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Urgent recall

Our food system under review

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Summary

What makes a food system successful? Historically, the criteria have been high output, low prices, and eradication of deficiency diseases. This understanding is outdated and needs redefining.

A successful food system is one that delivers high wellbeing, social justice and environmental stewardship. This report identifies eight indicators, illustrating that such a food system will:

1. have a neutral or positive environmental impact;
2. be productive in its use of energy and other inputs;
3. be diverse in species and genes;
4. support good jobs;
5. be dominated by short and simple supply chains;
6. be composed of assets that are controlled by a wide and inclusive set of stakeholders;
7. foster a positive and thriving food culture and the highest levels of public health;
8. make food affordable to everyone.

Based on these criteria, the UK food system is failing:

- **It is unsustainable:** we estimate the total environmental impact of the UK food system to be in the region of £5.7–7.2 billion per year, or 6.3–7.9% of the market price of food, and probably higher.
- **It is energy-intensive:** the UK food system uses roughly eight calories of energy to produce every one calorie of energy from food.
- **It supports bad jobs:** the UK food system employs approximately 11% of the UK labour force, but most of them are in the least well-paid jobs, with salaries of less than half the UK average.
- **It is highly complex and opaque:** both the decreasing share of total value going to farmers and recent events such as the horsemeat scandal testify to the extreme and increasing complexity of our UK system.
- **It is unequal:** all 17 million hectares of agricultural land is owned by about 0.25% of the UK population and the price of an acre of bare land has increased more than threefold from 2004.
- **It is volatile:** Britons spend less on food than almost any other EU country, but recent price spikes have hit poor households the hardest.

Including adverse environmental impacts, the cost of obesity and subsidies paid through the Common Agricultural Policy (CAP), we have estimated the total external cost of the UK food system to be between £11 billion and £26 billion. This means that our effective food bill is at least 12–28% greater than the price we pay at the till. The UK food system is failing, and with serious environmental, economic and social consequences.

To contrast with this picture, we sought examples from across Europe of where food systems are achieving the kind of success we have defined. There were many lessons to be learned from them.

- **Small-scale infrastructure is critical.** Local processing facilities sustain economically healthy communities.
- **Circular, resource efficient systems are possible but require willingness to break with the status quo.** Systems with low external inputs of energy and other resources can be remarkably successful but require innovative thinking and in some cases experimentation.
- **Short and integrated supply chains can bring benefits for farmers and local areas.** Reducing the gap between consumers and producers supports local enterprise and ensures a strong local system.
- **The social benefits of employment must be recognised.** Many producers understand that, while hiring people costs money, creating jobs for certain groups of people has wider social benefits beyond what they get from their employees.
- **Farmers and businesses can drive environmental change.** Many farmers make reducing environmental impacts a personal mission, though it's one that can also be good for their business. Some changes have a clear impact, such as reducing fossil energy use, but others would need to be monitored more closely.
- **Alternative models have already achieved considerable success.** Our examples illustrate that environmental and social gains are not mutually exclusive of economic ones.

With clear examples of where success has been possible, how have we become stuck in this food system that doesn't work for either us or for the planet? Much of the answer lies in the wider socioeconomic system – persistent and growing inequality, grinding poverty, and enduring unemployment forces many to compromise on the quality and healthfulness of what they eat, propping up companies that provide these products. The distribution of working hours – with most people either overworked or underemployed – forces households to seek time-efficiencies, opting for fast food and ready meals. The public policy fixation on economic outcomes, particularly GDP growth, crowds out alternative understandings of what matters for good lives. The non-monetary outcomes of systems, especially natural systems such as food and agriculture, are not used to the greatest advantage.

The dominant paradigm in which success is understood is outdated and flawed. Our food system is defective, because the way we understand it is defective. We need to address this so that we can manage our food system to support the greatest contribution to human wellbeing, in a way that is socially just and sustainable over time.

1. Motivation

Our food system isn't working. Obesity is spreading globally and diet-related illnesses are the biggest killers in most higher-income countries. Harsh agricultural methods degrade our lands and both cause climate change and suffer from its consequences.

From horsemeat to salmonella, the consequences of an unaccountable and dysfunctional industry are never far from the headlines.

But the modern food system is widely seen as a triumph of science and economics. The Green Revolution saved countless thousands from death by famine. And consumers have never been more spoiled for choice of food products.

How can these two points of view co-exist? It comes down to the critical issue of how we understand 'success' in our food system. Lack of clarity on this basic question allows a proliferation of distorted views. Only by looking at the full picture can we start to work towards a food and farming system that everyone can recognise as a success.

Introduction: What makes a successful food system?

The criteria we choose to define 'success' determines whether or not we observe success; different sets of criteria will paint a very different picture of which types of food system are 'successful' and which are not. Accordingly, the past half-century of food system change may be seen as a remarkable success, as a Sustainable Development Commission report notes:

> *"Measured against the vision articulated in the post World War 2 period, the story of UK food has been one of considerable success. These goals were widely recognised as:*
>
> - *raising production*
> - *lowering the price of food*
> - *reducing deficiency-related ill-health."*[1]

While that system and its objectives achieved much, our knowledge and circumstances have changed and this vision needs updating. Now we know that focusing on increasing output fails to account for the dangerous impacts of some inputs. Now we know that reducing the price of food will never be enough to completely eradicate hunger. Now we know that diseases of excess, rather than deficiency, may be the most deadly of all. In other words, a process of re-defining success in agriculture and food systems is necessary, and this report is a step towards that.

So we asked ourselves:

What should a food system be for? Is it just to feed people by continually increasing production? Who should benefit from it? Is it to sustain livelihoods and public health? Should it enhance local environments? And how do we know whether it's delivering those things? Ultimately, are we valuing, and measuring, what matters?

These are the questions motivating this study. They are big questions with no unique and simple answer. This paper is about starting to explore those answers. In the process we spoke with a range of fascinating people who told us about their experiences with food systems. We had the chance to visit inspirational, real-world examples of innovative approaches to producing and distributing food across Europe. And we explored the shocking state of the UK food system, calculating that the true cost of food is 30% more than the price we pay at the till.

Methodology

We used a range of research methods in order to answer the questions posed.

A set of interviews was conducted by phone with key experts and commentators. These were used first to familiarise ourselves with current debates concerning food systems, secondly to collect views on the core question of appropriate food system objectives and indicators, and thirdly to obtain suggestions for real-world examples. Interviewees were identified through existing contacts and through recommendations from previous interviewees. A list of those interviewed and consulted can be found in Appendix 1. Quotes from these interviews are used throughout this report. It was not possible to obtain input from the full range of stakeholders; as such, we are mindful of the absence of some stakeholders in this process.

A review of research and data was conducted based on searches of academic journals, online government archives and databases, and recommendations from interviewees. This review informed an understanding of food system objectives and indicators and provided the data and information to:

- Select a suite of indicators and
- Assess case studies and UK macro-data against those indicators.

Finally, we identified practical examples of food systems that achieve some aspect of success, according to our set of indicators. These were recommended by partners and interviewees. We travelled to sites in Germany, Italy, and the UK to learn from the people leading those projects and how they were creating successful food systems.

The paper proceeds as follows. Section 2 sets the scene with an overview of what our food system is and how it has changed in recent decades. Section 3 develops the analytical framework, elaborating on what we mean by success in the food system as well as examining the range of positions adopted by organisations and individuals. In this section we develop the framework of objectives and indicators that is used in Section 4 to illustrate a re-defined concept of success in food and agriculture systems. Section 4 also uses eight indicators to assess a number of case studies throughout Europe and examines the data for the UK as a whole for each indicator. Section 5 concludes and considers the most important questions that need more exploration.

2. Context

Our food system is wildly complex and intricately entwined with all areas of our economy and society. But in order to understand it, it's useful to zoom in on certain components and particular trends. Ten such trends give a good summary of how our system has evolved and what its characteristics are today. The direction and speed of change in this system reflect in some ways the dominant intellectual paradigm, neoliberalism.

What does our food system look like?

Defining our food system

What does it mean to talk about 'our food system'? We have to get energy and nutrients from where they naturally occur to our mouths – the food system is all of the processes and bits of machinery that make this happen. It encompasses the farmer growing crops in Devon; the fisherman landing mackerel in the east of Scotland; the processing plant that cuts up vegetables and seals them into plastic bags; the transport networks that shift everything imaginable along roads, across seas, and through the air; the supermarkets, grocers, butchers, and bakeries that stock the final products; the households that take all this food and make it into meals; and the waste disposal companies that pick up the leftovers to turn them into compost.

What is the food system?

> *"Our modern food system is a complex web of food supply and consumption which relies, and impacts, on the physical and material world through the use of resources for fertilisers, buildings, equipment; the biological world by using plants and animals; the social world by requiring labour and social organisations to create, process, distribute, cook, and deliver food; and the cultural world by shaping demands, meanings and aspirations for what and how food is consumed."*
> **Sustainable Development Commission (2011): Looking back, looking forward**

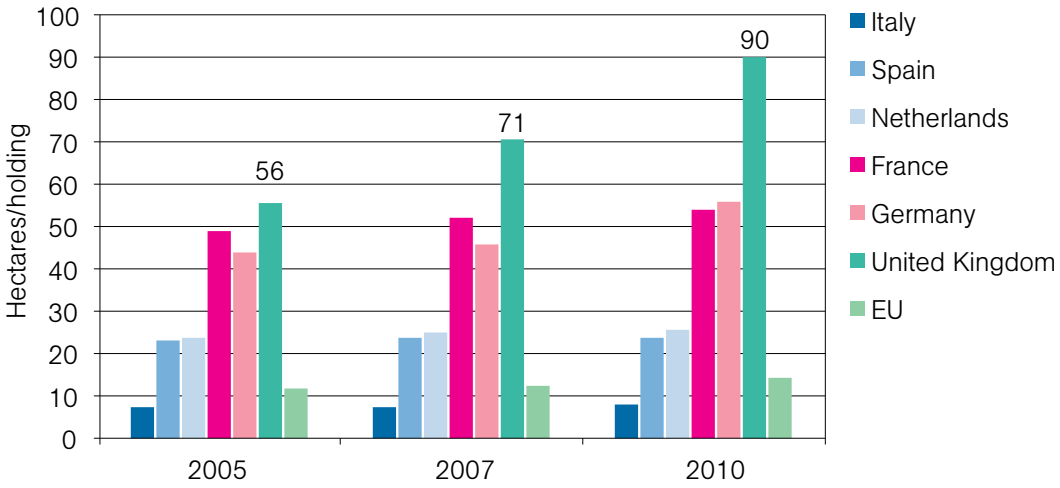
But the food system is so embedded in the broader economic system that it can be hard to say where it ends. For example, advertising companies may not deal in physical produce but they certainly shape what people choose to put on their plates.[2] Writers and journalists make a living from interpreting and disseminating food cultures. Labour market conditions determine how much time we have to prepare and eat meals. Even the location of our towns and cities and the transport we use to get around are shaped by where and how we produce food.

We all eat food. But how much does each of us know about what our whole food *system* really looks like and how it's changing?

Describing our food system: 10 trends

1. Our farms are getting bigger

Figure 1: Average farm size

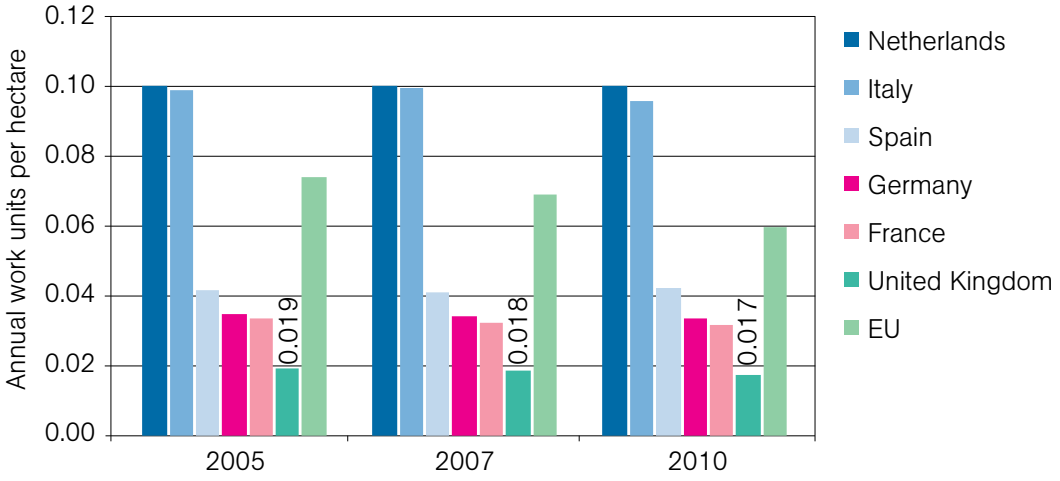


Source: Eurostat[3]

Farms across Europe have been increasing in size (Figure 1) and decreasing in number.[4] Generally, the largest farms are to be found in western and northern EU countries while southern and eastern nations retain a large number of small farms. UK agriculture is particularly focused on grazing, which tends to involve larger farms. Even among dairy farms, however, the UK's average herd size is significantly greater than the EU average.[5] Financial economies of scale, exacerbated by subsidy programmes, are a major pressure towards consolidation.[6]

2. They employ fewer and fewer people

Figure 2: Employment on farms

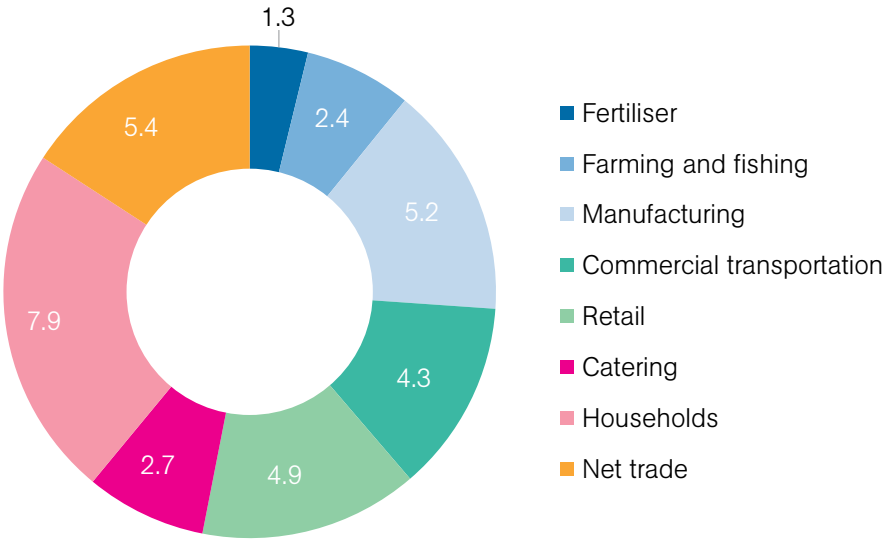


Source: Eurostat[7]

Fewer jobs than ever are supported on each hectare of land (Figure 2). The change over time reflects the rationalisation of smaller farms into bigger ones, and technological changes that replace the need for human labour.[8] For every 10 farmers in the UK, there are 41 people working in business and finance.[9] Of the total number of farmers in the 28 EU member states, 28% of them are Romanian.[10] In the UK, employment is falling in food manufacturing as well as in primary production.[11]

3. But they use lots of energy

Figure 3: Energy use in UK food system 2011 (mtoe)



Source: Defra[12]

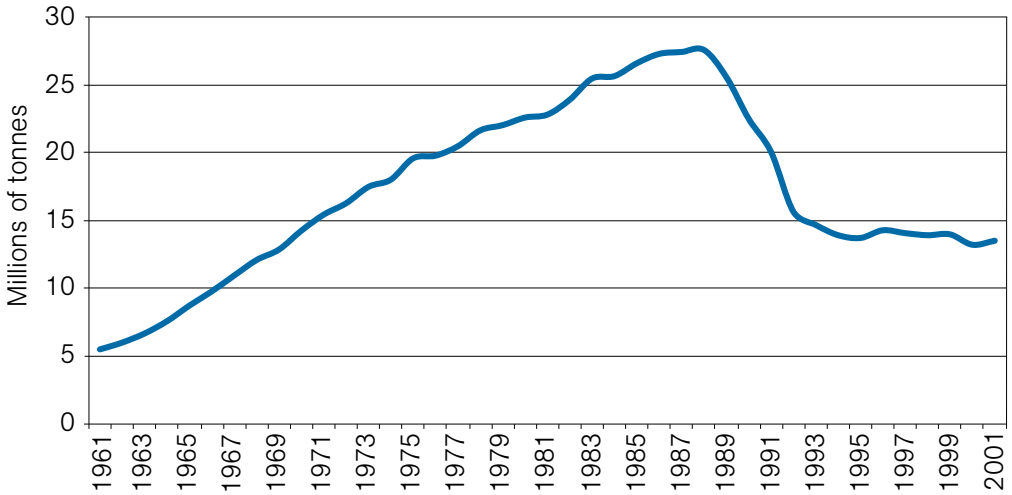
UK primary production uses nearly 4 million tonnes of oil equivalent (mtoe) in a year (represented by the two smallest wedges in Figure 3). The majority of energy used on farms is embodied in the fertiliser applied to crops, which is made with fossil fuels. In the UK, farms that use the most amount of energy (either per hectare or per livestock unit) are the most profitable.[13]

> *"The system we have has only really been formed in the last 50 years, at least in terms of its dependence on external inputs and its international basis. It's unprecedented, in a way."*
> **Interviewee**

However, the energy use in the food system as a whole is far greater still. Defra estimates that the energy embedded in the UK food system,[14] from agriculture through to retail and domestic consumption, amounts to 34 mtoe per year (Figure 3). If converted to electricity, that's enough to power the whole of the UK for more than a year.[15]

4. Artificial chemical use remains high historically

Figure 4: Consumption of nitrogenous fertilisers in Europe

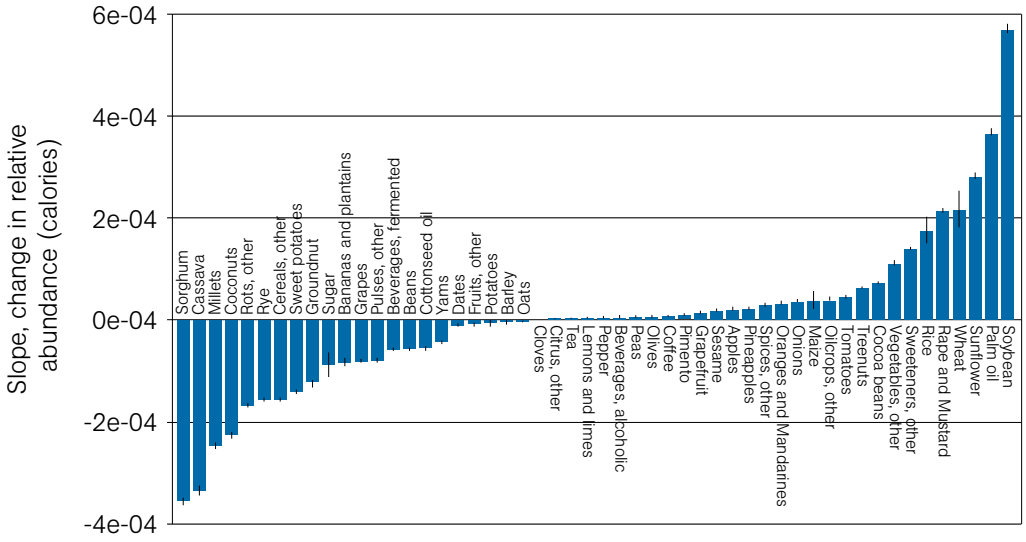


Source: FAO Statistics[16]

A dramatic change in farming methods in Europe took place following the Second World War: the use of synthetic chemicals (fertilisers, pesticides, and herbicides) sky-rocketed, reaching a peak in the 1980s (Figure 4). Following a significant reduction (which has been linked to the transition of Eastern European countries and improvements in agricultural techniques), chemical use has remained largely stable in recent years, but with slowly decreasing use per hectare in some countries (including the UK).[17]

5. We eat fewer species than we used to

Figure 5: Change in food energy from different crops (1961–2009)

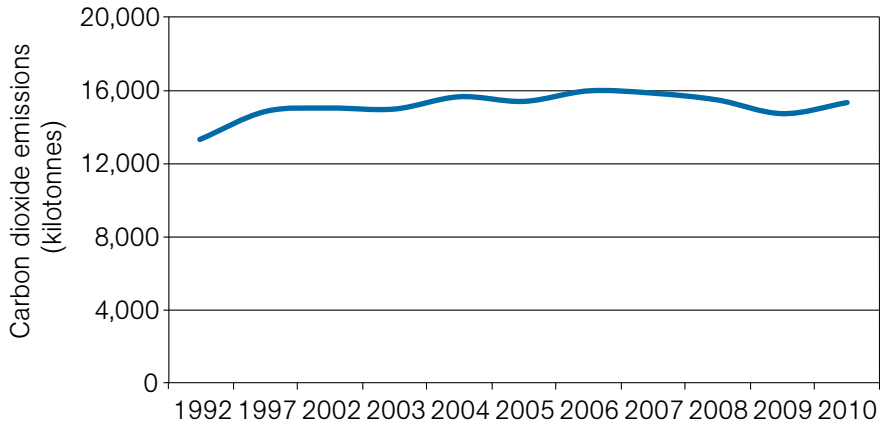


Source: Khoury *et al.* (2014)[18]

Globalisation has led to an increasingly uniform consumption of crops across the world. While individual countries have somewhat increased the variety of crops they consume, they have tended towards a common 'global diet', with the result that global crop diversity has decreased. Figure 5 illustrates the significant global shift away from marginal species such as sorghum, rye, and sweet potatoes, towards global crops such as soybean, palm oil, and wheat. Nearly 80% of UK crop production consists of just three species – wheat, barley, and oilseed rape.[19]

6. And they come from further away

Figure 6: Total CO_2 emissions from food transport

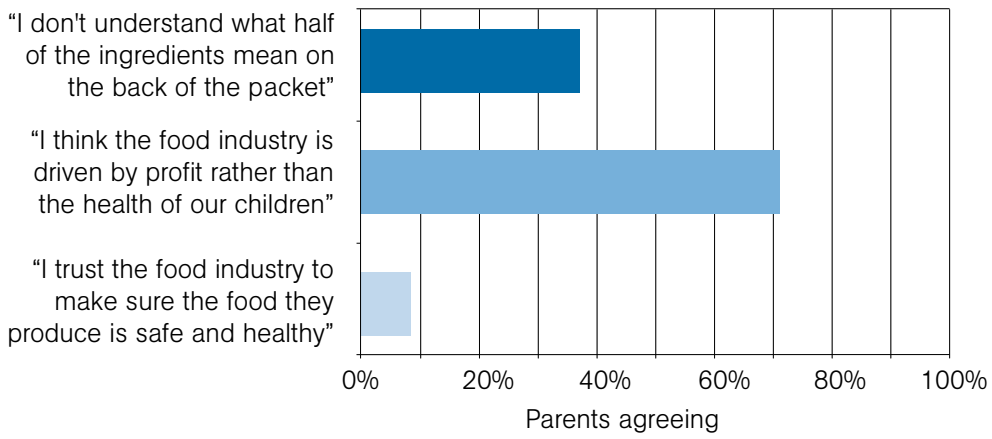


Source: Defra[20]

Total UK CO_2 emissions from food transport increased by 15% between 1992 and 2010 (Figure 6) with even larger increases in urban food kilometres[21] of 26% and air food kilometres of 162%.[22] While the distance food travels is not necessarily a good indicator of total environmental impact,[23] it does exemplify the increasing extent to which food is consumed away from its place of production.

7. It can be hard to know much about your food

Figure 7: Percentage of parents agreeing with statement



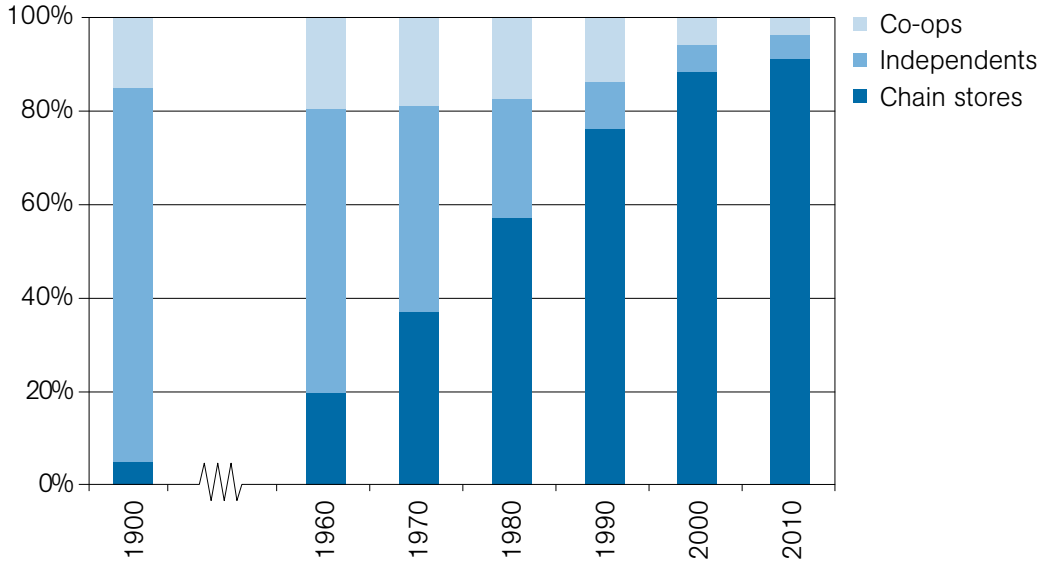
Source: Mumpanel (2014)[24]

We struggle to recognise the ingredients listed on food packets (Figure 7).[25] Supply chains are complicated, international, and secretive.[26, 27] Product brands proliferate, typically advertising a bewildering array of nutritional benefits,[28, 29, 30] but are mostly the output of only 10 mega-companies.[31] Consumers are psychologically distanced from where, how, and by whom food is produced.

There is an increasing trend towards 'value-adding' supply chains, i.e., products that have undergone some transformation between land and plate. In the UK, the farm-value share of consumer food expenditures is 36% (down from 47% in 1988).[32] In other words, for the most part what we are paying for is not the cost of food; it's the cost of making food into food products. On a typical grocery bill of £50, raw ingredients account for only £19.50.[33]

8. And control of our food is concentrated in ever fewer hands

Figure 8: UK grocery market share by value, 1900–2010

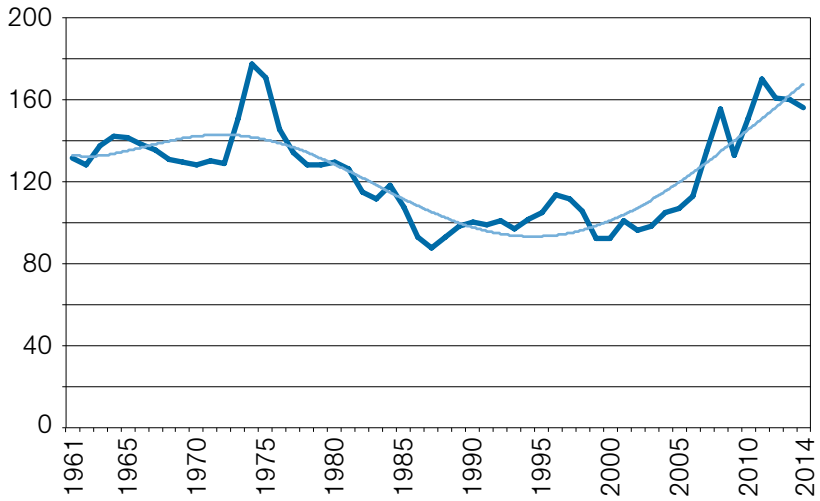


Source: Cabinet Office[34]

A small number of retailers control an increasing share of the grocery market (Figure 8). The Office for Fair Trading expressed concerns about the anti-competitive nature of this market,[35] resulting in the establishment of an independent Groceries Code Adjudicator to investigate complaints.[36] A similar process of consolidation occurred in the food manufacturing sector. Among the major European economies, the UK food manufacturing sector is by far the most dominated by large companies (followed by Germany)[37] and 92% of industry executives expect further consolidation.[38] Even at the primary production stage, concentration can be significant. For example, just six UK potato producers control 60% of production.[39]

9. Food was getting cheaper … until recently

Figure 9: FAO International Real Food Price Index[40] (2002–2004=100)

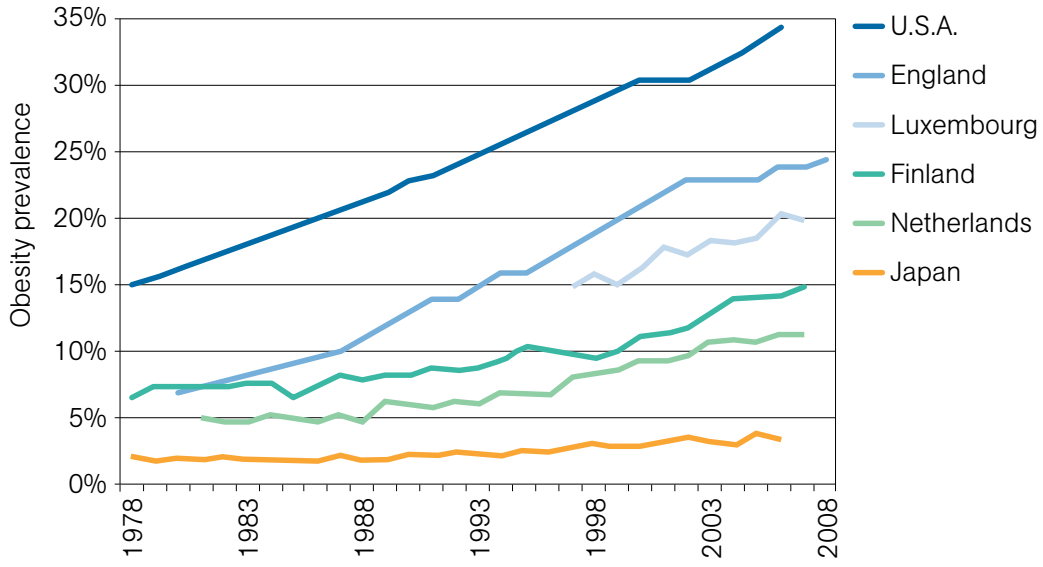


Source: FAO[41]

The industrial food system that has prevailed since the post-war period apparently brought the price of food to an all-time low (Figure 9).[42] However, dramatic price spikes in recent years illustrate that this cannot be taken for granted. Food price volatility is especially damaging to poorer households, for whom food is a larger proportion of expenditure.

10. And we're making pretty bad consumption choices

Figure 10: Percentage of the adult population assessed as obese



Source: Public Health England[43]

In almost all European countries, there is a trend towards higher obesity rates, with Hungary, the UK and Ireland topping the list.[44] A variety of other increasingly prevalent chronic illnesses have been linked to obesity and poor dietary choices. The costs in terms of lost lives, reduced wellbeing, and squandered resources have been the subject of many estimates, all of which are painfully high.[45]

The food and agriculture system according to interviewees

Our food and agriculture system is:

> *"[o]ut of touch with the real world – the way people live and the state of the biosphere – and with the new ideas that could help to put things right."*

> *"[d]ominated by Government subsidies and corporate profit, driving down rewards to farmers, regardless of food quality, water and soil conservation and energy inputs."*

> *"[p]redominantly shaped by the need to produce commodities and profit rather than sustaining food."*

> *"[h]ighly productive and innovative, and having an increasingly beneficial effect on natural capital."*

The food and agriculture system according to neoliberal economics

To a considerable extent, the outcomes and trends that we observe in the real world are a product of the framework through which we observe them. The dominant paradigm of neoliberalism uses neoclassical economics to understand and shape our modern food system.

In this framework, food is a consumer good like any other, produced by combining labour, capital, and land in some replicable way. Consumers have preferences for food that are consistent and reflect their best interests. In general, markets work in the interests of society to satisfy those preferences in the most efficient manner; the more of these apparent preferences that can be satisfied the better. Any market failures that exist can be corrected, largely by tailoring marginal financial incentives, and any further extensive government intervention is likely to exacerbate rather than improve the situation.

This is clearly a caricature. However, it highlights the broad principles that have been applied to a greater or lesser extent across different elements of our economy and society in recent decades.

There are (at least) five ways in which this framework mischaracterises our food system:

1. It unquestioningly commoditises food

Food is not, and should not be, like any other consumer good.
By homogenising agricultural outputs we can make them more amenable to trade and price competition. However, the nature of the good necessarily changes from something that reflects identity and is imbued with cultural significance, something that is appreciated in its own right, to a good that

is primarily instrumental, a means of achieving dietary sustenance and/or business profits, for which more is equivalent to better.[46] This shift from intrinsic value towards instrumental value should be recognised and subjected to debate, rather than built in to our system under the guise of a neutral framework of analysis.

2. It assumes consumer sovereignty

The idea that exogenous consumer preferences are the dominant force determining what gets produced and sold is excessively optimistic. Preference shaping through advertising by corporations facilitates more and more development of 'value-adding' supply chain processes.[47] These processes are taken to be socially productive because consumers are apparently willing to pay for them. Indeed, at least some of the added costs represent genuine improvements, such as increased durability. The neoclassical approach, however, takes the naïve view that so long as a consumer voluntarily pays for it, it must be socially valuable.

Furthermore, the assumption that consumer preferences are determined independently (i.e., from *within* the consumer) gives rise to the attitude that we cannot, or should not, influence them through public policy (despite significant such efforts from the private sphere).[48] From this perspective, policy focuses purely on correcting market failures on the supply side. As others have argued, this is patently inadequate.[49]

3. It ignores concentrations of power

Certain groups of consumers or producers have undue influence over laws, regulations, or even social norms. Market forces theoretically guarantee an optimal equilibrium only when no individual or sub-group can influence the market as a whole. This condition is violated when firms exercise market power (which exists at multiple levels in our food system), or, at a deeper level, when the rules that govern that market are dictated by a subset of those that operate in it. Political lobbying, regulatory capture (or the 'revolving door' between businesses and regulators), and enormous inequalities in financial and legal resources substantially divorce the idealised notion of market efficiency from the reality.

4. It prescribes marginal solutions

Simply 'internalising externalities', such as through incentives for environmental stewardship, may not be sufficient to guarantee that absolute impacts remain within acceptable limits. Externalities (environmental and social) are pervasive, and particularly so in our food system. In a situation of abundant and diverse externalities, it is not clear that market-based marginal incentives can provide a convenient solution. Even if it were feasible to establish financial (dis)incentives, an inaccurate model of (rational) behaviour cannot guarantee that individual changes add up to the necessary total.[50] In the face of unprecedented challenges to our environment and food security, unbounded trust in the ability of marginal solutions to keep us within environmental limits should certainly be considered reckless.

5. It ignores the perverse consequences of competition

The received wisdom of neoclassical economics, that free competition between private firms serves the best interests of consumers, is inappropriate in this context. In recent decades, almost all sectors of our economy have been forced into this frame, no matter how badly it fits. In many cases, public bodies are tasked with 'simulating' competition where true competition does not or cannot exist. In the food supply chain, competition has largely manifested itself in abusive relationships between different levels of the supply chain and significant effort to avoid direct price competition within the same level (such as supermarket discounting schemes that obscure individual product prices). It has been argued that 'what we need is not more competition in its present stereotyped form, but differentiation of business models.'[51]

In food systems market failure is the rule, not the exception. The standard analytical framework of supply and demand, perfect competition, and marginal incentives are simply not sufficient to understand how our food system functions in reality.

More fundamentally, a neoclassical view of our food system fails to elucidate the ultimate goals of that system. Ostensibly, the objective of neoclassical economics is to maximise utility; however, utility is typically pegged to monetary outcomes so that maximising marketised activity ends up being the objective.

This is insufficient on two counts:

- What we want from a food system should be acknowledged upfront, and should not have to be inferred from analytical assumptions.
- Maximising marketised activity is not an appropriate goal, nor is it the only objective that people care about (if they care about it at all).

In what follows, we explore the question of what a food system is explicitly for. We look at the various outcomes that society may value, and how those can be measured.

3. Framework

Making sense of such a complex system requires a simplified framework of analysis. We need to consider two things: what we're trying to achieve and how we're going to measure it. While much work recognises the need for good measures and indicators, the more fundamental debate over what we're ultimately trying to achieve occurs mostly under the surface. We propose an explicit answer to these questions.

> *"The economist, like every one else, must concern himself with the ultimate aims of man."*
> **Alfred Marshall (*Principles of Economics*, 1890)**

The analytical framework

In order to answer the question of what makes a successful food system, we adopt the following framework:

- The system has some set of purposes or objectives that we, as a society, value inherently (i.e., not as a means to some other objective). For example: happiness is an ultimate objective; we see it as something desirable independently of any other effects it may have (such as positive health impacts). Financial profit is not an ultimate objective; we value it because it is a surplus of resources that we can use to pursue other objectives. Ideally, our identified set of objectives should cover everything of relevance, nothing more, nothing less, and should not repeat itself.[52]

- Since those objectives cannot be easily and directly observed in all cases, we must employ observable indicators of those objectives. There are quantitative and qualitative measures, neither of which is more important. Furthermore, each of our chosen indicators will stand alone – aggregation of indicators into one 'score' is not considered desirable. This is to preserve the nuance of different incommensurable qualities.

Therefore, there are two layers of analysis:

1. What the objectives of a food system should be.

2. What indicators can be used to measure whether or not we achieve them.

In what follows we examine the various objectives and indicators attributed to the food system by different actors and put forward our own vision of this framework.

What objectives do we attribute to the food system?

> *"I've always been struck by how successful we have been at hitting the bull's-eye on the wrong target. I mean, for example, in cattle we've learned how to plant, fertilise, and harvest corn using global positioning satellite technology and nobody sits back and asks 'But should we be feeding cows corn?' You know, we've become a culture of technicians, we're all into the how of it, and nobody's stepping back and saying 'But why?'"*
> **Joel Salatin, speaking in *Food, Inc.***

What is our food system for? Why do we have it?

This almost seems like an absurd question – it's for food, of course. It is widely recognised, however, that food and farming systems are profusely multifunctional[53] – i.e., they have many different outcomes, some of which may not closely relate to food. There are many different ways to organise a food system, but how often do we ask *why* we should choose one over another? What is it that we're ultimately trying to achieve? Others have posed this question,[54] but few have explicitly explored the array of possible answers.

We review the position of various organisations and individuals in relation to this question. In many (even, most) cases, the answer is not given explicitly and must be inferred from various other statements. This in itself is revealing: without a clear and explicit discussion of what we expect food systems to achieve, how do we expect to measure progress or design appropriate policy? The intention here is primarily to present the range of views that exists, rather than to analyse the reasoning that leads to them.

The Department for Environment, Food and Rural Affairs

The first place to look for an articulation of the objectives, or the *why*, of our food system is our public institutions. In the UK, the main responsibility for food lies with the Department for Environment, Food and Rural Affairs (Defra). Defra's website lists five policies related to farming. Of these, two relate to animal health and one relates to reforming the EU's CAP. The remaining two titled policies are: *Simplifying farming regulations* and *Making the food and farming industry more competitive while protecting the environment*. The focus here is clearly economic.

This is reinforced by a speech delivered by the farming and food minister, George Eustice, to the National Farmers Union in February 2014.[55] In this speech, Eustice presents the burgeoning global population as an opportunity to boost UK exports and boasts that 'we will scrap 156 regulations and simplify 134 more'. The 'business of British farming' is 'at the heart of our long-term economic plan' in the hope of creating 'more jobs, more opportunities, and more financial security for hard-working people'. It seems clear that the primary role Defra sees for the food and farming system is one of economic growth with the objective of generating jobs and income.

The National Farmers Union

The National Farmers Union (NFU), an industry body whose aim is 'to champion farming in England and Wales',[56] also emphasises the economic, or business, role of farming. Naturally, given its stakeholders, public statements from the NFU typically emphasise the need to maintain or increase production levels, although this is sometimes framed as a question of self-sufficiency or food security. In the 2013 Annual Review[57] the then President talks of 'our ambition to produce more in this country' and describes the main objective of the CAP as 'increasing productivity'. There are many examples of this language.[58] Production cannot be an end in itself, however; we must presume, therefore, that this concern is for the objective of continued support for livelihoods (at least of those represented by the NFU).

The Institute of Economic Affairs

Many free-market commentators take a similar position, focusing on increasing production and efficiency to be the appropriate objective of public policy. For example, a paper from the Institute of Economic Affairs (IEA) concludes that it is 'morally imperative' that 'EU agricultural policy now focuses on maximising the Community's food production'. It explains that '[t]his is only likely to be achieved – and using methods that are efficient and cost minimising – if direct payments are rapidly phased out allowing the industry to restructure which will involve the concentration of production on larger-scale farms.'[59]

The European Union

The EU is more explicit about *why* it has an agricultural policy. In the process of reforming the CAP, the European Commission recently articulated an extensive and clear set of objectives under three main categories:

- viable food production;
- sustainable management of natural resources and climate action;
- balanced territorial development (which includes supporting local communities and developing small farms and local markets).

While the policies that are adopted do not necessarily achieve these objectives, it is notable that such a comprehensive and multi-functional conceptualisation of food and farming systems is adopted explicitly.[60]

Campaign to Protect Rural England

Some voices from the third sector are similarly explicit. The Campaign to Protect Rural England takes a high-level view close to that articulated by the CAP:

> *"Farming doesn't just mean growing crops. It should help us all to have: healthy, high quality food at a price which is fair to everyone; a beautiful, diverse and accessible countryside; and vibrant rural communities."*[61]

These three objectives parallel the economic, environmental, and social objectives of the CAP described earlier.

The United Nations

UN Special Rapporteur on the Right to Food, Olivier de Schutter, takes a yet different approach to understanding the objectives of food systems. In particular he decries the 'productivist paradigm' that is, arguably, exemplified by the positions of Defra, the NFU and the IEA.

> *"A new paradigm focused on well-being, resilience, and sustainability must be designed to replace the productivist paradigm and thus better support the full realization of the right to adequate food."*

De Schutter is quite clear that production itself should not be the ultimate objective.

Food Sovereignty Movement

A global movement of campaigners and small-scale producers, originating with the Via Campesina group in Latin America, put forward the concept of food sovereignty as a means of understanding what food systems should be for. Rather than seeing production as the primary output of agricultural systems, the framework of food sovereignty sees good lives for local people as the ultimate good. As such, food is 'sustenance for the community', and not just in a physiological sense.[62]

Table 1 summarises the objectives from these organisations and individuals. There is a clear spectrum from those that present economic factors as the central objective of food systems to those that see social and environmental factors as being of equal or greater importance. The first three of these organisations focus on the role of food production as an economic force for creating jobs and wealth. Their articulations of farming and what it is for tend to frame environmental, social, or cultural factors as constraints or side-benefits to production. At the other end of this spectrum, it is the social and environmental functions of food systems that are considered central, with economic factors playing an instrumental role.

Notably, many of these objectives do not fit the definition adopted above – i.e., an objective as something that is inherently valuable and not a means to achieving some other good. In particular, production itself is a means to creating human wellbeing through a number of channels (sustenance, health, employment, etc.). While production may be a useful indicator of a system's ability to achieve human wellbeing, it is sensible to distinguish its value as instrumental rather than intrinsic. Indeed, some experts openly question production-focused policy[63] and a recent report emphasises that the minor contribution of EU production to global food security is not a legitimate motive for maintaining production levels.[64] It may be just as important to monitor whether production genuinely leads to wellbeing as it is to monitor levels of production itself.

Table 1: Summary of food system objectives by organisation/individual

Organisation/individual	Objectives
Defra	· Production · Jobs
National Farmers Union	· Production · Jobs
Institute for Economic Affairs	· Production · Efficiency
European Union	· Production · Sustainability · Local community development
Campaign to Protect Rural England	· Human wellbeing · Protection of landscape · Local community development
United Nations/Olivier de Schutter	· Human wellbeing · Resilience · Sustainability
Food Sovereignty Movement	· Human wellbeing · Local community development · Sustainability

This exposition of food system objectives across different actors is undoubtedly imperfect and certainly incomplete; nevertheless, it presents at least three significant conclusions:

- The debate about what food systems are for, the *why*, occurs mostly under the surface and not in explicit terms.
- There is, in fact, a significant degree of agreement on the domain of objectives, with similar themes emerging from different actors; however, these objectives are often delineated differently and many actors focus on indicators in place of outcomes or objectives, as defined above.
- To the extent that disagreement exists, it is in terms of the focus of objectives (i.e., the extent to which economic or environmental and social elements are considered central).

We will narrow the range of objectives to the ones that we will adopt, but first we survey the measures associated with the full range of objectives.

How do we measure our objectives?

Measuring and monitoring our food system is a challenging task. The relevant variables are innumerable and data availability is inevitably incomplete. However, there is much that can be done and any incomplete picture is better than navigating blindly.

Broadly, the aim of an indicator should be to illustrate observable outcomes that can convey information about the extent to which objectives, such as **wellbeing, social justice,** and **stewardship**, are realised.

There are many typologies, or categorisations, of food system indicators. However, it is convenient to organise them into three groups:

- **economic** – indicators that relate to monetary flows and relationships;
- **environmental** – indicators that relate to non-human physical impacts;
- **social and cultural** – indicators that relate to non-monetary interactions between people.

Economic indicators

> *"Up to a point, increasing yield per hectare may well be an improvement.… Basically, like GDP, yield doesn't measure capital and debt. The Green Revolution was essentially a liquidisation of capital."*
> **Interviewee**

The economic relationships in the food system are copious and varied but relatively well-documented. Financial transactions – between seller and buyer, between employer and employee – are routinely logged; consequently the problem for the analyst is generally one of data collation rather than the more onerous task of data measurement. Perhaps partly for this reason, economic or financial indicators are widely available, apparently robust, and receive a great deal of attention.

The key variable that is measured is the total economic output of the food system. Defra periodically reports the total value of farm production and profit levels,[65] while the Office for National Statistics (ONS) reports the monetary value of subsequent stages in the food supply chain (as measured by gross value added).[66] The ONS also reports quantitative indicators of the number of people employed in these sectors and the wages they receive (qualitative indicators of working conditions are not as readily available).

Prices of food products are also available from the ONS; the percentage of that price that accrues to producers is calculated by Defra, although only for a limited number of products. Eurostat also records most of these indicators for all EU countries.

The centrality of these indicators to the prevailing understanding of success in food systems is quite clear. For example, Defra's monthly 'Farming and Food Brief'[67] consistently begins with a discussion of developments in economic indicators and devotes the large majority of the analysis to the 'economic' category. In the national media, the retail price of food is frequently the focus of headlines[68]; in local and specialist media, concern for farmgate prices and production levels is common.[69] A significant number of interviewees agreed that output and profits were the dominant measures of success employed in public debate, particularly by government and industry sources.

It is clear that these indicators are valid and essential indicators of the performance of our food system; however, they are not sufficient. Indeed, in isolation these indicators can give a much-distorted picture of the overall impact of food and farming by hiding insidious impacts on the environment and society.

Environmental indicators

Other than the actual harvest of produce, the physical impacts of food systems on the natural world (such as fertiliser run-off or destruction of habitat) are largely unintentional and so typically go unrecorded in the absence of special effort. Following a realisation of the sheer extent of physical impacts in the latter part of the twentieth century, however, understanding the impact of food and farming systems on the environment has become an area of increasing activity. Official statistics from Defra already report aggregate figures for a number of relevant indicators including fuel and fertiliser use, carbon emissions, and soil nutrient balances. In 2011, the UK National Ecosystem Assessment report provided a comprehensive overview of the 'ecosystem services' that enclosed farmland provides, including its role as a source (e.g. greenhouse gas (GHG) emissions) and a sink (e.g. absorbing wastes).[70]

As well as these high-level estimates, there is also a need to consider environmental impacts at the unit of production (i.e., per hectare of land) and by product line (i.e., per kg of a particular foodstuff). In contrast to aggregated impact data, such indicators can distinguish between local and global impacts.[71] Moreover, because such approaches allow comparisons between different practices and products, they permit a better understanding of the levers for change. This task has been taken up primarily in academic circles.

> *"Although there are examples of attempts to measure the environmental impacts of agricultural systems and to consider their wider economic impact, particularly in rural development approaches, these are often tangential to central measures, which are typically commodity focused."*
> **Interviewee**

A typical approach is to characterise unintentional environmental impacts as so-called externalities (impacts that are 'external', or unaccounted, in the decisions made by producers and consumers) and to estimate them using the monetary valuation techniques of environmental economics.[72] In this way physical impacts are made to be commensurable with economic impacts. Broadly, there are five main categories of environmental impacts that are covered: biodiversity, water use, GHG emissions, air pollutants, and water pollutants. The first major and extensive exercise of this kind calculated the total environmental externalities of UK agriculture in 1996 to be £1,567 million per year, or £139 per hectare of arable and permanent pasture.[73] Later efforts estimated impacts by product category, rather than by land area, finding that the true cost of a basket of UK food products (i.e., including externalities) is around 12% greater than the market price, and that livestock is the category with the greatest external impacts.[74] Inevitably these estimates do not include all categories of impacts (e.g. biodiversity is typically not valued) and are, therefore, underestimated. Additional uncertainty is created in the process of converting physical impacts to a monetary metric. Indeed, both methodological[75] and ethical[76] objections have been made to this procedure.

Non-monetary approaches continue to be used in parallel. For example, Pimentel *et al.* (2005)[77] compare the quantitative impacts of different farming systems in order to understand the comparative advantages and disadvantages of organic methods. Local studies have developed methods for measuring the physical impact of food systems, such as Low Carbon Oxford's FoodPrinting project.[78]

The OECD has collated a comprehensive compendium of environmental indicators for agriculture (covering all five categories mentioned) and compared trends across its members.[79] A recent effort from the World Resources Institute also comprehensively catalogued existing agri-environmental indicators, although without presenting the corresponding data.[80]

In terms of users, indicators of the environmental impacts of food systems are employed across a broad range of actors, reflecting the widespread acceptance of the fundamental unsustainability of our current food system. As already noted, government is at least cognisant of the range and magnitude of environmental impacts and reports indicators in many of its publications, though in most cases as an appendage to the economic focus. Third sector organisations and NGOs have been significant users and developers of environmental indicators, particularly those related to land use and biodiversity. For example, the RSPB and British Trust for Ornithology developed and continue to monitor the Farmland Bird Indicator.[81]

Social and cultural indicators

> *"Since WWII, European agriculture has been increasingly driven by the belief that food, and farming, is a commodity like any other tradable asset. The failure of policymakers to understand that food and farming is not a commodity – but a culture – is the root of the many failures of our food system today."*
>
> **Interviewee**

Most impacts on social relations are highly intangible and essentially unobservable (being experienced 'within' people) and consequently are inherently more difficult to measure in comparison to economic and physical impacts. However, this does not imply that they are of less importance. This category potentially includes the greatest variety of outcomes to which food systems contribute, from national public health, through thriving local communities, to a sense of identity. Clearly, these outcomes have value, whether or not we are able to valuate them.

Perhaps the most problematic impacts for which to develop indicators are cultural impacts. Food culture may be defined as the ideas, customs, and social behaviour of a particular people or society with respect to the food they produce and consume. It therefore encompasses a complex ecology of ideas and norms, each of which might be considered positive, negative, or neither. While such categorisations may be far from simple, an understanding of modern food culture should include such obviously undesirable things like the glorification of 'size zero' status. The purpose of monitoring the state of food culture and the impacts that certain food systems have on it should be to evaluate the ultimate impact on human wellbeing. As such, we should not argue that any particular food culture must be preserved or dominate, only that a positive food culture should exist. Perhaps the most significant and popular critique of modern food culture has been advanced by Michael Pollan. Through numerous writings[82] Pollan argues that Western attitudes have degenerated over the course of the twentieth century to a reductionist and functional model, which views food as simply an aggregation of necessary nutrients rather than an indivisible experience with hedonic,

social, and material elements. This attitude has facilitated and encouraged the simultaneous and paradoxical trends of worsening health outcomes and increasing diet-consciousness. There is no simple quantitative indicator that can adequately capture this complex picture;[83] qualitative analysis is necessary and preferable.

The impacts of food systems on local community dynamics are slightly more amenable to indicator construction. For example, in an empirical study conducted for Defra, Lobley *et al.*[84] use a socio-economic footprinting approach to develop a more holistic understanding of the social and community impacts of organic farming in particular. They use a suite of indicators including employment outcomes, the extent of direct marketing routes (short supply chains), and community activity.[85] Such approaches provide useful data, but in comparison to largely objective measures, such as environmental impacts, they will always be subject to much greater disagreement as to the most appropriate set of indicators.

In contrast to the intangibles of food culture and local communities, diet-related public health outcomes have been widely documented and studied across public sector bodies, academia, and third sector organisations. The leading indicator of the public health impacts of food systems is the incidence of obesity, typically measured by body mass index,[86] and data exists for many countries since the 1980s.[87] While this indicator is also influenced by changes in physical activity (i.e., not directly related to the food system), it is a simple and objective indicator that is strongly related to consumption patterns and causes significant loss of quantity and quality of life.[88]

Table 2: An overview of existing food system indicators

Indicator category	Prominent examples	Primary users	State of development
Economic	· Production value · Output price · Employment (quantity)	Government and industry	Developed
Environmental	· GHG emissions · Local pollutant emissions · Water use · Biodiversity	Government, academia, third sector	Developing
Social	· Employment (quality) · Community activity · Obesity rate	Government, academia, third sector	Under-developed

Bringing it all together

Table 2 summarises the preceding overview of food system indicators. Crudely categorised into economic, environmental, and social indicators, it is clear that different types of indicators are at different stages of development, with a large degree of consensus on measurement of economic factors and no consistent approach to measuring social factors (with the exception of obesity rates). There is a need, therefore, for more work in developing

standard approaches to measurement. Furthermore, understanding the impacts of our food system as a whole requires an approach to evaluation that integrates indicators of all relevant impacts.

Following the commodity price shocks of 2008, the UK government began to develop a programme that did just that, culminating in the Food 2030 strategy[89] that was accompanied by a comprehensive list of proposed indicators,[90] covering economic, environmental, and health outcomes (though with little to say on local communities or food culture). However, a Sustainable Development Commission report expresses concern that promotion of sustainability in food systems 'seemed to go into suspended animation in Whitehall after the 2010 election'[91] and other groups expressed concern that the framework did not properly recognise the role of communities in the food system.[92]

Beyond the UK, a number of initiatives have adopted more holistic approaches to evaluating food systems. In the USA and Canada, there are a number of examples of comprehensive assessment of food systems using a broad suite of indicators. A regional initiative in San Diego made an impressive assessment of the county's food system across a large number of data-driven local indicators covering health and wellbeing, stewardship, and thriving communities.[93] The Centre for Food in Canada[94] conducted a comprehensive review of national-scale 'performance metrics' for the Canadian food system settling on five headline indicators: industry performance, healthy food, food safety, household food security, and environmental sustainability. This is a well-evidenced and relatively holistic approach, although it neglects to consider cultural issues.

Our vision of a successful food system

> *"A successful food system is one which delivers the highest possible level of wellbeing for the population without compromising the sustainability of the system and its ability to feed future populations well."*
> **Interviewee**

We believe that the proper objective of any socioeconomic system is to cultivate wellbeing among citizens. As argued elsewhere, improving the quality of our lives is surely the most fundamental of objectives:

> *"Wellbeing is an overarching policy objective which combines economic and non-economic objectives into a single framework: it is not just about health or improving people's resilience, nor is it an optional extra to be considered once economic policy objectives have been met."*[95]

Food systems affect wellbeing through diverse channels including: employment, health, culture, and the natural environment.

However, it is not sufficient to simply maximise some notion of aggregate wellbeing (as the basic methods of neoclassical welfare economics do, with wellbeing narrowly associated with economic welfare). We must pay specific regard to whether outcomes can be considered socially just. And cultivating wellbeing must be based on a process that is sustainable over time.

In a previous publication[96] NEF outlined our understanding of a sustainable food system, focusing on four key dimensions: wellbeing, social justice, stewardship, and system resilience. See Appendix 2 for an excerpt from this publication. Updating this framework (by subsuming system resilience under wellbeing)[97] provides the foundation for our understanding of what a food system should achieve: **wellbeing**, **social justice**, and **stewardship.**

These three outcomes are valuable inherently: they are not the means to achieving any further good. We consider these to be the objectives, the *why*, of our food systems. Production, economic output, and efficiency are not what we ultimately value – they are intermediaries (some more effective than others) in the production of life's true goods.

The weight of experience suggests that the objectives advocated here are not necessarily the innate or automatic outcomes of the natural, social, and economic systems we currently experience: unhappiness, inequality, and unsustainability are at least as likely to prevail.[98] Therefore, we cannot be complacent about the capacity of our existing food system to deliver these objectives; we must make conscious and collective decisions. As you can't manage what you don't measure, this means developing a set of indicators that aligns with these objectives.

Based on the interviews conducted and the literature reviewed, we have chosen eight indicators to illustrate an alternative and holistic concept of what success looks like in food systems. This is based on our understanding that a food system that delivers high **wellbeing**, **social justice**, and **stewardship** will:

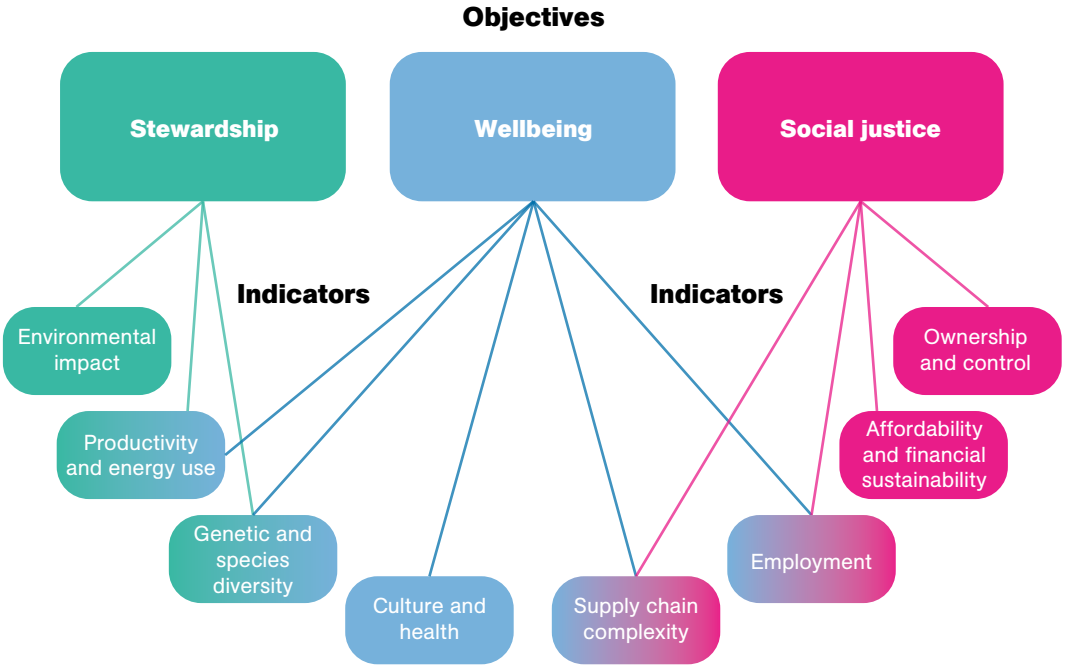
- have a neutral or positive environmental impact;
- be productive in its use of energy and other inputs;
- be diverse in species and genes;
- support good jobs;
- be dominated by short and simple supply chains;
- be composed of assets that are controlled by a wide and inclusive set of stakeholders;
- foster a positive and thriving food culture and the highest levels of public health;
- make food affordable to everyone.

The corresponding indicators are listed below. In Section 4 we examine each indicator in turn, first looking at why it is useful, then looking at what the data says about the UK food system's performance on that indicator, and finally focusing on a practical case study of a micro food system that performs well on that indicator. Figure 11 illustrates the relationship between objectives and indicators in our framework.

Indicators

1. Environmental Impact
2. Productivity and Energy Use
3. Genetic and Species Diversity
4. Employment
5. Supply Chain Complexity
6. Ownership and control
7. Culture and Health
8. Affordability and Financial Sustainability

Figure 11: Objectives and indicators



4. Success

We put our chosen framework into practice by making two parallel assessments. First, how does the UK's food system perform when we look at success this way? We find that there is much cause for concern. Secondly, what practical examples can we find of systems that do achieve success? We scoured Europe for some inspiration of how to do things right.

1. Environmental impact

Why choose this indicator?
Producing food is one of the most important ways in which humans alter the physical environment. All types of natural resources are employed in the process – soil, water, air, fossil fuels – and the impacts are both global and local. It is widely recognised that much food production over the course of the late twentieth century has been fundamentally unsustainable, potentially undermining both the ability to produce food in the future and the stability of wider ecological systems. As such, reducing the impact on global and local environments is a key measure of success for any food and farming system.

In this indicator category we examine five main areas of environmental impact, contributing to the objective of **stewardship**. First we look at the contribution of farming and food industries to climate change via the emission of **GHGs**, including the impact of land-use change and waste production and treatment. We look at the impact of farming on both **air quality** and **water quality**, which are primarily measured in terms of their impact on human health. And we look at **water use** and **biodiversity** for evidence of ecological impacts. Many categories of activity, for example, transportation or waste generation, are included within these five categories.

UK macro data

Greenhouse gases
After energy generation, agriculture is the second greatest source of GHG emissions in the UK.[99] The government's Committee on Climate Change (CCC) estimates that total agricultural emissions for 2012 were 56.6 Mt CO_2e from four main sources: agricultural soils, enteric fermentation (livestock methane), wastes/manure management, and stationary and mobile combustion (fuels used on farms).[100]

CCC estimates suggest that the food, drink, and tobacco manufacturing industry was responsible for a further 12.6 Mt CO_2e emissions in 2011[101] and Defra estimates emissions from food transport to be in the region of 15 Mt CO_2e in 2010.[102]

The CCC estimates that total net emissions from cropland land use and land-use change to be 11.7Mt CO_2e in 2012.[103, 104] It also estimates that grassland (some, but not all, of which will be pastureland) was a net carbon sink, absorbing 7.7Mt of net emissions in 2012. The total land-use emissions potentially associated with agriculture is therefore 4.1Mt (an underestimate since this includes sequestering from non-agricultural grasslands).

Waste is a further source of significant GHG emissions. WRAP estimates that around 15 million tonnes of food is wasted in the UK each year, half of which comes from households, including 250,000 tonnes (worth £1 billion) that was thrown away in unopened packaging.[105] Using data from WRAP and Defra on three sources of waste in the food and farming system – household food waste[106], non-animal farm waste[107], and food manufacturing waste[108] – the total GHG emissions can be estimated at 6.8Mt CO_2e.

Therefore, the total emissions from agriculture, land-use change and waste, is estimated at 95.4 CO_2e, or around a sixth of total UK emissions.[109] This excludes some significant impacts for which there is no data, such as the waste produced by food retailers and caterers. WRAP estimates that food and drink accounts for a greater proportion (a fifth) of UK emissions.[110] See Appendix 3 for a table of these tonnages and data sources.

In order to appraise the value of changes in emissions, the government uses an abatement cost approach based on the targets it expects to achieve.[111] This means that each tonne of carbon is valued at a price equivalent to the expected cost of reducing that unit of emissions. This price differs depending on whether or not the emissions occur within a sector covered by the EU Emissions Trading Scheme.

Using the government's approach to carbon valuation, the cost of emissions from the food and farming sector are estimated at £4.6 billion per year.

Air quality

Agricultural activities are a major source of three main air pollutants. Defra estimates that 253 kilotonnes of ammonia are emitted from agriculture each year. Government sources also estimate emissions of 20 kilotonnes of particulate matter (PM) (18 kilotonnes of PM10 and 2 kiltonnes of PM2.5) and 100 kilotonnes of nitrous oxide (NOx) (mostly from direct soil emissions). Further data on air pollutant emissions from the food industry[112] are available from Defra as well as the estimated damage costs for each tonne of various air pollutants.[113] Notably, the industry emissions data includes relatively few facilities – the true figure is likely to be far greater. Moreover, this estimate does not include the substantial air quality impact of transportation in the food system.

Table A2 in Appendix 4 details these costs (in 2013 prices) along with the emissions levels and the implied total annual costs. The total estimated cost

of air pollutants from agriculture is roughly £800 million per year, or about £47 per hectare per year. For the whole food industry the total estimated is roughly £19 million.[114]

O'Neill (2007) estimates the total air quality damages of agriculture at £583–1,959 million per year (2004 prices), though there are a greater range of pollutants included in that estimate.[115]

Water quality

We focus on nitrogen in waterways as the primary impact of agriculture on water quality. Nitrogen, in the form of nitrates, is found naturally in soil but also follows the application of nitrogenous fertilisers. These nitrates get washed off the land into rivers and lakes which cause two main impacts:

- damage to human health through drinking water, being linked to some forms of cancer;
- ecological damage from eutrophication of waterways.

A wide range of values have been attributed to costs of nitrates in the water supply. One study of health damages suggests that each kg of nitrogen applied to the land imposes an average cost of £1.06 (for mineral nitrogen) or £1.17 (for organic nitrogen) in the UK.[116, 117] Based on UK application rates, this would imply a total health cost in the region of £1.7 billion.[118]

Another approach is to estimate the cost of the investment required to clean drinking water to an acceptable nitrate content (<50mg/l) before consumption. Pretty *et al.* (2000) estimate this cost to be around £22 million in 2000.[119] O'Neill (2007) estimates that the costs agriculture imposes on water companies for cleaning their water from nitrates, pesticides and other treatments were £271 million in 2002/2003.[120] Since this investment does not eliminate contaminants entirely it cannot be considered an estimate of the full cost of agricultural runoff. These two estimates – £1.7 billion and £271 million – might reasonably be taken as upper and lower bounds, respectively.

Regarding the ecological costs of eutrophication, Pretty *et al.* (2003) estimated these to be in the region of £93–142 million per year in England and Wales (in 2013 prices).

A further significant impact on water bodies is run-off of the soil itself. The Parliamentary Office of Science and Technology quotes an estimated 44% of arable land at risk of water erosion at a rate of 0.1–0.3t/ha/year.[121] That implies a loss of between 198,000 and 594,000 tonnes of soil each year.[122] That's like filling 150,000 skips with soil and dumping them into rivers each year. Data from the 1980s suggest an even greater rate of erosion at that time.[123] These displaced soils cause a range of damage, including damage to roads and property, traffic accidents, footpath loss, and channel degradation.[124] More significantly, this erosion represents an enormous loss of potential for growing food productively, with 18% of organic matter in arable topsoils apparently being lost between 1980 and 1995.[125] It was not possible to assign a monetary value to this impact.

Water use

It is necessary to distinguish between water consumption within the UK and the total water footprint of the UK food system. If we're concerned about the environmental impacts in the UK then the former is of interest; if we're concerned with global water use then the latter is of interest. It has been estimated that the UK imports 62% of its water requirements as water embedded in products.[126] In 2008, the WWF estimated that the total water footprint of agricultural products consumed in the UK is 74.8 billion m^3 per year, 73% of the total UK water footprint (which also includes industrial products and household use).[127]

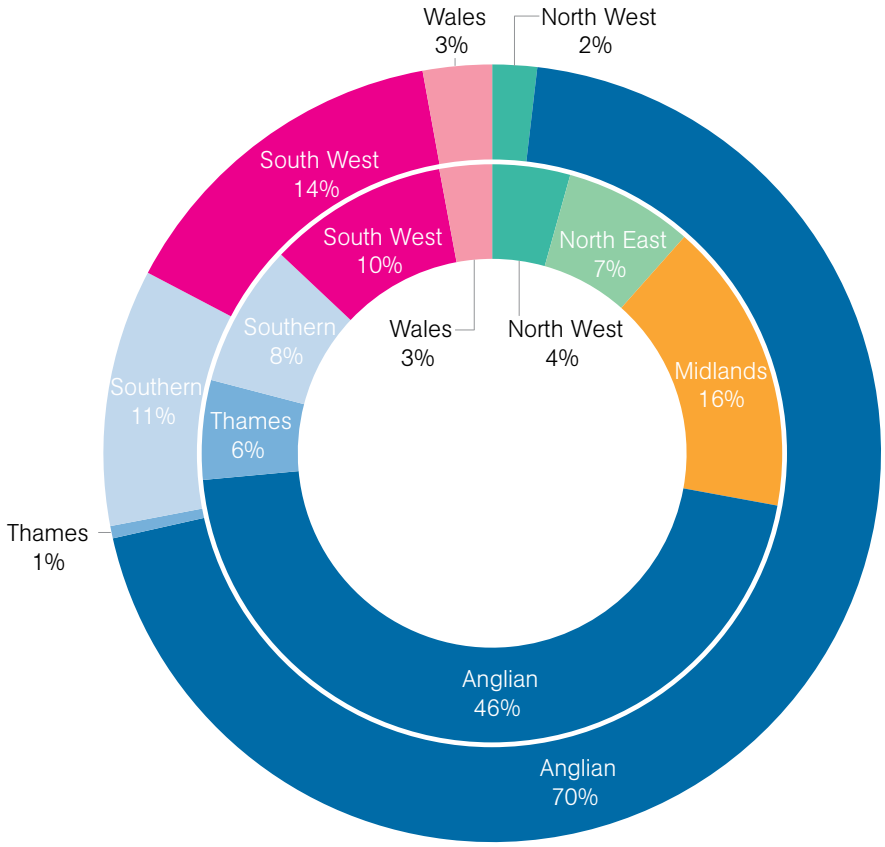
The UK is a comparatively wet nation, which means less irrigation is necessary. There are quite large regional variations in rainfall, however, with the south and east in particular being very dry. Therefore the impacts of using water for agricultural irrigation are different, likely being very low or zero in wet areas such as the west of Scotland, and relatively high in the South East of England.[128]

WRAP estimated that total water use (excluding large non-consumptive uses) in England and Wales by the agriculture sector was around 239 cubic metres in 2006.[129] Data provided by Defra suggests that the average abstraction for agricultural uses over the period 2000–2012 was 119 million cubic metres (though with considerable variability). This doesn't include the water used by farms provided through public water companies, only that which is directly abstracted.

The Environment Agency (EA) currently levies an Environmental Improvement Unit Charge (EIUC) for abstraction from water bodies. This charge is intended to cover the costs of compensating licence holders in areas where unsustainable abstractions must be prevented for the sake of the resource itself and the natural environment.[130] In other words, it reflects the environmental costs of water use (but not water quality, which was considered earlier). The level of the charge varies by area, reflecting different degrees of water scarcity and potential environmental damage.[131] Figure 12 illustrates the total water use by region in England and Wales (inner ring) and the total environmental cost of water use by region (outer ring) based on the EIUC.

Unlike many other environmental costs of food production, these costs are not 'external' (since the farmer does have to pay through their abstraction licence); as such, in theory, the price of food already reflects these costs. However, that does assume that the EA charges sufficiently reflect the true environmental damages, which is not certain.

Figure 12: Water use in England and Wales by volume (inner ring) and by environmental impact (outer ring)



Source: Defra and Environment Agency[132, 133]

Biodiversity

The varied impacts of decreasing biodiversity and the extent to which it is caused by agricultural production are complex problems to fully understand. No single indicator is sufficient to capture all the relevant qualities of biodiversity and monetary valuation is conceptually and methodologically difficult. However, the basic premise is that there is a '*fundamental conflict between the increasing needs of agriculture and the maintenance of non-crop biodiversity*'.[134]

The impacts are due to three main effects: the conversion of land into or out of agricultural use, thereby changing natural habitats; changes in the character of existing agricultural land (e.g. types of crops grown), again changing habitats; and changes to farming techniques (e.g. use of pesticides), which change food chain relationships or even directly harm wildlife.

A commonly used emblematic indicator is the Farmland Bird Index. Data shows that farmland bird populations have shown a significant decline since 1970, far more than any other category of bird (Figure A2 in Appendix 5).

A recent assessment of biodiversity in England, conducted by Defra, describes negative trends for all assessed farmland species with the exception of plant diversity in enclosed farmland.[135]

Summary of environmental externalities

The price of food reflects many factors, including the range of cost factors that farmers and manufacturers face in getting food products to market (fuel, labour, machinery, etc.). In many cases, environmental costs are not borne by any of the actors involved in the production and marketing of food – they are external to those decisions and are not reflected in the market price of food. After decades of concern, however, we now have some regulations that internalise certain environmental costs into the producers' costs. These include: the landfill tax, the EIUC (mentioned earlier), and the EU Emissions Trading Scheme. While the extent to which these regulations sufficiently reflect our best knowledge and closest estimates of the costs is debatable, the fact remains that the market price of food does at least partially reflect some of these costs.

The total cost of environmental externalities based on the above analysis (and excluding those that have been internalised) is in the region of £5.7–7.2 billion per year. The total market cost of food to UK households was £90.8 billion in 2012; therefore, the estimated externalities represent 6.3–7.9% of the market price of food. The biggest component of this is GHGs. Appendix 9 provides a more detailed breakdown of the full external costs evaluated. For those externalities that are related to agriculture, the cost amounts to roughly £274–361 per hectare.

Importantly, it has not been possible to include the full range of environmental costs. Non-monetised externalities include, but are not limited to: soil erosion, soil fertility loss, biodiversity loss, water pollutants from industry, and air pollutants from food transportation. There are also a number of non-environmental externalities that are not included; for example, development of antibiotic resistance through overuse and poor animal welfare. Therefore, the total costs calculated are considered to be significantly underestimated.

Micro case study: La Selva, Tuscany, Italy

In the Maremma region of southern Tuscany lies the LaSelva estate. Over a small area, this diverse landscape varies between mountainous panoramas to the beaches and bays by the Maremma coast. With its own variety of cattle and sheep and a very diverse crop rotation with cereal crops, tomatoes, fruit, vegetables, herbs, and vineyards, LaSelva contributes to this rich cultural landscape. Since 1980, the estate has been managed according to the guidelines of organic farming. When the company was founded by Karl Egger in 1980, his ideas were initially derided as utopian. Today, the demand for organic food has steadily increased and LaSelva products can be found in the organic range of supermarkets in Italy and abroad.

"Taking care of sustainability doesn't cost money; in the end it pays money."
Karl Egger, CEO, LaSelva

La Selva: continued

Environmental impact

LaSelva minimises its negative impacts on the natural environment by reducing, or eliminating, its use of external inputs. It enhances its positive impacts by adopting a multifunctional model of symbiosis between agricultural production and the local biodiversity.

In terms of GHGs, the typical significant source would be from synthetic fertilisers (which are produced using natural gas and lots of energy). This impact is largely eliminated at LaSelva through careful natural management of the soil's organic matter, which determines its fertility. Use of organic manures, conservation tillage, and a carefully designed crop rotation (including nitrogen-fixing legumes) negates the need for any further fertilisers. This may also have an impact on ammonia emissions, which can result from excessive use of inorganic fertilisers.

Although severe water scarcity is not typically a problem in the area, LaSelva adopts sophisticated water-saving technologies, including low-pressure distribution systems and drip irrigation, which eliminate unnecessary waste.

Biodiversity is a core element of LaSelva's operations. Since production is strictly organic, no pesticides are used whatsoever. Pesticides not only kill pests but also important food web links. However, the philosophy at LaSelva is not simply one of 'do no harm': 80 hectares of wild habitat have been created, including nesting sites for bird species, wetland areas, hedgerows, and wildflower meadows for bees. Such investments have clear returns. Large numbers of bees, which pollinate their crops, and ladybirds, which feed on crop-eating aphids, are observed at LaSelva.

Other indicators

LaSelva has more than 1000kW of solar installations on site. They sustain rare local breeds such as the Chianina cattle and the Appennin sheep. Like many of the other examples we visited, it has an integrated supply chain, with processing and marketing controlled by the same entity, and it employs up to 80 locals (depending on the season) with high reported work satisfaction and a very high rate of retention. Recognising that it doesn't just produce food, but also clean water and air, biodiversity and beautiful landscapes, LaSelva invites customers and guests to visit the site and enjoy those goods, too.

2. Productivity and energy use

Why choose this indicator?

As argued in Section 3 it has become typical to judge a system's success by the extent of its output. Clearly, the yield of a system is something that should concern us; not, however, in isolation. We should also be interested in how efficient a given system is at converting inputs into outputs – i.e., what is the output returned on the input invested? Often this is measured in monetary terms (return on investment); however, in cases such as the food system, where the financial cost of inputs has only a weak relation to their social costs, this measure is not particularly meaningful and physical measures may be more instructive.

This indicator, therefore, looks at outputs and inputs in combination. First, crop yields are considered in relation to external chemical inputs; secondly, energy output (calories) is considered in relation to energy inputs. The latter is related to the concept of energy return on energy invested (EROEI), which has been developed as an indicator primarily in relation to biofuels.[136]

This is an indicator of **wellbeing**, since productive processes allow us to make the most of our available resources, and **stewardship**, since a given level of production is produced with minimum resource use.

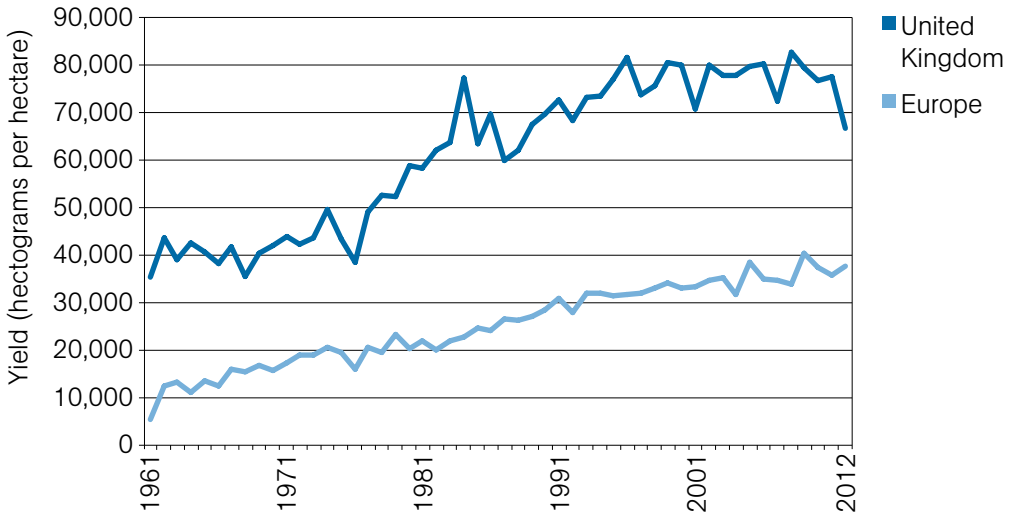
UK macro data

Yield output per use of inputs

UK crop yields have shown no significant trend over the past two decades (although they exhibit some volatility), following a more substantial increase in the preceding decades (Figure 13).[137] UK yield levels are among the highest in Europe, along with other northern European countries.

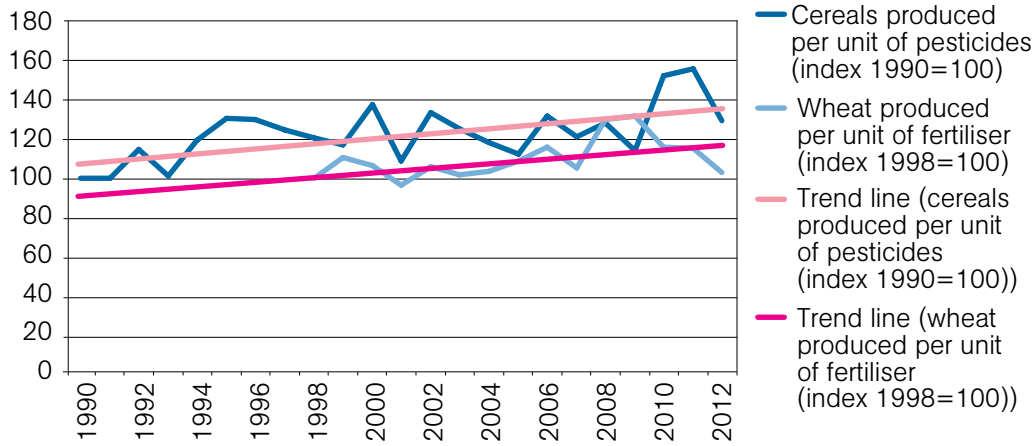
Using UK data on crop yields and rates of chemical inputs, it is possible to calculate the ratio between various inputs and crop outputs. Figure 14 illustrates the trends for two such calculations. Unfortunately, there is limited data for the period before 1990, which is the period in which the use of these inputs increased dramatically. We can observe, however, that since 1990 there appears to have been a very gradual increase in the output of crops that is achieved with a given level of inputs (pesticides and fertilisers), suggesting that the use of those inputs is becoming gradually more efficient. The government's own calculations suggest a similar trend in fertiliser efficiency for a range of crops.[138]

Figure 13: Wheat yield (Hg/ha)



Source: FAO[139]

Figure 14: Ratio of outputs to inputs in the UK (with linear trend lines)



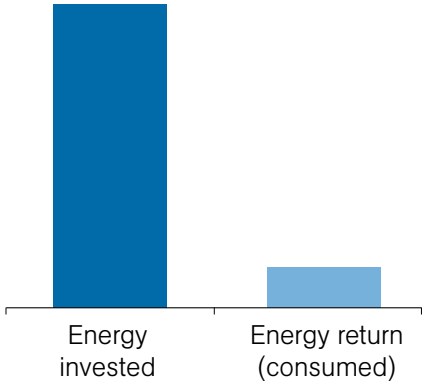
Source: FERA,[140] Defra,[141] FAO[142]

Energy return on energy invested

The UK food system is highly energy intensive, and not just in primary production. In fact, the greatest total use of energy occurs once food has been brought to the home, as indicated in Figure 3 in Section 2. The great majority of this energy use is derived from fossil resources, with the exception of the relatively small proportion of electricity that is now generated using renewable technologies (<10% in 2011, currently 15–20%).[143] Food prices are increasingly correlated with variations in oil prices.[144]

A calculation of the total energy input and output of the UK food system reveals that we use around eight times more energy whilst getting food to our mouths than that food delivers in calories. Figure 15 illustrates this difference. Markussen and Østergård (2013)[145] obtain a ratio of 4:1 for the EROEI of the Danish food system, though this does not include household energy use. Of course, a low EROEI cannot immediately be considered objectionable; after all, we cannot eat oil. Pimental *et al.* (1973)[146] long ago pointed out that fossil energy inputs actually pale in comparison to the solar energy converted by plants, but the point is that 'solar energy is unlimited in time, whereas fossil fuel supply is finite'. The large discrepancy between energy inputs and outputs is a problem because the currently employed inputs are finite in supply (not to mention environmentally destructive).

Figure 15: Energy return on energy invested in the UK food system



Source: Defra,[147] Eurostat[148, 149]

The estimate of energy invested includes the energy used in importing food;[150] however, it does not include the energy embedded in imported food (i.e., the fuel, fertilisers and other energy that was used in production of the food). As such, energy invested is underestimated and this will tend to make the above comparison seem more favourable.

Micro case study: Biolandhof Braun, Dürneck, Germany

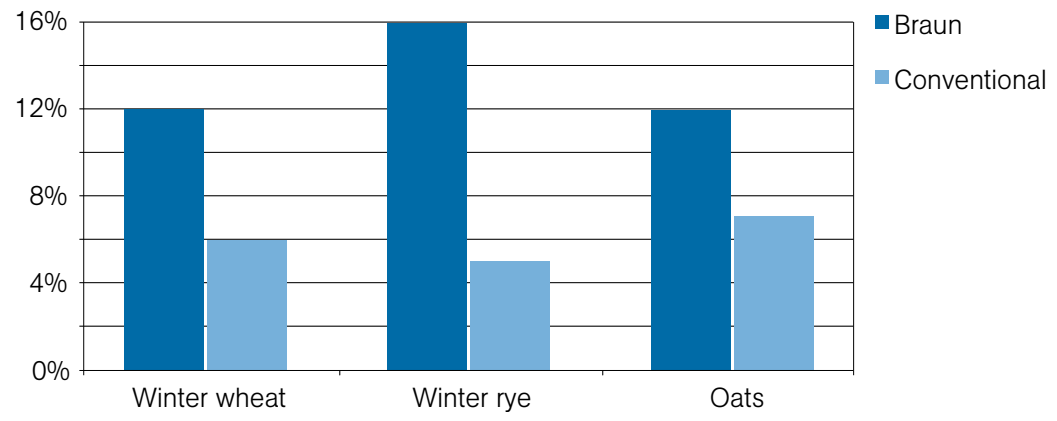
On a family farm in rural Bavaria, Josef Braun[151] is pushing the frontiers of innovation in farming practice. Having converted from a more conventional model of food production, Herr Braun has spent years experimenting with low-impact circular farming methods and can't imagine going back.

Energy use

Braun grows trees in between his crop fields. This has a number of benefits for regulating the microclimate at the field level, but their primary use is as a feedstock for a wood gas generator, which he keeps in a barn on site. This wood gas generator provides both carbon for spreading on fields as a fertiliser and wood gas that is fed into a generator to produce 30 kW electricity and 60 kW of heat and used to heat the buildings and dry hay. The electricity he produces on-site is more than enough to meet all of his power needs, and he even charges his electric car with it. Fitted to the roof of a large barn are 90 kW of solar panels that provide electricity and create heat, which is diverted to the inside of the barn and used for drying hay. The only external energy source that Braun uses is a small amount of fuel to power the tractor. He is rapidly approaching the much-discussed fully circular system.

Being a prolific innovator, Braun has attracted much attention from researchers. One team set out to assess how Braun's energy use compares to similar farms using more common models of production. They found that total energy use per kg of crop output was less than half that of a conventional farm. Converting these data to calculate energy returned on energy invested yields the results in Figure 16.[152] These are not directly comparable to the EROEI calculated for the UK as a whole, since only primary production of specific cereals is considered here.

Figure 16: Energy (calorific) returned as a percentage of energy (inputs) invested, Braun vs. comparable conventional farm



Source: Kronenbitter & Oppermann (2011)[153]

Biolandhof Braun: continued

Importantly, this comparison doesn't account for the type of energy input. Not only does Braun achieve a much greater energy return on energy invested, he also uses predominantly renewable energy sources from within his own system, unlike conventional methods.

Other indicators

After a successful period of growing crops under a more conventional system, Braun converted to fully organic methods in 1988 to reduce the *environmental impact* of his production. His *supply chain* is relatively simple with certain products sold on-site and others sold in local markets and shops.

3. Genetic and species diversity

Why choose this indicator?

There are two elements to agricultural diversity: genetic diversity is concerned with the number of genetic variants of a particular crop of livestock; species diversity is concerned with the number of different species of crop or livestock produced. There is a small amount of academic literature that suggests both may have a number of positive effects.

- **Genetic diversity** has been associated with greater disease resistance,[154] improved ecosystem functioning,[155] and higher production efficiency.[156] Preserving genetic resources is also considered valuable to provide a bank of possibilities for future research.

- **Species diversity** may be associated with ecological resilience (recovery from shocks),[157] disease suppression,[158] resistance to climate change,[159] and increased yield.[160] A further potential benefit of species diversity in production is that it must ultimately result in diversity in consumption (although there is a significant international element). A diverse diet is widely recognised as important for general health.

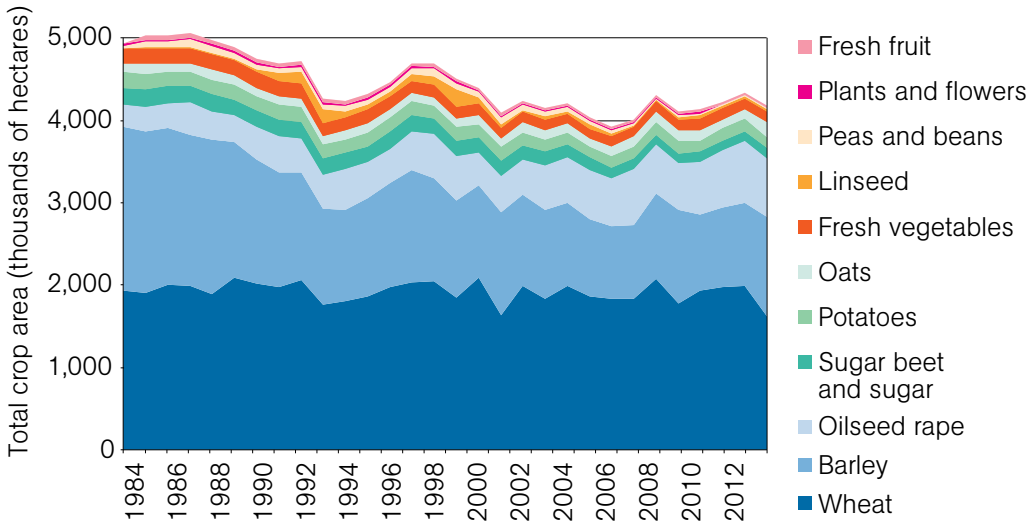
For these reasons genetic and species diversity is an indicator of both **wellbeing**, through potential health and production impacts, and **stewardship**, through ecological impacts.

The pressures that push the system towards greater uniformity include the convenience of standardisation to a highly concentrated retail and processing sector, and the convergence of diets at a global level (as illustrated in Section 2).

UK macro data

UK crop production is highly concentrated in a small number of crop species. As shown in Figure 17, production in the 1980s was composed of around 40% wheat and 40% barley, with all other crops accounting for only around a fifth of production. Over time, wheat has remained in a stable position of dominance, while barley production has been substituted to a significant degree by oilseed rape. Production of all other crops still accounts for the small remainder. We have therefore moved from a situation of two dominating species to three. This is an improvement in terms of diversity, perhaps, but hardly significant in the context of persistently high levels of concentration.

Figure 17: Total production area by crop

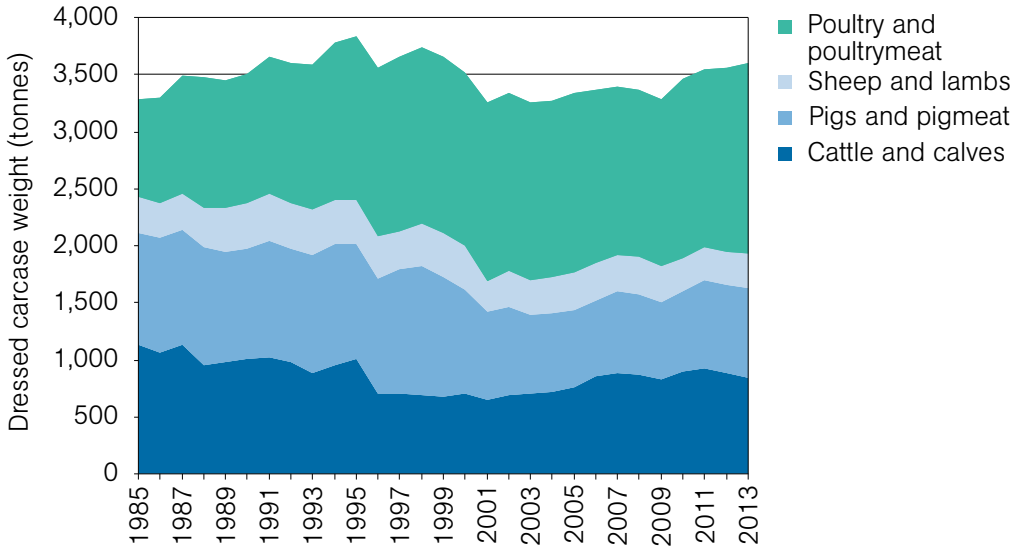


Source: Defra[161]

As of 2015, new 'Greening' rules in the EU CAP will require holdings less than 30 hectares to grow at least two different crops and larger holdings to grow at least three.[162] Given that the number of dominant species already equals three, it's not clear to what extent this rule will increase overall diversity.

As shown in Figure 18, livestock production was split fairly equally between cattle, pigs, and poultry in the 1980s, with sheep making up a significant minority. Since then the clear trend has been for poultry to make up an increasing proportion of production. Within these categories, production is concentrated in a small number of genetic varieties. Defra has estimated that 100 out of 130 native breeds of poultry, cattle, sheep, goats, pigs, horses, and ponies are at risk.[163]

Figure 18: Total livestock production (dressed carcase weight)



Source: Defra[164]

Micro case study: Schwäbisch-Hällischen Landschwein, Hohenlohe, Germany

In the German state of Baden-Wurttemberg, a producers' cooperative formed in 1988 and now comprises 1,480 members. Over time it has revived the fate of the indigenous Schwäbisch-Hällische pig, which had been considered extinct in 1982. The farmers work in harmony with each other and the environment to make a lasting impact on their region.

Genetic diversity

The economic pressures towards increasing rationalisation of agriculture in Germany led to a drastic reduction in the number of pig breeds that were produced over the twentieth century. Around the historic city of Schwäbisch Hall, local pork producers have rejected the industrial model of rearing large numbers of pigs indoors that is common in the rest of Germany.[165] In its place they have re-established the Schwäbisch-Hällische pig, an indigenous species that is naturally adapted to the conditions of the region and is claimed to be healthier and of superior taste. Re-establishing the breed doesn't just make sense for biological and ecological reasons; having a distinctive regional product also provides the farmers with a unique selling point and a niche in the market.

Other indicators

The *supply chain complexity* of the Schwäbisch-Hällische system is low and highly localised. Working on the principle of 'solidary economics', the 1,480 farmers constitute a cooperative organisation (Die Bäuerliche Erzeugergemeinschaft) employing 450 people to process and market their produce, which is controlled democratically, with one vote per farmer. The organisation sets a fixed price per kilogramme that will be paid to each farmer for their produce (depending on the production method – for example, organic meat receives €3.20/kg and free range receives €3.50/kg) and it is the responsibility of the rest of the supply chain to cover that cost in the market. The organisation also provides legal and advisory services to farmers free of charge. It is a system that has proven *financially sustainable* and has achieved substantial scale, now bringing in €110 million annually. The system also contributes significantly to local *culture*, through local food and farm festivals.

Micro case study: Domäne Mechtildshausen, Wiesbaden, Germany

At the heart of the Rhine-Main metropolitan area, a fully integrated food and agricultural system has been developed with the deliberate goal of creating employment for the local area. Now a thriving business and cultural centre, the Domäne Mechtildshausen provides a unique combination of ecological and social goods in addition to the food it produces.

Genetic and species diversity

The Domäne is the epitome of diversity: the small central compound hosts a slaughterhouse, bakery, hotel, restaurant, farm shop, butchers, and café; the age range of employees spans several decades; and the customers come from all kinds of social backgrounds. Most importantly, however, is the ecological diversity. The species on farm are copious: cows, chickens, quails, goats, horses, pigs, and donkeys; wheat, barley, maize, and 80 varieties of fruit, vegetables, and herbs. Consequently, it's possible for customers to satisfy a highly diverse diet in one visit to the farm shop. Moreover, the Domäne goes to particular effort to conserve certain species on the IUCN Red List.

Domäne Mechtildshausen: continued

Other indicators

The *supply chain complexity* of the Domäne is reduced to a minimum. Small-scale on-site processing facilities (such as the slaughterhouse and bakery) not only provide a direct link between primary production and retail, they are also used by other farmers in the area, who would otherwise feed their produce into larger centralised processing facilities and the subsequent supply chain. Moreover, these processing facilities deliberately incorporate a significant degree of transparency, being open for viewing by the public, like the rest of the farm. See page 46 for details on employment at the Domäne.

4. Employment

Why choose this indicator?

Research has shown that the negative impact of unemployment is far greater than the simple value of lost income.[166] In other words, the security, autonomy, and identity that come with having a job may be as valuable as the remuneration itself. Indeed, it has been argued that increasing levels of production in our economy serve primarily to provide employment, rather than to meet the marginal demand for more consumption goods.[167] As such, a *good* job (an important qualification) for every able individual is a key indicator of **wellbeing** and **social justice**.

There are, therefore, two relevant elements to this indicator: quantity (is the system a job creator?) and quality (are those jobs 'good'?). Quantity can be examined both in total and per unit of land or per unit of product (although it can be difficult to attribute labour to specific products). The quality of a job has been previously defined as consisting of a number of relevant factors, including security, fair pay, involvement in decisions, lifelong training, flexibility, and safety.[168]

UK macro data

As described in Section 1, UK agriculture employs very few people per hectare of land (0.02 annual work units/hectare) in comparison with other European nations. The UK also has the lowest level of agricultural employment as a proportion of the total labour force (less than 1%).[169] It is clear, therefore that UK agriculture is characterised by very low labour intensity and the UK labour force by very low agriculture intensity.

Arguably a comparison of employment across different agricultural regions is not particularly meaningful since we are comparing very different types of farming. There is a clear trend *within* the UK, however, towards the decreasing importance of labour in agriculture. Again, this is not necessarily a negative thing on its own, but several other factors should be taken into account. Are the jobs that UK agriculture supports *good* jobs? And is the decreasing trend driven more by demand for or supply of agricultural labour?

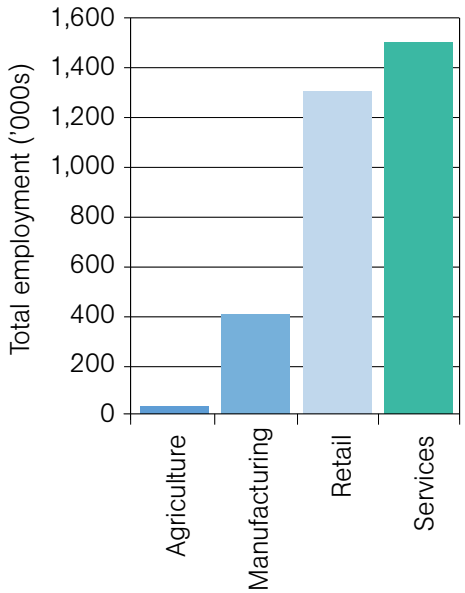
A recent survey of farm workers paints a mixed picture of the quality of jobs in UK agriculture. The average salary (£25,578) is slightly below the UK average, though many workers benefit from free accommodation. However,

many workers don't receive a salary and are paid by the hour and a significant proportion complains of being underpaid and over-worked, with long hours and few holidays. In addition, 46% of workers received no formal training over the past year. Nonetheless, 76% of farm workers say they are happy with their jobs.[170] Concerns have been raised regarding the exploitation of migrant workers in the agricultural sector.[171]

It is frequently assumed that the observed fall in agricultural labour in the UK is primarily due to structural changes in our economy, away from primary production and towards services, and due to changes in agricultural 'labour-saving' technology. The result being that the technical labour requirement (or demand) for agricultural labour is falling. An increasingly important determinant of this trend, however, may in fact be the *supply* of agricultural labour. According to the Farm Business Survey, commissioned by Defra, the average age of a farmer in England in 2012/2013 was 57 (Figure A4 in Appendix 6). This average has increased by four years over the past seven (i.e., it was 53 in 2005/2006), indicating a very low rate of entry by young farmers and causing concern amongst experts and practitioners. A key barrier may simply be negative perceptions of the profession.[172]

Looking at the food system as a whole, we can split categories of employment into four main sectors: agriculture, manufacturing, retail, and services.[173] Figure 19 illustrates that employment in these sectors differs by several orders of magnitude. Agricultural employment is greatly exceeded by manufacturing employment, which in turn is dominated by employment in the retail and service sectors. The total for the whole system (i.e., the sum of these four sectors, equal to 3.2 million jobs) represents approximately 11% of the UK labour force.[174] It is clear, therefore, that jobs in the food system are highly significant in the UK economy but are overwhelmingly not land-based.

Figure 19: Employment in the food system



Source: ONS[175]

Figure 20: Mean gross annual pay in the food system (UK average is for all economic sectors)

Source: ONS[176]

Figure 20 shows the average annual wages in each of these four sectors compared to the national average (Table in Appendix 6 has the data). All four sectors pay less than the average across the country; however, while manufacturing jobs earn a salary very close to the average, salaries of retail and service employees in the food sector are very low, at around half of the national average. In all cases the mean pay is lower than the median, indicating that there are more jobs below that average than above.[177] Therefore, while jobs in food retail and services are by far the most numerous, they are also by far the least well-paid. Such low wages, being insufficient to survive on, are typically topped up by the government in the form of tax credits and benefits – an effective subsidy to low-paying employers.

Significant concerns have been raised with respect to working conditions in the UK's food industry. Evidence suggests that migrant workers in particular are subjected to brutal treatment in some cases, being forced to work under physical and emotional abuse and for very little remuneration.[178] The British Retail Consortium reports that '[i]n 2012, 29 per cent of cases of labour exploitation reported to the UK Human Trafficking Centre occurred within the food processing and agricultural sectors.'[179]

Micro case study: Domäne Mechtildshausen, Wiesbaden, Germany

Employment

In 1984, the non-profit Wiesbadener Jugendwerkstatt[180] (Wiesbaden Youth Workshop) was founded with the aim of providing jobs and professional training programmes for local young people from disadvantaged social backgrounds. Shortly after, the Domäne Mechtildshausen was established on an agricultural site now comprising 700 hectares around the city of Wiesbaden with the intention of generating jobs for locals and providing training in a range of professions, from livestock rearing to bakery, for local youths. In total there are 150 employees, including 50 that are involved in primary production. As such, the number of agricultural jobs per hectare is around 0.07, roughly three times greater than the average for the UK and higher than the EU average. Around 70% of those who complete the training programmes go on to secure further employment. The city of Wiesbaden provides some funding for these training programmes, recognising that it prevents expenses in other areas (such as costs associated with crime and unemployment).

Other indicators

See page 43/44.

Micro case study: La Fageda, Catalonia, Spain

Thirty years ago, in the mountainous region of Garrotxa in northern Catalonia, a non-profit cooperative company was set up with the objective of integrating people with learning disabilities and severe mental disorders into the labour force. Today La Fageda is a regional force and one of the biggest yoghurt producers in Spain, generating €15 million of revenue in 2013 mostly from its range of dairy products.

"Some outcomes are less tangible, but no less satisfactory or relevant."
Albert Riera, Communications Director, La Fageda

Employment

Throughout its operations, from farm work to dairy products processing, La Fageda employs 245 salaried staff, of which 120 suffer some kind of learning disability or mental disorder. It says that the impact on the wellbeing of these individuals, who would otherwise be likely to languish at home under the support of family or the state, is obvious. The individual stories from employees attest to this impact.

In this model, the key outcome is the wellbeing of vulnerable individuals rather than strict production efficiency. As a result, a simplistic analysis might conclude that such a firm would not be competitive and would struggle in a commodified market. However, the significant success of La Fageda tells a different story: its social mission has spread into its brand, creating positive perceptions amongst conscious consumers. And yet, it has never used this social aspect to market itself or explicitly linked it to the brand. La Fageda doesn't want to actively remove the normality with which people should see its products or the fact of disabled and socially disadvantaged people having a decent job. In spite of this lack of promotion, a study from last year revealed that 70% of consumers are aware of the company's social project. Even during the economic crisis years, sales increased by 20%.

Nearly all of the employees joining La Fageda stay there until the end of their working lives and beyond. There are not many alternatives around. Many retired people choose to spend their time at La Fageda (off the payroll) with their leaders and psychologists because they have resources and facilities that they can use (such as sports and leisure).

Other indicators

In addition to its social mission, La Fageda also makes significant efforts to engage culturally with people in the area. Each year, 50,000 people visit the site, roughly a third of which is school visits, while another third is made up of families. The company promotes several cultural activities in the local area, like art workshops and sports events in the installations of a former Athletics club which La Fageda rebuilt for that purpose. It has recently applied its employment model for environmental ends, for example, starting a biomass energy project which will help it reduce gas consumption and will employ 20 people who find it hard to get into the labour market.

5. Supply chain complexity

Why choose this indicator?

The process and infrastructure that transform primary production into a particular final consumption product are typically referred to as a 'supply chain'. These chains can be very simple, for example where the producer and consumer is the same person, or highly complex, as in the case of products with many internationally sourced components.

Many advantages are posited for short and simple supply chains:

- **Transparency**. With fewer steps to monitor and fewer parties involved, there are fewer opportunities for fraud and consumers can make more informed choices.
- **Consumer awareness of production**. Bringing consumers of goods closer to producers may spread consciousness of how food is grown and how that impacts environment, culture, and community.
- **Local economic benefits**. With fewer parties and a smaller geographical scope, more of the value of the final product is captured by producers and local processors, rather than sucked away from local economies by national corporations.
- **Less processing**. Simple supply chains tend to be characterised by a lesser degree of chemical and mechanical processing and a greater degree of fresh ingredients, which may deliver health benefits.
- **Risk management**. Shorter supply chains permit a transparent distribution of risk and fewer incentives to pass risks up or down the chain through exploitative means.

For the potential impact on health and culture, as well as the tendency to wrest control away from centralised corporations and towards local economies, supply chain complexity is considered an indicator of **wellbeing** and **social justice**.

On the other hand, there are strong pressures for increased supply chain complexity:

- Profit-seeking businesses will naturally seek new production opportunities. In the absence of an increased aggregate demand for food (in the context of a relatively stable population) increased profits can primarily be achieved by generating demand for new products with 'added value'.
- More complex and extensive supply chains may sustain a greater number of total jobs, such that a concern for employment security may exert pressure against supply chain simplification. However, this does not apply where food products are imported.

In theory, each step in a supply chain should 'add value' to the product, be that combining primary ingredients into a new product, packaging the product for convenience or longevity, or simply getting the product to a new location. All of these processes 'add value' and, therefore, the price of the raw food increases as it passes along the supply chain. A Cabinet Office report[181] noted that:

> *"As more food is subject to "value-added processing" … and the supply chain responds to labour, regulatory and other costs, it might be expected that farmers' share of the retail basket will shrink."*

Consequently, increasingly long and complex[182] supply chains will be associated with a lower farmer's share of the final retail price. This quantitative indicator is, therefore, a guide to the trend in supply chain complexity.

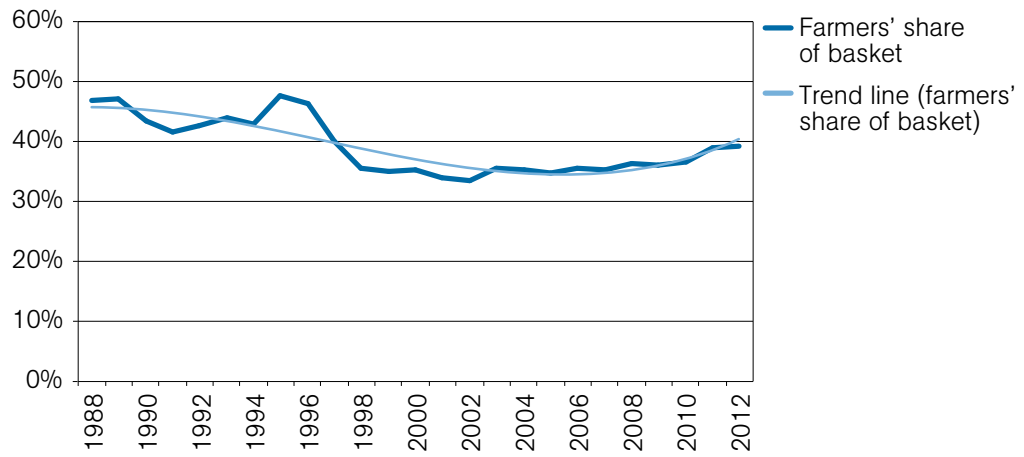
UK macro data

In the UK, the network of suppliers, processors, and distributors that intermediate between primary producers and consumers of food has never been more complex. When this system was largely invisible to consumers, who were offered an increasingly wide variety of products, there was little public concern for such complexity. The horsemeat scandal that erupted in early 2013, however, quickly cast a harsh spotlight on an unbelievably messy and ungovernable supply chain:

> *"Supermarket giant Tesco, frozen food firm Findus and budget store Aldi were supplied with products containing horse meat by Comigel, based in north-east France. Comigel instructed Tavola, its subsidiary in Luxembourg, to make the products. Tavola placed an order for the meat with Spanghero, in the south of France, which contacted a Cypriot trader, who subcontracted a Dutch trader. The Holland-based company placed an order with abattoirs in Romania, which sent the meat to Spanghero. … Comigel's factory in Luxembourg received the meat from Spanghero, and it was used in food products sent to stores across Europe, including the UK."*[183]

In response to these events, the UK government commissioned Professor Chris Elliott to conduct a review of the Integrity and Assurance of Food Supply Networks (the Elliott Review). Professor Elliott's interim report[184] points the finger squarely at the symptoms of 'dishonesties', unscrupulous elements of the industry and insufficient deterrents and enforcement, rather than any inherent problems with the structure or the nature of the industry. However, the government's published summary of consultation responses acknowledges that 'support for shorter food supply chains' was a key theme. Furthermore, in response to the question of which factors are most influential in creating the risk of fraud, a key theme was: 'Lengthy and complex food supply chains are more vulnerable to fraud.' Similarly, '[t]here was strong consensus among all stakeholders that shorter supply chains would lead to improved traceability.' A recent report from the parliamentary EFRA committee, also calls for a shortening of supply chains.[185]

Figure 21: UK farmers' share of the value of a basket of food items



Source: Defra statistics[186]

The long-run trend has been for farmers to receive a smaller proportion of the total value of final food products (Figure 21). However, this trend can be split into two distinct periods with the share falling substantially by 14 percentage points between 1988 and 2002 before stabilising and rising slightly between 1998 and 2012 (much of which will be due to the commodity price shocks in this period).

This aggregate picture masks substantial variation between products. The farmer's share of the price of a loaf of white bread fell from 16% to 11% between 1988 and 2012. When you buy a 75p loaf of bread, the farmer receives 8p. On the other hand, their share of the retail price of carrots rose from 30% to 47% over the same period. It can be expected that farmers will appropriate less of the total value of foods that undergo more processing (such as white bread) than unprocessed foods (such as carrots). As such, one can interpret the long-run trend towards decreasing farmers' value share as indicative of an increase in the degree of processing and the prevalence of processed foods. These 'value-adding' processes are both a source of jobs and economic activity and an upwards pressure on consumer prices, all else being equal. This measure will also decrease when an unequal distribution of power along the supply chain leads to pressure on farmer's margins.

It has been argued that the formal pursuit of greater competition in grocery supply chains has ultimately had a perverse effect in many cases. In a context of market concentration, horizontal competition at different points on a vertically disintegrated supply chain (i.e., split into producers, processors, and retailers) may simply lead to the transfer of risk and costs away from the most powerful link (invariably the supermarkets) towards the weaker links (processors, producers, and even consumers). Supermarkets maximise 'point value' through a combination of 'confusion marketing' to customers and exploitation of supply contracts. But, as Bowman *et al*. observe, 'the problems stem from structural problems and business models rather than bad behaviours',[187] leading to doubts as to the likely efficacy of the new Groceries Code Adjudicator, whose remit extends only to the symptoms of these problems.

Micro case study: Benediktinerabtei Plankstetten, Berching, Germany

In a historic monastery in central Bavaria, a group of enterprising monks have developed a remarkable system of local organic production and small-scale processing facilities that combines the interests of those concerned with the environment, the local economy, and personal spirituality.

"Looking back over the last 20 years and comparing the start with the success of today – there was no master plan; no one would have expected this."
Frater Andreas

Supply chain complexity
The supply chain in the Plankstetten system is very simple and largely controlled by the monastery. Grains, cattle, and pigs are produced on the 180 hectares of the monastery's own land and in cooperation with 30 organic farmers in the local area. All processing takes place within the monastery's bakery, butchers, and distillery and the final products are sold on-site in the farm shop and in a number of farmers' markets in local Bavarian towns. As a result, the total annual turnover of €1 million is captured by the monastery and local producers and is retained within the local area, providing security for the producers and the 100 employees of the monastery. This supply chain system depends critically on the availability of small-scale processing facilities at the monastery, providing a local outlet for regional producers. The retail of products at the on-site shop brings consumers (the majority of which visit the monastery for spiritual or cultural reasons) into contact with the ecological messages of the producers' philosophy. In contrast to the typical *dis*integrated supply chains in the UK, this model integrates the chain from production through to retail, eliminating the incentives for unproductive competition along the chain.

Other indicators
The monks take concerted action to reduce *environmental impact* and *energy use* through organic production principles, on-site energy generation from biomass and solar, and local distribution. In terms of *employment*, the monastery sustains a large number of jobs and provides training in processing methods; however, a concern for the future is the supply of young people interested in the industry who potentially face higher-paying options in other industries. The system also contributes significantly to *species diversity*, producing a full range of grains within a rotation of ten different crop plants.

Micro case study: Neumarkter Lammsbräu, Neumarkt, Germany

In a Bavarian market town, a local family business producing organic beverages has grown into a disruptive force in the national market. Motivated by the desire to pass the business on to the next generations, the philosophy of the brewery is that sustainability makes business sense. Lammsbräu is now the world's largest certified organic craft brewery.

"Organisms have the right to exist, but a company does not. You need to serve some useful function. Businesses that just focus on profit and growth won't survive."
Dr. Franz Ehrnsperger

Neumarkter Lammsbräu: continued

Supply chain complexity

The brewery sources 80% of its brewing inputs (barley, wheat, hops, spelt) directly from a producer cooperative of local farmers. They negotiate on price and quality, agreeing on a price for five years that is indexed to inflation, affording the producers a significant degree of security. The brewery then processes and markets the final products in both local and national retailers. As with the Plankstetten monastery, the Lammsbräu brewery sustains a system of local producers, integrating them with local processing facilities and creating a short local supply chain with a clearly understood distribution of risk. The business aim is to integrate fully with the region and to advance organic farming; consequently the future strategy will be to concentrate sales in Germany, rather than encouraging growth into further markets. This supply chain model also incorporates an impressive degree of transparency, with the annual Sustainability Report detailing the full range of environmental and social impacts of their products.

Other indicators

The brewery has an extensive system of *environmental impact* monitoring and publishes an annual report with masses of detailed information, from GHG emissions to waste produced. Nearly a quarter of their total *energy use* is met by renewable sources. They have a strong policy and history of *employee* welfare for their 107 employees – an annual survey reveals persistently high levels of satisfaction with working conditions and remuneration. In addition, 36% of the management staff is female. They also engage *culturally* with the region through various local events, including hosting a Hüttengaudi (an event celebrating Bavarian culture).

6. Ownership and control

Why choose this indicator?

Economic theory typically takes no position on what is a 'good' distribution of assets among members of a society, simply predicting that efficiency is greatest (or production is maximised) when the ownership of those assets can be exchanged freely. In many Western countries, the assets in question – principally land and companies (e.g. processors, manufacturers, retailers) – are indeed subject to relatively few constraints on trade.

What this frame of analysis excludes is the multiple functions of ownership. As well as a store of value, ownership of productive assets also confers control over their use and a sense of responsibility. A number of studies have found that differences in ownership regimes significantly affect individuals' attitudes towards a situation. For example, the variety of different community, municipal, and individual ownership models operating in Germany's renewable energy market has been widely praised for contributing to its success. Evidence from the UK suggests that companies which have a higher degree of employee ownership tend to outperform others.[188]

Therefore, this indicator looks at the degree to which ownership of the resources involved in the food system is dispersed and how control is exercised over those resources, with the understanding that a system in which a greater number of stakeholders have a degree of control over production is a system that is more democratic and resilient.

UK macro data

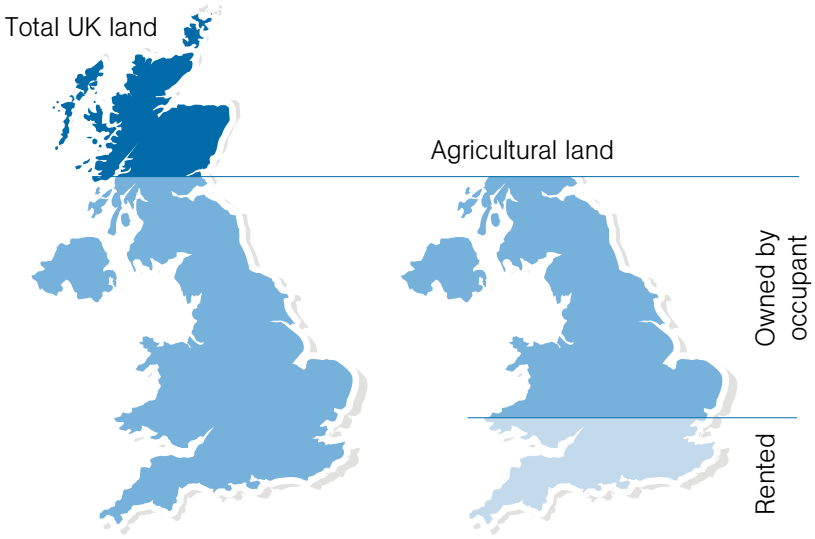
The ownership of food production assets can be grouped into two major categories: land and companies.

The ownership of land is distributed highly unequally in the UK.[189] Comprehensive recording of land ownership information has been extremely infrequent: Kevin Cahill recently undertook an enormous effort to document who owns all of the land in the UK and worldwide; before that, the previous serious effort for the UK was in 1873.[190] This lack of transparency is, in itself, notable.

Cahill reports the data illustrated in Figure 22. According to these estimates there are around 158,000 owners[191] of agricultural land (some of which is owner-occupied and some is rented), which Cahill reckons comprises about 0.25% of the UK population.[192] In other words, a tiny proportion of the UK population owns the majority of its land. In part this reflects the structure of the UK's agricultural industry described in Section 1: we have a relatively small number of holdings, which are relatively large. Scotland in particular has the most unequal pattern of land ownership in Europe, although recent changes have created the conditions for some communities to take back control of the land.[193]

The Royal Institute of Chartered Surveyors (RICS) estimates that the price of an acre of bare land stood at £7,754 in 2013, which has increased more than threefold from £2,400 in 2004.[194, 195] RICS attributes this astonishing surge partly to increased demand from investors (i.e., financial speculation) and partly to strong demand from farmers for more land. Such high prices are a clear barrier to new entrants, particularly those with little access to credit.

Figure 22: UK land ownership

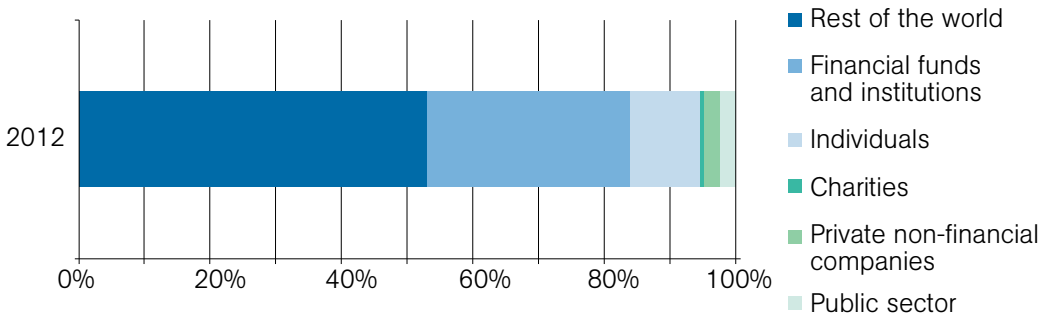


Note: Proportions by height, not area
Source: Cahill (2006) 'Who Owns the World'.[196] Data for 2004

Companies operating in the UK food system include processors and manufacturers, retailers, and catering and service providers. There is a huge diversity of companies, employing around 11% of the UK workforce (see the section on Employment). Compared to many sectors the food industry is

relatively more populated by small and medium-sized businesses (90% of food businesses are micro-businesses),[197] particularly in sectors that are not characterised by significant economies of scale such as catering services and specialist manufacturing. Larger companies may be publicly traded, with shares exchanged on the stock market. ONS data, illustrated in Figure 23, shows that the shares of UK-listed companies are not predominantly owned by individuals in the UK (only 10.7%), but mainly by financial funds and institutions[198] (30.8%) and overwhelmingly by investors from the rest of the world (53.2%).[199] The ownership of UK food companies in particular may diverge from this pattern; however, the data suggest that the portfolios of different categories of investors have broadly similar composition.[200]

Figure 23: Ownership of UK shares



Source: ONS[201]

Overall, therefore, ownership of production assets is strongly concentrated. The structure of our primary production sector creates a very small class of landowners. Ownership of companies is less clear: with a large proportion of small businesses the number of owners is likely to be relatively high; however, publicly traded companies are primarily owned by financial funds and institutions or overseas investors and the UK individuals that do own a share of food companies are likely to be few in number and relatively wealthy.[202]

Micro case study: Organiclea Workers' Cooperative, London, United Kingdom

In the urbanised lower Lea Valley of north-east London, a group of workers are growing and distributing food with the vision of creating a food system driven and controlled by local producers and consumers, not by centralised institutions and corporations.[203]

"With consensus decision-making you actually just get better decisions. It's more efficient, it's more resilient, and it's more empowering."
Adam Payne, cooperative member

Ownership and control

The land that Organiclea cultivates is owned by the local authority and rented to the organisation on a long-term lease. The local authority sees this relationship as part of its food-growing strategy, and therefore leases the land at a favourable rate. The organisation is strongly aware that the commercial price of agricultural land, which has increased particularly rapidly in recent years, is a massive barrier to the establishment of initiatives like this. It is an advocate for far-reaching land reform, arguing that historical land inequalities (described earlier) combine with CAP payments that are tied to land

Organiclea Workers' Cooperative: continued

area, effectively capitalising taxpayer funds into the value of land and perpetuating the exclusion of new farmers entering the industry. These public subsidies flow mostly to a concentrated group of big landowners since very small holdings are not eligible for the payment. At the same time, subsidy support for genuine social goods, such as environmental protection, remains a small proportion of the total.

Organiclea's operations are governed through a sociocratic model of organisation. In this model workers are split into several groups, or 'spokes', each of which is concerned with a certain area of operations, such as production or marketing. Organisational decisions are taken in a separate group, known as the 'hub', to which representatives from the spokes are elected on rotation. As a result, the organisation is highly non-hierarchical and has no formalised system of line management. With no outside shareholders, the workers are collectively responsible for the organisation. Control of the organisation and the decisions it takes are not dominated by a few personalities, or by the impersonal influence of finance. Worker satisfaction is apparently very high.

Other indicators

Organiclea's model recognises the wellbeing impact of *employment*: across its sites, it takes on around 150 volunteers every year, many of whom are referred by social workers and are recovering from mental health problems or are long-term unemployed. Other research evidences the positive wellbeing impact of such strategies.[204] The organisation takes responsibility for *environmental stewardship* by adhering to organic principles and producing sustainable energy on site. Its *supply chain* is strictly local and very simple, selling directly to end users through a box scheme, local market stalls, and restaurants and cafés in London.

7. Culture and health

Why choose this indicator?

The biological process of bodily sustenance is invariably accompanied by a set of social phenomena that both influences our consumption and helps us to interpret what it means with respect to our place in society. This set of social phenomena – which we might refer to as food culture – has clear impacts on wellbeing through the way in which it affects both our physical and psychological being.

As discussed in Section 3, more than any other indicator, different aspects of food culture are difficult to categorise as 'good' or 'bad'. An ideal evaluation would determine the contribution of changes in food-related ideas, customs, and behaviours on human **wellbeing**. In practice, it's hard to envisage a methodology that would accurately answer that question. It is important, however, that such difficulties do not cause an appreciation of food culture to disappear from the agenda. Moreover, there are some things that we can do, which, while less than perfect, can start to build an appreciation of the impacts of a changing food culture.

- We can document how food-related ideas, customs, and behaviours have changed and are changing.

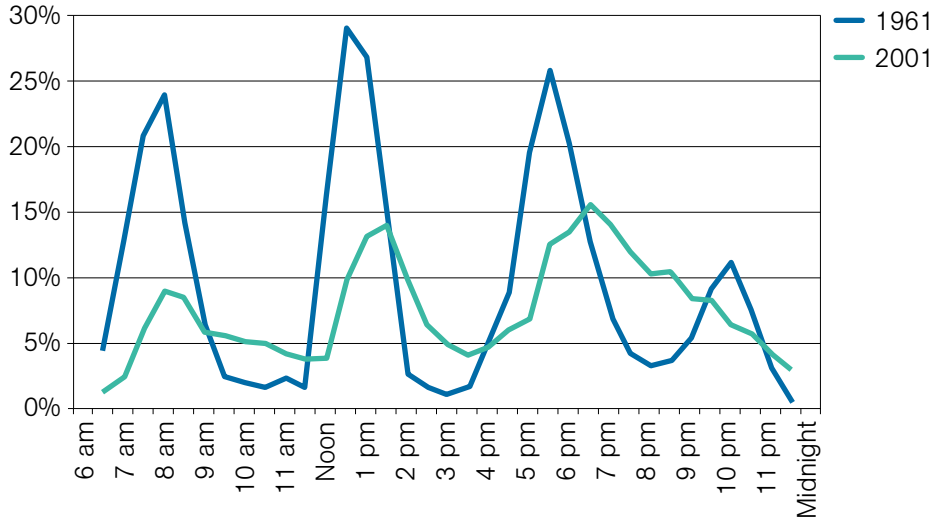
- We can qualitatively assess whether such changes might be expected to impact wellbeing outcomes and examine any evidence to that effect.

Health outcomes are given particular prominence here since they are so strongly linked to dietary behaviours and are an important determinant of wellbeing.[205]

UK macro data

The way we eat meals has changed dramatically. Fifty years ago, there were three clear mealtimes throughout the day. Now common mealtimes are much less clear cut, with more people grazing on the move and squeezing meals into busy schedules (Figure 24). Of the meals that are still consumed in the home, 60% are now eaten in front of the TV[206] and expenditure on takeaways increased by 11% between 2009 and 2012.[207] The habit of snacking is also a relatively recent phenomenon.[208] Although it is hard to exclude other influences, most studies find that children and adolescents who sit down to regular family meals have higher wellbeing and lower levels of depression and antisocial behaviour, as well as better school results.[209, 210, 211] In this context, the breakdown of established meal structures and behaviours could be a cause for concern.

Figure 24: Change in meal patterns 1961–2001. Percentage eating or drinking, in or out of home, by time of day

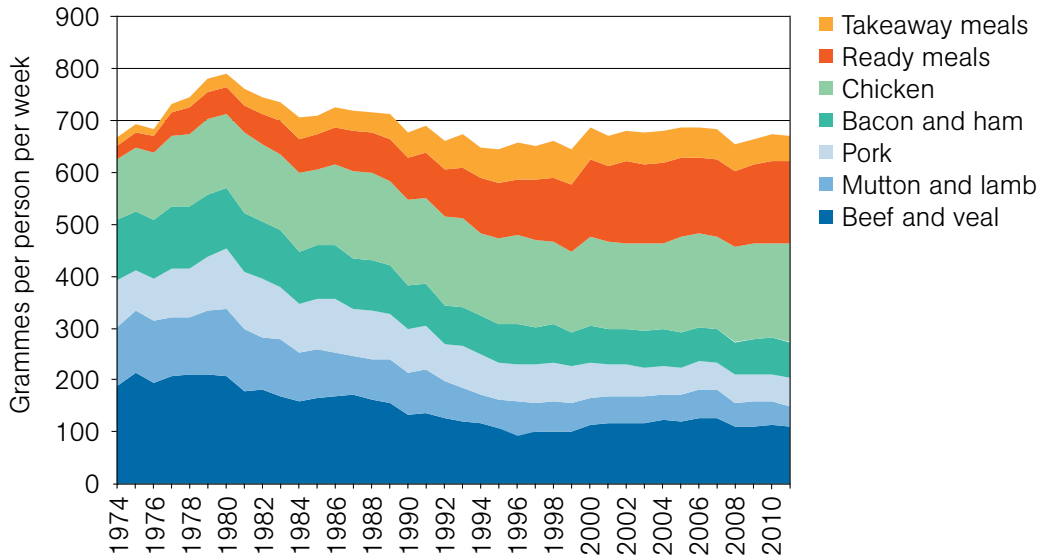


Source: Cabinet Office[212]

Our culinary preferences have become far more cosmopolitan. There have been various surveys designed to reveal the nation's favourite meal. The results vary – some find Indian to be most popular, others Chinese and even Mexican – but the consistent message is that Britons' favourite food is not British.[213] This need not be taken as a negative development – indeed, experiencing a variety of food cultures and incorporating them with our own could be an enriching process.

We're changing the way we eat meat. Over the past few decades there has been a dramatic shift in meat consumption towards chicken, ready meals, and takeaways (Figure 25), reflecting the trend towards increasingly processed food purchases. Recent survey evidence suggests, however, that more and more consumers are either turning away from meat (particularly young consumers) or choosing to buy higher quality meat but less frequently.[214]

Figure 25: UK meat consumption at home (grammes per person per week)



Source: Defra[215]

Eating disorders are common and highly detrimental to physical and psychological wellbeing. Survey evidence suggests that 6.4% of the UK's adult population screened positive for an eating disorder, such as anorexia or bulimia, in 2007,[216] a figure that is thought to be underestimated due to misreporting. It's not clear whether or not the incidence of eating disorders is increasing over time but it is reported that hospital admissions have increased substantially.[217] Compared with other psychological illnesses, anorexia and its variants have a particularly severe physical and mental impact with high mortality rates and relatively poor recovery prospects.[218]

People are growing more of their own food. Data from Defra's Family Food Survey indicate a gradual upward trend in the percentage of food that is home-grown in gardens or allotments, interrupted in 2012 by exceptionally poor growing conditions. Evidence suggests a robust link between time spent gardening and life satisfaction, which may be related to the acquisition of skills; the impact may be even greater than the impact of income on life satisfaction.[219]

Cookery books and TV shows remain a strong business. In recent years TV shows such as the Great British Bakeoff[220] have achieved sensational popularity and the strong sales of cookery books have catapulted several chefs into the list of the top twenty bestselling authors.[221] While the strong representation of food and cooking in the media does not necessarily correlate with high levels of home-cooking, it does indicate that there is a flourishing of interest in cookery, in theory if not necessarily in practice. Indeed, the trend towards more takeaways and ready meals seems a strange contradiction in this context, which might be explained by variations among unequal segments of the population.

Obesity is increasingly recognised as the greatest threat to public health now and in the future. Figure 10 in Section 2 illustrates the trend in obesity rates. The dominant influence, from a dietary point of view, is 'easy access to cheap, highly palatable and energy-dense foods lacking in good nutrition'[222] which, in many or most cases, are less expensive than higher quality food. High

densities of fast food restaurants and restricted access to supermarkets have been linked to significantly greater obesity rates, though the causation may occur in both directions.[223] A number of studies have estimated the economic cost of obesity, both directly to the NHS and to the UK economy as a whole;[224] the National Obesity Observatory takes £4.2 billion and £15.8 billion as reasonable estimates for these costs respectively.[225] If the price of food reflected these costs the UK's total food bill would be roughly 20% greater. Evidence suggests that there may be significant wellbeing impacts over and above the physical impact of obesity.[226]

Micro case study, Blaencamel Farm, Ceredigion, United Kingdom

In the countryside of central Wales, Peter Segger and his family have grown a production system that is proudly idealistic, rejecting a reductionist attitude and aspiring to a notion of food as so much more than mere bodily sustenance.

"Food can and should be enjoyed. We need to show how we can bring about a healthier and more diverse world."
Peter Segger

Culture and health

Peter's approach to operating as a food producer in his local region is based on his own observation that 'people actually want to cook food and sit down and talk about it.' The way people engage with each other over their food matters, what they know about how it was produced matters, enjoying the act of choosing ingredients and making meals matters. This translates into a model in which engagement with local consumers is key, where quality is of the utmost importance but the *way* you produce is just as important as *what* you produce.

Regular school visits are hosted on the farm, during which children are encouraged to pick vegetables, to feel and taste them, and are told the story of how the farm brings it all into being. They also receive visits from a wide variety of other groups, from researchers to other food producers. They engage actively with art and design – their woods are dotted with sculptures from visiting artists and their farmhouse has been acclaimed for its natural and sustainable design. The result is a system that recognises how food and farming relates to cultural relations between people and environment. By educating consumers about how their food is produced and cultivating the aesthetic aspects of agricultural life, Blaencamel proactively makes those cultural relations part of its business.

Other indicators

The environmental impact of Blaencamel farm is monitored closely, with detailed carbon balance sheets recorded periodically. Peter sees resilience and sustainability as going hand in hand, which underpins his continual drive to minimise his environmental impact and work with a circular system (e.g. producing all of his own compost). Blaencamel used to supply supermarkets with its produce but now prefers to distribute what it grows only within the Ceredigion region – Peter sees this as a more resilient business model, which he can ultimately pass on to his children.

8. Affordability and financial sustainability

Why choose this indicator?

To be able to afford food is a basic requirement for **wellbeing**. Similarly, to be financially viable is a basic requirement for successful production systems.

Affordability is determined by both the market price of food and the incomes, or equivalent support, of individuals. Since most individuals will get their food from a variety of sources, the affordability of any individual source is less relevant than the affordability of the system overall. As such, we consider only UK macro data for this indicator.

Financial sustainability of a production system is determined by its ability to cover costs with revenues from consumers. In addition, public support provided for goods that society values (such as a pleasant environment and strong communities) but which cannot or should not be sold on a marketplace is a legitimate component of financial viability. While the history and continued existence of all the case studies considered so far is one indicator of financial sustainability (and in some cases we have discussed funding sources), it is not possible to investigate specific financial details for particular cases for reasons of privacy. Therefore, again, we examine only the macro data for the UK.

UK macro data

Affordability

Is our food affordable? Or do the costs of producing food and food products impose an unacceptable burden? This isn't simply about the price of food, but rather the price of food in relation to the price of other goods and in relation to total available income and its distribution. In other words, affordability depends not only on how we produce and market food, but also on the condition of the wider economy and society. It's no good having low-cost food if we, or some sub-group of us, are still too poor to buy it. On the other hand, it is necessary to always keep in mind that, as Tim Lang argues, '[c]heap and plentiful food does not automatically yield better health and wellbeing.'[227]

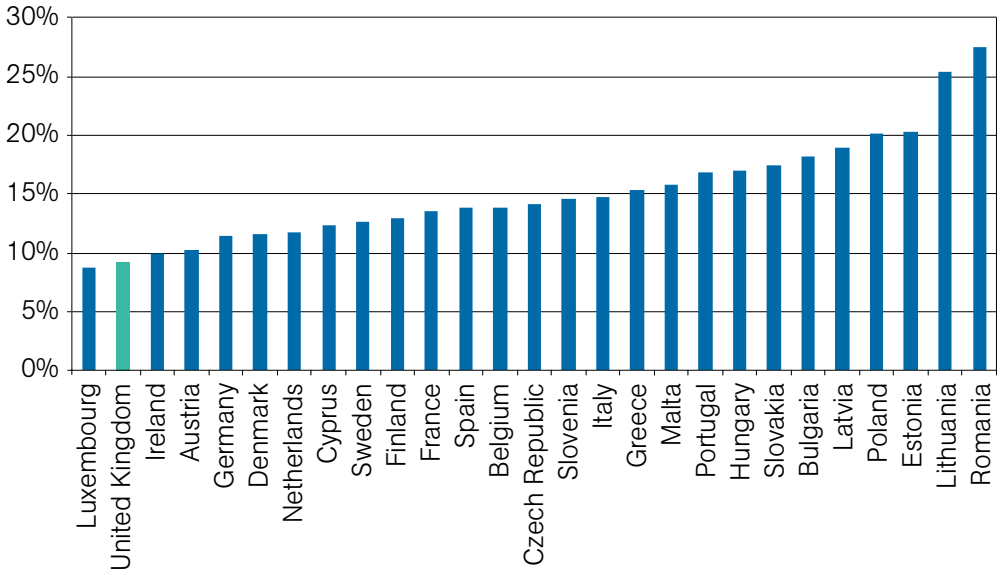
From a historical perspective, on average we increasingly devote less of our expanding incomes to food (Figure 33 in Appendix 7). From a certain perspective, this can be interpreted as a liberating trend: on average it has become progressively easier to satisfy our basic calorific needs and more of our income can be devoted to other needs and interests.

The importance of food in household expenditure varies dramatically across the EU (Figure 26). In comparison with other European countries, UK households have always spent a very small proportion of total consumption on food and drink (only wealthy Luxembourg spends a smaller proportion). This proportion is well below the average for the EU as a whole (9.3% compared to 13.0% for the EU 27 average in 2012). In large part this is due to the average affluence of UK citizens compared to other EU nations; however, this cannot explain the full difference since other EU countries with greater GDP per capita (namely Austria, Belgium, Denmark, Finland, France, Germany, Ireland, the Netherlands, and Sweden) devote greater proportions of their expenditures to food.

In some poorer EU countries, such as Bulgaria and Lithuania, food makes up more than a quarter of total expenditure. Again, however, income is clearly not the only determinant of the importance of food expenditure for these countries. Food expenditure is more important in Sweden than in Cyprus, and in Italy than in Slovenia, despite those countries being richer. This suggests, as one might expect, that there are significant social and cultural drivers that vary among countries, affecting the way local food is produced (and therefore its cost) and how it is consumed (e.g. a relatively greater preference for food over other consumption goods).

Therefore, is a decreasing food bill necessarily a good thing? As well as being a physical necessity, food is a hedonic and cultural experience – choosing to spend relatively more resources on this experience compared to other pursuits may equally be indicative of a flourishing food culture as much as relative poverty or lack of economic development. Consequently, a continual mission to reduce the proportional food bill on average is not obviously desirable, and could be at odds with fostering a rich food culture.

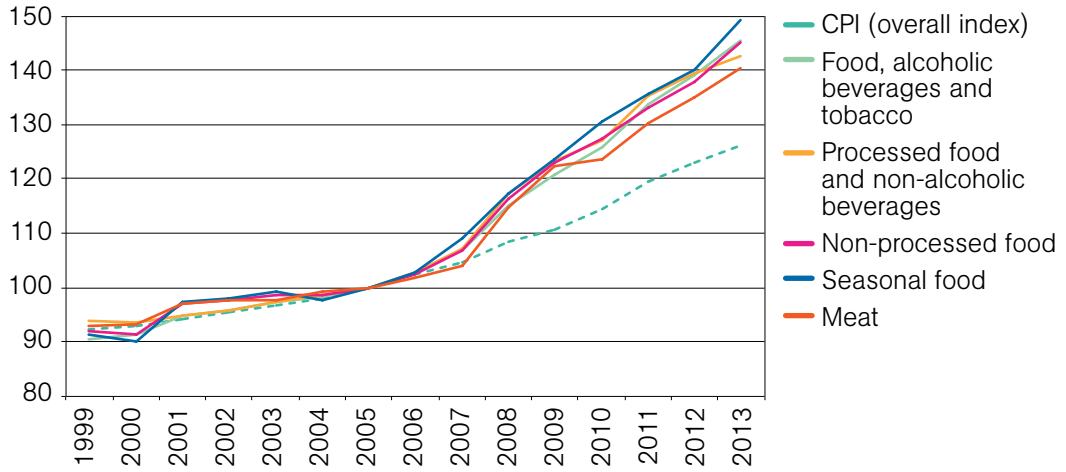
Figure 26: 2009 Household expenditure on food and non-alcoholic drinks as % of total expenditure



Source: Eurostat[228]

However, since 2007, UK consumer prices for food have broken away from the average rate of inflation and are now increasing much more rapidly (Figure 27).

Figure 27: CPI breakdown 1999 to 2013 (2005=100)

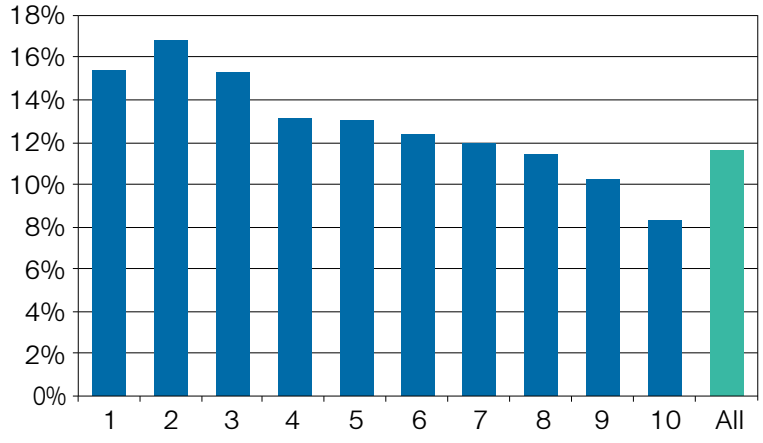


Source: ONS[229]

The result is that the trend towards a decreasing food bill has been attenuated since 2007, both in the UK and the EU on average.

Furthermore, the average trends mask significant differences across the income hierarchy, with lower income groups devoting significantly higher proportions of their expenditure to food (Figure 28). It is clear from this picture that those who stand to suffer most from breakaway food inflation are the least well-off. The historically low levels of food prices (even with the recent spike), especially in the UK, suggests that the key issue behind the recent trend towards increasing use of food banks in the UK is one of poverty and inequality, rather than expensive food. Any further effort to reduce food prices is likely to be an ineffective solution for poverty and inequality – these issues require direct solutions.

Figure 28: 2012 Household expenditure on food as % of total expenditure by gross income decile group (where 1 is lowest and 10 highest)



Source: ONS[230, 231]

Finally, while this section has investigated the market price of food in relation to income as a measure of affordability, there are a number of other prices that citizens must pay that are not reflected in that market price. Significantly, this includes the costs of subsidising agriculture through the EU CAP, the healthcare costs caused by poor diets and the costs of treating environmental damage and disease outbreaks. As an example, the UK's net contribution to the EU CAP subsidy programme is around £600 million,[232] which effectively increases the UK's total food bill by nearly a percentage point.[233, 234]

Overall, it is clear that the long-term trend in European nations has been towards increasingly affordable food. However, this trend has been somewhat reversed in recent years and many experts do not expect this trend to continue.[235] In many Western European nations, particularly the UK, the economic burden of food can certainly be considered affordable on average at present. However, extreme inequalities of income cause great variation in the economic burden of food purchases and vulnerability to changing food prices. Therefore, arguably, affordability has been achieved in the UK, while social justice has not. On this basis, a further push towards reducing the cost of EU food supply in the long run may not be justified, particularly where such an objective would be at odds with enriching food cultures or preserving environmental integrity.[236]

Financial sustainability

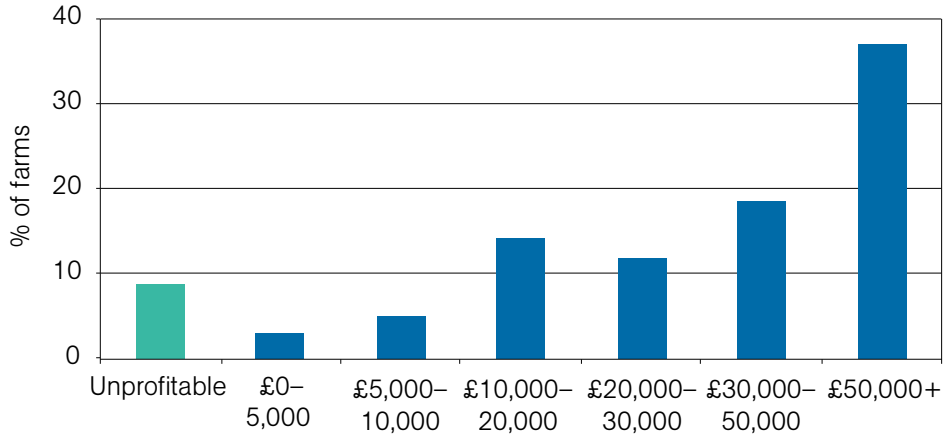
Are our farms profitable? Does their financial situation allow them to operate with security?

For the period 2004–2006, the average EU farm incurred total costs equal to 119% of market revenue.[237] In other words, EU farms were, on average, unprofitable without subsidies. This figure varies substantially from 94% (i.e., just profitable) for horticulture and granivores to 147% (i.e., highly unprofitable) for grazing livestock. However, it is clear that on the whole EU farms strongly depend on subsidies for their financial viability. Over the period 2006–2008, direct payments through the CAP made up 27% of all agricultural income; total subsidies were even more significant at nearly 40% of total income. This is not to suggest that subsidies should necessarily be vilified – public support to farms that deliver social and environmental goods that no one else directly pays for is widely considered to be legitimate. The reality, however, is that much of the subsidy received is not tied to such goods.

In the UK, total income from farming (a measure of profitability)[238] reached a low point in the early years of this century (Figure A6 in Appendix 8), the sector having suffered a number of disease outbreaks among livestock in the preceding decade. In recent years total income in the UK (excluding subsidies) has been positive on average, in contrast to the average for EU farms as a whole. Nevertheless, the great majority of income is still accounted for by subsidies (Figure 30).

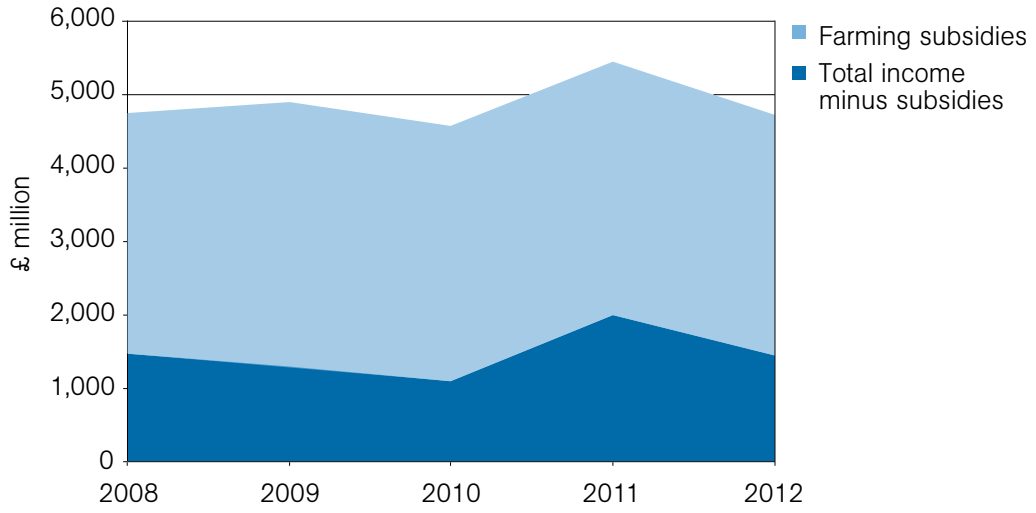
There is significant variation between farms. Defra statistics indicate that around 10% of UK farms are unprofitable even when subsidies are included,[239] as indicated in Figure 29. Certainly, this proportion would be greater if subsidies were excluded.

Figure 29: Profit levels of UK farms



Source: Defra[240]

Figure 30: UK farming income



Source: Defra[241]

Data gathered by Eurostat indicate that for each hectare of production, smaller UK farms record a greater Standard Gross Margin (a measure of profitability) than larger farms. To some extent this is likely to be due to differences in the type of farming across these size categories.[242]

Overall therefore, the total revenue from UK farming (including diversified activities) is sufficient to cover the total costs and the average farm is financially viable. However, the average farm may not be a particularly meaningful concept. At the least, it masks a divided and varied picture of three sub-groups: unprofitable farms (~10% of the total), farms that are only profitable due to subsidies, and other profitable farms. The boundary between the latter two categories is not clear. The subsidies that farmers receive are a mixture of payments for public goods and pure income support, while many public goods may still go unrewarded. Therefore, it is difficult to make any strong claim as to whether or not the financial sustainability of farms (which depends on those subsidies) should be considered genuine.

5. Conclusions

We've addressed the questions of how to define success and how to measure it. Putting it into practice led us to a fairly damning assessment of the UK's food system, as well as some lessons in success from projects across Europe. But some questions remain. What are the general themes from our various case studies that help us understand what success is and how it happens? And, zooming back out from the food system, what are the ways in which wider socioeconomic trends and phenomena impact the food system? Finally, what else do we need to know to start taking practical steps towards the kind of holistic success we have defined?

What is success and how do we measure it?

Our food system is defective, because the way we understand it is defective. We have argued that the dominant paradigm in which success is understood is outdated and flawed. We should manage our food systems to support the greatest contribution to human wellbeing, in a way that is socially just and sustainable over time. Such a system would be 'successful'. In practice, we have chosen eight indicators to assess whether existing food systems are conducive to these goals. This re-defining of success paints a strikingly different picture.

Looking at the UK as a whole, assessment of these indicators reveals a dismal situation. Environmental costs are high and clearly unsustainable. Energy use is heavily based on fossil fuels. Our production output is dominated by a small number of species, with many rare and indigenous species disappearing. Employment is highly skewed towards the least well-paid jobs. Our supply chains are complex and unsafe. Ownership of the means of production is concentrated in few hands. The cost of obesity may soon become unmanageable. However, there are a couple of glimmers of hope: the use of inputs per unit of output appears to be on a slow downward trend; compared with other nations, food prices are low on average (though highly volatile in the immediate past); and some aspects of food culture can be considered positive, such as the trend towards more home- and allotment-grown consumption.

Including environmental externalities, the cost of obesity and subsidies paid through the CAP, we have estimated the total external cost of the UK food system to be between £11 billion and £26 billion. This means that our effective food bill is 12–28% greater than the price we pay at the till. Appendix 9 details the total estimated external costs of the food system. There is a huge range of omitted costs, making this a significant underestimate.

Learning lessons from the pioneers

Looking at a smaller scale, we sought out examples where food systems exhibited some characteristic of success, according to our indicators. We drew on a range of examples from the UK, Germany, Italy, and Spain to demonstrate that success is possible in various different ways. A significant challenge is obtaining systematic data for small-scale systems

– it is frequently necessary to observe management practices rather than specific outcomes. However, there are many lessons to be learned from these case studies.

- **Small-scale infrastructure is critical.** Many of the examples we looked at involved local processing facilities that sustained economic activity in the area and prevented it leaking away to centralised facilities. For example, the Domäne Mechtildshausen houses a small abattoir that serves not only the organisation but farmers from the surrounding area.

- **Circular systems are possible but require willingness to break with the status quo.** Where circular flows of materials and energy were built into the examples we looked at, they were remarkably successful but required innovative thinking and in some cases experimentation. For example, Josef Braun's pioneering circular energy system dramatically reduces his carbon impact while making him more secure.

- **Short and integrated supply chains can bring benefits for farmers and local areas.** In many cases there is a conscious effort to reduce the gap between consumers and producers, and not just in a physical sense. Many told us that engaging consumers and supporting local enterprise were key components of building strength and resilience for the long term.

- **The social benefits of employment must be recognised.** Many producers understand that, while hiring people costs money, there are benefits beyond what they get from their employees. For example, La Fageda illustrates just what those benefits can look like – creating opportunities for people who might not otherwise get them.

- **Farmers and businesses can drive environmental change but monitoring can be onerous.** Many farmers make reducing environmental impacts a personal mission, though it's one that can also be good for their business. Some changes have a clear impact, such as reducing fossil energy use, but others would need to be monitored more closely.

- **Alternative models of success have already achieved significant scale.** Examples such as La Selva, the Schwäbisch Hall Cooperative, and La Fageda illustrate that environmental and social outcomes are not mutually exclusive of economic success.

But these examples are the exception to the rule. Overall, it is clear that we are struggling to rid ourselves of an outdated understanding of success, leaving our food and agriculture systems in a state unfit for the long term. Different ways are possible, but we need more common understanding of our ultimate goals and more active action to make the system work towards them.

Food in the wider socio-economic system

To some extent we have to zoom in on our food system in order to appreciate the nuances of its problems. However, we must not forget the context in which it operates, and how it can both influence and be influenced by the wider socioeconomic system. For example:

- **Persistent and growing inequality, grinding poverty and enduring unemployment** divide our society. Lack of financial means forces many to compromise on the quality and healthfulness of what they eat (or removes choice altogether if assistance from food banks is required), propping up companies that provide these products. While another tranche of society can enjoy fresh, healthy, and increasingly 'green' meals every day.
- **The distribution of working hours** – with most people either overworked or underemployed – forces households to seek time-efficiencies, opting for fast food and ready meals and being unable to grow their own produce in gardens or allotments.
- **The public policy fixation on economic outcomes,** including GDP growth, crowds out alternative understandings of what matters for good lives. The non-monetary outcomes of systems, especially natural systems such as food and agriculture, are not used to the greatest advantage. For example, agriculture and food production could be a powerful tool for social policy.
- **A homogeneous model of privately traded assets with no controls** dominates our business environment and capital markets, resulting in a highly concentrated distribution of assets and, consequently, control over what gets produced and how. Incentives to consistently deliver on social goods are absent, except when they happen to coincide with private interests.

This list is not comprehensive but an illustration of how these relationships are both an important context for thinking about the food and agriculture system and important research areas in their own right.

A transition towards a new food system

Changing our food system so that it delivers human wellbeing in a socially just and sustainable way will require action at multiple levels. As we have demonstrated, the existing context does not align the food system with these objectives. Ultimately we will need to change the rules of the game – that is, the policy, regulatory and institutional framework in which we operate day-to-day. As we see it, there are four key steps towards that end.

1. Recognising true value

As we have argued, before anything else, we need to explicitly recognise and value the outcomes that we desire from a successful food system. We also need to recognise the links between our economic system more generally (including the role of economics as a discipline) and the way the food system operates.

2. Developing and using new tools and metrics

With a clear idea of success, we then need the tools that allow us to consistently and confidently determine whether and to what extent those outcomes are achieved. We have outlined eight indicators as an example of an alternative framework, but more work is needed to consider other options and operationalise them. Revealing how different systems create value can help guide public policy and, in particular, how to allocate public funds.

3. Building public support and organising a movement

In parallel to the first two steps, we must ensure that the changes called for are the result of a genuine democratic demand. That must involve both making the intellectual and moral case for a transition and strengthening and combining the constituencies that will benefit from that transition. This includes not just producers who want to eliminate their environmental and social costs, but also parents worried about the health of their children, communities that want to support good jobs in their area, groups that care about preserving wildlife and habitats, and individuals struggling to afford and prepare healthy meals every day.

4. Changing the rules of the game

With an understanding of the outcomes we value, the tools to properly measure them, and support for a transition, we will then be in a position to make specific and deliberate changes to policy, regulations and institutions that can align the food system towards those goals. An obvious target is the EU Common Agricultural Policy, which is one of the key determinants of the structure of the agricultural sector in all European countries, including the allocation of investment funds. But other areas may be equally important, though less obvious, for example, regulating the advertisement of food products, or controlling financial speculation in food commodities.

Appendix 1: Interviewees

The following people were interviewed or provided written input to this report. However, this report is not necessarily indicative of their views or that of their organisation. Any errors are our own.

Abi Bunker, Royal Society for the Protection of Birds
Alan Rae, Fletching Glasshouses
Ariel Brunner, Birdlife International
Barbara Adolph, International Institute for Environment and Development
Charlie Cornelius, Iglu Food Pub
Chris Warburton Brown, The Permaculture Association
Christopher Jones, Agriculture Christian Fellowship
Clare Devereux, Food Matters/Sustainable Food Cities
Colin Tudge, Scientist and author
Connie Hunter, Women's Environmental Network
Dan Crossley, Food Ethics Council
Dave Watson, University of Essex
David Croft, Waitrose
Donal McCarthy, Royal Society for the Protection of Birds
Ed Hamer, Land Workers Alliance
James Skinner, New Economics Foundation Trustee
Jean Blaylock, UK Food Group
Jules Pretty, University of Essex
Julie Brown, Growing Communities
Jyotsna Ram, Oxford Brookes University
Lucy Bjorck, Royal Society for the Protection of Birds
Maria Scholten, Bogsa Uibhist/Scottish Crofting Federation
Mark Measures, Organic Research Centre
Peter Ritchie, Nourish Scotland
Tim Lang, City University London
Tracy Ledger, Public Affairs Research Institute
Vicki Hird, Friends of the Earth

Appendix 2: 'Re-framing the great food debate'

NEF (2009) 'Re-framing the great food debate' [243]

The dimensions of sustainable food

We consider sustainable food to be food associated with high levels of wellbeing, social justice, stewardship and system resilience. In this context we use and understand these terms as follows:

Wellbeing: 'Our working model is built on two headline measures which capture personal wellbeing and social wellbeing, reflecting crucial aspects of how people experience their lives. Personal wellbeing is broken down into five main components with a number of subcomponents: emotional wellbeing (positive feelings and absence of negative feelings); satisfying life; vitality; resilience and self-esteem (self-esteem, optimism and resilience); and positive functioning (which covers autonomy, competence, engagement, and meaning and purpose). Social wellbeing is made up of two main components: supportive relationships, and trust and belonging.'

Social justice: Refers to the belief that all individuals and groups should be afforded fair treatment and an impartial share of the benefits of society. As such, social justice must be rooted in the equitable distribution of power and resources – economic, political, social and environmental – within and between social groups. Social injustice and power (economic, political and social) are thus inextricably bound together.

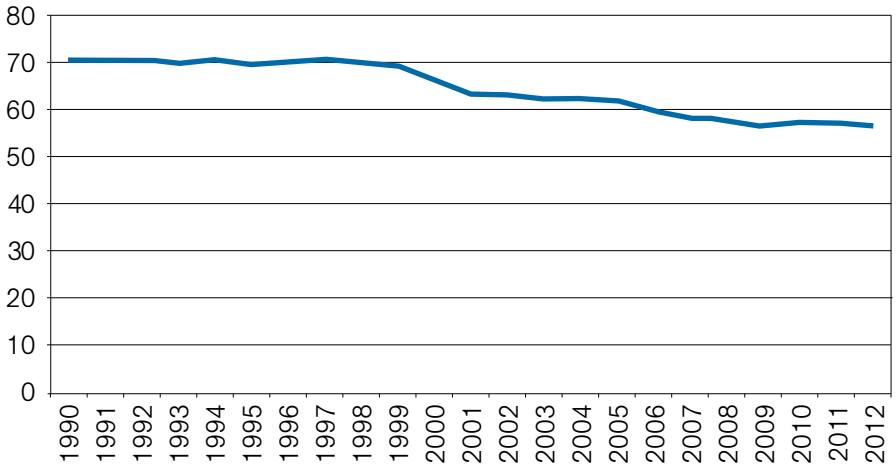
Stewardship: 'The long-term maintenance of valued environmental resources in an evolving human context'.

System resilience: The ability of a system to retain form and function in the face of shocks. For example, a resilient food system would have the ability to continue to provide sufficient quantities of an appropriate range of food in the face of a significant and sustained increase in energy prices.

Appendix 3: Greenhouse gases from the UK food system

After energy, agriculture is the second greatest source of GHG emissions in the UK.[241] The government's Committee on Climate Change (CCC) estimates that total agricultural emissions for 2012 were 56.6 Mt CO_2e from four main sources: agricultural soils, enteric fermentation (livestock methane), wastes/manure management, and stationary and mobile combustion (fuels used on farms).[245]

Figure A1: Greenhouse gas emissions from the agriculture sector 1990–2012 (Mt CO_2e)



Source: CCC[246]

CCC estimates suggest that the food, drink and tobacco manufacturing industry was responsible for a further 12.6 Mt CO_2e emissions in 2011[247] and Defra estimates emissions from food transport to be in the region of 15 Mt CO_2e in 2010.[248]

The CCC estimates that total net emissions from cropland land use and land-use change to be 11.7Mt CO_2e in 2012.[249, 250] It also estimates that grassland (some, but not all, of which will be pastureland) was a net carbon sink, absorbing 7.7Mt of net emissions in 2012. The total land-use emissions potentially associated with agriculture is therefore 4.1Mt (an underestimate since this includes sequestering from non-agricultural grasslands).

Using data from WRAP and Defra on three sources of waste in the food and farming system – household food waste, non-animal farm waste, and food manufacturing waste – the total GHG emissions can be estimated at 6.8Mt CO_2e.

Table A1 summarises these GHG emissions estimates.

Table A1: Summary of GHG emissions estimates

Emissions	Data source	Year	Mt (CO_2e)
Agriculture	CCC	2012	56.59
F&D manufacturing	CCC	2011	12.57
Food transport	Defra	2010	15.38
Land-use change	CCC	2012	4.08
Household food waste	WRAP	2012	0.46
Non-animal farm waste	EA	2001	0.47
Manufacturing waste	Defra	2009	5.84
TOTAL			**95.4**

Appendix 4: Air pollutant damage estimates

Table A2: Estimated damage costs of air pollutants from agriculture and food industry

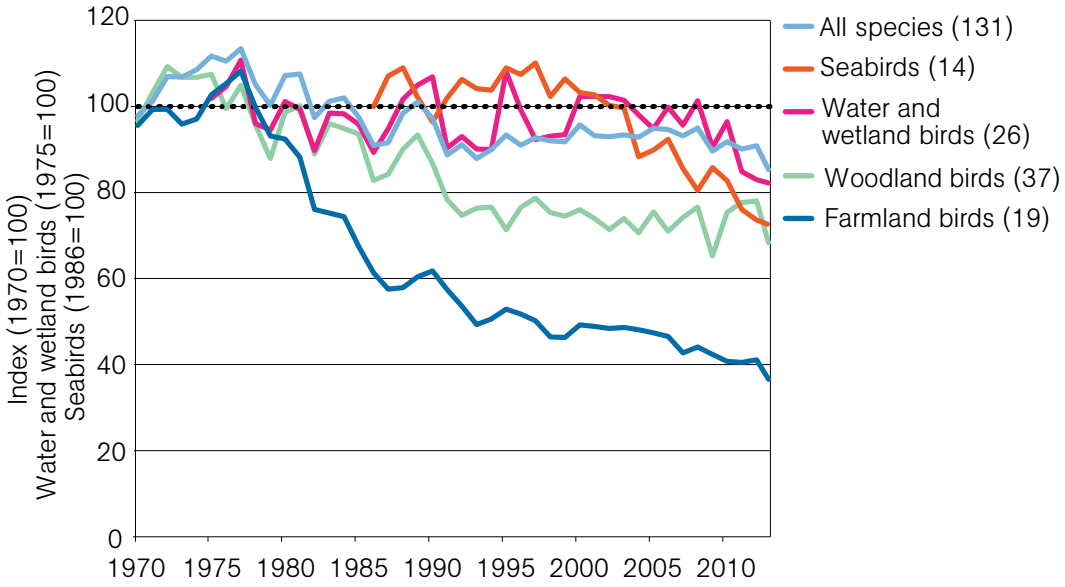
Agriculture				
Gas	Emissions (kilotonnes)	Year	Damage cost (2013 prices)	Total damage costs
Ammonia	252.96	2010	£2,049	£518,433,922
PM_{10}	17.69	2010	£10,084	£178,389,181
$PM_{2.5}$	2.04	2010	£10,084	£20,571,731
NOx	100	2010	£993	£99,251,715
				£816,646,550

Industry				
Gas	Emissions (kilotonnes)	Year	Damage cost (2013 prices)	Total damage costs
Ammonia	0.1837	2012	£2,049	£376,488
PM_{10}	0.6399	2012	£26,220	£16,778,255
NOx	0.0435	2012	£993	£43,174.50
SOx	1.281	2012	£1,697	£2,174,052
				£19,371,969

Source: Defra[251]

Appendix 5: Farmland Bird Index

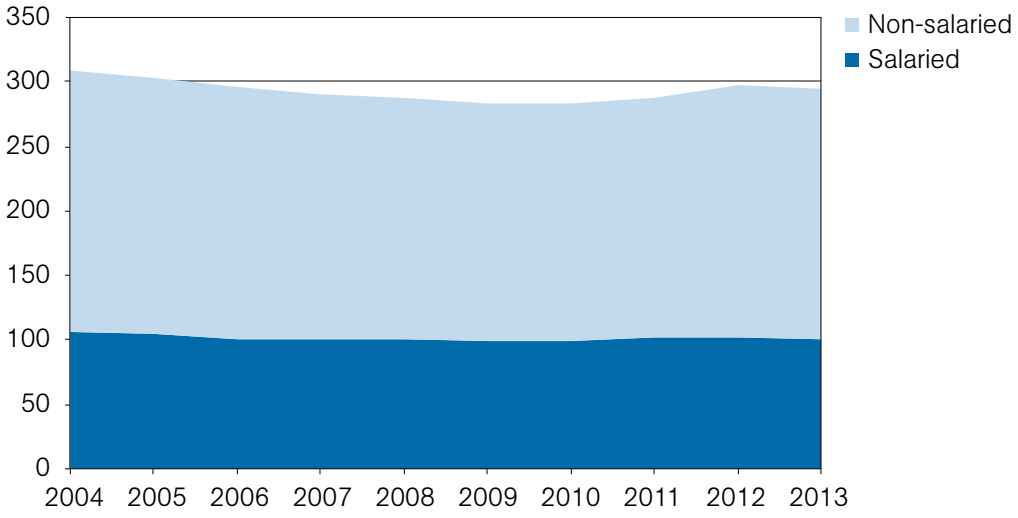
Figure A2: Populations of wild birds



Source: Defra[252]

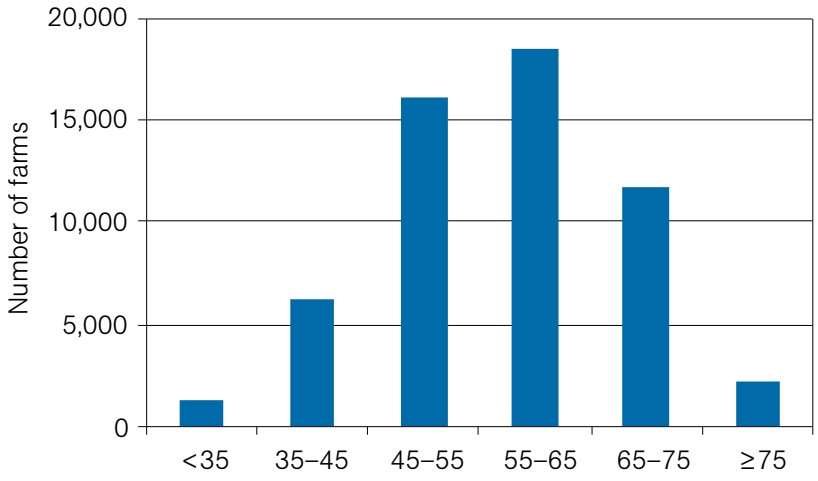
Appendix 6: UK food system employment

Figure A3: United Kingdom agricultural labour force



Source: Eurostat[253, 254]

Figure A4: Distribution of UK farms by age band of principal farmer



Source: Farm Business Survey[255]

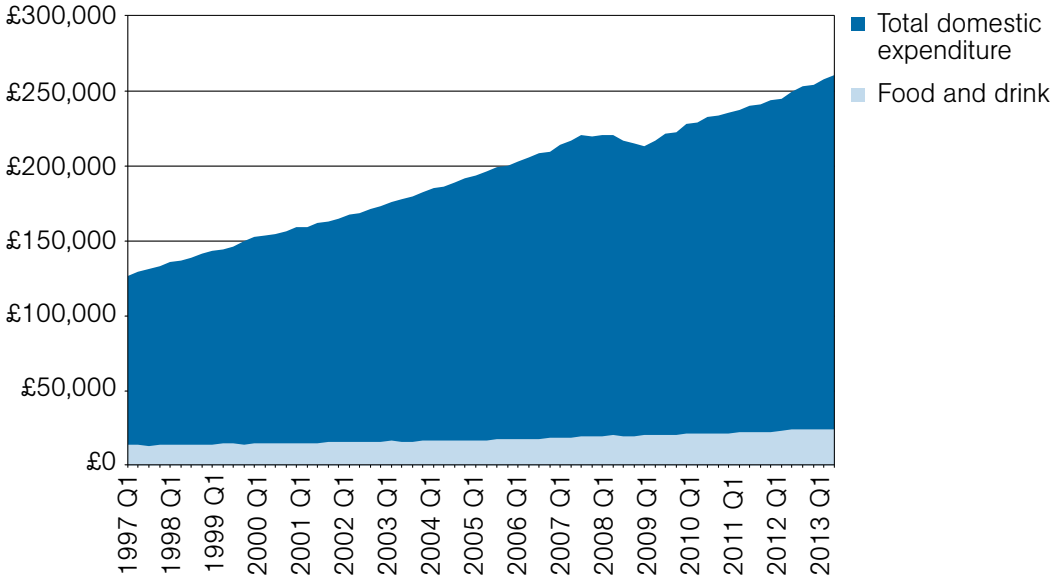
Table A3: Average gross annual pay in the food system

Average gross annual pay (2013)	Mean	Median
Agriculture	£19,697	£18,499
Manufacturing	£25,932	£20,341*
Services	£13,064	£10,235
Retail	£14,165	£11,539
UK average	£27,174	£21,905

*Median is for food manufacturing only (excluding beverage manufacturing).
Source: ONS[256]

Appendix 7: UK expenditure on food

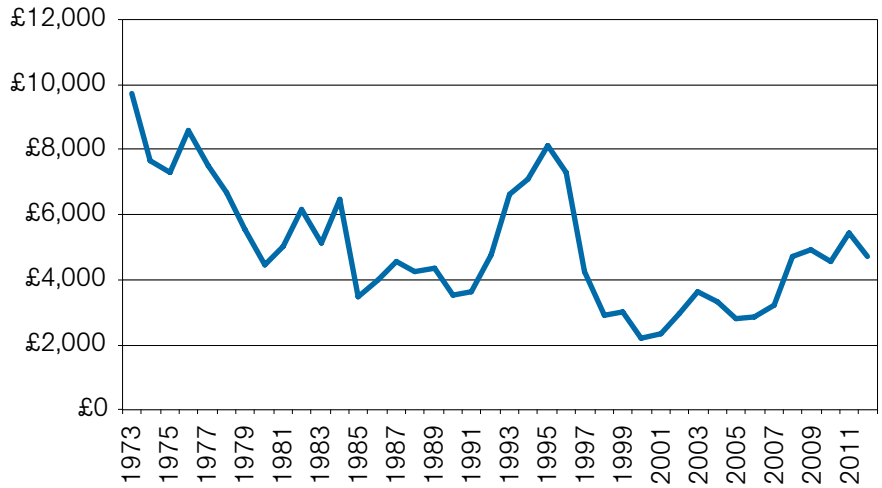
Figure A5: Total domestic expenditure and total domestic expenditure on food and drink (current prices, seasonally adjusted)



Source: ONS[257]

Appendix 8: UK farming income

Figure A6: Total Income from UK farming



Source: Defra[258]

Appendix 9: Total external costs of the UK food system

Table A4: Average gross annual pay in the food system

Impact Category	Description	Data source	Year	Physical impact	Impact units	Valuation	(range)	Valuation notes	External to market price of food?
GHGs	emissions from agriculture	CCC	2012	56.59	Total Mt CO_2e	£3,300,697,824	£3,300,697,824	2012 non-traded carbon price (2013 prices)	Yes
GHGs	emissions from F&D manufacturing	CCC	2011	12.57	Total Mt CO_2e	£77,697,647	£77,697,647	2012 traded price (2013 prices)	No
GHGs	emissions from food transport	Defra	2010	15.38	Total Mt CO_2e	£897,189,054	£897,189,054	2012 non-traded price (2013 prices)	Yes
Air Quality	damage from agriculture (ammonia, PM, NOx)	Defra	2010	372.69	kt emissions	£816,646,550	£816,646,550	marginal damage costs from Defra	Yes
Air Quality	damage from industry (ammonia, PM, Nox, SOx)	Defra, PRTR	2012	537.03	kt emissions	£19,371,969	£19,371,969	marginal damage costs from Defra	Yes
Water Quality	damage from nitrates in water (low estimate = clean up costs; high estimate = human health costs) + eutrophication cost	Defra, FEEM project	2012 (damage estimates 2000)	1576000	tonnes of N	£364,702,809	£1,872,962,360	based on marginal damage valuations from FEEM and eutrophication from Pretty *et al.* (2003)	Yes
Land Use Change	GHG emissions from land use change	CCC	2012	4.1	Total Mt CO_2e	£238,093,180	£238,093,180	2012 non-traded price (2013 prices)	Yes
Water Use	environmental cost of increased water scarcity	Defra/EA	2012	119.4	million cubic metres	£1,072,301	£1,072,301	valued using EIUC rates, England and Wales only	No
Waste	emissions from household food waste	WRAP	2012	0.46	Total Mt CO_2e	£39,339,669	£39,339,669	2012 non-traded (landfill) and traded (recycling) prices (2013 prices)	Yes
Waste	non-animal farm waste	EA	2001	0.47	Total Mt CO_2e	£3,019,955	£3,019,955	2013 non-traded (landfill) and traded (recycling and production) prices (2013 prices)	No
Waste	manufacturing waste	Defra	2009	5.84	Total Mt CO_2e	£44,784,423	£44,784,423	2014 non-traded (landfill) and traded (recycling and production) prices (2013 prices)	No
					Total environmental costs	£5,802,615,383	£7,310,874,981		
					Total environmental externalities	£5,676,041,056	£7,184,300,607		
					UK expenditure on food 2012	£90,757,000,000	£90,757,000,000		
					External costs (%)	6.3%	7.9%		
					UK agricultural land (ha)	17,259,000	17,259,000		
					Relevant (land-related) costs/ha	£273.73	£361.12		
					UK net contribution to CAP	£612,000,000	£612,000,000		
					Estimated cost of obesity	£4,758,883,249	17,902,465,555		
					Total external costs	11,046,924,305	25,698,766,162		
					External costs (%)	12.2%	28.3%		

Endnotes

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251. These damage cost estimates are intended for use in marginal valuations, i.e. small changes in air pollutant emissions. Multiplying a large flow by these values can only be an approximation for two reasons: (1) it carries much greater uncertainty; and (2) the marginal damage of an air pollutant may change when the scale of pollution changes substantially.
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