FoodPrinting Oxford

How to feed a City

LOW CARBON OXFORD
















Food has always played a central part in human activities and culture though the focus of attention has shifted radically in recent decades. For most of human history concerns about the security of food supply occupied individuals, societies and nations, and even when food was available its quality, unless you were very rich, was frequently awful. Much, though not all, of food was produced locally, and most people knew intimately how food was grown and processed. Today in the UK we spend about 11% of our income on food, a lower percentage than at any time in history. A frightening fraction of children know little about where food comes from, some unaware that meat comes from animals. Apart from the occasional health scare we seldom give a thought to the security of our food supply or the safety of what we eat.

In many ways we should rejoice that our lives are seldom shackled by the burden of finding food. But our release from these concerns in the rich world risks making us forget about the importance of food. Hunger and poor nutrition still afflict about 2 billion people including disadvantaged groups in our own society. The cornucopia of cheap sugary and fatty foods takes a dreadful toll on our health. And the environmental effects of food production are altering the world in front of our eyes at an alarming rate and one that imperils the capability of the planet to produce food in the future: food production is responsible, directly and indirectly, for a third of greenhouse emissions, is the most important single threat to biodiversity, and is responsible for very significant environmental pollution.

There is no better way for us to reconnect with food and the environment than to see what's happening locally. FoodPrinting Oxford is a great project that enables us to explore in detail what we eat and where it comes from, how much land, water and energy is required in its production, and what greenhouse gas emissions are involved. The numbers are fascinating, but perhaps more importantly the project explores what we might do to reduce our food footprint. The results are remarkably clear and consistent – the single most important thing we can do is to change our diets: reduce our inputs of meat and dairy. This would have health as well as environmental benefits. Reducing food waste and excessive packaging also score highly. Eating locally produced food can also cut emissions, though a tomato produced locally in a heated greenhouse may be worse than one freighted in from a warmer climate.

As this last example shows, calculating the environmental impact of what we eat is complex and we need to do it better. But this project shows what can be done today with existing methodologies and gives the city, and us all as individuals, very clear advice about what we might do. The challenges ahead to achieve global food security are immense but achievable. It requires radical action by food producers and governments, but these will be in vain unless all of us as individuals engage in debates about food and take responsibility for the consequences of what we eat. FoodPrinting Oxford does a splendid job in priming us for this future.

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1. Oxford's food supply plays a critical role in the city's sustainability

- Our food system accounts for a major part of the city's environmental impact - responsible for around 20% of our greenhouse gas emissions.
- The process of growing, processing, delivering and preparing our food requires industrial scale quantities of finite natural resources – land, water, and energy. In a finite and uncertain world, ready access to these resources cannot be taken for granted.
- We are almost entirely dependent on centralised food distribution systems. Whilst systems like these can be highly efficient, they can leave little room to adapt under unexpected circumstances.

Put together this means that our food supply is exposed to risk. FoodPrinting Oxford explores how individuals, organisations, and businesses in the city can manage this risk.

2 Approach

A lot of solutions are put forward to address food sustainability: buying locally, using global markets, industrial agriculture, peasant agriculture, organic food, GM crops, being vegetarian, eating British beef. FoodPrinting Oxford is not about finding or promoting one particular solution; it is about providing people with clear and quantitative information, so that they can compare options and take proportionate action.

The FoodPrinting Oxford project takes a systematic look at two aspects of the city's food system:

FoodPrints – what does it take to feed Oxford?

- The study uses a calculator developed by LandShare and Best Foot Forward to estimate the amounts of land, water, energy and greenhouse gas emissions associated with feeding Oxford – its FoodPrints.
- It compares the results with the FoodPrints under an alternative demand profile scenario, in order to test the potential for reducing the city's FoodPrints.
- Sensitivity analyses are carried out to identify which factors in the city's food system have most influence over FoodPrints.

Provenance - where does Oxford's food come from?

- The study investigates where Oxford's food comes from, and estimates the proportion which comes from local sources.
- It also carries out a detailed analysis of the extent to which the landscape around Oxford could provide for the city's food demands, currently, and under an alternative demand profile.

The report shows how this information can be used to make strategic choices about the city's food system. It identifies potential 'hotspots' for effective action, and outlines an approach for using the report's findings to take action.

3 What it takes to feed Oxford

- Feeding Oxford's population of 150,000 people requires a total of 53,000 hectares (530km^2) of agricultural land. This is equivalent to all of the land contained in a circle extending 13km outwards from the centre of the city.
- **Oxford's food system uses 398 million tonnes of water per year.** The same volume of water takes 8½ months to flow down the Thames to Oxford.
- **Oxford's food system uses a total of 6.6 million gigajoules of fossil fuel energy per year.** To buy this amount of energy in barrels of oil would cost around **£70 million**. This represents over one sixth of Oxford's total annual spend on food.
- **Oxford's food system emits the equivalent of 380,000 tonnes of carbon dioxide per year.** This is equivalent to twice the annual emissions from all of Oxford's cars.

4 Where the city's food comes from

- **Less than 1% of Oxford's food comes direct from local sources. The rest is split between UK (51%), EU (33%), and rest of world (15%).**
- Given a shift in diet and a re-allocation of farm production, **Oxfordshire could theoretically be self-sufficient in food.**
- The main food deficits in the county, in terms of production against consumption, are in dairy and fruit and vegetables.
- If all of Oxford's allotments and domestic gardens were given over to production, then it could produce half of the city's fruit and vegetables. But this would represent only 2% of the city's overall requirement for land to feed itself.

It takes around 530 square kilometres of agricultural land to feed Oxford. This is equivalent to an area extending out 13km in all directions from the centre of town, as illustrated on the map above.

5 The scope for change

- Oxford's food footprints are marginally better than the UK average. This is largely accounted for by diet and better than average performance in waste management. The 1-2% difference this makes saves the need for 1,000ha of land, and per year 10 million tonnes of water, the equivalent of 10,000 barrels of oil, and the equivalent of 3,500 tonnes of CO_2, in GHG emissions.
- Given an ambitious change in demand profile, but one which is within the bounds of current norms, Oxford could reduce its food footprints significantly (reductions of around 40% in land use, 25% in water use, 30% in energy use, and 45% in GHG emissions).
- To meet a significant portion (e.g. 20 to 30%) of Oxford's diet locally would require a change in demand profile, and increased dairy and fruit and vegetable production.

6 The most effective ways to take action

- The study underlines the importance of action across the whole supply chain.
- It emphasises that different solutions will suit different players, but that all should be backed up with knowledge about what is effective.
- The report shows that some choices are significantly more effective than others; reducing food waste and changes to diet are particular opportunities.
- However, the most effective solutions, overall, result from combinations of changes to diet, waste, kitchen energy, packaging and provenance.

Some of the most effective actions to reduce FoodPrints can also be healthier and save money. Like eating less meat and more veg, and reducing food waste.

SECTION 1

What does it take to Feed Oxford?

The manner in which our food is produced is one of the principal factors determining the resource intensity of our food supply.

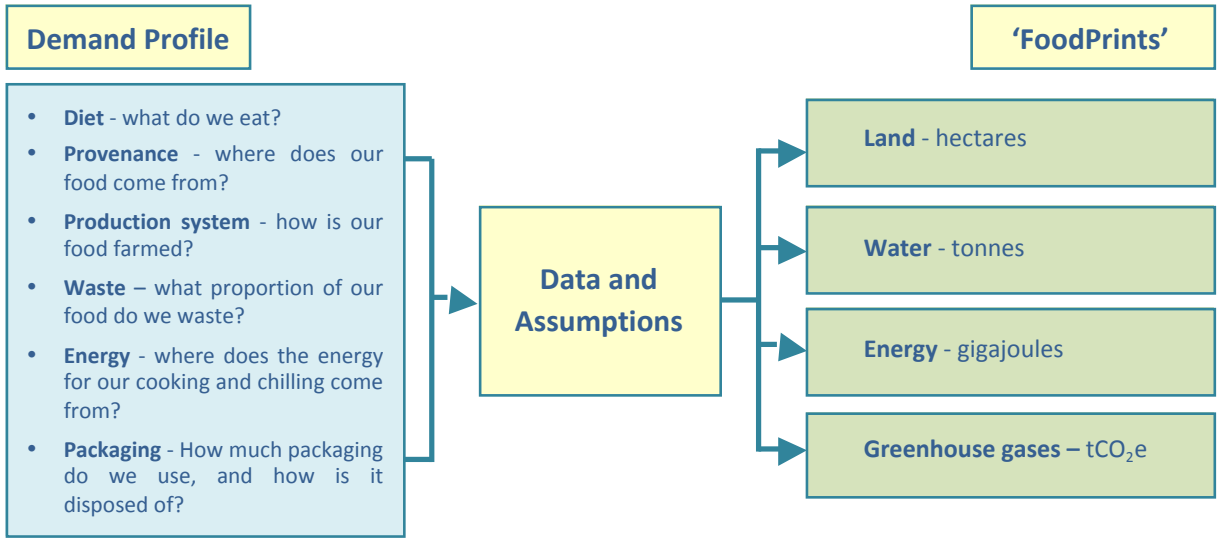
1.1 Our approach

Our objective is to quantify the principal resources ('FoodPrints') that are needed to feed the population of Oxford, and to understand how to manage them. We use an approach developed by LandShare and Best Foot Forward in a project called 'How to Feed a City'.

In 'How to Feed a City' we started by carrying out an investigation into the key sources of risk and environmental impact in the food supply chain[1]. The investigation identified the extent of our food system's reliance on land, water, and energy, and our emission of greenhouse gases as being critical sources of risk – findings which resonate with the UK Government's Foresight report on food and farming[2]. We then used 'life cycle analysis' techniques to (1) identify the key factors in the food supply chain - such as diet, farming system, food waste – which influence land, energy, water and greenhouse gases[3], and (2) to quantify their impact. Finally we used this data to construct a 'FoodPrint Calculator'[4], which enables us to estimate the energy, land, water and greenhouse gas footprints ('FoodPrints') associated with the 'demand profile' of a given population (Fig.1):

In order to use the FoodPrint Calculator to understand Oxford's food system we gathered evidence about Oxford's demand profile. Rather than building up evidence from scratch, we started with a default assumption that Oxford's demand profile is the same as the UK average. Then for each of the input variables in the demand profile we looked for reasons why it might be different to the average, and adjusted the input accordingly. This is described in section 1.2 below.

We then used the data and assumptions in our calculator to generate 'FoodPrint' results. For comparison, we also generated and tested an 'Alternative' demand profile. This approach is set out in Section 1.3.



FoodPrint Calculator – key inputs and outputs Fig.1

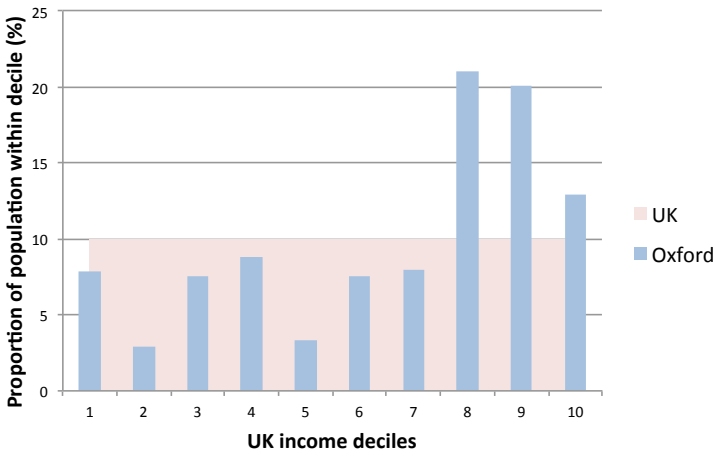
[1]How to Feed a City: a review of UK food chain resilience and environmental impact: http://www.LandShare.org
[2]Foresight: The Future of Food and Farming (2011), Final Project Report, The Government Office for Science, London
[3]Food Print Calculator assumptions and data sources: http://www.LandShare.org
[4]Food Print Calculator: online version: http://www.LandShare.org

1.2 Characterising Oxford's Demand Profile

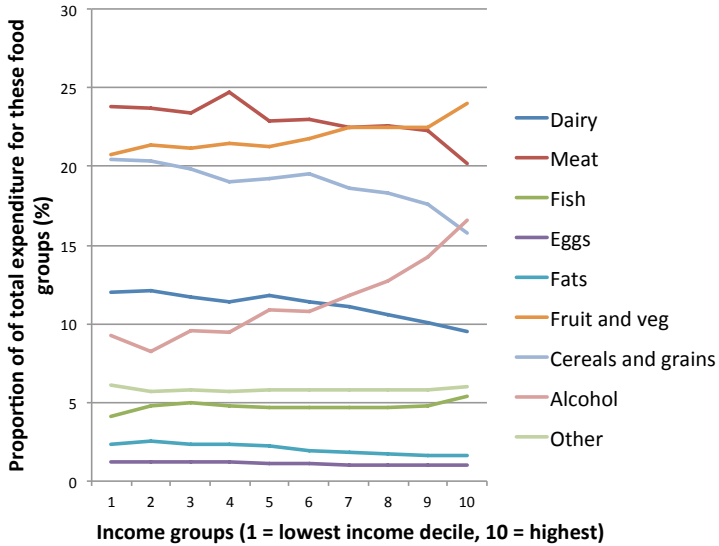
1.21 Diet - what do we eat?

For the purposes of our calculations, we are interested in the relative proportions of the major food groups (meat, dairy, fruit and veg, etc.) that are consumed by the population. Our default assumption is that these will be the same as the national average. However, we know from published statistics that there are regional and socio-economic patterns which effect diet balance[5]. Based on the patterns of consumption reported at a UK level for different 'income deciles (Fig.2), and the proportion of Oxford's population in each income decile (Fig.3) we estimated – in broad terms - how Oxford's economic profile might be expected to influence the city's overall consumption rates of different food groups[6] (Fig.4).

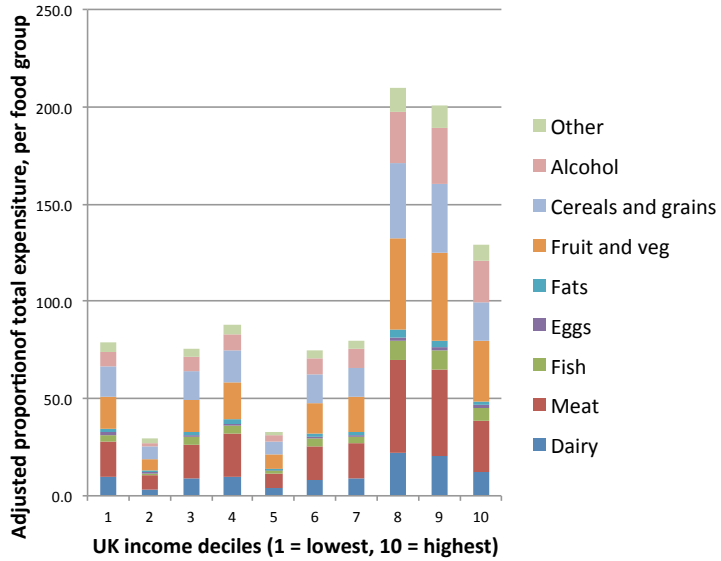
Income distribution of Oxford's population, compared to the rest of UK Fig.3



UK patterns of food consumption against income Fig.2



Oxford Food Consumption Profile - adjusted for the effect of local income distribution Fig.4



[5] 'Family Food' (2011), ONS / DEFRA

[6] Income influences on diet composition from ONS Family Food datasets. Income distribution for Oxford derived from ONS 'NOMIS' data.

Our principal findings are that:

- In line with similar studies, the impact of higher earning categories in the population boosts fruit and vegetable consumption as a proportion of overall expenditure, and depresses consumption of meat, fats, and grains / cereals (Table 1).
- Although Oxford's economic profile suggests that dietary variations within its population are likely to be high, the net effect of these patterns in terms of the difference between Oxford and the UK as a whole, is likely to be relatively small, in some cases negligible.

	Variation (%)
Dairy	-2.1
Meat	-0.5
Fish	-0.1
Eggs	-1.8
Fats	-4.8
Fruit and veg	**0.7**
Cereals and grains	-1.3
Alcohol	**4.7**
Other	**0.1**

Table 1: Difference between Oxford's consumption of major food groups, and UK average

[7] UK proportion from DEFRA, Agriculture in the UK, 2011; global split from DEFRA, Overseas Trade Data System2010

[8] See section 2 for detailed breakdowns of how these local provenance figures are estimated. The fresh vegetables figure reflects DEFRA's estimate that between 3 and 4% of fresh vegetables are grown on allotments and private gardens

[9] AERU 2007, Air Freight Transport of Fruit and Vegetables

1.22 Provenance - where does our food come from?

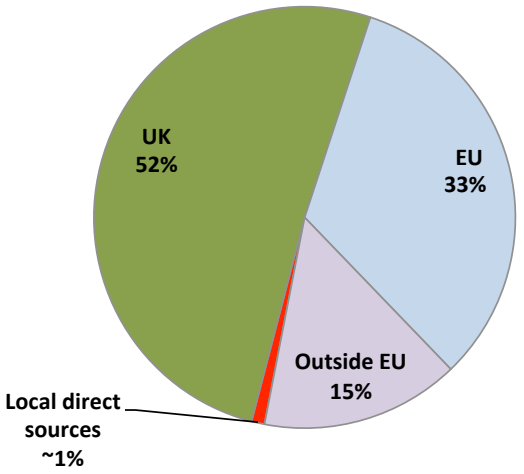
Section 2 of this report deals in some detail with the question of where Oxford's food comes from. The key findings can be summarised as follows:

- Food consumed in Oxford is overwhelmingly sourced through nationally managed supply lines, which in turn source food from the UK, EU, and countries beyond the EU in the proportions shown in Fig. 5[7]
- We estimate that around 1% of Oxford's food comes through local, direct sources, such as famers markets, local box schemes, direct farm sales to restaurants, and allotments and gardens (see Section 2.2).
- A notable variation from the 1% figure is the proportion of vegetables which come from local and direct sources. We estimate this to be around 3.5% – and 80% of these are likely to come from allotments and private gardens[8]

We also calculate the impact of air-freighted food on our Food Footprints. For the purposes of this study we found no evidence to suggest that Oxford would deviate significantly from national patterns for air freighted food.

- We assume that Oxford air-freights 10% of the fruit and vegetable imports which arrive from outside the EU[9]

Sources of Food consumed in UK, by value Fig.5



1.23 Production system - how is our food farmed?

The manner in which our food is produced is one of the principal factors determining the resource intensity of our food supply. Some of the biggest variations in the impact and resource intensity of production come down to what it is that is being produced. We account for this in our calculations for each food commodity type. We also know that differences between production systems for each commodity type are significant. Much of the impact is related to operational and site factors which occur at the scale of the individual farm. However, there are few straightforward 'proxies' further down the supply chain that we can use to give us a reliable impact on food footprints. The most relevant factor that we can apply is the proportion of food purchased which is organic.

The background, national figure for this is just over 1% (£1.7 to £2 billion[10] out of total food sales of £182 billion[11]).

As with balance of diet, there is a relationship between organic food consumption and the socio-economic group of the consumer. In order to estimate Oxford's organic food consumption relative to national averages, we adjusted national organic sales figures reported for social groupings (AB, C1, C2 etc.) to the proportions of those groups living in Oxford. The results are shown in Table 2, below.

- Based on the economic profile of Oxford's population, we might expect organic sales to be 12% higher than the national average

Table 2: Sales of organic food by socioeconomic group and adjusted for the proportion of each socioeconomic group in Oxford

	Proportions in grouping (%)[12]		Organic sales by social grouping (%)[13]	Expected difference in sales in Oxford (% of total sales)
	UK	Oxford		
AB: Higher and intermediate managerial / administrative / professional	27.4	51.9	36	+32%
C1: Supervisory, clerical, junior managerial / administrative / professional	23.7	18.4	31	-7%
C2: Skilled manual workers	17.7	10.3	14	-6%
D: Semi-skilled and unskilled manual workers	13.0	9.7	9	-2%
E: On state benefit, unemployed, lowest grade workers	18.2	9.8	10	-5
			100	+12%

[10] Soil Association Organic Market Report – figure for 2011 is £1.72 billion
[11] DEFRA 2011, Food Statistics Pocketbook
[12] Derived from ONS 'NOMIS' data
[13] Soil Association Organic Market Report, 2010

1.24 Waste – what proportion of our food do we waste?

Food waste is well recognised as playing a big role in food sustainability. Over 12.5 million tonnes of food waste is produced in the UK per year; 65% of this is from households[14], which represents around 15% of total household spending on food[15]. Food waste in the commercial supply chain is reported to have dramatically reduced in recent years[16], but avoidable food waste from domestic sources remains a key opportunity area for making improvements. Our calculations are based around the level of domestic food waste in the food system.

Comparative figures for food waste between local authorities are not available; however we can cautiously extrapolate from the variation in overall consumer waste reported for Oxford, as compared to the UK average. DEFRA statistics[17] show that average total domestic waste collection per person by Oxford City Council is 285kg, which is 37% lower than the national average. WRAP reports that 64% of domestic food waste is avoidable, and a further 18% is possibly avoidable. Based on the WRAP information, we assume that Oxford residents produce 37% less *avoidable* food waste (37% of 64%) than the national average. Our *cautious* assumption is therefore as follows:

- That Oxford residents' avoidable food waste is 37% lower than the national average, which represents a 24% reduction in overall domestic food waste.

1.25 Energy - where does the energy for our cooking and chilling come from?

'Kitchen energy' for cooking and chilling varies significantly according to food-type, and this variation is covered in our calculations by our diet input variables. For city-wide calculations it is safe to assume that average figures apply to other important variables, such as whether food is batch-prepared by caterers, or prepared and stored in the home. The remaining variable, which we adjust as an input variable in our calculations, is the proportion of energy which is supplied through renewable sources. For our Oxford calculations we found no evidence to suggest that uptake in the city of green energy tariffs is significantly different to the UK average.

- We assume for this study that energy from renewable sources is equal to the UK average.
- It is useful to note that currently 6.8% of UK electricity generation is from renewable sources, against a target of 15% renewables by 2020, set by the EU Renewables Directive[18]

1.26 Packaging - How much packaging do we use, and how is it disposed of?

Food packaging plays a significant role in life cycle analyses of the resource intensity of our supply chain. We calculate the impact of packaging according to two factors: (1) the amount of packaging waste associated with food, and (2) the proportion of this which is recycled. Packaging is largely determined by retailers and wholesalers, and recycling is determined by behaviour at 'end of use', mainly by householders. We could not find any localised data which suggested that levels of packaging would be different to UK averages, which reflects the fact that the principal retailers and wholesalers are unlikely to be making packaging decisions at a local level. However, domestic recycling rates do vary from city to city. DEFRA statistics[19] show that Oxford recycles 43.5% of its household waste, compared to a national average of 41%.

- For the purposes of this study, we assume that food packaging figures are around average, but that of total food packaging waste, 6% more is recycled than the UK average
- It is useful to note that there are significant variations between councils in recycling rates, for example South Oxfordshire District Council recycles 61.4% of its domestic waste, which is 56% greater than the UK average. The EU Waste Framework Directive sets a target for the UK to reuse compost or recycle 50% of domestic waste by 2020

[14] Cornwall Food and Drink and University of Exeter: A review of the UK food market, 2011
[15] WRAP, Household Food and Drink Waste in the UK 2011
[16] Cornwall Food and Drink and University of Exeter: A review of the UK food market, 2011
[17] Waste figures are for 2011, reported by DEFRA, Local Authority Collected Waste Statistics, 2010 - 2011
[18] DECC, Digest of UK Energy Statistics 2011
[19] All recycling statistics are from DEFRA – Local Authority Collected Waste Statistics, 2010 - 2011

1.3 Summary of inputs – Oxford and 'Alternative FoodPrint' figures

To generate 'FoodPrint' estimates for Oxford, we make *per capita* calculations based on the input variables described in section 1.2, and multiply up to reflect the population of the city[20]. In order to provide context for these figures, we also made the same calculations based on UK average figures, and also generated an 'Alternative' Oxford FoodPrint. The 'Alternative FoodPrint' scenario is based on a set of feasible if ambitious changes to Oxford's demand profile – see boxed text for more details of how we developed this scenario. All of our input variables (expressed as a percentage of the UK average), and the sources for our assumptions in the Alternative FoodPrint, are given Table 3, on page 16.

[20] Population of 153,700, which is the ONS 2010 projection forward from 2001 census

Oxford's 'Alternative FoodPrint Scenario'

In order to provide some 'aspirational context' for Oxford's FoodPrint results, we wanted to scope out the extent to which the city's FoodPrints could realistically be reduced. To do this we created an alternative scenario, based on ambitious but, we think, feasible adjustments to the city's demand profile. We based these adjustments on a combination of existing reports and targets from relatively mainstream sources, plus our own judgement about what people would think was reasonable. The rationale for each component of the demand profile – each input variable to our model – is summarised below. The results on the impact of each choice shed interesting light on some of these factors – not all of the choices reduce the City's FoodPrint.

Diet
We based our dietary balance on the WWF 'Livewell Plate', which was designed around a healthy and sustainable diet. The principal features of the diet are a reduction in white and red meat, and a compensating increase in consumption of fruit and veg and grains / starches. We think that it fits our 'feasible' criteria, because it is healthy rather than being extreme or 'ascetic'.

Provenance
The principal changes we made to the balance of provenance was to increase locally sourced food to 10%, and to eliminate airfreight. Counter-intuitively (to some) the shift in local consumption is by far the most challenging shift in terms of change of practice, since very little (<1% is currently sourced locally) and only a small fraction of food is currently imported by air.

Production system
We set organic at 10% of food, which is a significant (10 fold) shift upwards. We did this because organic is commonly perceived as a 'sustainable choice', and so we wanted to include a significant enough proportion to make an impact on our FoodPrint results.

Waste
We reduced the proportion of Oxford's food waste by half (from 11%% down to 5%) – which represents an elimination of all 'avoidable' food waste, as defined by WRAP.

Energy
We increased the use of renewable energy in domestic energy use (kitchen energy) from 7% to 15%, in line with the EU Renewables Directive targets set for the UK to achieve by 2020.

Packaging
We used industry targets (Courtauld 2: http://www.wrap.org.uk/content/courtauld-commitment-2-0) to define reductions in packaging usage on food products. For recycling rates we used the recycling rates reported for South Oxfordshire District Council – which sets a high standard Nationally. We extrapolated the percentage improvement that SODC achieved for all recycling to give rates for the expected recycling rate for the different materials categories (plastic, metal, paper, and glass)

Variable	Oxford	'Alternative' FoodPrint	
Diet			
	% of UK average	% of UK average	Basis for 'Alternative' inputs
Alcohol	105%	60%	WWF Livewell Plate[21]
Dairy	98%	100%	"
Fish	100%		100%
Fruit and veg	101%	152%	"
Grain and Starch	99%	116%	"
Red meat	100%	25%	"
White meat	100%	25%	"
Eggs	98%	50%	"
Oils and fats	95%	60%	"
Other	106%	163%	Remaining calories to match UK diet
Provenance			
	% UK ave (% all food)	% UK ave (% all food)	
Local	100% (1%)	1000% (10%)	Section 3 of report
UK	100% (51%)	80% (41%)	"
EU	100% (33%)	106% (35%)	"
Beyond EU	100% (15%)	87% (13%)	"
Air freighted fruit & veg	100% (10%[22])	0% (0%)	No air-freight

Table 3: Input variables for Oxford current and Alternative demand profiles

[21] WWF 2011, Livewell: a balance of healthy and sustainable food choices
[22] Only in reference to imports from outside EU

Variable	Oxford	'Alternative' FoodPrint	
Production System			
	% UK ave (% all food)	% UK ave (% all food)	
Organic	100% (1%)	1000% (10%)	10% organic
Waste			
	% UK ave (% wasted)	% UK ave (% wasted)	
% domestic food wasted	76% (11%)	36% (5%)	No avoidable[23] food waste
Energy			
	% UK ave (% consumed)	% UK ave (% consumed)	
% renewable	100% (7%)	214% (15%)	EU Renewables Directive[24]
Packaging			
	% UK ave (% recycled)	% UK ave (% recycled)	
Total usage	100%	90%	Industry targets[25]
Plastic recycling	106% (9%)	148% (13%)	Level achieved by SODC[26]
Paper and card recycling	106% (68%)	148% (95%)	"
Metal recycling	106% (9%)	148% (13%)	"
Glass recycling	106%(32%)	148% (45%)	"

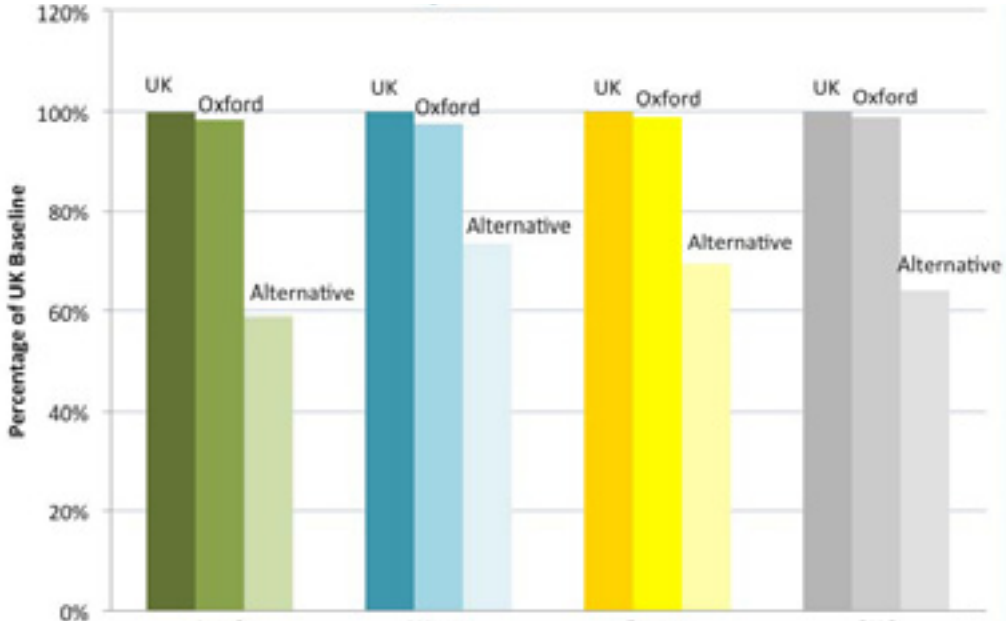
[23] WRAP 2011, Household Food and Drink Waste in the UK
[24] EU Directive on Renewable Energy: UK target for 2020
[25] Extrapolated from Courtauld 2 targets
[26] DEFRA Local Authority Collected Waste Statistics, 2010 – 2011 show South Oxfordshire District Council recycling 61.4% of domestic waste. The breakdown of rates for each waste type is extrapolated as equivalent change from national averages.

1.4 What we found – Oxford and 'Alternative FoodPrint' figures

The basic figures for Oxford's FoodPrints - for land, water, energy, and greenhouse gases (GHG) - are detailed over the following pages. All four figures are around one or two per cent lower than we would expect from a typical UK city of the same size, which is not a substantial enough difference for us to draw strong conclusions. However, when the figures are explored in more detail, they give us a useful strategic picture of the sorts of factors which have most impact on our FoodPrints. The figures also give us a measure of the magnitude of resources we require, and therefore the magnitude of the solutions we might need to reduce those resources. And the 'Alternative Footprint' analyses give us an encouraging perspective on the extent to which we might influence the size of our energy, land, water and GHG footprints.

Comparative figures for the different FoodPrint scenarios we explored are given in Fig. 6:

Comparison of Oxford FoodPrints against average and Aternate figures **Fig.6**

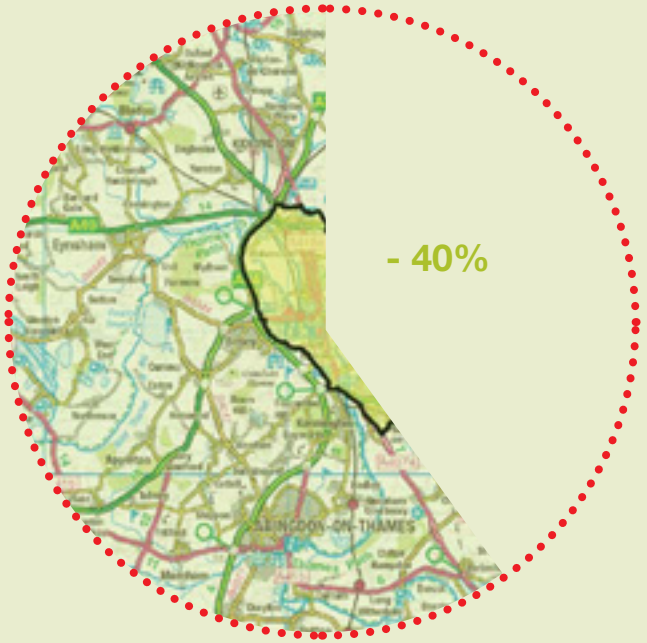


	Land	Water	Energy	GHG
UK - baseline	100%	100%	100%	100%
Oxford	98%	98%	99%	99%
Potential	59%	73%	69%	64%

1.41 Land

- **Oxford needs a total of 53,000 hectares (530km2) of agricultural land to feed itself.**
- **This is equivalent to all of the land contained in a circle extending 13km outwards from the centre of the city.**
- Oxford's consumption profile reduces its footprint by around 1,000 hectares (~2%), compared to an average UK city of the same size.
- To feed the total UK population with the same consumption profile as Oxford would require 21.2 million hectares of agricultural land (for reference, the UK has a total of 17.1 million hectares of agricultural land[27]).
- Based on our estimates, Oxford has the potential to reduce its land footprint by a further 21,000 hectares (40%).
- The main factors which account for Oxford's reduced land footprint given its current consumption profile are, starting with the greatest, reduced food waste, reduced consumption of oils and fats, red meat, and dairy.
- The factors which account for the much greater difference shown in the Alternative FoodPrint scenario are dominated by reduced red and white meat consumption, followed by reduced food waste and reduced consumption of oils and fats.

Based on our estimates, Oxford has the potential to reduce its land footprint by a further 21,000 hectares (40%)



[27] DEFRA 2010, Agriculture in the United Kingdom

1.42 Water

- **Oxford's food system uses 398 million tonnes of water per year**
- **The same volume of water takes 8½ months to flow down the Thames to Oxford**[28]
- Oxford's consumption profile reduces its water footprint by 10 million tonnes per year (2%), compared to an average UK city of the same size
- Based on our estimates, Oxford might have the potential to reduce its water footprint by a further 99 million tonnes per year (25%)
- The main factors which account for Oxford's reduced water footprint are, starting with the greatest, reduced food waste, reduced consumption of dairy, red meat, and oils and fats
- The factors which account for the much greater difference shown in the Alternative FoodPrint scenario are dominated by reduced red and white meat consumption, followed by reduced food waste and reduced alcohol. Increased fruit and veg consumption adds 26½ million tonnes of water to the footprint, but calorie for calorie this is more than compensated for by the shift in diet away from meat.

Oxford's food system uses 398 million tonnes of water per year. The same volume of water takes 8½ months to flow down the Thames to Oxford.

[28] Given average flow rate of the Thames entering Oxford of 17m^3/sec

1.43 Energy

- **Oxford's food system uses a total of 6.6 million gigajoules of fossil fuel energy per year.**
- **To buy this amount of energy in barrels of oil would cost around £70 million[29]. This is equivalent to over one sixth of Oxford's total annual spend on food[30].**
- In our calculations Oxford's consumption profile reduces its energy footprint by around 80,000 gigajoules per year (~1% or 10,000 barrels of oil), compared to an average UK city of the same size. This figure is negligible, and likely to be less than the margin of error in our estimates.
- Based on our estimates, Oxford has the potential to reduce its energy footprint by around 30%.
- The main factor which reduces Oxford's energy footprint in our calculations is the reduced figure for food waste. Organic food consumption has a small role to play, similar to favourable waste recycling rates and reduced meat and grain and starch consumption.
- The factors which account for the much greater difference shown in the Alternative FoodPrint scenario are dominated (again) by reduced red and white meat consumption, followed by reduced food waste. The reduced use of packaging, and the switch to 15% renewable energy both play a noticeable role in reducing the FoodPrint. Increased fruit and veg consumption adds to the footprint, but calorie for calorie this is more than compensated for by the shift in diet away from meat.

Based on our estimates, Oxford has the potential to reduce its energy footprint by around 30%.

[29] One barrel of oil contains around 6.1GJ of energy. The cost of a barrel of oil has ranged around the $110 mark for the 12 months ending March 2012

[30] Based on *per capita* food expenditure figures derived from DEFRA Food Statistics Pocketbook 2011

1.44 Greenhouse Gases

- **Oxford's food system emits the equivalent of 380,000 tonnes of carbon dioxide per year.**
- **This is equivalent to double the annual emissions from all of Oxford's cars.**
- In our calculations Oxford's consumption profile reduces its GHG footprint by around 3,500 tonnes of CO_2 per year (~1%), compared to an average UK city of the same size. This figure is negligible, and likely to be less than the margin of error in our estimates.
- Based on our estimates, Oxford has the potential to reduce its GHG footprint by around 36% - saving the equivalent of 135,000 tonnes of CO_2 per year.
- The main factor which reduces Oxford's GHG footprint in our calculations is the reduced figure for food waste. The other factors are dietary; reduced dairy and red meat consumption.
- The factors which account for the much greater difference shown in the Alternative FoodPrint scenario are dominated (once again) by reduced red and white meat consumption, followed by reduced food waste. The switch to 15% renewable energy also shows up as a significant factor in reducing the GHG FoodPrint.

Based on our estimates, Oxford has the potential to reduce its GHG footprint by around 36% - saving the equivalent of 135,000 tonnes of CO_2 per year.

Where does Oxford's food come from?

Perhaps the most striking feature of our current food supply system is not that we trade so much food from overseas, but that of the food that we source from the UK so little of it is sourced through local and direct sources.

Oxford's population consumes almost 130,000 tonnes of food per year, spending in the process around £450 million[31]. We found no evidence to suggest that the way this is spent in Oxford varies significantly from national market trends. This means that the majority of business will go through a relatively small number of large retailers and caterers (Fig.11[32]). These manage their supply chains through large-scale regional and national consolidation and distribution centres, which in turn source from a range of UK, EU and beyond-EU sources (Fig.12[33]).

The net result of this is that in broad terms, we can assume that Oxford uses the same food supply chain as the rest of the country; with a little over half coming from the UK, and of the rest around $^2/_3$ comes from the EU, and a final $^1/_3$ comes from beyond the EU.

2.1 Our Approach

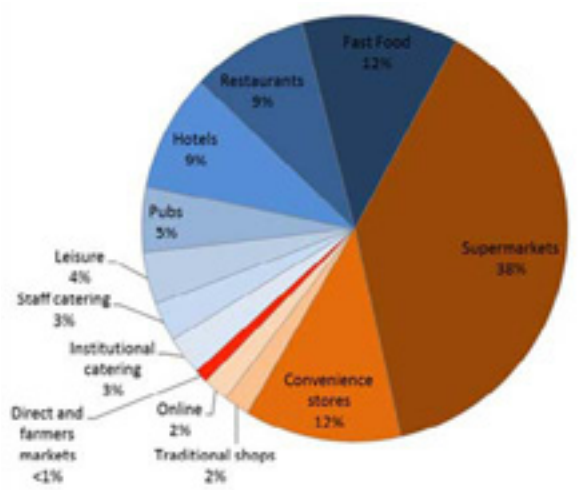
Perhaps the most striking feature of our current food supply system is not that we trade so much food from overseas, but that of the food that we source from the UK so little of it is sourced through local and direct sources.

Our focus in this study is therefore on local food - and for our purposes we do not attempt to suggest how much of our food supply *should* come from local sources; instead we look at how much *could* come from local sources, were the people and businesses of Oxford to decide to shift their balance of trade. We do this by:

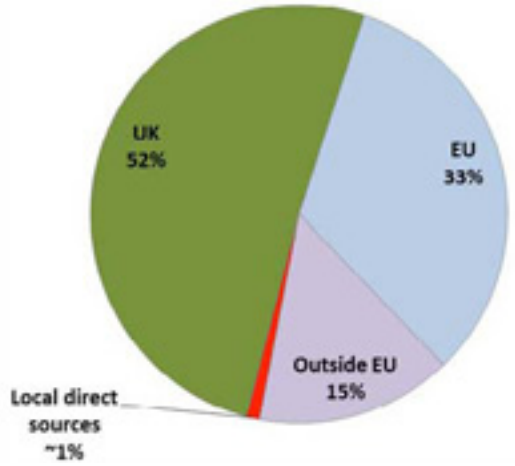
(1) Reviewing the scale of current local[34] food supply networks, and

(2 Investigating the potential capacity of local agricultural production to feed Oxford.

Share of UK food market by value Fig.11



Sources of food in UK by value Fig.12



[31] Expenditure based on total UK expenditure on food (DEFRA Food Statistics Pocketbook 2011)

[32] UK food market data adapted from DEFRA Food Statistics Pocketbook. Local direct sales figures estimated by using a baseline figure from FARMA, which reports takings of £220 million per year from farmers markets, as compared to a total value chain of £180 billion per year. Our 1% figure assumes that local and direct sales from sources other than farmers markets are worth no more than 7x the value of sales from farmers markets

[33] Trade balance breakdowns from DEFRA Overseas Trade Data System (MOTS)

[34] For our purposes we include food produced from land in Oxfordshire and supplied directly to Oxford. We do not include the portion of local production which gets incorporated into national supply chains and then redistributed back out to Oxford through centralised supply routes

The benchmark for measuring the capacity of both of these is the level of consumption that we generated for our FoodPrint analyses, in Section 1 of this report. The breakdown of these figures for the current Oxford diet is shown in the Fig.13:

2.2 Review of local food supplies into Oxford

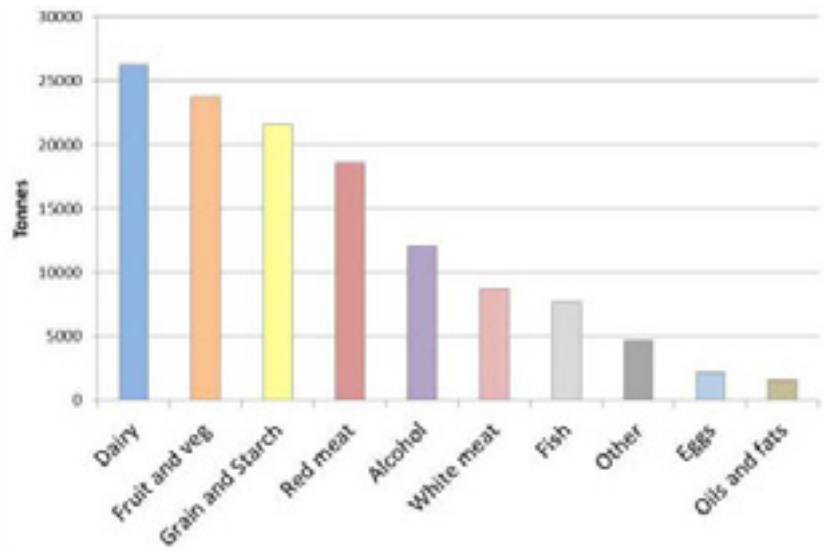
It is beyond the scope of this study to conduct a comprehensive survey of local food suppliers in and around Oxford. Instead, we have used local knowledge, contacts and data sources to help us make a rough 'order of magnitude' estimate of the scale of supply. We looked at three principal sources: local box schemes, farmers markets, and home-grown produce from allotments and private gardens. For our total figure, we add on a figure of similar scale to these sources to account for other routes to market, such as deliveries to restaurants and shops. We did not take into account that notional portion of local production which enters national supply lines and is then redistributed back to Oxford as part of the whole; we count this as being the same as UK-wide sourcing.

2.21 Local Box Schemes

We identified five principal box schemes supplying Oxford: Coleshill Organics, North Aston Organics, Tolhurst Organic Produce, Close to the Veg, and Veg in Clover, which supplies produce from Sandy Lane Farm. Acknowledging that not all produce from these schemes comes from Oxfordshire, we estimated that together these account for an average of around 500 boxes entering Oxford per week, and generate around £250,000 in sales annually from around 100 tonnes of vegetables.

New Routes to Market - a new social enterprise, named Cultivate (www.CultivateOxford.org), raised local share capital in 2012 to establish a market garden and supply food into Oxford.

Oxford's food consumption by weight Fig.13



2.22 Farmers' Markets

We made estimates, based on local knowledge, of the turnover from the four farmers markets which operate regularly in Oxford: East Oxford, Wolvercote, Gloucester Green, and Headington. We estimated the total value of local sales through these to be £750,000 per year, with a very rough 50:50 split between fruit and veg, and other produce. This figure is roughly in line with national figures for farmers' markets sales[35].

2.23 Home Grown Food

We calculated the total area of occupied allotments across the 36 sites in Oxford to be 47 hectares[36]. We used assumptions based on Garnett[37] to estimate production levels per hectare, giving a total of 500 tonnes of vegetable production per year.

Around 20% of Oxford's land area (or 900 hectares) is made up of domestic gardens[38], and based on figures for London[39] around 14% of households might be assumed to grow vegetables in their garden. Given only small fractions of these gardens will tend to be used for production, we estimate a total of around 15-20 hectares of vegetable production from private gardens in the city. Based on the same metrics as we used for allotments, we estimate that this might translate into a further 150 tonnes of home grown produce per year.

The total for home grown food, around 650 tonnes per year, is almost 3% of Oxford's total fruit and vegetable consumption. This figure roughly aligns with DEFRA estimates of between 3 and 4% of fresh vegetables consumed in the UK being produced in gardens and allotments[40]. **Interestingly, if one quarter of all domestic gardens was given over to vegetable production, then the combined figure for allotments and private garden production would be closer to 3,000 tonnes per year, or 12.5% of fruit and vegetable consumption for the city.**

[35] FARMA quotes national figures of £200 million, which is around 0.13% of the total food market. The Oxford figure is around 0.17%.
[36] Oxford Allotment Association – information on members and plots 2010
[37] Garnett T, (2000), Urban agriculture in London; rethinking our food economy, in Growing cities, growing food: urban agriculture on the policy agenda: a reader on urban agriculture
[38] Loram et al (2007), Urban domestic gardens: the extent & structure of the resource in five major cities, Landscape Ecology 22:4
[39] Figures from Capital Growth: www.CapitalGrowth.org
[40] DEFRA: Family Food 2010

2.24 What we found

Table 4 collates our estimated figures for Oxford's local and direct food supplies. Key observations are as follows:

- **The current total local food supply into Oxford is estimated to represent around 1% of total food consumption**
- **Over half of local food, in our estimates, comes from home-grown produce**
- **We estimate that around 3% of all Oxford's fruit and vegetable consumption is grown in gardens and allotments**

2.3 The potential for Oxfordshire to feed Oxford

Any discussion about the extent to which it might be desirable to 're-localise' a proportion of, or elements of, Oxford's food supply needs to be based on information about the extent to which surrounding agriculture could meet the food demands of the city. So we carried out an analysis of the potential for Oxfordshire to feed Oxford (making equal provision in our calculations also for the population of Oxfordshire outside Oxford).

2.31 How we worked this out

This analysis brings together two components: (1) analysis of the land requirements of Oxford's current and 'Alternative'[42] food demand profiles, and (2) analysis of current food production levels around the city. In both instances, the demand profiles are broken down according to the food categories and agricultural commodities involved (horticultural land for fruit and veg, feed crops, grass and forage for livestock, etc.) And for the purposes of our analysis we defined the area 'around the city' as Oxfordshire. This is not to suggest that the county boundary represents a natural 'foodshed'[43] for the workings of markets and logistics; rather it gives a realistic snapshot of the sort of agricultural landscape that the city would need to source its food from, were it to look locally.

Table 4: Estimated local and direct supplies of food into Oxford

	Value £/yr.	tonnes/yr.
Vegetables		
Boxes	250,000	100
Markets	200,000	80
Allotments	1,250,000	500
Private gardens	375,000	150
Total:	**2,075,000**	**830**
% of total vegetable consumption:		3.5%
Total overall vegetable consumption for Oxford per year:		**24,000 tonnes**

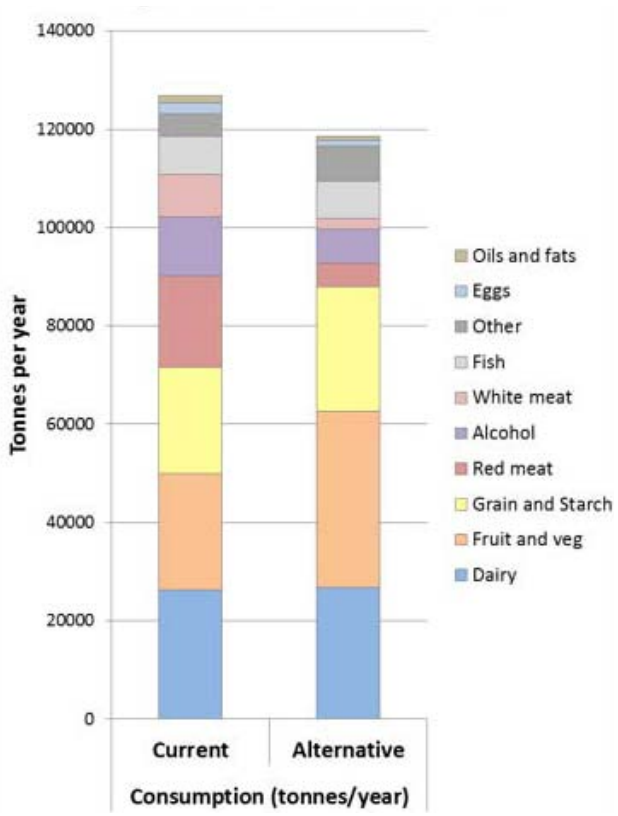
	Value £/yr.
All food	
Boxes	250,000
Markets	750,000
Allotments and gardens	1,625,000
Other	500,000
Total value of food from local sources:	**£3.13 million**
% of total food expenditure in Oxford:	1.01%
% with home-grown food removed:	0.48%
Total overall expenditure on food in Oxford:	**£310 million**[41]

[41] £310 million, based on average per capita weekly spend on food of £39.25, quoted in DEFRA: Family Food 2010
[42] 'Alternative' refers to the hypothetical demand profile defined in Section 3.1, and in essence involves less meat and more fruit and vegetables
[43] In the sense of: Kloppenburg et al 1996. Coming in to the foodshed. Agriculture and Human Values 13(3):33-42

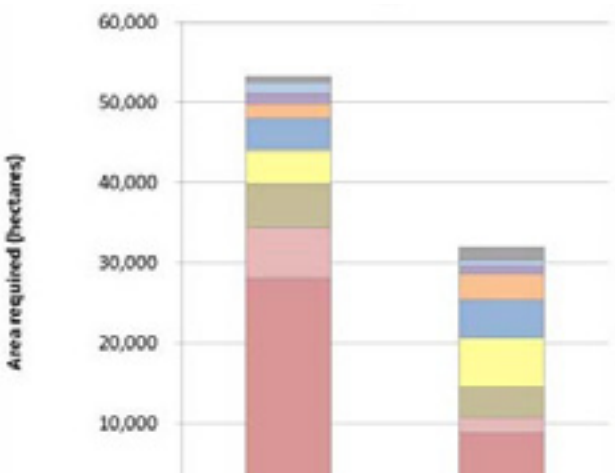
Analysis of land requirements

This was a three step process, carried out for Oxford's current food profile, and for its 'potential' profile. First we calculated the total consumption per year in tonnes for each component of the diet – based on a simple extrapolation from per capita consumption figures (Fig.14). We then converted these figures into land footprints, based on data sources used in our FoodPrint Calculator[44] (Fig.15). The third step was to allocate the land footprints for each component of the diet into agricultural land categories, so that we could compare the demand profile with the sorts of agricultural production available in Oxfordshire. This is a simple one-step conversion for arable and horticultural products. For livestock-based products (dairy, meat, eggs), we used figures generated by Cranfield[45] to allocate the footprint into the different categories of land (feed production, temporary grass, permanent pasture) required for each product type.

Consumption breakdown by weight - current and 'Alternative' Fig.14



Estimated Land area requirements for current and 'Alternative' diet profiles Fig.15



	Current diet breakdown (ha)	Alternative diet breakdown (ha)
Other	734	1,495
Eggs	1,330	832
Alcohol	1,330	967
Fruit and veg	1,780	3,248
Dairy	3,989	4,776
Grain and Starch	4,150	5,973
Oils and fats	5,490	3,919
White meat	6,300	1,870
Red meat	28,057	8,791

[44] Food Print Calculator assumptions and data sources: http://www.LandShare.org

[45] Determining the environmental burdens and resource use in the production of agricultural and horticultural commodities', Cranfield University http://www.cranfield.ac.uk/sas/naturalresources/research/projects/is0205.html

Analysis of current production capacity

With the demand profile expressed in terms of land areas, we were able to use the land areas reported in DEFRA's annual agricultural survey figures[46] as the basis for our comparisons. The survey reports land areas under a wide range of crop types and land use categories on a county by county basis.

The land area data gives a good indication of the current agricultural capacity of the county in terms of arable and horticultural production, feed crops, and temporary and permanent grassland[47]. However, the land area figures give an incomplete indication of livestock related production; since it does not tell us what sort of livestock is using the feed, forage or grass, or whether the stock being fed is actually reared in the county. We therefore carried out a separate analysis of current production, using conversion factors from Nix[48] to estimate meat, dairy and egg production given livestock numbers reported for the county in DEFRA's annual agricultural survey.

For both of these analyses, we adjusted production capacity to take account of the fact that Oxford only represents 24% of Oxfordshire's population[49].

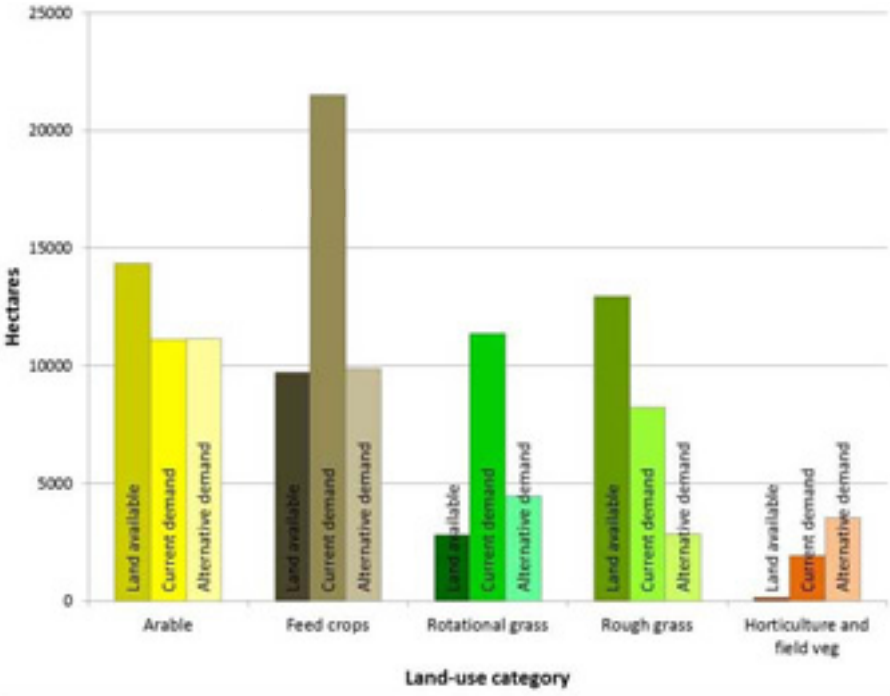
2.32 What we found

Land Availability

The extent to which Oxfordshire's landscape could theoretically provide for Oxford's population differs widely across land categories and is heavily influenced by the population's demand profile. Fig.16, details our principal findings. Our main observations are as follows:

- **Taking into account all food types and land use categories, Oxford's current demand profile requires 35% more of Oxfordshire's land than is theoretically available on an area per head of the population basis across the county.**

Land availability, broken down by land-use category, compared with land use requirements for current and 'Alternative' demand profiles Fig.16



[46] DEFRA, annual survey of agricultural and horticultural activity (2009) http://www.defra.gov.uk/statistics/foodfarm/landuselivestock/junesurvey

[47] It should be noted that the breakdown of land categories reflects a relationship between land quality and market conditions; which means that the proportions of land in each can change. So for example, at times of heightened demand such as during WWII, areas of pasture might go under the plough for the production of arable crops.

[48] John Nix Farm Management Pocketbook, 41st Edition, 2011

[49] To do this we allocated available production according to the proportion of Oxfordshire's population that lives in Oxford (150,000 out of 640,000). We did not attempt to take into account demand footprints from other nearby populations, such as London. If we were looking to evaluate the possibility of UK wide plan to localise food on a strict proximity basis, then this would raise the issue of 'overlapping footprints'. However, we would expect the reality of more localised food systems to leave far more room for flexibility – with only a proportion being sourced locally in any case, and with markets and pragmatism dealing with most of the remaining problems caused by unevenness in population and agricultural production.

- **Given the 'Alternative' demand profile, the city requires 25% less land than is theoretically available in the county.**
- Arable cropping for human consumption in Oxfordshire exceeds Oxford's demand for arable derived food, under both current and Alternative demand profiles.
- However, to feed the livestock required for Oxford's consumption of animal products needs the equivalent of all of Oxfordshire's current animal feed production, plus all of Oxfordshire's arable crops for human consumption. In the Alternative demand scenario the production of feed crops in Oxfordshire is sufficient to cover demand for livestock feed.
- There is significantly less fruit and vegetable production than would be needed to cover even a small proportion of the city's consumption requirements. This deficit is greater under the 'Alternative' dietary scenario, which relies on increased vegetable consumption to compensate for reductions in consumption of meat.
- Availability of temporary grass is below the levels needed to support enough livestock to meet Oxford's requirements, reflecting the fact that Oxfordshire produces significantly less livestock than it consumes. Oxfordshire has more than enough permanent grassland available for grazing compared to what is needed for either current or potential consumption scenarios[50].

Capacity for 'Self-Sufficiency'

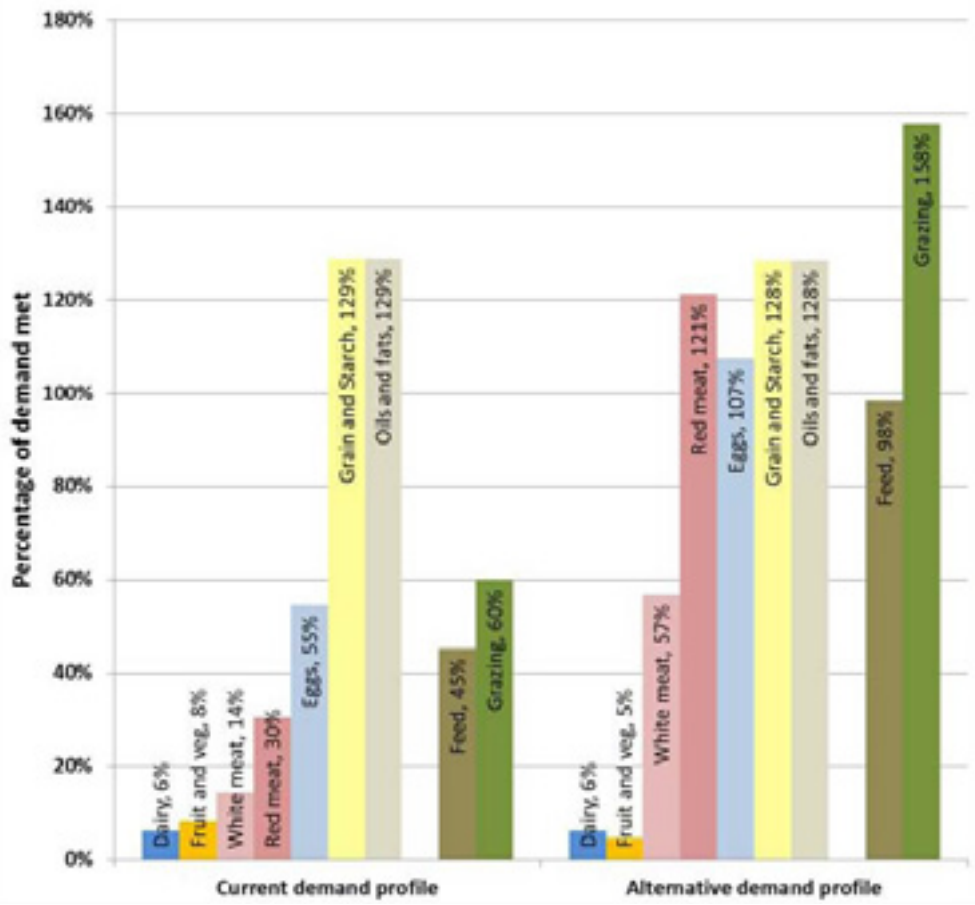
In addition to looking at land availability, we can also make a more focused estimate of Oxford's theoretical 'self-sufficiency' for each major food commodity category, based on agricultural production in Oxfordshire. This analysis is clearly only theoretical, since the produce flows in and out through wider markets. But it does give us a picture of our 'net position' in terms of food production / consumption, which is useful if we want to evaluate the feasibility of 're-localising' a proportion or elements of the city's food chain.

Arable cropping for human consumption in Oxfordshire exceeds Oxford's demand for arable derived food, under both current and Alternative demand profiles.

[50] It should be noted that our estimations for land requirements use a range of land categories, so while there may be plenty of rough grazing for red meat production, this is based on the assumption that much of the livestock's diet is based on feed crops and rotational grass.

Our findings are summarised in Fig.17, over the page. The chart shows self-sufficiency rates under 'current' and 'Alternative' demand profiles (as set out and used throughout this report). For each, it gives our estimates of food production as a proportion of consumption – based on current agricultural activities in the county. As well as direct production in-county, we also take a separate look at the extent to which feed crops and grass production[51] covers our demand for livestock derived products. We do this because these operate somewhat independently of livestock rearing – feed in particular is frequently traded off farm as a commodity crop. So by reporting these separately we can see a surplus or deficit in livestock 'carrying capacity', regardless of whether the stock itself is raised in-county.

Estimated self sufficiency in major food categories and for total animal feed and grazing requirements, for Oxfordshire under Current and 'Alternative'demand scenarios Fig.17



[51] We amalgamate rotational and permanent grass, with 1 ha rotational grass counting as 2 ha of permanent grass.

Our key observations are as follows:

- **Oxford and Oxfordshire is currently in deficit for most categories of its diet. It produces a surplus of grains and starches, reflecting the relatively high levels of arable production in the county. But this surplus arable capacity is negated by the county's deficit in grazing land and animal feed production, which is sufficient only to support around half of the livestock products consumed in the city.**
- **Under the Alternative demand profile, Oxford and Oxfordshire would be self-sufficient in many food categories, including red meat. It would also have sufficient additional livestock carrying capacity (feed and grass) to support its white meat and dairy demands, leaving a surplus of grazing land. This would mean that surplus arable food cropping land would theoretically be free to re-allocate into fruit and veg production; sufficient to cover demand.**

Clearly total net self-sufficiency in each food category would not be required for even a comparatively large shift to localised food sourcing. However, our results show that a shift towards significant local sourcing for Oxford would require:

1. A shift in the city's food demand profile.
2. Some reallocation of farm production, in particular increased dairy and fruit and vegetable production.

Our results do not cover the fact that there would also be a requirement to develop local markets, and logistics and processing capacity – as discussed in section 3.25

In common with the UK as a whole, Oxfordshire produces significantly less fruit and veg than it consumes. This can provide an opportunity for local business innovation.

SECTION 3

How best can we take action?

Our intention here is not to draw definitive conclusions, rather it is to show how FoodPrint information can be used to provide a logical framework for targeting action.

The best course of action depends on who you are. Shoppers, chefs, butchers, supermarket managers will all have different options open to them. It also depends on your priorities, since the different elements of a demand profile have different impacts on different FoodPrints. And, on the whole, quite different actions would be required to address the extent to which food is sourced locally. There are some synergies amongst the solutions to food sustainability, but no cure-alls.

Our findings provide a clear evidence base on which people can put together their own approach. The most important thing we can do is help point to which of the decisions people might make are most likely to count. This section does this in terms of FoodPrints, giving a summary of which actions count for which FoodPrint; the most effective commonly being referred to as 'hotspots'. We also highlight 'sweetspots' in the supply chain – places where people are well placed to take action and where that action is also a hotspot in terms of its effectiveness.

We also look at the implications of our findings about Oxford's local food supply chain – current and potential. Without suggesting how much of our supply chain should be re-localised, we summarise the possibilities, and highlight the main actions associated with them.

3.1 FoodPrints

3.11 Hotspots analysis – which decisions really count?

In the FoodPrint analyses carried out in Section 1 we showed the relative impact that different input variables in Oxford's demand profile (diet, food waste, recycling, air freight etc) have on each FoodPrint. This helps explain why the two scenarios (Oxford Current and Alternative) differ from the UK average. But the variations in impact in those analyses are largely a function of differences in the extent to which each of the variables has been modified. For example most of the reduction in land footprint in the 'Alternative' Oxford scenario is accounted for by the change in consumption of red meat. This effect is partly due to the fact that red meat production uses a lot of land, but partly also due to the fact that the scenario involves such a significant reduction in meat consumption.

To get a clearer picture of the impact of different input variables we calculated the percentage change to each FoodPrint metric achieved by a one percent change to the input variable. This means we can compare how much difference, for example, a 1% change in food waste makes to land area, or GHG emissions, compared to a 1% change in red meat consumption. Also, to make this 'impact factor' comparable between different FoodPrints, we look at the percentage impact on the FoodPrint, rather than the simple magnitude of change. The reference points from which we draw our percentages are the UK average figures for inputs and FoodPrints.

Because the results are somewhat derivative of a range of data and assumptions, we report impact factor categories rather than figures. This avoids giving a false impression of precision, but does point clearly to the key 'hotspots' for effective action.

The categories are as follows:

- Very Strong (>0.3% change to FoodPrint per percentage point change in input);
- Strong (0.1 to 0.3% change);
- Moderate (0.05 to 0.1% change).

Input variables scoring under 0.05% were not assigned an impact factor.

3.12 What we found

Our results are summarised in Table 5:

FoodPrint impact factor – inverse correlations in brackets

Input	Land	Water	Energy	GHGs
Alcohol				
Dairy	Moderate	Strong	Moderate	Moderate
Fish			Moderate	Moderate
Fruit and veg		Strong		Moderate
Grain and Starch	Moderate	Strong	Moderate	Moderate
Red meat	Very strong	Very strong	Strong	Very strong
White meat	Moderate		Moderate	Strong
Eggs				
Oils and fats	Moderate			
Provenance				
Air freight			Moderate	Moderate
Organic	Very strong[52]		(Moderate)	
Food waste	Very strong	Very strong	Very strong	Very strong
Renewable energy			(Strong)	(Very strong)
Packaging			Strong	Moderate
Recycling			(Moderate)	

Table 5: summarising the impacts of input variables on FoodPrints

[52] In our model, organic production significantly increases the land area requirement. While this picture is true for most farm product categories in most circumstances, the magnitude of effect is amplified by the land take for red meat. And much of the additional land requirement for organic red meat production is accounted for by the use of extensive, unimproved, grazing systems. It should be noted that even for Oxfordshire, a lowland and productive county, the area of rough / extensive grazing land exceeds consumption requirements – in sharp contrast to other land categories.

Our main observations are as follows:

- **Reducing food waste is the most effective way of reducing FoodPrints**
- **Reducing red meat consumption is almost as effective as reducing food waste[53]**
- **Dietary balance has impacts across all FoodPrint categories**
- **Other factors (waste, energy, air freight, and recycling) have FoodPrint impacts, but these are less significant, and their impact is focused on energy and GHG FoodPrints**
- **Provenance does not have a significant direct impact on FoodPrints**

3.13 Mapping this on to the supply chain – who is best placed to act?

To analyse who might be best placed to take advantage of the hotspots identified in section 3.12, we mapped them on to the supply chain; integrating them with a qualitative analysis of the capacity for different parts of the supply chain to act on the hotspots. We call this a 'sweetspot analysis'. Our intention here is not to draw definitive conclusions, rather it is to show how FoodPrint information can be used to provide a logical framework for targeting action.

The impact factors we use in this sweetspots analysis are based on combined figures for all four FoodPrints[54], Land, Water, Energy, and GHGs (Table 5), although the same type of sweetspot analysis can be made for each FoodPrint in turn. For the qualitative analysis we chose five different classes of supply chain actors: Consumer, Caterer, Retailer, Processor, and Farmer. We then categorised each actor's ability to influence each impact factor as High, Medium, or Low. We then integrated both scores to identify 'sweetspots', as shown in Table 6, below[55]:

[53] Based, as with all of our calculations, on current typical production systems. There are significant variations in the impacts associated with red meat produced under different farming systems. So red meat can theoretically be consumed with a smaller FoodPrint. But as yet there are few, if any, simple options widely available in the supply chain which guarantee that the meat in question has a lower FoodPrint.
[54] No weighting was used, so all four FoodPrints contribute equally in this analysis
[55] The scores shown in the box below the table are sequential, but do not represent a continuous scale

The ability of actors in the supply chain to act and influence the impact factor is scored: High, Medium, or Low as shown in the top right hand corner of each cell. Sweetspots are coloured and scored according to the ability to act, combined with the impact factor, as shown below the table.

Impact factor		Consumer	Caterer	Retailer	Processor	Farmer
V strong	Food Waste	5 H	5 H	4 M	5 H	3 L
	Red Meat	5 H	4 M	4 M	4 M	3 L
	Farm system[56]	3 L	3 L	4 M	4 M	5 H
Strong	Renewable energy	4 H	4 H	4 H	4 H	4 H
Moderate	Dairy	3 H	2 M	2 M	2 M	1 L
	White meat	3 H	2 M	2 M	2 M	1 L
	Grain and starch	3 H	2 M	2 M	2 M	1 L
	Fruit and veg	3 H	2 M	2 M	2 M	1 L
	Packaging	1 L	1 L	3 H	3 H	1 L

Table 6: Supply Chain Sweetspots

Combined effect of impact factor and supply chain scored as follows:

Impact factor \ Ability to act	H	M	L
V. strong	5	4	3
Strong	4	3	2
Moderate	3	2	1

Note on farm systems

Our 'Farm system' impact category in the sweetspots analysis acknowledges the significance of farm system impacts on food resource footprints, and the categorisation as a hotspot is based on our FoodPrint results for organic / conventional farm system. But as noted elsewhere, our organic figures do not represent a simple story, and we have insufficient evidence to describe a clear directional impact from the choice of organic versus conventional products. Our sweetspots analysis is therefore skewed towards the production end of the supply chain. This reflects the impact that on-farm decisions can make, but also reflects what we see as a lack of clear proxies or indicators of these impacts at the consumer, or demand-side of the supply chain.

[56] Please see note on farm system in main text

3.2 Provenance – where should our food come from?

3.21 Localisation as a means of diversification

The ability of our current food supply system to buy in food from UK-wide, and international sources means that we are well insulated from localised failures of production – such as crop failures or animal diseases. This use of trade to hedge the risk of fluctuations in food supply is age-old, probably second only in vintage to food storage. However, a complete reliance on trade can also carry risks. Factors such as logistical failures, fuel availability, or geopolitical strife can all affect our ability to access markets. Food systems have therefore traditionally balanced trade against local production.

Quite where the balance lies in terms of modern circumstances is open to question. But concerns have been raised about the ability of our current food system to continue to feed us in the event of disruptions to current sources of supply[57]. Analyses often point to our exposure to the risk of acute and unexpected disruptions to the supply chain, rather than there being a long-term question over our ability (at least at a national scale) to provide for ourselves[58]. The central issue is how rapidly our food supply systems, which are highly adapted to current market conditions, would be able to adjust to change and carry on. This 'resilience' question is familiar in logistics circles, where a balance is classically struck between highly efficient 'lean' systems, and more 'agile' systems which take a less pared-down approach but retain the capacity to respond to change[59].

The most striking feature of our current food supply system is perhaps not that we trade so much food from overseas, but that of the food that we source from the UK so little of it is sourced through local and direct sources. Obtaining a significant proportion of our food through local sources, via separate supply lines to existing centralised ones, would probably be less efficient in many ways than our current approach. But it could potentially help increase resilience in the supply chain, by providing additional options for supplying food if our existing sources became impaired. Essentially, to a greater or lesser extent, there is a case for using 'localisation as a means of diversification' in the supply chain.

3.22 Food zones

A very useful framework for thinking about balanced food sourcing has been developed by Growing Communities, in Hackney, London[60]. This framework sorts provenance into six 'Food Zones' arranged as concentric circles radiating outwards from the point of consumption – see Fig. 18. The Food Zones range from 'Urban Domestic' through to 'Further Afield' – which means beyond Europe. The Food Zones approach is about setting targets for the proportion of diet sourced from each zone, and the breakdown of food categories sourced in each zone.

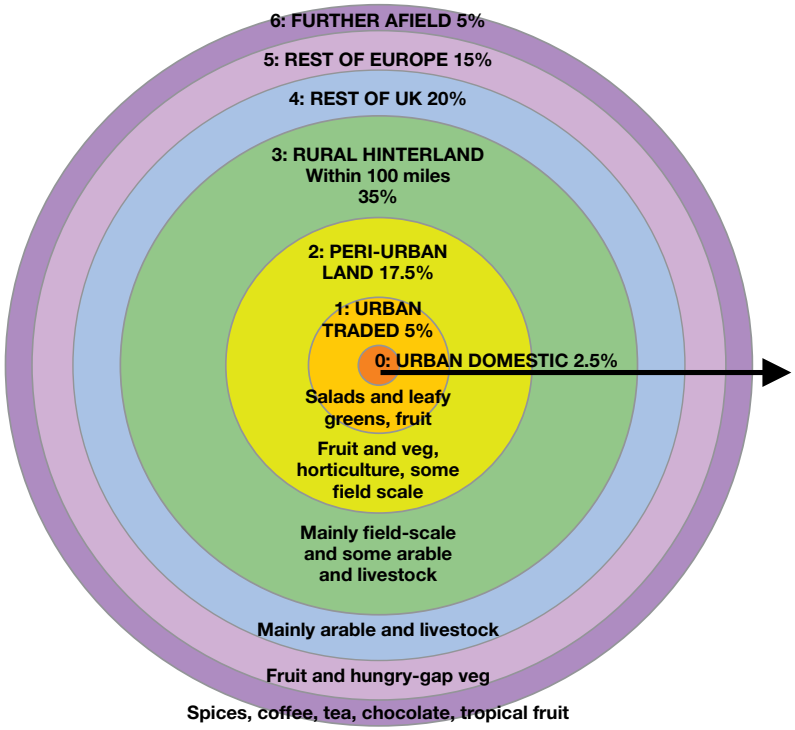
LandShare's FoodPrint calculator frames provenance in these terms, allowing users to allocate food classes across different Food Zones, and it then reports the resulting 'balance of trade' and distribution of land usage.

3.23 Applying the Food Zones to Oxford

Given current patterns of food sourcing, the practical questions that arise when relating this approach to FoodPrinting Oxford apply to the innermost Food Zones. Current supplies from these zones play an important, but in terms of volume marginal role in the city's food system. Increasing these volumes by 50%, or even by two or three-fold would do little to increase the extent to which local sourcing effects the overall resilience or sustainability of the city's supply – it would still provide only one or two percent of the food the city consumes. To play a functionally significant role in diversifying the supply chain we might expect local Food Zones to represent at least 10% or perhaps even a third of food supplies.

[57] See for example: Chatham House (2009), Food Futures – Rethinking UK Strategy
[58] A good analysis of 'Can Britain Feed Itself?' is provided by Simon Fairlie in The Land, 4, Winter 2007-8
[59] See: Cranfield / DfT (2003), Creating Resilient Supply Chains – a Practical Guide
[60] http://www.growingcommunities.org

Growing Communities' Food Zones Fig.18



In Section 2 we analysed the extent to which current and potential demand for food could be matched with food production in Oxfordshire. This roughly equates to the sort of landscapes that would be encountered in Food Zones 1, 2 and 3. We can therefore start to identify some of the practical changes that would need to be made to accommodate the sort of phase-shift in sourcing discussed above.

These practical changes are summarised as follows:

3.24 Matching agricultural production with food consumption

The main priorities for action to increase local self-sufficiency, based on our analyses and assuming that the proportion sourced locally would be similar for each of the food groups, would be:

- **Adjusting the population's consumption profile.** Reducing food waste and changing diet along similar lines to the 'Alternative' demand profile in this report, in particular reducing meat consumption, helps match supply with demand simply because it dramatically reduces the city's overall land footprint. The effect is significant, and it seems unlikely that a phase shift in local sourcing could be met without at least some shift in the population's consumption profile.
- **Increasing fruit and vegetable production. Although as a product class it lends itself well to local production and distribution, Oxfordshire has a striking fruit and vegetable deficit.** This deficit represents an opportunity to establish and expand market gardens and orchards in the county. Also, our estimates in section 2.3 suggest that increased urban production could close a significant proportion of the deficit (converting ¼ of domestic gardens over to production could cover >10% of supply).
- **Increasing dairy production.** The other major deficit in production versus consumption is in dairy. A shift in diet could free up sufficient land to produce the feed-crops and temporary grass required to support a much larger dairy herd in the county. Given the capital challenges, processing needs, and the tendency for regional specialisation associated with dairy, such a shift is likely to represent a bigger challenge than an increase in fruit and vegetable production. But if local markets were strong and reliable, a shift could theoretically be possible.

3.25 Creating local food infrastructure

It is clear that greater local sourcing would require more than a shift in local production; we would also need the means to link the production up to local markets. Although our FoodPrinting and land capacity analyses do not specifically shed any light on this area, we can identify three main categories of action that would need to be addressed:

- **Processing.** A phase shift in local food supplies would need a commensurate shift in processing capacity. Particular gaps are likely to exist for commodities that are not already produced in high volumes, such as dairy, and in commodities where the supply chain is heavily centralised, such as wheat milling and baking.
- **Logistics.** Experience tells us that existing local supply lines often lack the optimisation and efficiencies associated with larger, more integrated and organised logistics operations. Typically they involve multiple small operations, each with their own systems and vehicles. This can mean duplication, and restrict access to larger food outlets, which need to manage large volumes in a predictable manner. Given a shift towards more local supplies, we would expect to see a big opportunity for developing and optimising local logistics: linking suppliers and processors to the point of sale. We might expect this to be a service provided by independent operators; creating a joined up ordering system, and managing a consolidation and distribution operation.
- **Markets.** A big question is whether existing local routes to market, such as farmers markets and box schemes, are inherently limited in scale, or whether they could actually take up a significant share of the market for food. Whichever is true, were we to see a phase-shift in local supplies, we would expect the need for participation by the existing major players: supermarkets, convenience stores, and multiple caterers. This is an important area for market innovation.

3.3 Our suggestions for taking action

Two clear messages that come out of the FoodPrinting work are that, given a shift in demand profile, it would (1) be possible to significantly reduce Oxford's resource FoodPrints, and (2) that it would be possible to source a much greater proportion of the city's diet locally.

In order to achieve this sort of result we can compare the effectiveness of individual 'interventions' in the supply chain, for example diet, versus waste, versus provenance. But **it is clear from our analyses that effective change is likely to require 'complexes' of several interventions**, as in the 'Alternative Oxford' scenario. This is partly because of an additive effect, partly because different interventions cover different FoodPrints, and partly because some interventions are contingent on others to be practicable. So for example, the sort of localisation of the supply chain discussed in section 2 is only really practicable given the changes in demand profile outlined in the 'Alternative Oxford' scenario.

As we have emphasised before, quite how these sorts of strategies are put together should be left up to the individuals and organisations involved – there are lots of right answers. But we do think it is valuable to provide a framework which encourages action, and informs the decisions people make. We think this sort of framework should incorporate the following features:

3.31 Engagement across the supply chain

Our sweetspots analysis in section 3.13 highlights the fact that different parts of the supply chain have agency in different ways over different elements of our food footprint. So it's not accurate, for example, to think that it's 'all about behaviour change in consumers'. **We need all parts of the supply chain to be interested in taking action.**

Our suggestion is that any initiative for Oxford should be inclusive in scope, but have specific 'entry points' designed for target setting and action-planning in different parts of the supply chain. These might work through a process of engaging high profile participants, signing them up to an action plan, and demonstrating the kudos and benefits they accrue as a result. Participants might include:

- **Consumers. For the sake of accessibility these might be in existing groups (e.g. Local Action Groups, schools, student groups).**
- **Caterers. Including restaurants, public and private sector institutional caterers.**
- **Retailers. Ideally including existing 'big players' in the market, such**

as supermarkets and potential 'big players', such as community enterprises.

- **Farmers. The critical point about Oxford's FoodPrints, and therefore its 'food community', is that it clearly includes the broad acres outside the city. It is therefore critical to engage farmers.**

3.32 Knowledge-based action

This report demonstrates that there are big differences in the effectiveness of different supply chain interventions, and it challenges some of our default perceptions about the role and impact of current 'sustainable practices'. So we strongly recommend that any sustainable food strategy draws on and is tested against the current 'state of the knowledge'. We suggest that three sorts of information are used:

- **The findings in this report.** FoodPrinting Oxford provides valuable strategic information about the hotspots for change in Oxford's food system, and the scope and challenges associated with a shift to more localised food sourcing.
- **Complex information.** Food sustainability is complicated, and sometimes counter-intuitive. The FoodPrint Calculator provides a 'beta version' of the sort of decision support tool that could help people navigate this complexity when they make supply chain choices. It brings together a wide range of data sources and assumptions, and although this knowledge is evolving and assumptions should be adapted over time, the FoodPrinting approach is a good way of putting the current state of the knowledge into practice. An example of one scale at which it can be used is shown in our case study – section 3.4.
- **Applied information.** Turning a theoretical plan into practical action requires a different type of technical knowledge. It's the sort of knowledge involved in putting a logistics system together, or adapting recipes in a restaurant. In many cases the techniques exist already, and can be borrowed from other applications. In all cases it is the sort of knowledge and know-how that resides amongst the people who will actually be making things happen – chefs, farmers, supermarket buyers. So their input in informing strategies will be important.

3.33 Setting targets and measuring progress

This is hardly a revelatory suggestion for any kind of strategy, **but generating meaningful metrics against which to set targets and measure progress is an important challenge for food sustainability.**

- **Outcomes-based metrics.** Our view is that it is important to measure outcomes, rather than methods, hence our focus in this report on FoodPrints: land, water, energy and GHGs.
- **Practicality versus precision.** Measuring and reporting systems are primarily there to support the development and adaptation of management decisions. As a result, the 'level of proof' required when collecting data is significantly less than you would need, for example, if you were carrying out scientific research. With this in mind, we would recommend that reporting systems err on the side of using 'quick and dirty' rapid assessments, as opposed to onerous information gathering processes, which can be difficult to maintain.
- **Building in recognition.** We think it is appropriate to set FoodPrint targets for the city as a whole, but that solutions and contributions to those targets should be recorded at the level of participants in the initiative.

3.34 Demonstrating clear benefits

People will take action because they think it's the right thing to do. But it is easier to take really significant action if it results in benefits to the individual or organisation taking action. There are several ways in which managing FoodPrints and rethinking provenance can do this:

- **Risk management.** In many respects the basic philosophy of our approach equates sustainability in the food system with resilience and risk management. This makes sense at the level of the city's food supply, and it also makes long-term business sense for any organisation which deals with food.
- **Market share.** There is on-going debate about the size of market for 'sustainable products'. But there is a natural interest in reliable food supplies, and potential for an emerging market in providing and

guaranteeing that reliability, to consumers and business-to-business customers.

- **Co-benefits.** There are lots of examples of how the sorts of interventions explored in this report coincide with cost savings and efficiencies, for example reducing packaging, waste, and energy expenditure. On an individual basis, the sort of shifts in dietary profile described in the 'Alternative Oxford' scenario coincide with conventional advice on healthier eating (less meat, and more fruit and vegetables).

3.35 A starting point for Oxford – specific recommendations

We propose a discrete and tightly focused initiative to get the FoodPrinting approach started in Oxford. We suggest this is focused on the service / catering sector, because of its profile and its ability to engage a wide range of stakeholders, including food professionals and the public. The work could be carried out by LandShare and its existing project partners, such as Best Foot Forward.

The initiative would run over 6 months, and would incorporate the following components:

- **Pathfinder Caterers.** We would recruit 6 'Pathfinder' caterers, including at least two restaurants, a college from the University, and at least two more institutional caterers, such as a school, hospital, factory canteen. Pathfinders would benefit from publicity, and would be able to advertise their participation in the project.
- **FoodPrinting Process.** We would work with each Pathfinder to carry out a four-step audit and action-planning process, based on the experience of our case study work with the Turl Street Kitchen (Section 3.4). The steps would be:

1. A rapid assessment of key food sustainability data and information for the catering operation
2. FoodPrint 'hotspot analysis' and reporting
3. A workshop with key workers (for example: chef, buyer, catering manager) to identify practical actions, and to set targets
4. Review of progress against targets

- **Follow-up seminar.** The Pathfinders would be brought together after 6 months, to share findings and experience, and to report on progress.

Using the initiative to inspire wider action:

- The initiative could be developed into a city-wide scheme, with other caterers / restaurants signing up to the FoodPrinting approach and being able to advertise their participation.
- The contribution of caterers to reducing Oxford's FoodPrint could be used to create impetus for setting FoodPrint targets for city as a whole, and for involving other sectors and other parts of the community.

Case study – Turl Street Kitchen

3.4 Case study – Turl Street Kitchen

3.41 Background

The Turl Street Kitchen (TSK) is a social enterprise café-bar-restaurant that opened in Oxford in October 2011. The organisation aims to reflect its social ethos in the way it does business, and as a result it takes an interest in the sustainability of the food it serves. As part of this study we undertook a rapid assessment of the Kitchen, in order to demonstrate how hotspots for action could be identified in a working business in Oxford.

3.42 Information gathering – rapid assessment

Our objective was to gather enough information to test how well the Turl Street Kitchen is currently performing in terms of food sustainability, and to scope out where it might focus its efforts to make improvements. Because we were not attempting to carry out a detailed audit, our emphasis was on 'accurate and quick' information, rather than 'precise and laborious'. We were able to make the process simple; asking for the sort of information that the chef would have 'off the top of his head' – see appendix for the questionnaire that we used. This meant that contact time involved only an hour or two of TSK staff time.

3.43 Analyses

Our analyses were similarly straightforward. We used the FoodPrint Calculator, plus some additional calculations, to investigate the following:

1. TSK's FoodPrints

- We used energy, waste, recycling, and food purchasing figures collected from the kitchen to estimate input variables, which we then used to calculate TSK's annual resource and GHG FoodPrints (Table 7).
- We used the total calorific value of TSK food purchases to calculate the 'effective population' that the kitchen supports (49). We then compared this against UK average FoodPrint figures for a population of the same size (shown as UK baseline in Table 7).
- Because TSK operates as a bar as well as a restaurant, we calculated 'food only', and 'all food and alcohol' figures, to make comparisons more meaningful.

The results are as follows:

	Food only			All food and alcohol		
	UK baseline	TSK	Difference	UK baseline	TSK	Difference
Land (hectares)	18	15	-17%	18	17	-6%
Energy (GJ)	2,440	1,700	-30%	2,470	1,820	-26%
Water (tonnes)	129,000	109,000	-16%	136,000	143,000	5%
GHGs (tonnes CO^2)	131	89	-32%	135	101	-25%

Table 7: TSK annual FoodPrint requirements, compared against baseline of UK Average figures for a population of the same 'effective' size

The basic pattern is clear; that TSK performs impressively compared to the national average. This can be accounted for by three main factors:

- **Dietary profile.** As can be seen in Fig.19, TSK's food procurement profile is significantly skewed away from meat and dairy, and towards fruit and vegetables (although the kitchen serves a mixed menu). The impact of diet balance accounts for half of TSK's GHG and Energy savings, and virtually all of its Water and Land area savings.
- **Recycling.** TSK recycles around 90% of all its waste. This level of recycling, rather than recycling's inherent 'impact factor', has a significant impact on the kitchen's energy FoodPrint; accounting for over a third of the difference we found.
- **Renewable energy.** TSK uses a green energy tariff, and although this only guarantees a proportion of renewable sourcing, it has an impact of GHG FoodPrint; accounting for a quarter of the difference we found.

2. Key variations (menu choices)

We compared the FoodPrints of four current menu items (Fig.20). In doing so we converted recipes into 800 kCal meal portions, to create a fair comparison.

- FoodPrint results were similar to expected, with significant variations between dishes, and bigger FoodPrints for red and white meat items than for the vegetable dishes.
- Energy FoodPrints were surprisingly similar in all four dishes. This may reflect the recipes, which for example included significant dairy (cheese and crème fraiche) in the case of the veg bake.

Comparison of diet profile of TSK and UK average (% of total weight consumed) Fig.19

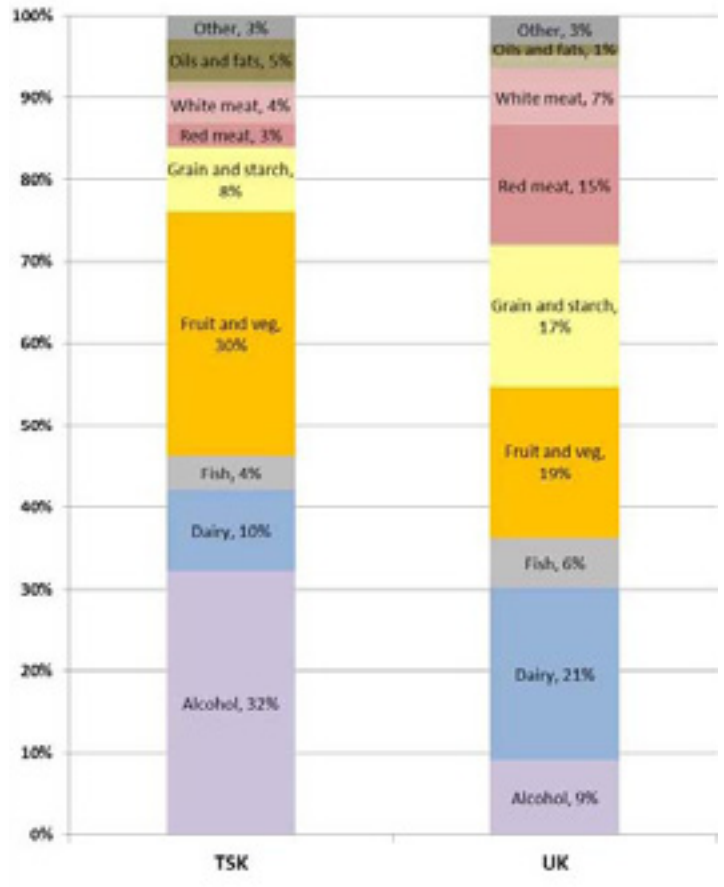
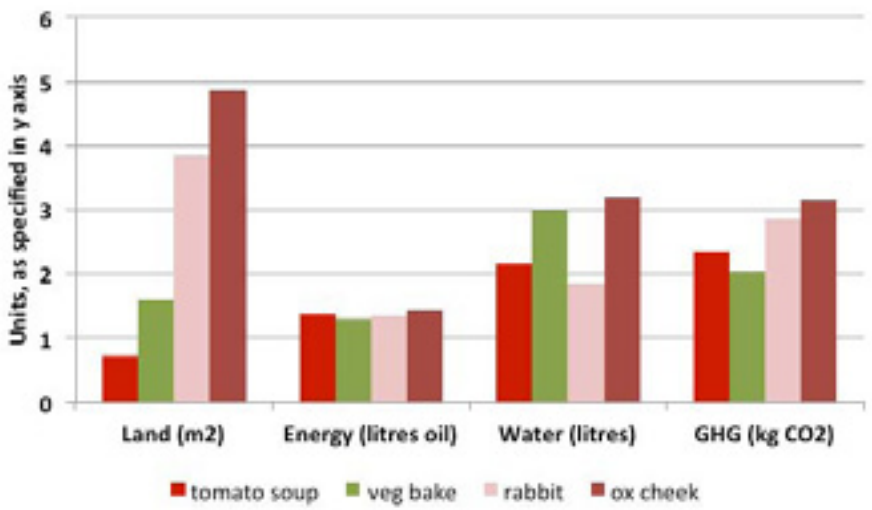


Chart comparing FoodPrints of four menu choices at Turl Street Kitchen, equalised to an 800 kCal meal portion Fig.20



3. Provenance

The TSK estimates that around 10% of its food comes from local sources. This is five to ten times higher than the average for the UK.

3.44 Identifying hotspots for action

Our analyses suggest that TSK is already performing well, although the 'Oxford Alternative' scenario outlined in this report suggests that greater gains should be possible. We can make an analysis of where these gains might be made based on the TSK findings, along with what we now know more generally about Hotspots in the supply chain (section 3.1).

A set of recommendations for closer scrutiny and further action may therefore be as follows, in order of priority:

1. **Food Waste.** **Avoiding waste is far more effective than even the best recycling methods.** Even though our TSK review does not include any quantification of waste, it does give us a flavour of current activity. And we know that even if the kitchen is performing very well that reducing food waste from preparation, spoilage losses, and plate waste, is still likely to represent a significant opportunity for making FoodPrint gains[61].

2. **Diet balance.** We found significant variations between menu options. Moving the menu towards the best performing dishes might involve, for example, providing customer information on FoodPrints, or giving attention to recipe proportions.

3. **Maintaining existing performance.** Much of what TSK is doing is already effective, so it is important to recognise where those gains are being made, and take action to maintain or enhance their positive impact on performance. For example:

- **Recycling.** The high levels of recycling provide important benefits, and should be maintained.
- **Energy use.** The current choice of energy tariff also plays a positive role. It could be improved to increase the proportion of renewables in the mix, and reduce the sell-on of Renewable Obligation Certificates.
- **Provenance.** The 10% local figure should be verified, and built on. This might include aiming for a higher proportion of local sourcing, or possibly more importantly, aiming for closer engagement with one or two local suppliers.
- **Staff and customer engagement.** TSK shows a high level of commitment to involving staff and customers in decisions about sustainability. This 'cultural approach' should help secure deeper and longer-term results, and create more opportunities for innovation.

[61] Good advice can be found through www.thesra.org/what-we-offer/audits-toolkit/food-waste-toolkit




EAT
SEASONABLY













The Veg Van

www.lowcarbonoxford.org