soil fertility – these do not form part of the FLW calculation.

At Canalside, if there is produce surplus to the weekly veg. shares it is made available to members as extras. When not all extras are taken they become waste and are composted on site. The extras will occasionally include lower quality or undersized vegetables – these would very likely be lower than 'grade 2' produce and would never get near any retailer. The on-farm waste therefore consists of surplus 'extras'. The on-farm waste during the study period is calculated as a proportion of the whole harvestable crop during that time, as there is no specific on-farm waste that could be linked to the study group. [Appendix 2.2, table 32A]

When the composition of the on-farm waste during the study period was analysed it was found to contain vegetables with a lower proportion of inedible waste [UFW], therefore a lower figure of 10% UFW was used [appendix 2.1, table 31].

## **2.3 FRESH VEGETABLE CONSUMPTION ASSESSMENT**

### **2.3.1 Family Food Survey Data and '5 a day'**

Using the data gathered from the waste study it was possible to accurately record the FV consumption per household by deducting potato consumption. National comparison was drawn from the Family Food Survey 2012. [FFS, 2012] The FFS survey gave average quantities of all vegetables purchased as 1086g per person per week, with 183g of fresh green vegetables and 551g of other vegetables totaling 734g of fresh vegetables per person per week [FFS 2012 p5]. Potatoes were not included in the total.

As a comparator with what FFS term fresh green vegetables, the Canalside portions of leafy green vegetables (LGV) have been used. FFS does not separate salad and other vegetables, so the calculation of average waste was retained at 30%. The national average weekly consumption of FV per person was calculated as:  $734\text{g} \times 70\% = 514\text{g}$  and for LGV as:  $183 \times 70\% = 128\text{g}$ .

To calculate the national average '5 a day' portions of FV:

514g = 6.4 x 80g portions of FV per person p/week (p/w)

128g = 1.6 x 80g portions of LGV per person p/w

73.5 g = 0.92 portions of FV per person p/day (p/d)

18 g = 0.225 portions of LGV per person p/d

To calculate a per person rate from the household data an exit survey was carried out of Canalside participants (table 30). From this it was calculated that the average household size was 2.2 (all adults and children over 11 counting as 1 and children 5 to 10 as 0.75.\*

[\* Child 5 – 10 counted as 0.75 and 11 – 16 as adult equivalent NHS, 2014 average calorie intake of boys and girls 7 – 10 (1552g/2000g)]

## **3.0 RESULTS AND DISCUSSION**

### **3.1 ISSUES OF METHODOLOGY**

#### **3.1.1 Estimations**

For practical and resource reasons important elements of the study were essentially estimates, though the author is confident that in most cases estimation has erred on the side of caution and over, rather than underestimated AFW. There is confidence that the estimation of edible food at 80% is reasonably accurate, given the cross-referencing with an external source. Resources allowing, the detailed weighing out of edible and inedible parts that was carried out with the first share would have been repeated in the following 3 weeks.

It wasn't practical to separate out a PAFW category. It is clear from the contents of the caddies that many CSA members, as predicted, consume a significant –though unquantified - amount of produce that fell within PAFW.

The second and more significant area of estimating was the amount of AFW in the caddies. During the first week the AFW was separated and weighed – this still involved some subjectivity and was made more difficult when the rotting process had begun in earnest! Indeed given the warm weather and the perishable nature of leafy waste in particular – it was more practical to estimate the AFW. This task was helped by the fact that certain things were known: the actual weight of all the individual household's caddy waste, the overall figure for edible/inedible food and the knowledge gained from weighing out the less degraded caddy contents.

The average total household waste from all participants was 19.1% (22.9%

for group 1 and 16.6% for group 2). This figure is less than the estimated UFW of 20% and if we add in the average AFW of 6.1% ( 7.1% and 3.8% respectively) theoretically the figure should have been around 26%. The explanation for this is a combination of the following factors: a) participants consumed a significant quantity of PAFW; b) the allowance for carry over waste to be included from before the first study week did not off-set what was actually wasted after the last study week; c) a small number of participants misunderstood the instructions and only returned waste they considered AFW to be weighed in the first week of their study period.

### **3.1.2 Comparators**

No direct comparison can be made with other studies as no other study, to the author's knowledge has been conducted with the same methodology. It would have been preferential to have a direct comparator group to study. However, both finding a suitable sample group and calculating the weight of their vegetable purchases would have been well beyond the practical resources available. Nevertheless there is reason to believe that the WRAP data on AFW is robust and suitable to be used for comparison purposes.

The data collected to compare with national statistics on FV consumption as with the waste data is not a direct like for like comparison. The weakest link in the data is the calculation of average household size from the data in table 30 which may not be a truly representative sample and certainly the number of large share families is proportionately lower.

### **3.1.3 Background of Canalside members**

The behaviour and attitude of participants cannot be solely attributed to their membership of Canalside. It would not be possible to calibrate any sort of proportionality in terms of its influence and the author would certainly concede that simply by joining a CSA would suggest a more than average understanding of food and environmental issues leading to a greater awareness than most of food waste issues. The impression gained of Canalside members during the research matched that of a study of another CSA: '*...over the duration of their involvement they had become increasingly enrolled into, and motivated by, the wider value system in which the CSA is situated*' [Kneafsey 2008, p64]

Table 30 shows that 85% of participants thought being part of Canalside positively influenced their attitude to waste, just over half said it was a major influence.

## **3.2 HOUSEHOLD AFW**

The average AFW for Canalside members of 6.1% was 5 x lower than the national average AFW derived from WRAP data of 30% for salad and vegetable waste (SVW). Allowing for errors in estimation discussed and the fact that methodologies were different this is clearly a very significant

difference even accepting that part of the reason for the low levels of waste would have been pre-existing attitudes to waste. However, the 'waste awareness' that preceded joining the CSA is almost certainly linked to a knowledge of related issues such as the environment, nutrition, climate change and biodiversity, which in themselves are the sort of things, a CSA nurtures. The CSA membership and the direct relationship with the produce builds on that awareness base and for more than half of the small sample asked it was the major factor in their attitude to food waste.

From discussions with participants it was clear that their membership of Canalside had increased the amount and range of produce they consumed. They were also, based on suggestions from the website and conversations with others, eating more parts of the produce –such as would come under WRAP's PAFW definition. With the produce being organic members knew that if they washed off the dirt, root vegetables didn't need to be peeled (though some still did), whilst parts like brassica leaves and stalks were eaten by many.

As all harvested edible produce was made available either within their share or from the 'extras' box Canalside members were eating a significant amount of produce that would have not been acceptable as supermarket standard. It would be interesting as part of a further study to estimate just how much would meet the 'cosmetic' standards required.

### **3.3 SUPPLY CHAIN WASTE / ON FARM WASTE**

Table 31 recorded that only 10.5 kilos of AFW was generated on the farm, just 0.65%. With no series of complicated supply chain stages and most importantly no 'grading-out' this figure demonstrates the wastefulness of the supermarket system. All edible food is made available to members in their share quota or as 'extras'. Arguably even this tiny contribution to the AFW total ought to be included in household waste, as members could have taken it! On the rare occasions where there is a substantial surplus produce is sold in a local store.

### **3.4 COMPARING FV WASTE IN CANALSIDE MICRO-FOOD SYSTEM AND THE UK SUPERMARKET FOOD SYSTEM**

As a food system the waste generated by Canalside is a fraction of that generated by the supermarket system by any estimate of the latter. AFW on the farm was less than 1% and with household AFW estimated as 6.1% the total was just 6.71%. The best estimate of fresh vegetable waste along the supermarket supply chain in the UK is shown in table 7 derived from WRAP and Bowen. Bowen replicated his studies, with some provisional strategies to reduce waste, but still recorded figures of 38%, 39% and 36% FLW in the years 2009-12. [Bowen 2012 p21}

Table: 11 Complete Food Chain (CFC) comparison of FLW

\* data from table 7

Food system	Supply chain FLW	Household FLW	Total CFC FLW
Canalside CSA	0.65%	6.1%	6.71%
Supermarket	36%*	30%	55.2%

As a food system we can estimate losses along the supermarket CFC of 55.2% more than 8 x the FLW of Canalside. The tiny amount of waste on the supply side at Canalside demonstrates how supermarket 'cosmetic standards' contribute FLW in the mainstream FFV supply chain. Food losses on the farm are of no benefit to the farmer, they represent a real financial loss; the only beneficiaries of FLW are supermarkets. Similarly, consumer AFW cost the average household £480 annually [WRAP, 2009 p6] but effectively represent 30% extra sales to supermarkets – and it is perhaps this more than anything else that tells the story!

### 3.5 FRESH VEGETABLE CONSUMPTION AND '5 A DAY' PORTIONS

Appendix 3.1.7 shows the (seasonally adjusted) estimated figures for the daily contribution to Canalside members FV consumption as 176g equivalent to 2.2 '5 a day' portions and of LGV as 46g equivalent to 0.575 '5 a day' portions. Though this figure was lower than expected it is still 2.4 and 2.6 x the national average total daily FV (73.5g) and LGV (18g) consumption.

Adding on the estimated 31% of additional consumption of FV (table 30) the Canalside figures rises to 230.5g FV and 60g LGV (see figure 6), which is more than 3 x the national average for both.

series 1 = FV    series 2 = LGV

Figure 6: FV and LGV consumption (g per person p/d)

There are further factors to consider that might suggest the nutritional benefit gained by Canalside members is even greater. Firstly, nearly all the FV is picked on the day of collection, though in late winter and spring there is a significant increase in stored vegetables. FV begin to degrade nutritionally from the moment they are harvested – what HLPE refer to as FQLW. For example: *'Ascorbic Acid (vitamin C) begins to deteriorate immediately after harvest and degrades steadily during storage for all classes of F & V products, with "losses" that could reach 100% in four days for fresh spinach.'* [HLPE, 2014 p24] With FV 'shelf-lives' of up to 11 days [Gustafsson, 2009 p64] the nutritional quality gap between Canalside FV and the supermarket is potentially very large.

Furthermore as the produce is certified organic, there are higher levels of many essential micronutrients. The most recent and exhaustive meta-analysis comparing organic to conventional crops found that: *the concentrations of a range of antioxidants such as polyphenolics were found to be substantially*

higher in organic crops/crop-based foods, with those of phenolic acids, flavanones, stilbenes, flavones, flavonols and anthocyanins being an estimated 19 (95% CI 5, 33) %, 69 (95% CI 13, 125) %, 28 (95% CI 12, 44) %, 26 (95% CI 3, 48) %, 50 (95% CI 28, 72)% and 51 (95% CI 17, 86)% higher, respectively. [Baranski, 2014 p1] This suggests that organic produce is equivalent to having one or two extra '5 a day' portions. [Newcastle University, 2014]

The fact Canalside members usually get at least 10 different vegetables, with a corresponding range of micro-nutritional qualities is another advantage and even though members don't choose what they want, they soon learn to appreciate the less familiar. Canalside members benefit from the fact *'choice and variety in a diet are far from being the same thing'*. [Kneafsey, 2008, p50]

With average national weekly vegetable purchases of 1086g per person [FFS, 2012 p12] and waste at 30% (which may be a little less for the 369g of processed vegetables) it is very probable that vegetables make up less than 1 ½ portions of '5 a day' for most people. For Canalside members that figure is likely to be around 3 ½. The national average levels of LGV, which are among the most micronutrient rich of all FV [Walsh, 2003] are alarmingly low and go some way to explaining some of the micronutrient deficiencies in the UK. The figures were even surprisingly low at Canalside, which maybe because AFW was not separated into categories and LGV waste was likely to be proportionately lower - having less inedible parts (see 2.1.1).

The author accepts that table 12 includes considerable conjecture but presents it to promote consideration of the accuracy of current estimates of F&V consumption. It has been assumed that waste levels for Canalside members would remain at 6.1% whereas it could be argued they would be less prudent with produce from other sources. However, it has been assumed that purchases of processed vegetables and fruit are at national average levels – anecdotal feedback from the study would suggest levels would be higher.

National Nutrition and Diet Survey (NNDS) data is based on food diaries and it is not clear to what extent, if at all waste has been allowed for. NNDS give an overall '5 a day' adult average of 4.1 portions by including juice, baked beans and pulses not included in their vegetable statistics. [NNDS, 2012 p53] The sense from this study is that there is almost certainly an over-estimation by NNDS and notes a lack of correlation between their findings and FFS data when WRAP food waste levels are applied. In terms of Canalside CSA the lesson for governmental and public health bodies is how do we learn from their example?

Table 12: Estimations of overall levels of daily F&V consumption from 3 different studies

	Veg.	FV	Proc	All	Fruit	Fruit	Total	'5 a day'
--	------	----	------	-----	-------	-------	-------	-----------

	Waste level		. Veg. <sub>1</sub>	Veg.	Waste Level		F&V	Portions
NDNS	N/A	N/A	N/A	185	N/A	100	285	3.6
FFS	30%	74	35	109	26.3%*	116	225	2.8
Canalside	6.1%	230	47	277	6.1%*	148*	425	5.3

\*Fruit waste based on WRAP data [WRAP, 2008 p33]; \*\*Fruit purchased based on FFS data. 1. Processed veg. based on FFS data

### 3.6 NET YIELD EFFICIENCY [NYE]

In section 1.1.5 a hypothetical scenario was set out comparing what the author terms 'net yield efficiency.' This term reflected the standpoint that food production and food consumption do not exist in isolation of each other, they are part of the inter-linked process that forms a food system. The final question that this research asked was: allowing for accepted yield differentials, could an agroecological local food system still out-perform the supermarket food system.

The evidence displayed in table 12 suggests that the scenario painted in table 2 may even have under-estimated Canalside's NYE. This research suggests that from the same acreage a complete agroecological food system, as exemplified by Canalside CSA, is 20 – 40% more efficient than conventional farming and the supermarket food system.

Table 13 hypothetical scenario comparing NYE -updated

Farm type	Field yield (t)	Field losses (t) % and crop left		Supermarket supply chain losses (t)		Consumer waste (t)	Net yield
Organic CSA	800 (a)	5%	760	0.65% [0%]	755 [760]	6.1% [10%]	<b>709</b> [684]
Convention grower –good year with supermarket demands	1000	5%	950	15% (b)	807.5	30%	<b>565.25</b>
Conventional grower using study Figures [bad year]	1000	5%	950	36% [30%] (c)	608 [665]	30%	<b>426</b> [465.5]

Figures in red are from table 2

Agro-ecologists have generally focused on the wide range of different advantages low input farming has to offer such as: much reduced 'external' costs – estimated to be only 25% of conventional agriculture [Pretty, 2000], building long-term soil fertility, reduced GHG emissions and opportunities for carbon sequestration, greater biodiversity and healthy produce. The author believes that the scale of waste savings in the agroecological food system not only add food waste reduction to that list but also NYE.

## 4.0 CONCLUSIONS AND RECOMMENDATIONS

### 4.1 CONCLUSION

*The qualities of food –both aspects such as taste and the meanings that it carries such as commitment to community –shape how foods will be treated: the care with which they will be cooked, whether they will be thoughtlessly wasted or whether they will be shared, lovingly, with others. Whilst some of these qualities, such as taste, may be inherent to the food, other qualities are socially constructed and brought to foods by consumers because of their priorities and the relationships they have with producers and others.*  
[Kneafsey, 2008 p156]

The relationships that Kneafsey describes are central to Canalside and at the heart of an agroecological approach to food systems. The UK supermarket food system has quite consciously built up a huge barrier between consumer and producer and both are, to a large part, puppets dancing to the supermarkets' tune.

In the drive to feed the world in the 21<sup>st</sup> Century, the corporate voice is all too dominant whether it is Tesco, PepsiCo or Monsanto. The cry is simply: more, more, more: more high energy inputs, more low nutrient outputs and more waste – and all with huge knock-on consequences socially and environmentally. This small study, looking at one local food scheme feeding 149 families gives a glimpse of a better way of doing things. Understanding food systems in their entirety includes consumer actions and behaviours. The supermarkets have a huge influence on consumer behaviour –they devote £ millions in doing so and as a result wastefulness is endemic and our diets are increasingly lacking in essential micronutrients whilst over-flowing with fat, sugar and salt.

FLW and FQLW are embedded in the developed world food system – with estimated overall pre-consumer food losses in Europe and North America that exceed 4 of the 5 other regions of the world. [FAO, 2011 p5] With the technologies available to 21st Century farmers, food producers and retailers such levels of FLW are simply inexcusable and, it would seem, an essential part of the food system. And, when one adds on consumer food waste it is hard but to conclude that the system is indeed dysfunctional and in need of radical re-appraisal.

As figure 2 shows, the UK produces or imports approximately twice as much food as it needs – whilst this may suit the supermarkets and the corporate food producers – it is very little benefit to the rest of us who pick up the tab for wasted energy, land and water, waste disposal costs, unnecessary GHG emissions and a huge, diet related, health bill.

## **4.2 RECOMMENDATIONS**

A full research study is carried out working with a number of UK CSAs to systematically evaluate:

- Levels of AFW, not just from CSA shares but all food waste
- The overall diet and health of CSA members

And:

- That community linked public bodies especially those with a health remit, such as hospitals and schools consider creating a form of CSA that their employees and other community members could join
- NDNS assessment of F&V consumption fully takes account of AFW
- That agroecological organisations re-evaluate the importance of FLW and FQLW as well as fully assessing the NYE of agroecological food systems

## 5.0 REFERENCES

Baranski M, Srednicka-Tober D, Volakakis N, Seal C et al [2014] 'Higher antioxidant and lower cadmium concentrations and lower incidence of pesticide residues in organically grown crops: a systematic literature review and meta-analyses' *British Journal of Nutrition* [online] available from <[http://www.researchgate.net/publication/263432810\\_Higher\\_antioxidant\\_and\\_lower\\_cadmium\\_concentrations\\_and\\_lower\\_incidence\\_of\\_pesticide\\_residues\\_in\\_organically\\_grown\\_crops\\_a\\_systematic\\_literature\\_review\\_and\\_meta-analyses](http://www.researchgate.net/publication/263432810_Higher_antioxidant_and_lower_cadmium_concentrations_and_lower_incidence_of_pesticide_residues_in_organically_grown_crops_a_systematic_literature_review_and_meta-analyses)> [2/8/14]

Bates, B., Lennox, A. and Swan, G. (2010), "National Diet and Nutrition Survey: Headline Results from Year 1 of the Rolling Programme (2008-09)", Food Standards Agency and the Department of Health, London.

Bond M, Meacham T, Bhunnoo R and Benton, T (2013) 'Food waste within global food systems. A Global Food Security report.' [online] available from <[www.foodsecurity.ac.uk](http://www.foodsecurity.ac.uk)> [3/8/14]

Bingham S, Cassidy A, Cole T, Welch A, (1995). 'Validation of weighed records and other methods of dietary assessment using the 24 hour urine nitrogen technique and other biological markers' [online] available from <<http://www.ncbi.nlm.nih.gov/pubmed/7794870>> [16/5/14]

Blythman, J [2004] 'Shopped – the shocking power of the British Supermarkets' Fourth Estate (Harper Collins) London

Bowen S & Wilson A [2012] 'War on Waste' [online] available from <<http://www.potato.org.uk/sites/default/files/%5Bcurrent-page%3Aarg%3A%3F%5D/Workshop%20%20-%20War%20on%20waste%20-%20Bowen%20%26%20Wilson.pdf>> [7/7/14]

Canalside [2014] 'Canalside Community Growing Scheme' [online] available from <<http://www.canalsidecommunityfood.org.uk/about-canalside/introduction/>> [9/7/14]

Defra [2012] 'Family Food 2012' Defra, London, [online] available from <[https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/265245/familyfood-2012statsnotice-12dec13.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/265245/familyfood-2012statsnotice-12dec13.pdf)> [12/6/14]

Doron, [2012], 'Waste not, want not: How fairness concerns can shift

attitudes to food waste' [online] available from<  
[http://www.fabians.org.uk/wpcontent/uploads/2012/05/Fabian\\_Waste\\_Pamphlet\\_5.12\\_web.pdf](http://www.fabians.org.uk/wpcontent/uploads/2012/05/Fabian_Waste_Pamphlet_5.12_web.pdf)> [23/7/14]

EU [2012] 'EU Marketing Standards for fresh fruit and vegetables', [online] available from<  
[http://ec.europa.eu/agriculture/fruit-and-vegetables/marketing-standards/index\\_en.htm](http://ec.europa.eu/agriculture/fruit-and-vegetables/marketing-standards/index_en.htm)> [3/8/14]

FAO [2011], 'Global Food Losses and Food waste', [online] available from<  
<http://www.fao.org/docrep/014/mb060e/mb060e00.pdf>> [14/7/14]

FAO [2014] 'Food balance sheets' [online] available from<  
<http://faostat.fao.org/site/368/default.aspx#ancor> [3/8/14]

FIAN [2014], 'G8 New Alliance for Food Security and Nutrition in Africa', [online] available from<  
[http://www.fian.org/fileadmin/media/publications/2014\\_G8NewAlliance\\_screen.pdf](http://www.fian.org/fileadmin/media/publications/2014_G8NewAlliance_screen.pdf)> [29/7/14]

Foresight [2011], 'The Future of Food and farming' [online] available from<  
<https://www.gov.uk/government/publications/future-of-food-and-farming>> [22/6/14]

FSA [2008], 'Consumer Attitude to Food standards' FSA, London, [online] available from<  
<http://tna.europarchive.org/20130513091226/http://www.food.gov.uk/news-updates/news/2010/jan/trackerdec09>> [11/8/14]

Friends of the Earth (FoE) [2002] 'Supermarkets and Great British fruit', [online] available from  
[http://www.foe.co.uk/sites/default/files/downloads/supermarket\\_british\\_fruit.pdf](http://www.foe.co.uk/sites/default/files/downloads/supermarket_british_fruit.pdf) [4/8/14]

Garnett T, [2008] 'Cooking up a Storm' Food Climate Research Network, University of Surrey [online] available from<  
[http://www.fcrn.org.uk/sites/default/files/CuaS\\_web.pdf](http://www.fcrn.org.uk/sites/default/files/CuaS_web.pdf)> [23/6/14]

Gleissman S, [2007], ' Agroecology: The Ecology of Sustainable Food Systems', Taylor and Francis US

Guardian, The [2014] 'UK future food security threatened by complacency, MPs warn [online] available from<  
<http://www.theguardian.com/environment/2014/jul/01/uk-food-security-threatened-complacency-mps-report>>

Gustafsson K, Jonson G, Smith D, Sparks L [2009] 'Retailing Logistics and

fresh Food Packaging', Kogan Page, London

Hall J & Tolhurst I, (2006), 'Growing Green' The Vegan Organic Network, Altrincham UK

HLPE,[2014], 'Food losses and waste in the context of sustainable food systems. A report by the High Level Panel of Experts on Food Security and Nutrition of the Committee on World Food Security, Rome 2014' [online] available from<<http://www.fao.org/cfs/cfs-hlpe/en/>> [2/8/14]

HSCIC, [2014] 'Statistics on obesity, physical activity and diet, England 2014' [online] available from< <http://www.hscic.gov.uk/catalogue/PUB13648/Obes-phys-acti-diet-eng-2014-rep.pdf>

IAASTD [2009] 'Agriculture at a crossroads' IAASTD  
[http://apps.unep.org/publications/pmtdocuments/-Agriculture%20at%20a%20crossroads%20-%20Synthesis%20report-2009Agriculture\\_at\\_Crossroads\\_Synthesis\\_Report.pdf](http://apps.unep.org/publications/pmtdocuments/-Agriculture%20at%20a%20crossroads%20-%20Synthesis%20report-2009Agriculture_at_Crossroads_Synthesis_Report.pdf)  
[17/7/14]

IBIS [2014] independent food retailers [online] available from<  
<http://www.ibisworld.co.uk/market-research/fruit-vegetable-retailers.html>  
[1/8/14]

IFOAM [2014] 'Definition of Organic Agriculture' [online] available from<  
<http://infohub.ifoam.org/en/what-organic/definition-organic-agriculture>>  
[2/6/14]

Institute of Mechanical Engineers [2013] 'Global Food waste Not, Want Not.' [online] available from  
<http://www.imeche.org/knowledge/themes/environment/global-food> [6/7/14]

Kummu M, de Moel H, Porkka M, Siebert S, et al, [2012] 'Lost food, wasted resources: Global food supply chain losses and their impacts on freshwater, cropland, and fertiliser use' [online] available from< [http://www.wdrg.fi/wp-content/uploads/2012/10/kummu\\_et\\_al\\_2012\\_lost\\_food\\_wasted\\_resources\\_STOTEN.pdf7C772EA7](http://www.wdrg.fi/wp-content/uploads/2012/10/kummu_et_al_2012_lost_food_wasted_resources_STOTEN.pdf7C772EA7)> [21/7/14]

Lichtman S, Pisarska K, Berman E, Pestone M, et al [1992] 'Discrepancy between self-reported and actual caloric intake and exercise' [online] available from< <http://www.ncbi.nlm.nih.gov/pubmed/1454084>> [4/8/14]

Lundqvist J, de Fraiture C and Molden D [2008] 'Saving Water: From Field to Fork – Curbing Losses and Wastage in the Food Chain.' SIWI Policy Brief. [online] available from  
<[http://www.sivi.org/documents/Resources/Policy\\_Briefs/PB\\_From\\_Filed\\_to\\_Fork\\_2008.pdf](http://www.sivi.org/documents/Resources/Policy_Briefs/PB_From_Filed_to_Fork_2008.pdf)> [27/7/14]

Newcastle University [2014] 'New study finds significant differences between organic and non-organic food' [online] available from <<http://www.ncl.ac.uk/press.office/press.release/item/new-study-finds-significant-differences-between-organic-and-non-organic-food>> [1/8/14]

NHS [2010], '5 A Day – What's it all about?' Department of Health , London

NDNS [2013] 'National diet and Nutrition survey 2013' Department of Health [online] available from<  
[https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/207708/NDNS-Y3-report\\_All-TEXT-docs-combined.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/207708/NDNS-Y3-report_All-TEXT-docs-combined.pdf)> [2/8/14]

NHS<sub>1</sub>, [2014] 'What should my daily intake of calories be?' [online] available from<<http://www.nhs.uk/chq/pages/1126.aspx?categoryid=51>> [5/8/14]

NHS<sub>2</sub>, [2014] 'How many calories does a child 7 – 10 need?' [online] available from<<http://www.nhs.uk/chq/Pages/how-many-calories-do-children-need.aspx?CategoryID=51>> [12/8/14]

Parfitt J, Barthel M, MacNaughton S, (2010) 'Food waste within food supply chains: quantification and potential for change to 2050' [online] available from<  
[rstb.royalsocietypublishing.org/content/365/1554/3065.full](http://rstb.royalsocietypublishing.org/content/365/1554/3065.full)> [5/7/14]

Pinkerton T & Hopkins R (2009), 'Local Food' Green Books, Totnes Devon UK

De Ponti T, Rijk B, Van Ittersum M (2012) 'The crop yield gap between organic and conventional agriculture' Plant Production Systems, [online] available from<  
[https://www.wageningenur.nl/upload\\_mm/9/a/9/4eff5e4c-0058-4fac-9441-288b83a105d4\\_The%20crop%20yield%20gap%20between%20organic%20and%20conventional%20agriculture%20De%20Ponti%20et%20al%202012.pdf](https://www.wageningenur.nl/upload_mm/9/a/9/4eff5e4c-0058-4fac-9441-288b83a105d4_The%20crop%20yield%20gap%20between%20organic%20and%20conventional%20agriculture%20De%20Ponti%20et%20al%202012.pdf)>  
[27/7/14]

Pretty J, Brett G, Gee D, Hine R, et al (2000). 'An assessment of the total external costs of UK agriculture'. Agricultural Systems 65: 113-136.

Quartermaster [2014] 'Table of conversion factors for converting edible portion weights of food to 'as purchased' weights of foods: vegetables' [online] available from  
<[http://www.quartermaster.army.mil/jccoe/publications/recipes/section\\_a/a006.pdf](http://www.quartermaster.army.mil/jccoe/publications/recipes/section_a/a006.pdf)> [22/7/14]

Sainsbury's [2013] 'Annual report and financial statement' [online] available from<[http://www.j-sainsbury.co.uk/media/1616189/sainsburys\\_ara.pdf](http://www.j-sainsbury.co.uk/media/1616189/sainsburys_ara.pdf)>  
[7/8/14]

Soil association [2014], 'Community Supported Agriculture' [online] available from <http://www.soilassociation.org/comunitysupportedagriculture> [12/6/14]

Smil V (2010) 'Improving Efficiency and Reducing Waste in Our Food System', *Environmental Sciences*, 1:1, 17-26 [online] available from <<http://www.vaclavsmil.com/publications/>

Sonesson U, Anteson F, Davis J, Sjöden P. [2005] '*Home Transport and Wastage: Environmentally Relevant Household Activities in the Life Cycle of Food*'. *Ambio* 2005 Jun; 34(4-5) 371-5

Stolze M., Piorr A., Härring A., Dabbert S. [2000.] 'The environmental impacts of organic farming in Europe.' *Organic Farming in Europe: Economics and Policy*; Volume 6. P143 University of Hofenheim, Stuttgart, Germany. [online] available from <<https://www.unihohenheim.de/i410a/ofeurope/organicfarmingineurope-vol6.pdf>> [9/2/14]

Stuart T [2009] 'Waste – uncovering the global food scandal' Penguin Books, London UK

Stuart T [2012] 'Waste' [online] available from <[www.tristramstuart.co.uk/FoodWasteFacts.htm](http://www.tristramstuart.co.uk/FoodWasteFacts.htm) [7/4/14]> [5/7/14]

Tansey G & Worsley T [1995] 'The Food System – A Guide' Earthscan Publications, London UK

UK Statistics [2014] 'Market share of grocery stores in Great Britain' [online] available from <<http://www.statista.com/statistics/279900/grocery-market-share-in-the-united-kingdom-uk/>> [7/7/14]

UNCTAD [2013] 'Wake up before it's too late' Trade and Environmental Review 2013 online] available from <http://unctad.org/en/pages/PublicationWebflyer.aspx?publicationid=666>> [2/6/14]

UNECE [2010] 'UNECE Standard FFV – 10 Carrots', [online] available from <[http://www.unece.org/fileadmin/DAM/trade/agr/standard/fresh/FFV-Std/English/10Carrots\\_2010.pdf](http://www.unece.org/fileadmin/DAM/trade/agr/standard/fresh/FFV-Std/English/10Carrots_2010.pdf)> [3/8/14]

USDA [2014], 'Estimated Calorie needs per day table', [online] available from <http://www.health.gov/dietaryguidelines/dga2010/dietaryguidelines2010.pdf> [2/8/14]

Walsh, S [2003], 'Plant Based Nutrition and Health' The Vegan Society, St. Leonards, Sussex UK

WHO<sub>1</sub> [2014] 'Food Security' [online] available from <[www.who.int/trade/glossary/story028](http://www.who.int/trade/glossary/story028)> [7/4/14]

WHO<sub>2</sub> [2014] 'Obesity and Overweight' [online] available from [www.who.int/mediacentre/factsheets/fs311](http://www.who.int/mediacentre/factsheets/fs311) [7/4/14]

WRAP<sub>1</sub> [2007] 'Understanding Food Waste' [online] available from <[http://www.wrap.org.uk/sites/files/wrap/FoodWasteResearchSummaryFINALADP29\\_3\\_07.pdf](http://www.wrap.org.uk/sites/files/wrap/FoodWasteResearchSummaryFINALADP29_3_07.pdf)> [24/7/14]

WRAP [2008] 'The food we waste' [online] available from <<http://www.ifr.ac.uk/waste/Reports/WRAP%20The%20Food%20We%20Waste.pdf>> [24/7/14]

WRAP [2009] 'Household food and drink waste in the UK' [online] available from <[http://www.wrap.org.uk/sites/files/wrap/Household\\_food\\_and\\_drink\\_waste\\_in\\_the\\_UK\\_-\\_report.pdf](http://www.wrap.org.uk/sites/files/wrap/Household_food_and_drink_waste_in_the_UK_-_report.pdf)> [24/7/14]

WRAP [2011] 'Fruit and Vegetable Resource Map'[online] available from <[http://www.wrap.org.uk/sites/files/wrap/Resource\\_Map\\_Fruit\\_and\\_Veg\\_final\\_6\\_june\\_2011.fc479c40.10854.pdf](http://www.wrap.org.uk/sites/files/wrap/Resource_Map_Fruit_and_Veg_final_6_june_2011.fc479c40.10854.pdf)>

## 6.0 APPENDICES

### APPENDIX 1: HOUSEHOLD WASTE STUDY RESULTS

#### APPENDIX 1.1 VEGETABLE SHARE SIZES

The size of shares varies from week to week, indeed there will even be some small variation in the same week on the 3 different pick-up days. Canalside members pay the same every month for their type of shares. In value terms this evens out over the year with peak produce typically August – November and May – June being the lowest. Giving the medium share a value of 1, a large share approximates to 1.5 and a small share to 0.67.

Table 14 – Canalside households and share size July 2014

Veg. share size	Households	Medium equivalent share
Small	61	40.5
Medium	73	73
Large	15	22.5
Total	149	136

#### APPENDIX 1.2: STUDY GROUP 1 (Weeks 1 and 2 of the study June 24<sup>th</sup> to July 8<sup>th</sup>)

Study group 1 comprised 9 medium shares and 6 small shares, a total of 15 participants

Table 15: Size and make up of veg. shares Group 1 – Medium shares

Weight (grams)	Week 1	Week 2	Weight (grams)	Week 1	Week 2
Carrots	300	300	Beetroot	300	500
Chard	180	0	Broad Beans	400	840
Coriander	100	0	Mushrooms	110	120
Cucumber	500	650	Onions	400	400

Lettuce	300	300	Sugar Snap Peas	120	150
Spring Onions	150	150	Calabrese	0	200
			Total	2860	3610

Table 16: Size and make up of veg. shares Group 1 – Small shares

Weight (grams)	Week 1	Week 2	Weight (grams)	Week 1	Week 2
Carrots	200	200	Beetroot	200	335
Chard	120	0	Broad Beans	260	560
Coriander	60	0	Mushrooms	70	80
Cucumber	350	350	Onions	260	260
Lettuce	200	200	Sugar Snap Peas	80	100
Spring Onions	100	100	Calabrese	0	120
			Total	1900	2305

### Appendix 1.2.1 Group 1 Estimated Edible Portion

Table 17: Estimated Edible Portion of weekly veg. shares Group1 (calculated as 80% of total)

Weight (g)	Medium total	Medium Edible	Small total	Small Edible
Week 1	2860	2290	1900	1520
Week 2	3610	2890	2305	1844
Total	6470	5180	4205	3364

### Appendix 1.2.2 Group 1 Waste

Table 18: Group 1 participants – medium shares; waste record

Group 1 med. Weight (g)	Week 1 total waste	Week 1 AFW	Week 2 total waste	Week 2 AFW	Combined total waste	Combined AFW	AFW as % of edible portion*
1	400	50	1400	180	1800	230	4.4%
2	620	150	1550	500	2170	650	12.5%
3	270	210	1160	260	1430	470	9.1%
4	485	100	825	70	1310	170	3.3%
5	295	0	490	20	785	20	0.4%
6	480	80	655	70	1135	150	2.9%
7	435	70	1010	150	1445	220	4.2%
8	405	80	730	70	1135	150	2.9%
9	800	650	1045	210	1845	860	16.6%

\* Group 1 medium share edible portion = 5180g

Table 19: Group 1 participants – small shares; waste record

Group 1 weight (g)	Week 1 total waste	Week 1 AFW	Week 2 total waste	Week 2 AFW	Combined total waste	Comb. AFW	AFW as % of edible portion*
10	350	100	580	150	930	250	7.4%
11	745	150	830	200	1575	350	10.4%
12	485	400	70	20	555	420	12.5%
13	455	150	630	250	1085	400	12%
14	140	0	105	0	245	0	0%
15	970	160	715	240	1685	400	11.9%

\* Group1 small share edible portion = 3364g

Table 20: Group1 – combined total of all waste as % of combined total share

Group 1 Weight (g)	Number of participants	Total 2 week share	Total all 2 week shares	Total all waste	Total all waste as %
Medium	9	6470	58230	12055	20.7%
Small	6	4205	25230	6075	24.1%
Combined	15		83460	19130	22.9%

Table 21: Group 1 – combined estimated edible waste as % of combined edible food

Group 1 weight (g)	Number of participants	Total 2 week edible share	Total all 2 week edible shares	Total all edible waste	Total all AFW as % of edible food
Medium	9	5180	46620	2920	6.3%
Small	6	3364	20184	1820	9.0%
Combined	15		66804	4740	7.1%

### **APPENDIX 1.3 STUDY GROUP 2 (Weeks 3 and 4 of the study July 12<sup>th</sup> to July 26<sup>th</sup>)**

Study group 2 comprised 1 large share, 6 medium shares and 6 small shares, a total of 13 participants.

Table 22A: Large veg.share Group 2, approximately 50% bigger than a medium share – same proportional contents

	Week 3 total weight	Week 4 total weight
Large veg. share*	6725	6005

\* As there is only one large share in the sample it is not deemed to representative of all large share members

Table 22B: Size and make-up of veg. shares Group 2 – Medium Share

Weight (grams)	Week 3	Week 4	Weight (grams)	Week 3	Week 4
Chard	200	170	Broad Beans	600	540
Coriander	100	100	Kale	300	300
Cucumber	1200	1200	Fennel	100	0
Lettuce	300	300	Onions	400	400
Tomatoes	150	150	Potatoes	600	600
Sugar Snap Peas	0	120			
			Total	4350	3880

Table 23: Size and make-up of veg. shares Group 2 – Small Share

Weight (grams)	Week 3	Week 4	Weight (grams)	Week 3	Week 4
----------------	--------	--------	----------------	--------	--------

Chard	140	110	Broad Beans	400	360
Coriander	70	70	Kale	200	200
Cucumber	800	800	Fennel	70	0
Lettuce	200	200	Onions	260	260
Tomatoes	100	100	Potatoes	400	400
Sugar Snap Peas	0	80			
			Total	2870	2580

### Appendix 1.3.1 Group 2: Estimated Edible Portion

Table 24: Estimated edible portion of weekly veg. shares Group 2 (calculated as 80% of total)

Weight (g)	Large total	L. edible	Med. total	Med. edible	Small total	Small edible
Week 3	6725	5380	4350	3480	2870	2300
Week 4	6005	4800	3880	3100	2580	2065
Total	12730	10180	8230	6580	5450	4365

### Appendix 1.3.2 Group 2: Waste

Table 25: Group2 – Large and medium shares waste record

Group 2 Large/medium Weight (g)	Week 3 total waste	Week 3 AFW	Week 4 total waste	Week 4 AFW	Combined total waste	Combined AFW	AFW as % of edible portion*
16 [large.]	970	20	725	20	1695	40	0.4%
17 [med.]	415	0	230	30	645	30	0.45%
18 [med.]	770	180	690	40	1460	220	3.3%
19 [med.]	795	325	255	80	1050	405	6.2%
20 [med.]	560	170	390	130	950	300	4.6%
21 [med.]	650	55	515	80	1065	135	2.1%
22 [med.]	600	380	1435	300	2035	680	10.3%

\*Group 2 large share edible portion = 10180g, medium share edible portion = 6580g (table 23)

Table 26: Group 2 – Small shares waste record

Group 2 small weight (g)	Week 3 total waste	Week 3 AFW	Week 4 total waste	Week 4 AFW	Combined total waste	Combined AFW	AFW as % of all edible food *
23	730	50	315	20	1045	70	1.6%
24	990	350	620	30	1610	380	8.7%
25	560	90	355	30	915	120	2.7%
26	370	60	290	170	1225	230	5.3%
27	780	15	245	40	615	55	1.3%
28	415	70	630	150	1410	220	5.0%

\* Group 2 small share edible portion total = 4365g (see table 23)

Table 27 Group 2 Combined total waste as % of combined total share

Group 2 Weight (g)	Number of participants	Total 2 week share	Total all 2 week shares	Total all waste	Total all waste as %
Large	1	12730	12730	1695	13.3%
Medium	6	8230	49380	7205	14.6%
Small	6	5450	32700	6820	20.9%
			94810	15720	16.6%

Table 28: Group 2 Combined estimated edible waste as % of combined edible food

Group 2 Weight (g)	Number of Participants	Total 2 week edible share	Total all 2 weeks edible shares	Total all AFW	Total all AFW as % of edible food
Large	1	10180	10180	40	0.4%
Medium	6	6580	39360	1770	4.5%
Small	6	4365	26190	1075	4.1%
Combined	13		75630	2885	3.8%

## APPENDIX 1.4: WASTE, ALL PARTICIPANTS

Table 29: All participants – combined totals waste and AFW as %

Both groups Weight (g)	No. of participants	Total of weight of all shares	Total of all waste	Total all waste as % of total	Total edible food	Total AFW	Total AFW as % of all edible food
Large	1	12730	1695	13.3%	10180	40	0.4%
Medium	15	107610	19260	17.9%	85980	4690	5.5%
Small	12	57930	12895	22.3%	46374	3895	8.4%
<b>Combined</b>	<b>28</b>	<b>178270</b>	<b>33850</b>	<b>19%</b>	<b>142534</b>	<b>8625</b>	<b>6.1%</b>

## APPENDIX 1.5 EXIT INTERVIEW DATA

Table 30: Exit interview responses

Participant share size	Adults in household	Children 11 - 16	Children 5 -11	Fresh veg. consumed from other sources	Vegan or vegetarian	Influence of CSA on food waste
Small	2	0	0	+0-10%	no	Major
Small	2	0	0	+ 25%	no	Major
Small	1	0	0	+ 25%	no	Not really
Medium	2	1	1	+ 50%	no	Major
Small	1	0	0	+ 10%	no	Major
Medium	2	0	2	+ 10%	no	Minor
Small	2	0	0	+ 0-10%	no	Not really
Small	1	0	0	+ 25%	no	Minor
Large	2	3	0	+ 20%	no	Minor
Medium	2	0	0	+ 33%	no	Major

Medium	2	0	0	+ 50%	no	Minor
Small	2	0	0	+ 50%	1/2	Major
Small	2	0	0	+ 50%	no	Major
Medium	2	0	3	+ 100%	no	Minor
Medium	1	0	0	+ 0-10%	yes	Major
Medium	2	0	0	?	?	?
Medium	2	0	0	?	?	?
Medium	2	0	0	?	?	?
Totals 18	32	4	6	+ 31%	@ 10%	85% *

\* Major and Minor influence responses combined

## APPENDIX 2 TOTAL CONSUMABLE FOOD CHAIN WASTE

### APPENDIX 2.1 ON FARM WASTE

Table 31: On farm waste

Veg. type	Week1	Week 2	Week3	Week 4	Total
Carrots	300g	500g	700g		1.5k
Chard	1000g			500g	1.5k
Coriander	500g			1500g	2k
Kale				1000g	1k
Lettuce	1000g	3000g	1000g	700g	5.7k
Total	2800g	3500g	1700g	3700g	11.7k

Note: Rather than taking the working assumption of edible food being 80% of total produce, given the low waste typical of the waste vegetables in table 31; edible food is assumed to be 90%. This gives 10.5k of AFW.

Total produce for all 149 households during 4 weeks trial period

## APPENDIX 2.2: TOTAL HARVESTABLE CROP

Table 32A: total harvestable crop during 4 weeks study period

	No. of shares	Edible weight of 1 share over 4 weeks	Combined edible weight	total weight of share over 4 weeks	Combined total weight
Large	15	17.95k	269.25k	22.4k	336k
Medium	73	11.76k	858.48k	14.7k	1073k
Small	61	7.73k	471.53k	9.65k	589k
Total	149		1599.26k		1998k

Table 32B: farm waste as % of total produce

	All shares	'Extras' as waste	All produce	Farm waste as %
Edible produce	1599k	10.5k	1609.5k	0.65%
Total produce	1998k	11.7k	2009.7k	0.58%

## APPENDIX 2.3: CANALSIDE MICRO-FOOD SYSTEM TOTAL WASTE

Table 33: Canalside food system waste

	All produce	On farm waste	On farm waste %	Household waste	Household waste %	Total system waste	Total Waste %
Edible produce	1609.5k	10.5k	0.65%	97.5k	6.1%	108k	6.7%
Total produce	2009.7k	11.7k	0.58%	379.5k	19%	391.2k	18.9%

## APPENDIX 3: FRESH VEGETABLE [FV] CONSUMPTION

### APPENDIX 3.1

#### Average weekly household FV and Leafy Green Vegetables [LGV] consumption calculation process:

During the 4 weeks study period the weight of all three share sizes, less potatoes and waste, were totaled:

##### Appendix 3.1.1 Edible Large shares (ELS)

ELS total weight for 4 weeks = 17.95 kilos\* [less potatoes (1.80k)] = 16.15k  
Less average waste at 6.1% = 15.165k (of which LGV = 3951g)

\* Edible shares weeks 3 & 4 = 10180g; weeks 1 & 2 from Canalside records = 7770g (large share approx. 1.5 x medium share)

Total consumption of FV per large share p/w = 3791g  
(LGV = 988g p/w)  
FV = 542g p/d = 6.8 x '5 a day' portions p/household  
(LGV = 141g p/d)

### **Appendix 3.1.2 Edible Medium shares (EMS)**

EMS total weight for 4 weeks = 11.76 kilos [less potatoes (1.2k)] = 10.56k  
Less average waste at 6.1% = 9.916k (of which LGV = 2634g)

Total consumption of FV per medium share p/w = 2479g  
(LGV = 658g p/w)  
FV = 354g per/d = 4.4 x '5 a day' portions p/household  
(LGV = 94g p/d)

### **Appendix 3.1.3 Edible Small shares (ESS)**

ESS total weight for 4 weeks = 7.729kilos [less potatoes (0.8k)] = 6.929k  
Less average waste at 6.1% = 6.506k (of which LGV = 1756g)

Total consumption of FV per small share p/w = 1626g  
(LGV = 439g p/w)  
FV = 232g p/d = 2.9 x '5 a day' portions p/household  
(LGV = 63g p/d)

### **Appendix 3.1.4 Average FV Consumption for all Canalside Households**

The 149 households collecting FV during the study included:

Large shares (15):

Total average weekly consumption of FV = 15 x 3791g = 56865g (14820 LGV)

Medium shares (73):

Total average weekly consumption of FV = 73 x 2479 = 180967g (48034 LGV)

Small shares (61):

Total average household weekly consumption of FV = 61 x 1626 = 99186g  
(26779 LGV)

Total average ALL household weekly FV consumption for all shares during

study period = 56825g + 180967g + 99186g = 337018g  
 Total average ALL household weekly LGV = 14820g + 48034g + 26779g = 89633g

FV average p/household = 337018g/149 = 2262g;  
 LGV: average p/household = 89633/149 = 602g

Average household weekly FV consumption = 2262g, of which 602g = LGV

### **Appendix 3.1.5 Household to per Person conversion**

Converting per household figure to per person figure based on 40.5 adult equivalent people in 18 households.\*

Average Canalside household size = 40.5 /18 = 2.25

[\*Table 30; child 5 – 10 counted as 0.75 and 11 – 16 as adult equivalent NHS, 2014 average calorie intake of boys and girls 7 – 10 (1552g/2000g) ]

FV = 2262g/2.25 = 1005g  
 LGV = 602g/2.25 = 266g

#### **3.1.5.1 Conversion to '5 a day' portions**

Average FV consumption per person p/w = 1005g = 12.6 x 80g portions per person per week

Average LGV consumption per person p/w = 266g - 3.3 portions of fresh greens

### **3.1.6 Average daily amount of FV and LGV and '5 a day' portions**

FV = 1005g/7 = 144 g = 1.8 portions per person p/d

LGV = 266g/7 = 38g =0.4 portions per person p/d

### **3.1.7 Adjusting FV consumption for seasonal variations in size of share**

Table 34: Estimated annual average weight of weekly medium shares based on sample shares across the year – the average weekly share was 1.22 x greater than the study period average.

Month	Mar. '13	May '13	July '13	Sept. '13	Nov. '13	Jan. '14	July '14*	Total	Av. Weight
Weight	4.1k	2.8k	4.3k	5.5k	7.0k	4.0k	3.7k	31.4k	4.5k

\* average weight during study [3.7k]

Allowing for same waste ratio and deducting same proportion of potatoes, it can be estimated that average daily FV consumption over the calendar year would also 1.22 x greater.

Estimated annual average FV per person p/d:

$$\underline{144 \text{ g} \times 1.22 = 176\text{g}}$$

$$\underline{176\text{g} = 2.2 \text{ portions}}$$

Estimated annual average LGV per person p/d:

$$\underline{38 \times 2.2 = 46\text{g}}$$

$$\underline{46\text{g} = 0.575 \text{ portions}}$$

Compared to national average of 73.5g or 0.92 portions of FV per person p/d and 18g or 0.225 portions of LGV.

Consumption of FV from Canalside alone = 2.4 x national average and LGV  
2.6 x national average

**APPENDIX 4: TABLE FOR CONVERTING 'AS PURCHASED' PORTIONS OF VEGETABLES TO 'EDIBLE' PORTIONS. [source Quartermaster 2014]**

**TABLE OF CONVERSION FACTORS FOR CONVERTING "EDIBLE PORTION" WEIGHTS OF FOODS TO "AS PURCHASED" WEIGHTS OF FOODS**

**VEGETABLES**

The E.P. (Edible Portion) weight of all vegetables, unless otherwise specified, is used in the recipes. This table lists raw items and easy, one-step conversion factors to determine how much A.P. (As Purchased) weight of vegetables to process.

To use these factors, multiply the E.P. quantity of ingredients listed in the recipe by the appropriate conversion factor given below to arrive at the quantity of the item (A.P.) to process.

EXAMPLE: 3 lb sliced cucumbers (pared) E.P. (ingredient weight) x 1.19 (conversion factor) = 3.57 lb (3 lb 9 oz) fresh cucumbers A.P. The E.P. quantity may be determined from an A.P. quantity by dividing the A.P. by the conversion factor as follows:  
3.57 lb (3 lb 9 oz) fresh cucumbers A.P. ÷ 1.19 (conversion factor) = 3 lb cucumbers (pared) E.P.

	Conversion Factor E.P. to A.P.		Conversion Factor E.P. to A.P.
<b>VEGETABLES, FRESH:</b>			
Alfalfa sprouts . . . . .	1.00	Cabbage (trimmed) . . . . .	1.16
Asparagus (trimmed) . . . . .	1.89	Cabbage (trimmed and cored) . . . . .	1.25
Beans, green, whole (trimmed) . . . . .	1.14	Carrots (peeled) . . . . .	1.22
Bean sprouts . . . . .	1.00	Cauliflower (trimmed and cored) . . . . .	1.20
Broccoli (trimmed) . . . . .	1.64	Celery (trimmed) . . . . .	1.37
Broccoli, flowerets (trimmed) . . . . .	2.20	Celery leaves . . . . .	34.48
Brussels sprouts (trimmed) . . . . .	1.11	Corn-on-Cob (husked and silked) . . . . .	1.43
		Cucumbers (peeled and seeded) . . . . .	1.67

CH-1

(OVER)

Item	Conversion Factor E.P. to A.P.	Item	Conversion Factor E.P. to A.P.
Cucumbers (pared) . . . . .	1.19	Pea pods, Chinese, snow (trimmed) . . . . .	1.06
Cucumbers (unpared) . . . . .	1.05	Peppers, sweet (stemmed, seeded, cored)	1.22
Eggplant (pared) . . . . .	1.23	Peppers, sweet (stemmed, seeded, ends removed)	2.08
Eggplant (unpared) . . . . .	1.03	Potatoes, white (pared) . . . . .	1.23
Endive (trimmed) . . . . .	1.11	Potatoes, sweet (pared) . . . . .	1.25
Escarole (trimmed) . . . . .	1.11	Radishes (trimmed) . . . . .	1.09
Garlic, dry (peeled) . . . . .	1.15	Romaine (trimmed) . . . . .	1.06
Greens, collard (trimmed) . . . . .	1.35	Rutabagas (pared) . . . . .	1.18
Greens, kale (trimmed) . . . . .	1.41	Spinach (trimmed) . . . . .	1.09
Lettuce (trimmed and cored) . . . . .	1.08	Squash, summer (trimmed & unpared)	1.05
Mushrooms, sliced (trimmed) . . . . .	1.10	Squash, fall and winter:	
Mushrooms, whole (trimmed) . . . . .	1.10	Acorn (seeded) . . . . .	1.15
Onions, dry (peeled) . . . . .	1.11	Butternut (pared and seeded) . . . . .	1.19
Onions, green with tops (trimmed) . . . . .	1.20	Hubbard (seeded) . . . . .	1.12
Parsley (trimmed) . . . . .	1.05	Tomatoes (stemmed) . . . . .	1.02
Parsnips (pared) . . . . .	1.18	Turnips (pared) . . . . .	1.23

**APPENDIX 5 PARTICIPANT STUDY BRIEF**

Canalside Food Waste Study

Study designed to measure the vegetable waste of Canalside CSA members.

**Please initial**

1. I confirm that I have read and understood the participant information sheet for the above study and have had the opportunity to ask questions
2. I understand that my participation is voluntary and that I am free to withdraw at any time without giving a reason
3. I understand that all the information I provide will be treated in confidence
4. I understand that I also have the right to change my mind about participating in the study for a short period after the study has concluded (cut off 31<sup>st</sup> July)
5. I agree for anonymised quotes to be used as part of the research project
6. I agree to take part in the research project

Name of participant: .....

Signature of participant: .....

Date: .....

Name of Researcher:.....

Signature of researcher: .....

Date:.....

**APPENDIX 6 PARTICIPANT INFORMATION SHEET**

## Food Waste Study: Participant Information Sheet

### 1. What is the purpose of the study?

The study is designed to measure the vegetable waste of Canalside CSA members. It will be combined with data about Canalside 'on-farm' waste to get an overall figure for waste from the field to the consumer. The total producer – consumer waste at Canalside, as an example of a CSA food system, will then be compared with comparative data on food waste, particularly for vegetables.

### 2. Why have I been asked to take part?

Canalside CSA is the only community-growing scheme being studied. The study needs as many CSA members as possible to take part in the study to increase statistical validity.

### 3. Do I have to take part?

Your participation is entirely voluntary.

### 4. What do I have to do?

- You need to commit to the study for a 2 or 3 week period.
- When you collect your share you will be given a kitchen caddie to be used for veg- share waste **only** – peelings, leaves –ALL unused veg share bits.
- Do not to put in any food waste from any other source – please dispose of those as you normally would.
- It may help to store your share separately from any other vegetables.
- Also, if you have any of your veg-share left from the previous week please also put any waste in the Canalside study caddie. \* Therefore **all veg-share waste** during the 2-week period should go in the caddie.
- You will need to bring the caddie back the following week when the waste will be weighed and removed for composting while you collect that week's share.
- You will be given the caddie back so that the exercise can be repeated the following week.
- When you return the caddie at the end of the 2<sup>nd</sup> and 3<sup>rd</sup> week, the waste will be weighed and composted again. You will be asked for your thoughts about the study while you collect your veg-share.

#### **5. Will my taking part in this study be kept confidential?**

The data collected will be anonymised.

#### **6. What will happen to the results of the research study?**

The results will be used as part of my MSc Research Project in to food waste. The project itself is part an MSc in Food Security at Coventry University. Anyone who wishes to withdraw his or her data from the study can do so by contacting me.

#### **7. Who is the researcher's responsible body?**

The project has been reviewed and approved by the Faculty of Business, Environment and Society Ethics Committee at Coventry University.

#### **8. Contact for Further Information.**

Nigel Baker email: [bakern8@coventry.ac.uk](mailto:bakern8@coventry.ac.uk)

Supervisor: James Bennett email: [apy073@coventry.ac.uk](mailto:apy073@coventry.ac.uk)

- to get the most accurate measure of waste; counting in the previous week's left-over veg-share waste will offset what is not used from the 2<sup>nd</sup> week's share.

## Medium - High Risk Research Ethics Approval

Where human participants involved in the research and/or when using primary data - Staff (Academic, Research, Consultancy, Honorary & External), Students (Research & Professional degrees) and Undergraduate or taught Postgraduates directed to complete this category of risk.

Project Title

**An evaluation of Community Supported Agriculture as an alternative food system assessed in terms of net yield, food waste and fruit and vegetable consumption relative to conventional food systems**

### Record of Approval

**Principal Investigator**

I <b>request an ethics peer review</b> and confirm that I have answered all relevant questions in this checklist honestly.	X
I confirm that I will carry out the project in the ways described in this checklist. I will immediately suspend research and request new ethical approval if the project subsequently changes the information I have given in this checklist.	X
I confirm that I, and all members of my research team (if any), have read and agreed to abide by the Code of Research Ethics issued by the relevant national learned society.	X
I confirm that I, and all members of my research team (if any), have read and agreed to abide by the University's Research Ethics, Governance and Integrity Framework.	X

Name: Nigel Baker.....

Date: 07/04/2014.....

**Student's Supervisor (if applicable)**

I have read this checklist and confirm that it covers all the ethical issues raised by this project fully and frankly. I also confirm that these issues have been discussed with the student and will continue to be reviewed in the course of supervision.

Name: James Bennett.....

Date: 05/06/2014.....

**Reviewer**

Date of approval by anonymous reviewer: 12/06/2014

**STUDENT RESEARCH PROJECT RISK ASSESSMENT**

<b>Person(s) undertaking project:</b>	Nigel Baker
<b>Project supervisor:</b>	James Bennett

<b>Brief outline of project:</b> <i>Outline the types of activities that will take place or items fabricated i.e. face to face interviews, public surveys, water sampling, machining vehicle parts, brazing etc.</i>	Brief interviews with participants. No formal interviews or questionnaires.  Handing out and collecting in kitchen caddies. Weighing and composting vegetable food waste only
---	--

<b>Dates of study (from – to)</b>	June – July 2014
<b>Location(s) of activity:</b> <i>Country and specific area.</i>	

<b>Will the project involve laboratory work?</b> <i>If yes, you will be required to complete separate risk assessment(s) prior to carrying out any laboratory work.</i>	No
<b>Will the project involve workshop work?</b> <i>If yes, you will be required to complete an induction and may carry out a separate risk assessment(s) prior to carrying out any workshop work.</i>	No

<b>Will the project involve travel? (If yes, complete this section as fully as possible. The form may require review prior to travel to add missing details)</b>	<b>yes</b>
<b>Contact details at destination(s):</b>  <b>Contact details of next of kin in case of emergency:</b>	15 mile trip to Radford Semele from Warwick – a journey I do weekly anyway Helen Salisbury 01926 495425

<b>Approximate dates of travel:</b> <i>Your supervisor must have details of travel plans once confirmed.</i>	<b>During June and July</b>	
<b>Arrangements to maintain contact with the University:</b>		
<b>Emergency contact information:</b>	<b>School/Faculty contact (Daytime): 02476 .....</b> <b>24hr University contact (Protection Service): 02476 888 555</b> <b>Local healthcare/emergency services: .....</b>	
<b>Has suitable travel insurance has been obtained? (<i>Please attach a copy of certificate</i>)</b>		<b>No</b>
<b>If EU travel, has EH1C card been obtained?</b>		<b>No</b>
<b>Has advice/vaccinations from GP been sought (<i>where appropriate</i>)?</b>		<b>No</b>
<b>Are medical kits required (<i>i.e. in countries with poor healthcare facilities</i>)?</b>		<b>No</b>
<b>Are there any warnings issued by the FCO* against travel to the area?</b>		<b>No</b>
<b>Have you registered with the FCO* service LOCATE? (<i>British nationals only</i>)</b>		<b>No</b>

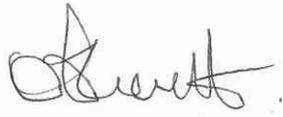
\*FCO = <http://www.fco.gov.uk/en/travel-and-living-abroad/travel-advice-by-country/>

**PLEASE USE THE HAZARD CHECKLIST AS A GUIDE WHEN COMPLETING THIS SECTION.**

Hazard	Precautions to be used
<p>Work factors:  <i>E.g.: dealing with the public, interviewing on sensitive issues, lone working, driving, working on boats, laboratory work; biological, chemical hazards etc.</i></p>	<p>I will possibly be touching vegetable waste (it should be bagged) that could be a week old. I will wear rubber gloves and there is hand washing nearby.</p>
<p>Site specific factors (in the field):  <b><i>E.g.: remote area, construction site, local endemic diseases, political unrest, terrorism risk etc.</i></b>  <i>If travel abroad see FCO* website – list any risks greater than there would be for the UK</i></p>	<p>n/a</p>
<p>Environmental factors (in the field):  <i>E.g.: extremes of temperature, altitude, weather conditions, tidal conditions, cliffs, bogs, caves, mountains etc.</i></p>	<p>n/a</p>
<p>Equipment:  <b><i>E.g.: operation of machinery, use of specialist equipment, manual handling/transportation, compressed gases, etc.</i></b></p>	<p>n/a</p>

<p>Other:  <b>Detail any special arrangements required, i.e. permissions required, accommodation, travel, catering etc.</b></p>	<p>n/a</p>
---	------------

*This assessment must be reviewed before any significant project changes are made.*

<p><b><u>Assessment carried out by:</u></b></p>  <p><b>Signature:</b>  Position: Senior Lecturer, Environmental Science  <b>Date:11/06/14</b></p>	<p><b><u>Authorisation to proceed:</u></b></p> <p><b>Signature:</b>  Position:  <b>Date:</b></p>
--	--