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Rethinking Britain's Food Security

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Executive Summary

- While the term food security has mainly been used in relation to the security of food supply in developing countries, at both national and at household levels, the issue has recently moved up the policy agenda in developed countries, including the UK. Two key themes in this debate are:
  1. How much food should the UK produce? Are there optimum and sustainable levels of self-sufficiency?
  2. How resilient is the UK's contemporary food supply and how does it look for the foreseeable future?

- The rapid increase in food and feed commodity prices and in food retail prices from 2006 through to 2008 has raised political awareness of the potential vulnerabilities and volatilities of national food supply, at a time when food policy has been the focus of strategic review from the UK government.

- The UK government's policy towards the security of its national food supply is predicated upon the workings of the international market-place and trade in food and feed products. Defra's recent formulation of a set of indicators to measure UK food security marginalizes the real challenges facing food supply in the near future. The impression is of a set of indicators and a policy mind-set rooted in the recent past rather than looking to the future.

- A number of voices have been heard in the renewed policy debate. Farming organizations have taken the opportunity to lobby the government for more support for food producers and the nation's food production capacity for both domestic and international markets.

- In terms of home production, the UK is around 60% self-sufficient in food overall, and around 74% self-sufficient in the types of food that can be grown here. However, these figures mask wide variations between commodities, and also hide the extent to which foods ostensibly produced in the UK depend on imported inputs such as energy or animal feedstuffs. Although UK self-sufficiency levels are declining from highs in the 1980s, by recent historical standards they are not unusual: the UK has depended on food imports to meet the needs of its population for more than a century. Although the UK is more dependent on food imports than some comparable EU countries, 68% of its food imports come from other EU states. The EU as a whole has a high level of food self-sufficiency, though soya products, for feed and food ingredients, are a notable exception.

- The EU both governs the degree and forms of government supports available to food producers and regulates the standards of food produced and consumed within the member states. The EU provides an important context for any re-thinking of national food supply and policy action.

- Recent debate has explored the 'resilience' of the food supply — its ability to prevent, withstand and recover from serious shocks. This report suggests that contingency planning is inadequate to the challenges now facing the food system, presented here as the New Fundamentals. These are the framing realities that policies concerning food supply must in future address. The issues include climate change; water; biodiversity and eco-systems support; energy and non-renewable fossil fuels; population growth; land use; soil; labour; and dietary change and public health.

- The report concludes that there is now compelling evidence for a rethinking of policy around national food security, **but only if this is built into and on a sustainability framework**. The UK government has a key role to play and must recast its thinking in ways that address the real resilience problems of the current millennium.

Explaining Food Security

Food security is a term deployed in a number of ways. A prominent use is to describe the challenges of feeding people adequately in developing countries both at the household level and at the national or regional levels – notably in times of external stress such as poor harvests, which impact upon food supply in such regions and are transmitted down to vulnerable populations at national and household level. Given that currently approximately 850 million people in the world are classified as living in hunger, this is a paramount concern. At the household level, food security is also used in developed countries in relation to food affordability and access issues for low income consumers. The conventional definition of food security is that given by FAO in 1996: "[F]ood security exists when all people, at all times, have access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life".[2]

The term can also be used in the context of national 'self sufficiency' – whether a country, such as the UK, can meet its own food needs. For some this is a slippery slope to protectionism or national autarky. The OECD defines food security as a "[c]oncept which discourages opening the domestic market to foreign agricultural products on the principle that a country must be as self-sufficient as possible for its basic dietary needs." [3]

The UK government, through Defra, states that: "A national food security policy must […] address availability, access and affordability." [4] It defines these three aspects as follows:

- Availability is about how much food there is and how reliable is the supply;
- Access covers the transportation and food distribution system which get food to where it is needed; and
- Affordability is about food being available at prices that people can afford to pay, and in particular, whether low income consumers can afford enough nutritious food.

At the global level, the issue according to Defra is "whether enough food is being produced to meet demand, and whether there are efficient and effective trading and distribution systems to get food to where it is needed."[5]

Two key themes that emerge from the UK approach with regard to its own national food security:

1. How much food does the UK need to produce? For example, are there optimum levels of sustainable self-sufficiency?

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[2] FAO (1996) *Rome Declaration on World Food Security*. Rome: Food and Agriculture Organisation.
[3] OECD (2008) OECD Glossary of Statistical Terms: Food Security. http://stats.oecd.org/glossary/detail.asp?ID=5006 (accessed June 19 2008). Paris: Organisation for Economic Co-operation and Development.
[4] Defra (2008) *Ensuring the UK's Food Security in a Changing World*, London: Department for Environment Food and Rural Affairs: 2.
[5] Ibid : 2.

2. How resilient is the UK's contemporary food supply and how does it look for the foreseeable future?

These issues have garnered a great deal of public debate and policy-makers' attention due to the rise in food prices that occurred globally from 2006 to 2008

National Food Security and the global rise in food prices: 2006-8.

From late 2006 there was a rapid rise in food commodity prices, which impacted upon food prices for consumers around the globe through until late 2008 – a so-called "price peak". This "price peak" varied in its intensity depending upon the commodity or product concerned. A range of explanations were put forward with different emphases coming from different expert analyses. The causes were some combination of increases in demand linked to a number of supply dislocations. Frequently cited amongst these factors are:

- The rise in demand for feed commodities for meat production to supply the rapidly expanding affluence of populations in China and other developing nations and regions.[6]
- This was matched by competition for the use of food and feed commodities, such as maize in the USA (20% of the crop), for use as biofuels. [7]
- These demands coincided with poor harvests among key commodity exporters (e.g. the Australian wheat harvests in 2007)
- And with increased speculation on commodity prices, related to the fall in value of the dollar upon which commodities are traded.[8]
- Historically low levels of world food reserve stocks increased the sense of vulnerability and response. For example China was restocking its grain reserves, which had fallen to a recent low. One analysis has put this as the key role of China in the price rises rather than demand for feed crops for increased meat consumption.[9]
- Input costs for, notably fertilizers costs, were sharply rising due to the rapid increase in the cost of a barrel of oil.[10]
- Individual producer nation responses are attributed with increasing world prices further. For example, in the wheat market export restrictions by Argentina, Russia, the Ukraine and Kazakhstan are attributed with affecting around one-third of the supply to the world market. Rice was also affected in this way.[11] However, the extent

[6] Von Braun, J. (2008) *Rising Food Prices: What should be done?* IFPRI Policy Brief April. Washington, D.C.: International Food Policy Research Institute; HM Treasury. (2008) *Global Commodities: a long term vision for stable, secure and sustainable global markets*, June, London: HM Treasury: 32.
[7] FAO (2008*) Biofuels: prospects, risks and opportunities* State of Food and Agriculure (SOFA) Report 2008; IMF (2008*) Food and Fuel Prices – Recent Developments. Macroeconomic Impact and Policy Responses*. June 30 2008. Washington D.C.: International Monetary Fund; HM Treasury (2008) op. cit.: 33
[8] HM Treasury (2008) op. cit.: 23
[9] Ray, D. (2008) *Data show that China's more meat based diet is NOT the cause of ballooned international corn prices?* APAC Weekly Policy Articles, May 23 2008. Agricultural Policy Analysis Centre, University of Tennessee: Knoxville.
[10] HM Treasury (2008) op. cit.
[11] Ibid: 34

to which food and feed commodities are internationally traded varies. For example, from 1998-2002 only 4% of rice was traded internationally, compared with 14% of maize and 17% of wheat.[12]

For the UK, the Office for National Statistics figures in August 2008 showed food inflation to be running at an annual rate of 13.7% with the trends upward; in the three months to June 2008, it had been 10.6%. Food was a key driver of overall inflation to 4.4%. Prices for oils and fats had risen by an annualised 29%, meat by 16.3%, bread and cereals by 15.9%, vegetables, including potatoes, by 11.1%, and fruit by 10.7%.[13]

While the current price rises will fall back, to what extent is not clear. There is evidence of a significant rise in wheat production from harvests in 2008 and futures prices for rice have recently signaled a fall in the near future. However, there is always a time lag before such factors impact upon actual price on the shelves. The rate of food inflation was slowing by late October 2008, but one study suggested that food prices would continue to remain comparatively high and volatile in the foreseeable future and that for the UK food prices would remain "higher as a proportion of household income than they have been in the past". [14]

One widespread impact of the food price rises has been social and political unrest in a wide range of countries, from Mexico to Italy; from Indonesia to Egypt to Haiti to Argentina. Social protests provide clear reminders to governments that an adequate food supply is of fundamental importance for political stability. National governments have responded, in turn, with a range of measures: from reduction of import tariffs, to caps on domestic prices, to the application of export tariffs amongst producing countries to reduce prices (causing further protest from some producers). In the UK the price peak served to move food security back up the political agenda.

UK Government and national food security

The UK government's policy towards the security of its national food supply is predicated upon the workings of the international market place and trade in food and feed products. This policy is framed by a belief in the continued trajectory of increased liberalisation of trade in food and feed products. Defra Minister Margaret Beckett articulated the UK government's approach in March 2006:

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[12] Ibid: 35

[13] Office for National Statistics (2008). Consumer Price Indices July 2008, http://www.statistics.gov.uk/pdfdir/cpi0808.pdf [accessed August 16 2008]. London, Office for National Statistics.

[14] Davies, J. (2008) "Has food price inflation peaked?" *Farmers Guardian*, October 31, 2008: 12; EFFP (2008) *EFFP Retail Food forecast*. London: English Food and Farming Partnerships in association with Cranfield School of Management. athttp://www.effp.com/Documents/EFFP's%20Retail%20Food%20Price%20Forecast.pdf (accessed 31 October 2008).

"Another key concern in the changing policy environment is the question of food security – something which lay at the heart of the CAP's ambitions when it was first developed. We do not take the view that food security is synonymous with self-sufficiency. …It is freer trade in agriculture which is key to ensuring security of supply in an integrating world. It allows producers to respond to global supply and demand signals, and enables countries to source food from the global market in the event of climatic disaster or animal disease in a particular part of the world. …it is trade liberalisation which will bring the prosperity and economic interdependency that underpins genuine long term global security." [15]

Beckett's words reflected the thinking that informed the earlier HM Treasury and Defra joint paper "A Vision for the Common Agricultural Policy", in December 2005, which reinforced the belief that an active role on international markets was a key to ensuring efficient food production and an internationally competitive farming industry in the UK.[16] This paper was one in a line of government position papers on national food security and related issues (see Table 1). The paper recommended an ending of direct payments to farmers under the CAP, apart from reduced levels of support for rural development and environmental protection activities.[17]

Table 1. Major statements on UK Food Security

Date	*Policy / document*	*Comment*
1947	Agriculture Act	
1972	UK signed the Treaty of Rome and other EU treaties?	Signaled intention to shift to CAP
1975	Food From Our Own Resources	White Paper
2005	A Vision for the CAP	HM Treasury & Defra
2006	Food Security and the UK: An Evidence and Analysis Paper	Defra paper
2008	Global Commodities: a long-term vision for a stable, secure and sustainable markets	HM Treasury
2008	Ensuring the UK's Food Security in a Changing World	Discussion paper
2008	"Food Matters: Towards a strategy for the 21st Century	Cabinet Office: Food Policy strategy document includes food security

The UK government's policy position towards national food security was articulated further in Defra's "*Food Security and the UK: An Evidence and Analysis Paper*" in

[15] Beckett, M. (2006) "Action in Response to Opportunity and Challenge", Speech by Rt. Hon Margaret Beckett, Secretary of State for the Environment, Food & Rural Affairs at the Agra-Europe Outlook Conference: London, 23 March 2006 at http://www.defra.gov.uk/corporate/ministers/speeches/mb060323.htm [accessed 10 Oct 20006]
[16] HM Treasury and Defra (2005) *A Vision for the Common Agricultural Policy*, London: H M Treasury and Department for Environment, Food and Rural Affairs.
[17] Ibid

December 2006.[18] For Defra, UK national food security was not an issue of primary concern: "Poverty and subsistence agriculture are root causes of national food insecurity. National food security is hugely more relevant for developing countries than the rich countries of Western Europe".[19] Furthermore, the level of national food self-sufficiency was not seen as a precondition of national food security. Rather, the analysis argued that national food security and the security of the UK's food supply were strengthened by the UK's role in international trade, reflecting its long history as a trading nation. The integration of the international supply of food commodities into UK food chains was seen as offering flexibility, for example to compensate for unexpected harvest loss.

The resilience of the UK food supply was also enhanced by the flexibilities and expertise of supermarket food supply chains which dominate the delivery of food to the point of sale to the public. Climate change was identified as having greater impacts upon less developed countries than developed economies, from the point of view of world food stocks and adequacy of the global food supply. The diversion of cereal and oil seed crop plantings towards biofuels was seen as manageable in a global context.[20] For UK food supply chains a number of past shocks (such as the 2000 fuel protests and the Foot and Mouth disease of 2001) and future potential supply chain shocks (such as a flu pandemic or shortage of non-renewable energy, or of certain food commodity crops) were assessed. The key risk identified was disruption to energy supply, upon which food supply chains are dependent.[21] Overall, the view was expressed that such risks are potentially manageable with appropriate contingency planning and flexibility of supply – as found in both current international trade and contemporary commercial supply chains. The analysis did warn that the challenge of shocks to the supply systems depended upon their scale, pervasiveness and duration.[22]

The rise in the commodity prices, global shortages in food commodity reserves, and widespread rising food prices triggered both public protests across the globe and international protests and policy responses, as outlined in the previous section. Against this backdrop the issue of food security rose up the agenda in British policy debate. The Prime Minister Gordon Brown, newly installed in June 2007, authorized his Strategy Unit to provide an investigation into food and food policy in the UK. The issue of food security was also included in the Strategy Unit's final analysis which echoed Defra's position that food security was different from self-sufficiency and was integrated within international trade. This integration of UK food production within the international economy was illustrated by key inputs such as oil, fertilizers and pesticides, and feed which are internationally traded and produced, as well as a healthy export trade from British producers.[23]

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[18] Defra (2006) *Food Security and the UK: An Evidence and Analysis Paper*, December, Food Chain Analysis Group, London: Defra.
[19] Ibid: 23
[20] Ibid: chapter 6
[21] Ibid: 63
[22] Ibid: 63
[23] The Strategy Unit (2008) *Food Matters: Towards a Strategy for the 21st Century*. London: Cabinet Office: 32-34.

The PM Strategy Unit's policy prescriptions were followed by a further Defra discussion paper *Ensuring the UK's Food Security in a Changing World*, which raised the question of how to monitor the resilience of the UK's internationally traded food supply, in the wake of shocks such as has led to the international price rises. To this end Defra put forward a set of indicators for food security. [24] The striking feature of the indicators, partially explained by the need to base them upon known data, was that sustainability and environmental change issues remained relatively marginalized. The proposed indicators reflect an analysis that while quite properly rooted in past experience, remains insufficiently forward looking (see Table 2).

Table 2: Defra's proposed headline and supporting food security indicators (July 2008)

Theme	**Proposed headline indicators**	**Potential supporting indicators**
Global availability	Trends in global output per capita	Real commodity prices Stock to consumption ratios International trade as % of global production Agricultural research spending Sustainability related indicator
UK trade and diversity	Concentration/diversity of supply	Share of UK imports from EU EU-wide productive capacity UK potential in extremis
Food chain resilience	Energy dependence of the supply chain	Energy reliability Diversity of oil and gas imports IGD retailer stock levels Cereal stock ratios Retailer concentration ratios Business continuity planning Port capacity
Affordability	Share of spending on food by low income households	Food inflation for low income groups Fruit and veg purchases by low income households Fruit and veg inflation
Safety and Confidence	Public confidence in food safety measures	Trends in cases of pathogens Food covered by assurance schemes Consumer confidence in food availability

Source: Defra (2008) *Ensuring the UK's Food Security in a Changing World*: 29.

The proposed indicators highlight the global food production capacity to meet consumption needs at the macro-level, and also social dimensions of the food vulnerabilities of low income households. Two key resilience features identified are energy supply, and concentration in relation to diversity of food supply. The latter

[24] Defra (2008) *Ensuring the UK's Food Security in a Changing World*, London: Defra

focuses upon EU-wide growing capacity and UK food growing capacity "*in extremis*", that is measures of self-sufficiency at these different levels. However, both the affordability and the food safety and consumer confidence indicators fail to include health impacts of diet and their true costs. Furthermore, there is a compelling case for a complete set of sustainability indicators to be added. Indeed, many of these environmental indicators are already being focused upon within UK Government and its food and its farming strategies. On the one hand, indicators need to be based upon measurable data, but on the other environmental indicators are being developed under the Single Food and Farming Strategy and other sustainability policy initiatives. The need to monitor and measure new and appropriate data is part of the challenge of sustainable development policy. There is little evidence of a proper integration of these two strands of policy work, food security indicators with food sustainability indicators; let alone a reframing of policy around food supply informed by an appreciation of the new challenges facing the system. The impression is of a set of indicators rooted in the recent past rather than looking to the future.

The rising debate on UK food production & food security

Differing positions have been taken on the issues of UK food security by economic and political groups in the UK. For the National Farmers Union (NFU), the gathering concerns around rising food commodity prices from late 2006 through 2007 and into 2008, offered a policy opportunity to press the case for governmental supports for UK farming, such as through increased R & D investment, in the wake of the shift from production subsidies to support for public goods for the multifunctional benefits of agriculture under the CAP reforms of 2003.

The NFU President Peter Kendall picked up and became more vocal about UK national food security from 2007 onwards; focusing on the need for the Government to support British agriculture's contribution to both national and global food production.[25] The UK's food security has been grabbed by different organizations within the farming community as a vehicle for promoting renewed government support for UK farming. At the more activist end of the farming community were Farmers for Action (FFA) who had coordinated the fuel depot blockades in 2000 that caused such a degree of dislocation to food distribution. The Country Land and Business Association (CLBA), representing the large landowners in the UK, linked the need to ensure adequate food production with the CAP reform context of environmental stewardship and in relation to future environmental change. The CLBA have called for food production levels to be considered within the wider complex debates around land use and environmental change and resource depletion.[26]

[25] NFU (2008) Action on food security should start at home, July 18, Press Release, at http://www.nfuonline.com/x29277.xml?action=preview (accessed 11 Oct 2008).
[26] Aubrey Fletcher, H. (2008) Letter to The Times, March 8, at http://www.timesonline.co.uk/tol/comment/letters/article3507292.ece (accessed 10 0ct 2008).

Within the farming sector the Commercial Farmers Group, a small collection of medium sized commodity farmers, has advocated greater national food self sufficiency since 2004.[27] Linked to this has been a broader concern about support for the rural fabric, to which the farming industries are key contributors. One study estimated that by 2006 the farm share of the UK food basket was down 23% from 1988.[28] To this end Baroness Byford, from her role as the Conservative spokesperson on Food and Rural Affairs in the House of Lords, raised questions about national food security from the floor of the chamber from 2005 to 2007 and to wider audiences. It was the view of the Conservative spokesperson that "it is not possible to separate food production from social and rural issues".[29] The interlinking of the issues of economic and social rural pursuits has been advanced by groups such as the Countryside Alliance, who allied farming concerns over the growing economic crisis in UK farming in the late 1990s to opposition to the proposed ban on fox hunting made by the new Labour Government.

The Conservative Party's Quality of Life group produced a position paper *Blueprint for a Green Economy* report (2007) that identified food security as a key vulnerability issue for the UK. The group challenged the conclusions of the Defra analysis paper, arguing that "the issue of 'food security' is ignored by the present Government" and that the "UK therefore needs a food and farming policy which fully acknowledges the importance and value of domestic production; otherwise climate change, international insecurity, a growing world population with rising standards of living will make us increasingly vulnerable".[30] In an effort to distance this position from an advocacy of farming commodity growers, the paper concludes that: "This is not a policy driven by the need to safeguard our ability to provide the commodities that our people need". [31] Subsequently, Jim Paice, the Shadow Agriculture spokesperson, stressed that the food security was "at the core" of its *Quality of Life* agenda and so was a clear policy difference from the Labour government.[32]

The challenges of environmental change and resource shortage, particularly the end of peak oil upon which the global food supply is highly dependent, informed the Green Party's stance as articulated by the Party leader Caroline Lucas MEP, particularly with the publication of *Fuelling the Food Crisis*.[33] The policy path advocated is for a retreat from trade liberalization and recourse to a more local and regionally based economic exchange and food supply. The growing awareness of the environmental limits, from

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[27] Commercial Farmers Group (2004) *Food Security: The pressure on global food supply*. Commercial Farmers Group: Barton-on-Humber at http://www.commercialfarmers.com/CFGDoc2004.pdf (accessed Oct 12 2008).
[28] Hampson, S. (2006) *Differentiation: A sustainable future for UK Agriculture*, July. John Lewis Partnership: London: 4
[29] Byford, Baroness (2002) Speech to LEAF Conference on World Rural Woman's Day, November 14th, at http://www.assuredcrops.co.uk/_code/common/item.asp?id=4029605 accessed Oct 10 2008.
[30] Quality of Life Policy Group (2007) *Blueprint for a Green Economy: Submission to the Shadow Cabinet*, Quality of Life Policy Group: 160. www.qualityoflifechallenge.com (accessed 09 Oct. 2008).
[31] Quality of Life Policy Group 2007: 160
[32] Farmers Guardian 6 October 2007: 6
[33] Lucas, C.. Jones, A. & Hines, C. (2006) The Fuelling of the Food Crisis. Brussels: The Greens/European Free Alliance. http://www.carolinelucasmep.org.uk/2006/12/08/fuelling-a-food-crisis/ (accessed 11 Oct 2008).

fossil fuel reserves to fresh water to land availability, has been reflected to varying degrees in the Conservative Party's stance and the previously mentioned Chatham House study in to food supply resilience.

For Development policy-makers and analysts, one area of market expansion for developing countries' farmers has been the export of food, notably fruit and counter seasonal vegetables, to European consumers, not least the UK. UK government Development policy has supported these developments as a market-led instrument for poverty reduction among African farmers trading on their comparative advantage. In addition, UK Development policy advocated further de-coupling of supports for producers to allow this comparative advantage to flourish. However, this policy direction was challenged by the concept of food miles that raised questions about the cost of the externalities generated upon the environment, such as when air freighted long distances to ensure freshness at the final retail location.

These concerns were taken up by UK retailers and also UK producers. The issue of reducing food miles, like national food security, was enthusiastically taken up by British farmers and their trade press.[34] For the Development lobby, the debate over UK national food security was also a potential basis for a retreat to state or CAP supports for UK domestic production, with potential disadvantage to the perceived comparative advantage of African producers.

The resilience of the UK food supply, embedded as it is in the international trading system, is a key concern that has arisen in policy debates. Another concern has been the extent to which the UK should produce food and what the levels of productive capacity should be. In the next section, the nature and extent of the UK's food self-sufficiency is looked at in more detail and it is also considered within the context of the European Union's self-sufficiency and regulatory governance.

The condition of UK food self sufficiency

Throughout the 20th century, the UK's self-sufficiency ratio (the proportion of food consumed in the UK that is produced in the UK) fluctuated, but imports always contributed significantly to the total food supply (Table 3). The two world wars severely disrupted the food system, with imports restricted, food control centralized, domestic production considerably boosted and the distribution of some foodstuffs rationed. However, although overall self-sufficiency during World War II increased from a historic low of about one-third at the beginning to around two thirds by the end[35], in 1944 imports were still substantial ─ accounting for 56% of consumption of wheat flour, for example, and 73% of sugar.[36] After WWI, the 1920 Agricultural Act introduced price supports to maintain domestic production, but these were soon discontinued, and imports returned to

[34] Gairdner, J. (2006) *Local Food is Miles better: The Farmers Weekly Food Campaign.* Crawley: Reed Business Information.
[35] Minns, R. (1980) *Bombers and Mash: The Domestic Front, 1939-45*. London: Virago.
[36] Defra (2006), op cit: 11.

pre-war levels. In the aftermath of WWII, food shortages all over Europe gave rise both to the Agriculture Act of 1947, with its focus on increasing domestic productivity, and the Common Agricultural Policy of the nascent European Union, whose subsidies later contributed to the UK's highest period of self sufficiency of the 20th century, during the 1980s.

Table 3. Indicative UK self-sufficiency rates at different periods

Pre-1750	Around 100% of temperate produce,
1750-1830s	90-100% except for poor harvests
1870s	Around 60%
1914	Around 40%
1930s	30-40%
1950s	40-50%
1980s	60-70%
2000s	60%

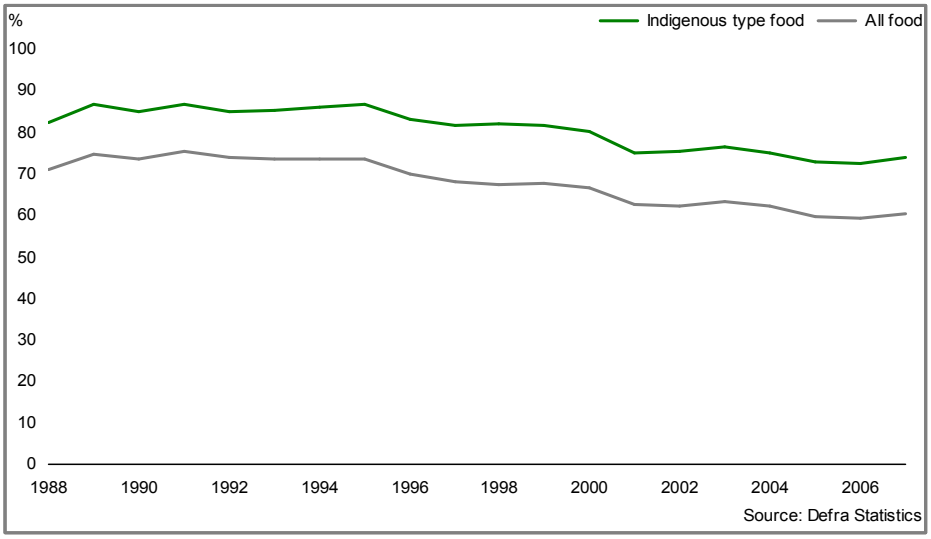
Source: Defra (2006) *Food Security and the UK: An Evidence an Analysis Paper.* https://statistics.defra.gov.uk/esg/reports/foodsecurity/foodsecurity.pdf

In its 2006 assessment of food security in the UK, Defra offers an explanation for the fundamental question of why we produce less food than we consume. It says that the basic, though not the whole, answer lies in the theory of comparative advantage, first articulated by the 19th-century political economist David Ricardo, which holds that a country will be better off if it specializes in producing the things it is best at producing, rather than trying to produce everything it needs. In relation to UK food production, factors cited by Defra as affecting comparative advantage include the relative scarcity of productive land, the limitations of climate, and seasonality. Other factors include consumer preferences for goods that are produced elsewhere, such as Parma ham, and a lack of competitiveness among UK producers, which may be due to lack of collaboration or competitive barriers such as trade rules.[37] Whether the doctrine of comparative advantage can accommodate the challenges now facing the globalised food system is a conundrum that underpins current debates on food security and self sufficiency.

According to Defra figures, the UK is currently 74% self-sufficient in indigenous-type food (the sort that can be grown here), and 60% self sufficient overall, for all foods – in other words, 40% of the food we eat is imported (Chart 1). As Defra points out, by modern historical standards, these figures are not unusual.

[37] Defra (2006) op cit : 24

Chart 1. Self-sufficiency ratios for all foods and indigenous-type foods, 1988-2007



Source: Agriculture in the UK Tables and Charts, Chart 7.4
https://statistics.defra.gov.uk/esg/publications/auk/2007/excel.asp

However, it is also true that self-sufficiency is declining. Taking the long view, it has fallen from 100% to 60% over the past 200 years. More recently, the ratios for all foods and indigenous-type foods have fallen by 15% and 10% respectively over the past 20 years (Table 4). Defra attributes the decline to market forces, including consumer preferences for more exotic and varied produce, cheaper transport and communications making distant sourcing more viable, fewer trade restrictions, and wider sourcing by supermarkets and food service companies, partly in response to the other factors.[38] Globally, the UK's share of world production of staple goods has fallen since 1979 (Table 5).

Table 4: UK decline in self-sufficiency, 1988-2008

	1988	**1998**	**2007**	**% change, 88-08**
All foods	71.1	67.5	60.5	-14.9
Indigenous-type foods	82.6	81.9	73.9	-10.5

Source: Agriculture in the UK Tables and Charts, Chart 7.4
https://statistics.defra.gov.uk/esg/publications/auk/2007/excel.asp

[38] Defra (2006) op cit.: 36

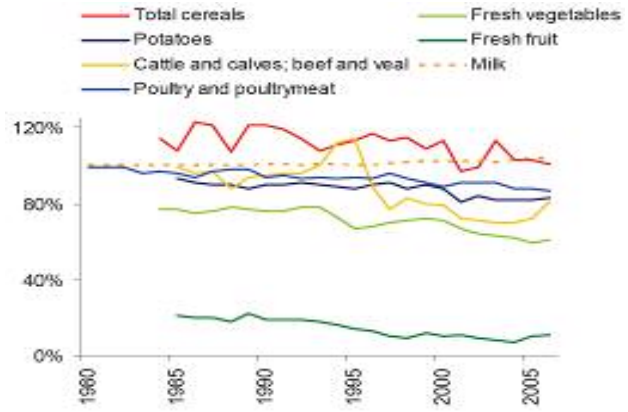
Table 5: UK share in world production, 1979-2004 (%)

Product	1979-81	1989-91	1999-2001	2004
Cereals	1.20	1.19	1.04	0.97
Meat	2.21	1.86	1.48	1.26
Fruit & Vegetables	0.68	0.50	0.27	0.21

Source: FAO Statistical Yearbook 2005-2006
http://www.fao.org/statistics/yearbook/vol_1_1/pdf/b01.pdf;
http://www.fao.org/es/ess/yearbook/vol_1_1/pdf/b02.pdf;
http://www.fao.org/es/ess/yearbook/vol_1_1/pdf/b03.pdf

Within indigenous products, the aggregate figures mask wide variation between sectors, ranging from 100% for cereals to around 10 per cent for fresh fruit (Chart 2). These variations are to some extent due to the limitations of UK climate and agriculture, but they also reflect changing consumer tastes (especially the taste for year-round supplies of fruit), policy measures (such as CAP support), and the comparative advantage of various sectors (which is itself affected by global trends and policies).

Chart 2: UK food self-sufficiency ratios by commodity, 1980-2005



Source: Cabinet Office Strategy Unit (2008a*) Food: An analysis of the issues* (updated 8 August 2008), p77.

Looking more closely at the figures within a particular sector, horticulture (which has relatively low levels of self-sufficiency and produces a group of foods consumers are being urged to eat more of), it can be seen that there is further variation. While Defra comments that "physical production of staple commodities has not been in … decline"[39], it can be seen from Tables 6 and 7 that since 1997 the planted area for fruit and vegetables has declined overall, and that planted areas and in some cases production volumes have fallen for many indigenous British fruits and vegetables. In cases where

[39] Defra (2006) op cit: 34

planted area has been reduced but production has stayed the same or gone up, due to improved yield and husbandry, this raises the question of what has displaced the horticultural crops that were formerly grown.

Table 6: Change in UK planted area for fruit and vegetables, 1997/07

Type of production	**% change**
Field vegetables	-24%
Protected vegetables	-52%
Total vegetables	-24%
Orchard fruit	-19%
Soft fruit	-1%
Glasshouse fruit	+224%
Total fruit	-14%
Total Fruit and vegetables	-22%

Source: Based on Defra Basic Horticultural Statistics 2008
https://statistics.defra.gov.uk/esg/publications/bhs/2008/default.asp
2007 figures provisional

Table 7: Change in UK area planted and production (by volume) of selected indiginous vegetables and fruit by volume, 1997-2006

Product	Change in area planted	Change in volume of production
Carrots	-8%	+13%
Parsnips	-18%	-13%
Turnips & Swedes	-14%	-9%
Onions, dry & green	-7%	+6%
Brussels sprouts	-41%	-42%
Cabbage	-26%	-17%
Cauliflower	-23%	-36%
French & runner beans	-46%	-49%
Peas for market	-40%	-28%
Peas for processing	-15%	-26%
Asparagus	+73%	+66%
Leeks	-28%	+3%
Field lettuce	-1%	-20%
Rhubarb	-36%	-17%
Tomatoes	-34%	-26%
Cucumbers	-39%	-31%
Apples	-33%	+29%
Pears	-40%	-14%
Plums	-31%	+17%
Strawberries	+6%	+125%

Source: Based on Defra Basic Horticultural Statistics 2008
https://statistics.defra.gov.uk/esg/publications/bhs/2008/default.asp

Table 8 shows how home production as a percentage of new supply (another way of expressing self-sufficiency) has fallen for fruit and vegetables since 1988.

Table 8 UK Home production of fresh fruit and vegetables as percentage of new supply, 1988-2006 (%)

	Fruit	Vegetables
1988	18	78
2006	11	59

Source: Based on Agriculture in the UK 2007, Chart 5.9 & 5.12
https://statistics.defra.gov.uk/esg/publications/auk/2007/Chart%203-2.xls

A corollary of falling self-sufficiency has been an increase in imports. The UK is a major importer and a somewhat smaller exporter of food and drink, within the EU and with the wider world. In 2006, imports of food, feed and drink were worth £25bn and exports £10.5bn, both having increased by just over 2% on the previous year.[40] Of the UK's food and drink imports, 68% came from other members of the EU – ie, from "low-risk, stable trading partners", and no single country accounted for more than 13% of UK food and drink imports.[41]

Although UK food imports have "always"[42], exceeded exports, the gap has been increasing steadily since the 1960s, and doubled between 1995 and 2005.This is due to a tailing off of exports, as much as to a rise in imports. Defra attributes this partly to inflation and the strength of the pound (imports and exports are measured by value, not volume), which made UK exports relatively more expensive, and to the impact of BSE and foot and mouth disease, which restricted export markets. However, some commodities saw significant rises in imports between 1996 and 2005, including poultry meat (+82%), eggs and egg products (+163%), breakfast cereals (+229%), pork (+171%) and beef and veal (+101%).[43]

Compared with some other European countries, the UK has a relatively low level of food and drink exports, and a high level of imports. In 2005, the UK had the largest trade deficit of any EU country in trade with countries outside the EU (€5.35 million). It was also the largest net importer of food and drink products among EU states, with an intra-EU trade deficit of €10bn. The Netherlands, by comparison (with a much smaller population) has a trading surplus within the EU of €15bn.[44]

Looking again at a specific sector, horticulture, in more detail, it can be seen that the EU trades busily both among member states and with external countries, often exchanging the same type of products, though presumably of different quality or at different times of year (Table 9). Imports into the UK of non-indigenous fruits have increased significantly, bearing out comments that consumers are seeking greater variety (Table 10). While imports and exports operate independently and can not be expected to compensate for each other, it is hard not to notice that for some indigenous crops, imports have been increasing even while home production, in both acreage and volume, have been declining (Table 11)

[40] Defra (2008) *Agriculture in the UK 2007*: 62
[41] Defra (2008) *Ensuring the UK's Food Security in a Changing World. A Defra Discussion Paper, par 4.10*.
[42] Defra: *UK Food an Drink manufacturing: an economic analysis :21*
[43] Ibid: 22
[44] Ibid: 23

Table 9: EU 27 Internal and external trade in selected fruit and vegetables, by volume, 2006 (000 tonnes)

Product	Trade between EU member states	Imports from non member states	Exports to non-member states
Cauliflowers	**332**	**2**	**29**
Tomatoes	**1632**	**296**	**148**
Cucumbers	**524**	**21**	**41**
Apples	**1664**	**757**	**911**
Pears	**507**	**311**	**245**
Peaches and nectarines	**651**	**29**	**186**
Oranges	**1284**	**836**	**258**
Lemons	**432**	**297**	**86**
Clementines	**792**	**121**	**183**

Source: Agriculture in the European Union: Statistical and Economic Information 2007, Chart 4.5.3.1
http://ec.europa.eu/agriculture/agrista/2007

Table 10: Change in volume of imports to the UK of selected non-indigenous fruit 1997 – 2006

Fruit	Change in volume of imports
Avocados	+197%
Bananas	+46%
Grapes	+114%
Small oranges	+68%
Peaches and nectarines	+10%

Source: Based on Defra Basic Horticultural Statistics 2008
https://statistics.defra.gov.uk/esg/publications/bhs/2008/default.asp

Table 11: Change in UK production, area planted and net imports 1997 -2006, selected indigenous vegetables

	Change in area planted	Change in volume production	Change in net imports
Cabbage	-26%	-17%	+71%
Cauliflower and broccoli	-23%	-36%	+35%
Beans	-46%	-49%	+94%

Source: Based on Defra Basic Horticultural Statistics 2008
https://statistics.defra.gov.uk/esg/publications/bhs/2008/default.asp
net imports =imports – (exports and re-exports)

Some limitations of the self-sufficiency ratio as an indicator

The self-sufficiency ratio is inevitably a crude measure of a complex and dynamic set of variables. Defra (which has referred to the "so-called self-sufficiency ratio"[45]) is sceptical of self-sufficiency as an indicator of food security, for reasons discussed elsewhere in this report. However, it is also arguable that self-sufficiency ratios, as currently presented, are a poor indicator of the extent to which the UK is actually producing the food it eats.

The most important criticism is probably that the self-sufficiency statistics mask the extent to which goods ostensibly produced in the UK depend on imported inputs, notably oil and gas, fertiliser, feed and machinery. Defra recognizes this limitation, and uses it to support its argument that self-sufficiency is 'an illusion'[46] in a world where production depends on inputs bought on the world market. In a 2005 paper, the government estimated that 69% of pesticides and 63 % of primary energy used in the UK for agriculture were imported[47], and a 2006 paper put the import figure for fertiliser at 37%, up from around 10% in the 1970s.[48] The EU as a whole imports fertilisers from a range of external countries, including Russia, Norway, Egypt, Morocco, Tunisia, Libya, Ukraine and Belarus.[49]

Another problem is the statistics themselves vary slightly. The figures of 74% and 60% for all food and indigenous type foods, which are widely quoted, appear for example in Defra (2008) *Ensuring Food Security in a Changing World* and in Defra (2008) *Agricultural Statistics in your Pocket* (p31), but Defra (2008) *Food Statistics Pocketbook* (p6) gives the figures 72% and 58% respectively. Elsewhere, in a discussion of the

[45] Defra (2006) op cit: 5
[46] HM Treasury & Defra (2005) *A Vision for the Common Agricultural Policy:* 47
[47] Ibid: 48
[48] Defra (2006) op cit: 46
[49] European Fertiliser Manufacturers' Association 2008
http://cms.efma.org/EPUB/easnet.dll/ExecReq/Page?eas:template_im=000BC2&eas:dat_im=000C55

origins of food consumed in the UK, based on slightly different calculations, the figure given for the UK is 49%, implying that less than half of food consumed in the UK originates here.[50]

It is hardly surprising that there are discrepancies, given the complexity of the calculations involved.[51] These not only involve adjustments to compensate for imports, exports and some inputs, but also require imports and exports of processed foods to be re-valued so that they represent their constituent ingredients. This is done by multiplying the imports and exports by a 'revaluation factor', determined by the degree, or average value added, of processing.[52] Whether a food is highly or lightly processed depends on the increase in value, not on the complexity of the nature of processing.

Implicit in this calculation is the fact that self sufficiency figures are calculated by value, not by volume or calorific content.[53] Given the volatility of prices and currency exchange rates, this can have a distorting effect on the ratios, and in any case means that the tables do not represent 'real' (i.e. edible) self-sufficiency at all. The Defra report cited notes that "a better measure of self sufficiency might use volume measures or even nutritional values", but concludes that adjusted prices are a close enough proxy 'if the adjustment factors are appropriate'.[54] One of the authors of this report was told by a Defra statistician involved in compiling the tables that value rather than volume is used because this simplifies the process of revaluing imports and exports to their unprocessed value. "Volume would be better, and it used to be done that way a long time ago, but at great effort." Commentators such as Mellanby and Fairlie, whose proposed models for a UK agricultural system geared to achieving higher self-sufficiency are described below, based their calculations on food volumes and human calorific requirements.

A final caveat arises from the fact that much agricultural and horticultural data is collected via farm surveys. The data are therefore limited by the number and scope of questions that can practicably be put to farmers already overwhelmed with paperwork. So, for example, planted area and production figures for only four named varieties of apple are reported in the 2008 horticultural statistics.[55] Efforts for this report to establish, for example, the number of holdings growing specific horticultural crops, now and in the past, proved difficult.

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[50] *Agriculture in the UK 2007*, Chart 7.5

[51] Described in Annex C of Defra (2006) op cit.

[52] Defra (2006) op cit, Annex C: 82-84. The revaluation factor is given as 1.0 for unprocessed or raw commodities, 0.27 for lightly processed foods such as joints of meat or cereal flours, and 0.10 for highly processed foods such as chocolate biscuits or chutney.

[53] 'Self sufficiency is calculated as the value of production of raw food divided by the value of raw food for human consumption' Defra (2008): *Food Statistics Pocketbook:* 31.

[54] Defra (2006) op cit Annex C: 82

[55] Basic Horticultural Statistics 2008, Tables 4 and 5, https://statistics.defra.gov.uk/esg/publications/bhs/2008/fruit%20details.pdf

Some estimates of the UK's potential for food self-sufficiency

"It is generally agreed that the day of cheap food is at an end, and before long Britain will be unable to import all it wants, even if we can pay for such imports. At the same time our population is increasing and our need for food is therefore increasing". With these words, in 1975, the ecologist Kenneth Mellanby published *Can Britain Feed Itself*, a short book which demonstrated how, by adapting both consumption and land use, the UK could feed its population, then around 53 million, with an adequate but simple diet of around 2800 calories per person per day, based on cereals, potatoes, milk, sugar and a reduced ration of meat, using conventional agricultural methods[56].

In 2007, Simon Fairlie responded to contemporary anxiety about Britain's levels of self-sufficiency by updating Mellanby's analysis to determine not just whether the UK could produce enough to feed its current population of 60 million, but also which of six agricultural system might do so most successfully[57]. Fairlie, a campaigner for sustainable land-use and planning, was partly motivated by a wish to test the widespread criticism that organic farming uses too much land to be able feed an expanding global population. Both writers based their calculations on published data on UK food production and land-use.

Table 1~~2~~ compares the results. The 'chemical with livestock' system is Fairlie's update of Mellanby's calculations, but reflects improved crop yields since 1975. The 'chemical vegan' (ie stockless) system is shown to be the most economical in terms of land use − Fairlie notes that this is 'the ideal farming system for any society wishing to reduce the number of its farmers to a minimum, or grow wide areas of biofuels, or support large urban areas – all main objectives of modern social policy'.[58] The organic systems, especially the one with livestock, are relatively land-hungry, the latter leaving only 2.6m 'spare' hectares for such things as biomass production. This is partly because of lower yields and partly because of the need to allocate land for green manuring. Nevertheless, they both manage to feed the population with a basic diet. Finally, however, Fairlie proposes two models for a form of organic permaculture, which would go a step further and enable the UK to become more self-reliant not just in food but also in 'fodder, fertility, fibre and fuel'.[59] The daily meat allowance per person provided in the livestock permaculture system is about half that consumed today. A drawback of the vegan permaculture system could be that it would produce a 'lopsided land economy'[60], with activity concentrated in the arable areas.

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[56] Mellanby, K. (1975) *Can Britain feed Itself?* London: The Merlin Press: 2
[57] Fairlie, S. (2007) 'Can Britain feed Itself?' in *The Land* 4 (Winter 2007-08): 18-25
[58] Ibid: 20
[59] Ibid: 22
[60] Ibid: 25

Table 12: Projected requirements for land use, and ratio of area used: population fed, under various agricultural systems designed for UK self-sufficiency

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Agricultural system	Arable area required (million hectares)	Pasture required (million hectares)	'Spare' area (supplementary food production or other use, million hectares)	Ratio of area: population fed
Conventional agriculture, 1975 (Mellanby)	5.3	5.7	7.8	1 ha arable + 1 ha pasture feed 10 people
Chemical with livestock, 2005	4.4	6.4	7.6	1 ha arable + 1.5 ha pasture feed 14 people
Chemical vegan, 2005	3	-	15.6	1 ha arable feeds 20 people
Organic vegan, 2005	7.3		11.2	1 ha arable feeds 8 people
Organic with livestock, 2005	8.1	7.8	2.6	1 ha arable + 1 ha pasture feed 7.5 people
Livestock permaculture, 2005	7.5	5.9	2.8 + 6 woodland	1 ha arable + 0.8 ha pasture feed 8 people
Vegan permaculture	7.2	-	8.8 + 6 woodland	1 ha arable supplies 8.5 people

Sources: Fairlie, S. (2007) 'Can Britain feed Itself?' in *The Land* 4 (Winter 2007-08) pp18-25
Mellanby, K. (1975) *Can Britain feed Itself?* London: The Merlin Press

EU food self -sufficiency

An important strand in Defra's argument that the UK enjoys a high level of food security as a result of its global supply chain has been the fact that a high proportion of its imports comes from other EU member states. As a whole, the EU has a high level of self-sufficiency in foodstuffs (Table 13), though soya products are a conspicuous exception (used primarily as animal feed and to a lesser extent as minor but pervasive ingredients in manufactured foods). Table 14 shows the self-sufficiency of various EU countries in selected commodities, but the Eurostat data is patchy, and the method of calculation or data collection may be inconsistent across reporting countries.

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Table 13: EU-25 / EU 27 self-sufficiency, selected products, 2005/06 (%)

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Durum wheat	88
Common wheat	103.5
Sugar	104.8
Olive oil	113.6
Sunflower oil	52
Rape seed oil	92
Soya oil	5
Soya cake & equivalent	2
Pigmeat	108.2
Beef/veal	96.4
Poultrymeat	102.7
Sheep and goat meat	78.2
Eggs	102.5
Honey	56

Source: Agriculture in the European Union Statistical and Economic Information 2007
http://ec.europa.eu/agriculture/agrista/2007

Table 14: EU member states' self sufficiency in certain agricultural products, 2005/06 (%)

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Product	Den-mark	France	Germ-any	Italy	Nether Lands	Portu-Gal	UK
Cereals	105	213	129	87	22	27	106
Potatoes	n/a	108	109	62	n/a	71	83
Sugar	124	186	139	76	173	107	53
Fresh vegetables	n/a	n/a	n/a		n/a	n/a	n/a
Fresh fruit	n/a	n/a	n/a		n/a	n/a	n/a
Milk / milk products	n/a	n/a	n/a		n/a	n/a	n/a
Eggs	80	97	73	106	n/a	98	90
Meat	351	109	99	76	n/a	75	88
Oils and fats	0	89	n/a	37	n/a	n/a	n/a

Source: Agriculture in the European Union Statistical and Economic Information 2007, chart 3.8.3
http://ec.europa.eu/agriculture/agrista/2007
n/a = not available

In the recent past, the net trade of the EU as a whole has been almost in balance, but while finished products have formed the bulk of agrifood exports, the EU has always been a net importer of commodities and intermediate products. In recent years, however, there has been a shift in EU agrifood trade, with the EU's export share of many global commodity markets (such as butter, sugar, cereals and beef) declining, and its share of global trade in other agrifood sectors improving. As a result, in 2006, the EU became, for the first time since the introduction of the CAP, a net exporter of agrifood products, with a surplus of €3bn. However, in 2007, the trade balance became negative again, deteriorating by €5.3bn in just one year. This has been attributed to a decrease in sugar exports, linked to reform of the EU sugar regime, and to the significant rise in the cost of imports of commodities such as maize and soya.[61] This highlights the EU's exposure to price and supply fluctuations in key commodities where dependence on imports is high.

[61] D-G Agriculture and Rural Development (2008): MAP-Brief *EU Agricultural Trade in 2007 – An Update*, June 2008. http://ec.europa.eu/agriculture/publi/map/brief8.pdf

The Europeanisation of UK food production & regulation

Of the UK's food imports 68% come from EU member states (although these figures might mask the extent to which these imports are feed or include foods that originate from outside of the EU).[62] The EU's food policy has two main elements. Firstly, subsides have been given to food producers and processors under the Common Agricultural Policy. The most recent reforms of the CAP have decoupled the payment of supports gradually from production and shifted them towards payments for the provision of public goods such as environmental stewardship and rural development through a Single Payment Scheme. However, land must be kept in Good Agricultural and Environmental Condition to receive such payments, and recipients must comply with some 18 regulations relating to food and agriculture.

Agricultural supports are still decided at the EU level. The current direction of travel, ie the de-coupling of supports from production, is likely to be contested in the run up to the end of the current EU budget and CAP deadlines which are due to end by 2013. Some other member states advocate maintaining supports to farmers for the multi-functionality of agriculture and the public goods produced and maintained, in opposition to the UK Treasury and Defra's stance. The French Agriculture Minister, Michel Barnier, opposed the UK's ambitions to seek future reductions of CAP supports against the background of rising commodity and food prices, and argued for increased food safety and quality standards within the European market – seeking "protection, not protectionism" for EU consumers and producers.[63]

The second element of EU food policy is the regulation of the single market around a range of food quality and safety standards from food hygiene to compositional standards to environmental and animal welfare standards – the types of standards that must be met under cross compliance. In other words, food supply in Europe is governed by increasing EU regulation as well decreasing supports and subsidies. The UK's food standards are largely regulated at the EU level as part of the single European market. These quality standards, particularly the sanitary and phytosanitary measures, provide a barrier to any food and feed imports that can not match the required specifications. Consequently the enforcement of these standards has an impact upon the international trade of food and feedstuffs from beyond the European borders into the single market, and vice-versa, from GM food and feed to meat from areas deemed to have inadequate animal disease prevention, such as with foot and mouth disease. The combination of these factors suggests that an EU dimension to the UK food security policy debates needs to be more fully thought out.

[62] The Strategy Unit (2008) op cit: 32
[63] Hall, B. & Thornhill, J. (2007) 'Paris for "protection, not protectionism"', *Financial Times*, Oct 25 2007: 6.

How resilient is the UK's current food supply?

Resilience and the Food supply

The term 'resilience' in physics refers to the property of any material to absorb energy, but in public policy the connotations of stress and strain are usually translated to mean the capacity of social processes and institutions to withstand shocks or external threats. In practice, resilience is a term used in both business and government to indicate what is necessary to 'keep the show on the road' in times of crisis. For government, one feature is preparing for civil contingencies. In a 2003 review, the Cabinet Office defined civil contingency planning as "the application of knowledge, measures and practices to anticipate, guard against, prevent, reduce or overcome any hazard, harm or loss that may be associated with natural, technological or man-made crises and disasters in peacetime".[64] The Civil Contingencies Act (2004) which followed that review defined such circumstances as "an event or situation which threatens serious damage to human welfare."[65]

Food supply clearly fits such thinking in that, like water or the money supply, it can be disrupted by events as varied as terrorism or fuel shortages. Much business continuity management, encouraged *inter alia* by the insurance sector, is based on planning for such sudden shocks, disasters, crises, extreme threats and discontinuities. The focus is on enabling capacities to be rebuilt or re-activated after shocks. A study conducted in 2005, by the Resilience Centre in Cranfield University's Department of Defence Management & Security Analysis, produced reassuring findings for its funder, Defra.[66] Taking three scenarii – loss of power, fuel and people – the study argued that most UK food retailing is resilient overall, in that it could withstand loss of stores, people, supplier, power, fuel or site access. One vital function of government is to ensure that people would be fed in the event of unforeseen events, and the UK has – like many states – elaborate systems for such events.[67]

Within food policy, however, evidence is mounting of the need to consider not just short-term, immediate shocks but what we refer to as 'systems threats'. For a number of years, studies have been pointing to the vulnerabilities of current food systems and to their reliance on resources and infrastructure which should not be assumed to be permanent. A number of New Fundamentals for 21st century food supply are emerging, for which evidence is strong and which suggest that resilience might have to be rethought on wider

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[64] Cabinet Office (2003) *Dealing with disaster*. Revised 3rd edition London: Cabinet Office p.1. http://security.homeoffice.gov.uk/news-publications/publication-search/guidance-business/dwdrevised1.pdf?view=Binary

[65] Civil Contingencies Act, (2004). London: HMSO http://www.opsi.gov.uk/acts/acts2004/ukpga_20040036_en_1

[66] Peck H (2006). *Resilience in the Food Chain: A Study of Business Continuity Management in the Food and Drink Industry*. Final Report to the Department for Environment, Food and Rural Affairs. July. http://www.defra.gov.uk/science/Project_Data/DocumentLibrary/FT0352/FT0352_4705_FRP.doc

[67] Some myths about that world emerged in the aftermath of the Argentinan corned beef crisis in the 1960s. see Smith D, Diak H, Penningon H, Russell E. (2005). *Food Poisoning, Policy and Politics: Typhoid And Corned Beef In The 1960s*. London: Boydell Press

terms.[68] The next section summarises what these are how, and how they are likely to reshape the architecture of food and farming policy at all levels from international to local.

The challenges to UK food supply and its resilience: the new fundamentals from climate change to dietary change

Climate change

Agriculture and food chains are having an impact on climate change and, *vice versa,* climate change will seriously affect what food and farming industries can do and promise. Climate change's impact will have direct effects on what kinds of farming is conducted and what crops can be grown where, and will shape how farming works. Evidence on this has been building for years but has most succinctly been considered by the International Agricultural Assessment of Science, Technology and Development (IAASTD), an evidence-based project initiated by the World Bank and FAO in 2002 but which ran from 2005 to 2006 and was co-sponsored by various UN agencies and other stakeholders.[69] This final IAASTD report has suggested complex effects of climate change throughout world agriculture, ranging from water stress to the spread of invasive pests. Regions will be affected differently according to latitude, altitude and topography. Similar comprehensive assessments are required for the entire food supply chain.

On the land, what meteorologists sometimes call 'extreme weather events' – wind, rain, floods – are likely to increase with disastrous effects on crops and yields, and with knock-on effects, such as drains on insurance leading to higher premiums. The impact of Australia's three year drought, for instance, was considerable and contributed to the rapid rise of world grain commodity market prices 2006-08. In the UK the National Farmers Union has begun to alert its members to coming pressures from climate change. Farming will have to adapt. In some areas of the UK, Grades 1 and 2 agricultural land is under pressure from flooding, which could destroy seasonal crops, not least through rising sea levels such as in the Fens which has 37% of England's acreage for vegetables grown in the open.[70] Important academic research and information systems are emerging, such as the Global Environmental Change and Food Security (GECAFS) project which focuses upon food security in geographic areas vulnerable to climate change, coordinated from Oxford University.[71]

Besides being affected by climate change, agriculture and food systems are also significant contributors to it. The Stern report for the UK Treasury concluded that farm

[68] Barling D, Lang T, Sharpe R. (2008). Food Capacity: the root of the problem. *Journal of the Royal Society of Arts*, 154, 5533, 22-27
[69] IAASTD (2008). *Global Report and Synthesis Report*. London: International Assessment of Agricultural Science and Technology Development. http://www.agassessment.org
[70] NFU (2008). *Why Farming Matters in the Fens*. Newmarket, National Farmers Union. http://www.nfuonline.com/wfmpub/x158.xml
[71] Global Environmental Change and Food Security (GECAFS) project. See: http://www.gecafs.org/about/index.html

animals alone are responsible for 31% of greenhouse gas (GHG) emissions and fertilizers for 38% of nitrous oxide (N_2O).[72] For all the attention on animals' methane effects, the effects of fertilizers are not receiving their due, yet increased use can be implied as part of the promise of further agricultural intensification. Viewing the problem from the consumer end of the supply chain, the European EIPRO study found that food, drink, tobacco and narcotics (lumped together) accounted for an estimated 20-30% of the environmental impact of all consumption by European consumers. Meat and meat products (including meat, poultry, sausages or similar) was the largest contributor, accounting for 4-12% of the impact on global warming of all consumer products.[73]

Water

Water is essential for all life. Agriculture is the greatest user of water worldwide, accounting for an estimated 70% of potable water use, with livestock playing a significant part in that.[74] The Intergovernmental Panel on Climate Change has suggested that globally aquifers for large cereal-producing land areas are under stress. This could herald the curtailment or perhaps the end of such production in areas such as parts of the USA and Australia.[75] Within Europe, the south east of Spain which feeds much horticultural produce to the UK, is likely to be in water stress. In the UK the east of England hotspots for large-scale cereal growing are under continual threat from shortage of adequate water supply. Water-intense systems of growing have added pressures on water conservation even in an overall water rich country such as the UK.

New ways of auditing embedded water within food products will be needed by policy makers. One methodology has been championed by Dutch researchers.[76] They have calculated, for instance, that one 150g beefburger contains 2,400 litres of embedded water if all that is used to grow grain, feed and water the cow, wash equipment, be used in processing and so on, is accounted for. That particular calculation might not fit a beef burger produced from a wet Welsh or Pennine hill-reared animal. Certainly, water policy is likely to need calculations which take account of different methods of rearing.

Prof Tony Allan of SOAS University of London has developed the notion of 'virtual water' to identify how products are traded within and between countries already water-stressed.[77] Using Allan's thinking, MacGregor and Vorley of the International Institute of Environment and Development have suggested that 189 million m3 of virtual water is

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[72] Stern N. (2006). *The Stern Review of the economics of climate change*. Final Report. London, H M Treasury

[73] Tukker A, Huppes G, et al. (2006). Environmental Impact of Products (EIPRO): Analysis of the life cycle environmental impacts related to the final consumption of the EU-25. EUR 22284 EN. Brussels, European Commission Joint Research Centre: 15 http://ec.europa.eu/environment/ipp/pdf/eipro_report.pdf

[74] Clarke R, King J. (2004). *The Atlas of Water: mapping the world's most critical resource*. London, Earthscan; FAO (2006). *Livestock's Long Shadow*. Rome: Food and Agriculture Organisation

[75] Intergovernmental Panel on Climate Change (2007). *Climate Change 2007: The Physical Science Basis. Summary for Policymakers*. Approved at the 10th Session of Working Group I of the IPCC, Paris, February 2007. Geneva, IPCC

[76] Chapagain AK, Hoekstra AY (2006). *Water Footprints of Nations*, vols. 1 and 2. UNESCO-IHE Value of Water Research Report Series No. 16 Paris: UNESCO

[77] Allan JA (2003). Virtual water - the water, food and trade nexus: useful concept or misleading metaphor? *Water International,* 28, 4-11

imported to the UK each year through green beans from Africa.[78] Each bean stem 'uses' four litres of virtual water; this from a country exposed to water stress. If that water is potable, morality issues are raised: is water which might otherwise improve sanitation and health of indigenous people being colonised to provide out-of-season vegetables for rich countries, or is this helping improve living standards and development?

Water counting is likely to be as important for 21st century food and farming as carbon and GHGs are. WWF and Waterwise are two UK NGOs which are pioneering thinking and use of this thinking for policy-makers. Waterwise, for instance, has shown how foods differ dramatically when measures of calories and water are combined. Beans and potatoes deliver more calories per litre of water used than do rice or pork or beef.[79] Such data is likely to reshape dietary advice.

While many countries, globally, have a high proportion of their farmland irrigated, the Royal Agricultural Society of England's recent report stated that irrigation accounts for only 1% of total UK water abstraction and 4% of the crop area, but this produces 20% of crops by value.[80] A number of large agribusinesses are heavy users. A third of all potatoes and a quarter of all fruit and vegetables are supplied by just 1000 agri-businesses in Eastern England.[81]

Biodiversity and eco-systems support

By 1995, the FAO was estimating that since 1900 about three quarters of the genetic diversity of domestic agricultural crops had already been lost.[82] The world's natural fisheries are now widely judged to have been depleted, with 52% of wild stocks "fully exploited" according to the FAO's classification.[83] In the UK, the Natural Environment Research Council states that in 1983- 2003 butterflies dropped 71% and native bird species 54%. In 1963-2003 UK native plant species dropped 28%.[84] The loss of bees – the cause of which is currently under study – is of immediate concern due to their role in pollination.

The planet's ecosphere is mainly plant-based biomass on which we humans exist as proportionally a tiny fraction. Yet humans have imposed a disproportionately large impact on what is in fact a relatively thin biological layer that covers the planet's material world. In its dozen or so millennia of existence, farming has firstly drawn on ecosystems

[78] James MacGregor and Bill Vorley of IIED, personal communication, data presented at an IIED/DfID seminar November 2006
[79] Zygmunt J (2007). *Hidden Waters*. London: Waterwise. www.waterwise.org.uk
[80] Godwin R, Spoor G, Finney B, Hann M, Davies B. (2008). *The Current Status of Soil and Water Management in England*. Stoneleigh, Warwickshire, Royal Agricultural Society of England: 10.
[81] Ibid.
[82] FAO (1995). *Dimensions of Need: an atlas of Food and Agriculture*. Rome, Food and Agriculture Organisation. http://www.fao.org/docrep/U8480E/U8480E00.htm#Dimensions%20of%20need
[83] FAO (2007). *State of Food and Agriculture 2007*. Rome, Food and Agriculture Organisation
[84] NERC (2008). What is being done about biodiversity loss? Swindon, Natural Environment Research Council http://www.nerc.ac.uk/research/issues/biodiversity/tackling.asp#uk

yet then contributed to their rapid destruction.[85] Awareness of the rapid reduction of biodiversity has, until relatively recently, engendered a split between conservation and farming perspectives and policies, separating biodiversity protection from food production. Conservation bodies welcomed and championed the EU's set-aside scheme, for example, because it allowed farmers to be paid to deliver biodiversity as an environmental good. Intensive food production was demonized as a threat. Historically much farming, especially intensive agrichemical-based, has conceived of 'nature' as something that has to be tamed, resisted or pushed back. This old philosophical schism needs to be questioned. Without doubt future food systems will have to choose whether to build biodiversity support into their practices or, as some are already arguing privately, abandon any pretence to do so and go 'hell for leather' for intensive production to raise output globally, whatever the impact on biodiversity.

The core argument for preserving and enhancing biodiversity has been articulated by FAO thus: "[w]hen natural diversity is lost, so is irreplaceable genetic material, the essential building blocks of the plants and animals on which agriculture depends. These plants and animals are the result of 3,000 million years of natural evolution - and 12,000 years of domestication - and selection." [86] A more immediate rationale is that biodiversity within crops also protects against disease. Future food production in the UK could better use the rich biodiversity we already have. The national apple collection at Brogdale, for instance, has approximately 2,000 varieties yet supermarkets normally sell a handful of commercial varieties.

Energy and non-renewable fossil fuels

An estimated 75% of the fossil energy used annually globally is expended by developed country populations. About 17% of that unequal share goes on the production, processing, and packaging of food products.[87] On farms, the availability of cheap and plentiful petroleum has been a key factor in the 20th century rise of productivity. The internal combustion engine and oil-driven machinery replaced animals as motive power, releasing not just horses and oxen but humans from hard labour. The number of horses and mules on US farms, for instance, plummeted from 12 million in 1945 to 2 m in 1960 while the number of tractors doubled.[88] As in the USA, their size and output on UK farms grew enormously. Oil-based equipment delivered and symbolized modernity and efficiency. Their application was central to the productionist vision of modern farming, a key to increased output and the commitment to larger farms and lower prices. Energy input in the form of fertilizers, for instance, is considerable. One US study showed how in

[85] Fowler C, Mooney C. (1990). *Shattering: food, politics, and the loss of genetic diversity*. Tucson, University of Arizona Press
[86] FAO (1995). *Dimensions of Need: an atlas of Food and Agriculture*. Rome, Food and Agriculture Organisation. http://www.fao.org/docrep/U8480E/U8480E00.htm#Dimensions%20of%20need
[87] Pimentel D, Pimentel M. (1996). *Food, Energy and Society*. Niwet, CO, Colorado Press
[88] Effland A, Dmitri C, Conklin N (2005). *The 20th Century Transformation of U.S. Agriculture and Farm Policy*. Washington DC, USDA Economic Research Service. www.ers.usda.gov/publications/eib3/

1945-1985, energy inputs in the form of fertilizers for maize crops grew from 974 to 15,650 MJ/hectare, a far greater growth in energy input than for machinery.[89]

First major doubts about the wisdom of this growing reliance surfaced with the 1971-74 oil crisis, the moment at which Western governments realized both that oil resources might be finite and, more importantly, that oil power has shifted from Texas to the Middle East. Questions were raised about possible limits to growth – from oil, population and above all geopolitics.[90] Critical analyses emerged on the food system's reliance on oil and cheap energy.[91] Such thoughts were downplayed as 'limits' continued to be pushed back due to the Green Revolution, the result of a combination of F-1 hybrids (plant breeding), fertilizers and access to capital (in lieu of farmer-retained seeds).

Oil has not just reshaped both how humans farm and the entire food supply chain. Food is trucked, shipped and flown increasing distances. In the UK, Food supply now accounts for about one fifth of total energy use.[92] The supermarket revolution has been based on logistics and distribution systems, premised on computers and oil. Higher living standards and car ownership enabled consumers to drive increasing distances to get their food in the name of convenience. Although distance that food travels is not necessarily a proxy for a food's GHG load, reliance on oil grows with the range of non-seasonal foods on offer in supermarkets. Although the UK draws heavily from within the EU for its food imports, this carries an oil reliance. Some of this can be seemingly perverse in its outcomes: milk being exported while other milk is imported – the food swap phenomenon.[93] This was normalized from the 1980s. In 1989-1999 there was a 90% increase in road freight movements of agricultural and food products between the UK and the rest of Europe.[94] The food systems accounts for over a third of all road freight. As large supermarket chains consolidated, the distance people drove to the shops grew. From 1985/6 - 1996/8 average UK travel to shop distances increased 57%.

An entire pattern of food supply chains has emerged due to cheap oil but this is now threatened by looming peak oil, the point at which oil supplies finally begin to drop. Oil companies and analysts diverge as to when that moment is due but not that it will happen relatively soon.[95] For UK food policy questions emerge: what would a food system look like which both fed more people and provided the energy to produce, let alone distribute?

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[89] Pimentel D, Pimentel M. (1990). Land, Energy and Water: the constraints governing ideal U.S. population size. Teaneck NJ, Negative Population Growth Forum; Heilig G.K. (1993). Food, Lifestyles, and Energy. In DG van der Heij, ed., *Food and Nutrition Policy*. Proceedings of the Second European Conference on Food and Nutrition Policy. The Hague, Netherlands, 21-24 April 1992. Wageningen, Pydoc**:** 60-86

[90] Meadows DH. and Club of Rome. (1972). *The Limits to growth; a report for the Club of Rome's project on the predicament of mankind*. New York, Universe Books.

[91] Leach G. (1976). *Energy and food production*. Guildford, IPC Science and Technology Press for the International Institute for Environment and Development; Rockefeller NA. (1977). *Vital resources: reports on energy, food, & raw materials. Report of the Commission on Critical Choices for Americans*. Lexington MA, Lexington Books

[92] Smith A, Watkiss P, Tweddle G, et al. (2005). *The Validity of Food Miles as an Indicator of Sustainable Development*. Report to DEFRA by AEA Technology. London, Department for the Environment, Food and Rural Affairs

[93] Lucas C, Jones A, Hines C. (2006). *Fuelling a Food Crisis: The impact of peak oil on food security*. Brussels, The Greens /European Free Alliance in the European Parliament

[94] Jones A. (2002). *Eating Oil*. London: Sustain: 2

[95] Leggett J. (2005). *Half Gone: Oil, Gas, Hot Air and the Global Energy Crisis*. London, Portobello Books

Could solar power or hydrogen or biofuels fill the oil deficit? Most observers are uncertain to say the least. Biofuels have already been racked by controversy over land use shifting from food to fuel.[96] Optimists merely profess certainty that more oil will be discovered or created from tar-based sources or technical efficiencies such as factor four thinking.[97] While increased efficiency could postpone peak oil, it will not remove it. The era of western food and farm efficiency reliant on oil is probably coming to an end.

Population growth

According to the UN Population Division, current world population is c 6.7bn and projected to rise by over 25% by 2050.[98] This increase of 2.5 billion is equivalent to the total size of the world population in 1950, and it will occur mostly in less developed regions, whose population is projected to rise from 5.4 billion in 2007 to 7.9 billion in 2050.[99] In contrast, the population of the more developed regions is expected to remain largely unchanged at 1.2 billion, and would have declined, were it not for the projected net migration from developing to developed countries, which is expected to average 2.3 million persons annually. Some calculations have estimated maximum world grain capacity at 3300 million tones per annum, 60% more than today, which suggests a looming gap between food production capacity and global population.[100] This is the stark issue: more people to feed, equitably and healthily. Such prognoses suggest that there is likely to be renewed economic and moral pressure on Europe – a region not expected to be catastrophically constrained by climate change, compared to Africa – to maximize food production.

In the last half century, world food production has risen remarkably and has been the success of productionism. Production has kept ahead of demand.[101] But difficulties lie ahead. According to FAO figures, measured as kilos per capita, the growth of availability of main crops such as grains, soy, potatoes – which rose admirably from the 1960s due to investment in new farm systems – began to level off in the from the 1990s.[102] Urbanisation is rising. In 1975 the world's urban population was 40% of world total. By

[96] FAO (2008). *State of Food and Agriculture 2008 - Biofuels: prospects, risks and opportunities*. Rome, Food and Agriculture Organisation; Tokgoz S, Elobeid A, et al. (2007). *Emerging Biofuels: Outlook of Effects on U.S. Grain, Oilseed, and Livestock Markets*. Staff Report 07-SR 101. Ames (Iowa), Iowa State University Center for Agricultural and Rural Development; Evans A. (2008). *Rising Food Prices: Drivers and Implications for Development.* Written Evidence to House of Commons International Development Committee Inquiry into Food Security. New York and London, Center on International Co-operation (New York University) & Royal Institute for International Affairs (Chatham House)

[97] von Weizacher EU, Lovins AB, Lovins AH. (1996). *Factor four: doubling wealth - halving resource use : the new report to the Club of Rome*. London, Earthscan

[98] UNFPA (2007). *State of World Population 2007: Demographic, Social and Economic Indicators*. http://www.unfpa.org/swp/2007/english/notes/indicators.html. Washington DC, UN Population Fund

[99] UN Population Division (2007). *World Population Prospects: The 2006 Revision*. New York, United Nations Population Division. http://www.un.org/esa/population/publications/wpp2006/wpp2006.htm

[100] Frey S, Barrett J. (2007). *Our health, our environment: The Ecological Footprint of what we eat*. International Ecological Footprint Conference 'Stepping up the Pace: New Developments in Ecological Footprint Methodology, Applications', Cardiff, http://www.brass.cf.ac.uk/uploads/Frey_A33.pdf :p2

[101] Smil V. (2000). *Feeding the world: a challenge for the twenty-first century*. Cambridge MA; MIT Press

[102] FAO calculations in Lang T, Heasman M (2004). *Food Wars: the global battle for mouths, minds and markets*. London, Earthscan

2005 it was almost half. This puts a further burden both on remaining rural populations to feed the urban masses and on the urban population to recognize its reliance on the primary food labour force. The UK urbanised a long time ago but it accelerated that process while feeding itself using other lands. In the UK, as elsewhere, multiple pressures will be exerted on land due to requirements to feed more people. The Office of National Statistics anticipates the UK population, currently 60 million, growing to 65m by 2016 and 71m by 2031; this assumes a net inflow of migration.[103] This has implications for the labour force. According to the ONS[104], there are currently 3.3 people of working age for every person of state pensionable age but this ratio is projected to fall to 2.9 by 2031.

One variable which could feed more mouths is to reduce waste. Despite the promise of post war science to reduce waste, in 2007 UK consumers threw away 6.7 million tonnes of food annually, roughly a third of food purchased. Only a fifth is unavoidable – peelings, cores, bones. The avoidable waste occurs due to a combination of factors such as excess purchasing, marketing, obeying sell-by-dates, large portion sizes, plate waste and price incentives. Whatever the reason, the net effect is embarrassing if not shameful. Nearly one quarter of the 4.1 million tonnes of avoidable food waste is thrown away whole, untouched or unopened.[105] Of this, at least 340,000 tonnes is still in date when thrown away. 1.2 million tonnes is left on plates. The wasted food is valued at £10.2 billion, £420 per year for the average UK household; £610 per year if the household has children. This suggests a need to reshape consumer culture, as well as production, and to re-skill people at the very least not to jettison waste.

Land

As populations urbanise, frequently land which was formerly prime or peri-urban growing land is covered by housing. Globally, the growth of mega-cities places new demands for regular food supplies, echoing what UK cities have already gone through but without the colonies or purchasing power necessary to feed them. Various methodologies have been developed to try to assess capacity. These include footprinting, calculations of material resource throughput and carrying capacity. One calculation for London, for example, found that the city's total footprint is estimated to be 48,868,000 global hectares (gha) or 6.63 gha per capita. If this was globally equitable – i.e., if it reflected London's portion of the world's 'biocapacity' – this would be 1,210,000 gha or 0.16 gha per capita.[106] London's food accounted for 41% of the footprint. To turn this into its global fairshare would require Londoners to consume 70% less meat, eat more than 40% local seasonal unprocessed food, and cut waste by one tonne a year.

[103] Office of National Statistics (2007). National Projections UK population to rise to 65m by 2016. http://www.statistics.gov.uk/cci/nugget.asp?id=1352 London, Office of National Statistics
[104] Ibid
[105] WRAP (2008). *The Food We Waste*. Banbury, Waste & Resources Action Programme (WRAP). http://www.wrap.org.uk/retail/food_waste/research/the_food_we_waste.html
[106] Lyndhurst B, Greater London Authority. (2003). *London's ecological footprint: a review*. London, Greater London Authority: 11-12

Consistently, studies of footprinting point to the need to reduce meat and dairy consumption. One methodology developed by the Stockholm Environment Institute has compared the footprint of different diets – notionally 'healthy' ie meeting nutrition guidelines, local, sustainably produced etc - with current food patterns. Shifting from the current to a healthy diet would reduce the footprint of the average UK consumer from 0.82 gha to 0.64 gha per person.[107] This same study found that meat consumption accounted for 46% of the impacts of the conventional diet, followed by dairy products (9%) and alcoholic drinks (8%).

While what people eat shapes land use, land is also being used for fuel. In Africa, for instance, timber is a primary cooking fuel. In consumer societies, land is now being utilized for biofuels in a variety of ways: cereal crops into ethanol and oil seed crops into bio diesel.[108] In the UK, future land use is currently being reviewed by the Chief Scientist's Foresight Programme and is already squeezed by a number of competing demands: food, housing, water, carbon sequestration, roads, timber, amenity, tourism and cultural identity ('the view'). Defra estimates that 70% of English land is farmed, producing 0.7% of GDP, 7% of greenhouse gases and around 70% of indigenous food consumed here.[109]

Soil

Soil is the basis for food production and arguably civilization. Unless soil health is protected by good management and conservation, food production halts, yet according to the UN Environment Programme globally nearly 2 billion hectares of land are affected by human-induced soil degradation. Within Europe, assessments have identified problems such as sealing (under roads, house, concrete), erosion, contamination, acidification, and degrading.[110] The European Agricultural Conservation Foundation has estimated that soil erosion and degradation caused by conventional agriculture affect c. 157 million ha (16% of Europe, roughly three times the total surface of France).[111] Average soil erosion rates in Europe are judged to exceed the average rate of soil formation, with most EU countries affected. In the Mediterranean – from which the UK derives much horticultural produce – soil erosion is deemed "very severe".

Is this kind of worrying assessment warranted of the UK? The 2008 report from the Royal Agricultural Society of England has expressed concern about the weakened state of

[107] Frey S, Barrett J. (2007). *Our health, our environment: The Ecological Footprint of what we eat*. International Ecological Footprint Conference 'Stepping up the Pace: New Developments in Ecological Footprint Methodology, Applications', Cardiff, http://www.brass.cf.ac.uk/uploads/Frey_A33.pdf
[108] FAO (2008). *State of Food and Agriculture 2008 - Biofuels: prospects, risks and opportunities*. Rome, Food and Agriculture Organisation
[109] Miliband Rt Hon D. (2006). *A Land Fit for the Future*. Speech by the Secretary of State to the conference on the 80th anniversary of the founding of the Campaign for Protection of Rural England. London, Defra
[110] European Environment Agency and UN Environment Programme (2000). *Down to earth: Soil degradation and sustainable development in Europe. A challenge for the 21st century*. Copenhagen, European Environment Agency
[111] ECAF (1999). *Conservation Agriculture in Europa. ECAF First Report*. Brussels, European Conservation Agriculture Federation. http://www.ecaf.org/news.html

UK soil science due to a decline in policy support and research infrastructure.[112] There are some signs that this may change, not least due to concerns about climate change.

Defra estimates that 10 billion tonnes of carbon are stored in UK soils. Soil contains up to 58% carbon. [113] The soils of English uplands alone contain more carbon than all the trees of the UK and France added together. In 2003, 3.73 million tonnes of carbon were emitted from UK soils and 1.52 mt were added to them. An annual 13 million tonnes of carbon is lost from UK soil each year, equivalent to 8% of UK carbon emissions from fuels. On carbon grounds alone, accurate care of soils is of vital importance, and there is no doubt that more accurate, comprehensive assessments of the state of UK soils are urgently needed. Defra is currently reviewing its policy with regard to soil monitoring.[114] No decisions have yet been taken on what new indictors might be; meanwhile it advises farmers to do their own on-farm testing. Given that the UK has such varied geological terrain and soils, a national picture of use to farmers is hard to generate. The Countryside Survey does some soil monitoring.[115] The 2007 Countryside Survey is to be published in November, providing results for carbon and PH; a subsequent report will give minerals and soil biodiversity.[116] A Millennium Assessment on England has been announced which will include assessment of the state of soil and biodiversity.

In 2007, the Environment Agency published a report on pollutants in soil, finding higher levels in urban than rural soils, in part suggesting the legacy of industrial pollution. Soil dioxins, for instance, grew in 1880-1980 but have dropped by 70% since 1980 reflecting both de-industrialisation and the effectiveness of controls.[117]

Labour

Agriculture is still the world's largest employer with 40% of the world's population employed in agriculture, largely at a subsistence level.[118] Of the approximately 1.1 billion men and women working in agricultural production in the mid 1990s, nearly half did so on a waged basis.[119] Millions of these workers earned the lowest wages in the rural sector, lower even than the amount required to subsist. Farming is not just hard work but

[112] Godwin R, Spoor G, Finney B, Hann M, Davies B. (2008). *The Current Status of Soil and Water Management in England*. Stoneleigh, Warwickshire, Royal Agricultural Society of England.
http://www.rase.org.uk/activities/core_purpose_work/soil_full_report.pdf See also:
http://www.sustainablefood.com/guide/soilissue.html
[113] Defra (2008). *Consultation on the draft Soil Strategy for England*. London, Department for Environment, Food and Rural Affairs. March. http://www.defra.gov.uk/corporate/consult/soilstrategy/consultation.pdf.
[114] http://www.defra.gov.uk/environment/land/soil/index.htm
[115] Countryside Survey. http://www.countrysidesurvey.org.uk/reports.html
[116] Judith Stuart Defra soil personal communication
[117] Environment Agency (2007). *UK Soil & Herbage Pollutant Survey*. London, Environment Agency.
http://www.environment-agency.gov.uk/science/922254/923462/?version=1&
[118] Halweil, B. (2000). "Where have all the farmers gone?" *World-Watch* 13, 5, 12-28
[119] FAO (1996). Farm wage labour: poorest of the rural poor. Rome: Food and Agriculture Organisation.
http://www.fao.org/docrep/x0262e/x0262e19.htm [accessed Jan 23 2008].

hazardous.[120] Worldwide, agriculture accounts for at least 170,000 occupational deaths each year, half of all fatal accidents.[121] Although the value of food production in 2000 was only about 3% of gross world product, the agricultural labor force accounts for approximately 22% of the world's population, half the world's total labor force, and 24% of GDP in countries with per capita incomes of less than $765 (the low-income developing countries, as defined by the World Bank).[122]

In the UK, the agricultural labour force was just under 700,000 persons in 1984. By 2007 this had shrunk to just over 500,000. Within this movement, there had been a shift from full time to part-time workers. In 1984, they were 21% of the total; by 2007 they were 43%. In 2004, the number of part-time workers exceeded full-time workers for the first time (excluding seasonal workers and salaried managers). The proportion of seasonal and casual workers has remained relatively stable over this period. The average age of farmers has risen to 58 years in 2005, with 30% over 65 years. Only 3% are under 35 years of age. This suggests a combination of barriers to entry – land prices, larger holdings, requirement for capital - and disincentives with other careers being more attractive. Farm wages are historically low but have improved although they are still about four fifths of the average industrial wage. [123] The UK farm is the most dangerous workplace, according to the likelihood of being killed while at work[124]

Use of migrants as a core farm labour force is an issue which rose up the UK policy agenda following the tragic deaths of migrant Chinese cockle pickers in Morecombe Bay in 2005. This accelerated legislation on gangmasters and the creation of the Gangmasters Licensing Authority and scheme. The Defra 2006 Food Industry Sustainability Strategy rightly referred to the vulnerability of migrant workers to poor conditions.[125] Horticulture and agriculture are the highest users, by sector, of migrant labour. Exact numbers are hard to generate. On the one hand, some estimates of recorded use suggest low use of migrant labour. One study for example refers to use of migrant labour on cropping farms as 7% of seasonal part time labour, on livestock farms 9%, and in horticulture 9% of seasonal full time and 11% of seasonal part time labour.[126] Yet on the other hand, Defra's 2007 rural development plan, for example, stated that many rural industries such as agriculture, food processing and hospitality are "heavily reliant on migrant labour" and estimated that in second stage food processing "some 90% of the

[120] Hurst P, Termine P, Karl M. (2005). Agricultural Workers and their Contribution to Sustainable Agriculture and Rural Development. Rome & Geneva, Food & Agriculture Organisation, International Union of Foodworkers, International Labour Organisation

[121] IAASTD (2008). *Global Report and Synthesis Report*. London: International Assessment of Agricultural Science and Technology Development. http://www.agassessment.org. p 17

[122] Millennium Ecosystem Assessment (Program) (2005). Ecosystems and human well-being: synthesis. Washington, DC, Island Press: 6

[123] Defra (2008). Average earnings and hours of agricultural and horticultural workers (England and Wales). https://statistics.defra.gov.uk/esg/datasets/ehrwtma.xls [accessed October 31 2008]

[124] HSE Statistics 2007/08 http://www.hse.gov.uk/statistics/index.htm

[125] Defra (2006). *Food Industry Sustainability Strategy*. London, Department of Environment, Food and Rural Affairs: 73

[126] Webster S, Jones P. (2007). *The likely effectiveness of Lantra's Skills Competence Framework*. Reading, University of Reading and Delta-Innovations: 20

work force supplied by labour providers is made up by non UK migrant workers."[127] Some observers are suggesting that as Eastern European EU member states become more prosperous, the attractions of working on UK farms will diminish.

Whatever the source, UK farm work appears to draw considerably on temporary workers. One study estimated that in any month there were an average of 99,460 directly recruited temporary workers on farm enterprises and 125,254 recruited by labour providers (such as gangmasters).[128] This gave a total of 224,713 and included students on the Seasonal Agricultural Worker Scheme (SAWS).[129]

Dietary change and public health

Pressures on supply are accentuated when diets change. The process known as the nutrition transition is used to describe a process which happened many decades ago in developed countries and is now evidenced in developing countries. In the nutrition transition, diets change from reliance on simple staples and become more plentiful, but in the process more high-value-added processed foods and meats, dairy and soft drinks are consumed.[130] This has an impact both on supply chains (shifting control from primary producers to processors and retailers) and on public health (accelerating the incidence of diet-related non-communicable diseases). Increased meat and dairy consumption is central to both 'push' and 'pull' effects. Although the move from the simplest diet is welcomed by consumers, not least in widening their range of foods, it carries hidden, slower effects which add burdens later.

The evidence on the effect of inappropriate diet on health has been known for decades.[131] Diets and lifestyles which are characterized by high consumption of fatty, sugary, processed (salty) foods, a lower than desirable consumption of fruit and vegetables, combined with a decline in physical activity are associated with a range of non-communicable diseases such as coronary heart disease, diabetes, strokes, and some cancers. This picture continues to develop and consolidate,[132] but this knowledge has not been adequately factored into agricultural policy. The legacy of the 1940s productionist approach to agriculture was a focus on quantity; this was understandable given the 1930s

[127] Defra (2007). *Rural Development Plan for England 2007-2013*. London, Department for Environment, Food and Rural Affairs http://www.defra.gov.uk/rural/rdpe/pdf/wholedoc.pdf pp 3-137

[128] Williams J. (2005). *Temporary workers in UK agriculture and horticulture. A Study of employment practices in the agriculture and horticulture industry and co-located packhouse and primary food processing sectors*. Report to Defra, Agricultural Wages Board for England & Wales, and Work Permits UK. Framlingham Suffolk, Precision Prospecting Ltd. http://www.defra.gov.uk/farm/working/gangmasters/pdf/research-study1.pdf

[129] See description from HM Revenue and Customs: http://www.hmrc.gov.uk/employers/saws.htm [accessed October 31 2008]

[130] Popkin BM. (2002). "An overview on the nutrition transition and its health implications: the Bellagio meeting." *Public Health Nutrition*, **5,** 1A: 93-103

[131] Keys A. (1970). Coronary heart disease in seven countries. *Circulation*, 41(supplement 1), 1-211; COMA (1974). Diet and Coronary Heart Disease: Report of the Advisory Panel of the Committee on Medical Aspects of Food Policy London, Department of Health and Social Security; WHO/FAO (2003). *Diet, nutrition and the prevention of chronic diseases*. Report of the joint WHO/FAO expert consultation. WHO Technical Report Series, No. 916 (TRS 916). Geneva, World Health Organisation & Food and Agriculture Organisation

[132] WCRF/AICR (2007). *Food, Nutrition, Physical Activity and the Prevention of Cancer: a Global Perspective*. London: World Cancer Research Fund / American Institue for Cancer Research. http://www.dietandcancerreport.org/

evidence on diseases of deficiency. [133] Today, problems of under-, over- and mal-consumption co-exist. The 'westernisation' of diet around the world via the nutrition transition leads inevitably to a rise in mortality and morbidity from non-communicable diseases.[134] This effect has been documented even in food cultures such as China which has very low intakes of dietary fat, by western standards.[135]

The connection between the nutrition transition and ill-health is not immediate – like the impact of food-borne pathogens – but slow and population-based. This is costly both in health and financial terms. Since the 1990s, the World Bank and World Health Organisation have itemised the enormous health care costs attributable to dietary factors.[136] In the UK, the Treasury has estimated how diet-related ill-health, already a significant drain on NHS spending, will grow unless there is investment in prevention and dietary and lifestyle change.[137] The issue of obesity has come to symbolise this health impact.[138]

This understanding of public health nutrition needs to be factored into 21st century food and farming policy. What would agriculture look like in the UK if a prime goal was to deliver public health? It is likely that there would be a shift towards producing more crops for direct human consumption – less grain for animals, less dairy or what meat and dairy production there was back onto the hills and more grass-fed. The replication by Simon Fairlie of Sir Kenneth Mellanby's 1975 study 'Can Britain Feed Itself?' has begun to outline some implications (see above).[139] Research into a closer relationship between public health nutrition and primary production needs to be extended and conducted on a rigorous basis, incorporating a focus on micro- as well as macro-nutrients.

The implications of these new fundamentals for UK sustainability

Each of the above issues requires important, even radical, changes from the current food system both globally and locally, yet policy responses tend to view each issue separately. Mainstream government policy attention looked to be grabbed by the 2006-08 commodity price rises, and brought high profile to the FAO meeting in June 2008, but public and government attention decline once the price of oil declined and as the financial crisis became critical in late 2008. In truth, future policy will have to address the new

[133] Boyd Orr, J. (1936). *Food, Health and Incom*e. London: Macmillan.
[134] WHO (2002). *World Health Report 2002: reducing risks, promoting healthy life*. Geneva, World Health Organisation
[135] Chen J, Campbell TC, Li J, Peto R. (1991). *Diet, Life-style and Mortality in China. A Study of the Characteristics of 65 Chinese Counties*. Oxford / Ithaca NY; Beijing PRC, Oxford University Press / Cornell University Press / People's Medical Publishing House
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[137] Wanless D. (2002). *Securing Our Future Health: Taking a Long-Term View*. London, H M Treasury; Wanless D.(2004). *Securing Good Health for the Whole Population*. London, H M Treasury
[138] Foresight (2007). *Tackling Obesities: Future Choices*. London, Government Office of Science
[139] Mellanby K. (1975). *Can Britain Feed Itself?* London, Merlin; Fairlie S. (2007). Can Britain Feed Itself? *The Land*, 4, Winter 2007/08, 18-26

fundamentals together because each has important knock-on effects on the others. The squeeze on oil affects irrigation technology. Desertification in the South will put pressure even in countries such as the UK both on its food production capacities and as an outside pressure in world migration and demand for food. The state of the soil and availability of nutrients and fertilizers (in whatever form) determines what foods can be grown. Vice versa, public health requirements for healthier diets will reshape what food production looks like in the future. A lower red meat consumption – better for health – would alter land use, both because animals are inefficient energy converters and because too much grain is being grown for fodder rather than direct human consumption anyway when it might be better used for 'third generation' biofuels perhaps or as carbon sinks. Climate change, of course, will reconfigure everything in the food chain – what is grown, how, where and by whom. Urbanisation and the global rise in population will place heavy demands on food production. And so on.

Each of the new fundamentals is connected to others. Policy responses will have to be carefully thought through. As the rush into biofuels in the mid 2000s has already shown, a policy which appeared to make sense – lowering reliance on fossil fuels merely contributed to commodity price rises, with or without a speculative element. Cumulatively, the new fundamentals suggest the need for a renewed policy commitment to make all food systems more sustainable. They redefine what is meant by 'sustainable'. Being low carbon alone will not be sufficient. Sustainable food requires big change on environmental, economic and social grounds. Policy-makers will have to judge food systems by more complex criteria than mere quantity or even price, important though these are.

Vulnerability of food production dependency upon chemical pesticides

The reliance of much of UK food production upon the application of chemical pesticides is beginning to show some clear limitations which suggest that more ecological based forms of pest management are going to be needed in the future. There is a growing convergence of trajectories around the chemical pesticide industry in the form of concentration of ownership, cost of regulatory approval[140], and increasing removal of pesticides on health and safety grounds from the EU market.

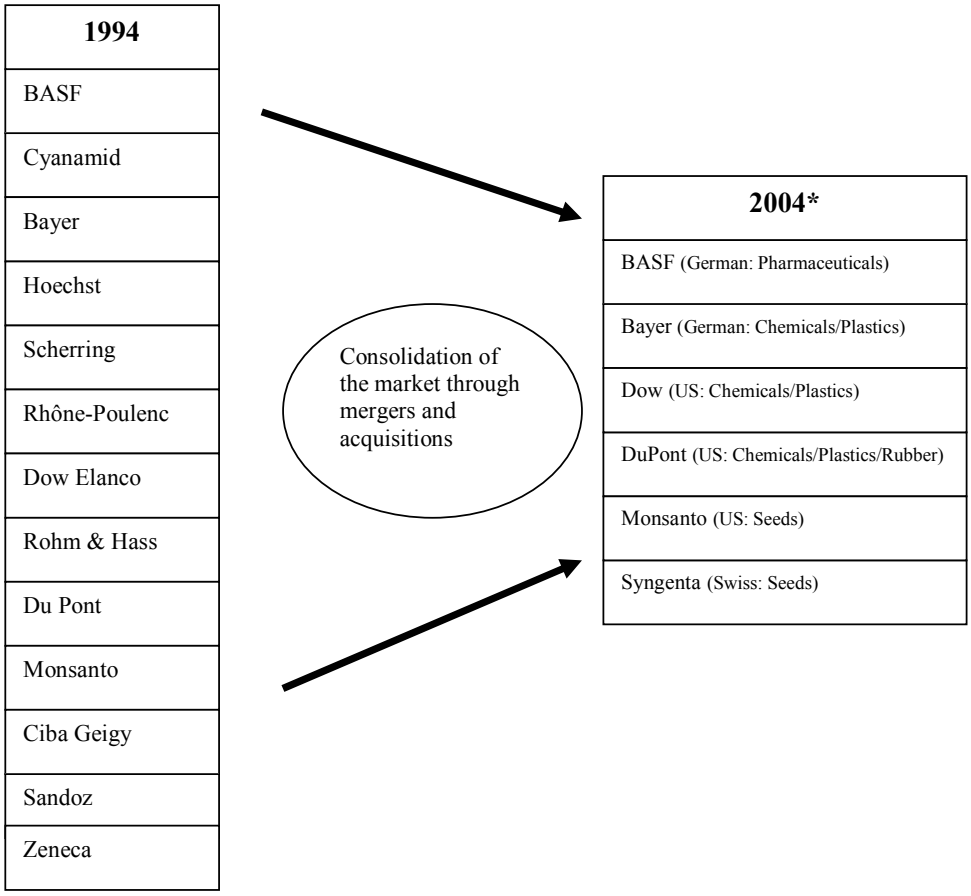
The history of pesticide market concentration is shown in Figure 1. In 1994 the global pesticide market was dominated by 13 research and development-based companies. By 2004, the number of these major companies, representing 77% of global sales, had dropped to six: Bayer (Germany), BASF (Germany), Dow (US), DuPont (US), Monsanto (US), Syngenta (Swiss). The consolidation came about because of mergers and acquisitions. At the same time, there has also been an increase in the manufacture of generic pesticides, particularly from India and China. These chemicals are produced by companies who do not carry out research and development into their own products or

[140] The Crop Protection Association estimates that the cost of obtaining regulatory approval for a pesticide active ingredient is £140 million. CPA (2005) *Pesticide Product Route Map*. Peterborough: Crop Protection Association.

develop new products. The UK growers and farmers may not be seen in future as a worthwhile market for costly R & D applications given the costs of getting through the EU regulatory market.

A new draft EU regulation authorising pesticide active ingredients has the potential to remove more pesticide active ingredients from the European market, compared with the current Directive. One version of the draft regulation analysed by NOMISMA[141] (an Italian Economics Research Institute sponsored by Syngenta and Bayer) said that "the new Regulation would risk removing 60% of existing pesticide active ingredients from use".[142]

Figure 1: Consolidation of the global pesticide industry (source: Dinham 2005)[143]



[141] Nomisma (2008) *European Agriculture of the Future: The role of plant protection products*. Bologna: Nomisma.
[142] Agra-Europe (2008) 'New pesticide rules might see 60% of existing active substances withdrawn', No 09.08, 30.01.08.
[143] Dinham, B. (2005) Agrochemical markets soar – pesticide pressures or corporate design?, Pesticides News, 68, 9-11.

The combination of foreign ownership, tighter regulation and so costs of bringing new chemical pesticides to the market may well combine to reduce the suitability of chemical pesticides to British growing conditions both on R & D grounds and due to regulatory grounds. While those pesticides banned in the EU may be applied to food and feed imported to the EU and UK markets, it remains to be seen for how long the UK authorities will be able to defend food and feed imports reliant upon the application of such pesticides. This is an area of potential vulnerability that needs to be thought through and may prove an impetus to the development of more ecological rather than chemical based pest management systems in the EU and the UK.

UK food supply vulnerabilities: some stakeholder insights

Recent research, based upon interviews with British food chain stakeholders,[144] found a number of specific vulnerabilities and anxieties around the UK's food supply. Arising from qualitative research, the vulnerabilities do not represent an exhaustive critique of the food chain, but reflect interviewees' experience of the realities of the food supply in the context of the global factors described above.

- It was widely accepted that UK food production must become more sustainable, and for many sustainability was inherent in the definition of food security. But this raises the fundamental and unresolved problem of **who pays**? The consumer via prices, the taxpayer via subsidy or land stewardship payment, or the farmer via reduced income?

- The reduction of **public funding of agricultural research** by successive governments was widely seen to have set British farming back and penalised UK farmers in relation to EU competitors.

- The key problem facing many farmers and growers is **lack of viability**. Many years of marginal profit or even loss have led to lack of investment and made it difficult to attract new entrants (e.g. sons and daughters) into farming. This has led to consolidation and contraction in the sector, and also to loss of skills and labour: migrant workers now do skilled work, such as pruning or animal husbandry, as well as unskilled, seasonal work such as picking. **Migrant labour**, however, is a precarious reservoir for agricultural labour and skill.

- There was a sense that the current **government is not committed to supporting UK farming.** Most discussion of food system resilience talks about 'shocks' to the system, but slow attrition is another form of threat.

[144] Food Security & Sustainability, a research project carried out by the Centre for Food Policy, funded by the Esmée Fairbairn Foundation. To date, 32 elite interviews have been conducted with people involved with or influencing the UK food supply, from various sectors and stages in the chain.

- In relation to taking steps to make farming and food production more sustainable – and therefore, in the long term, more secure – there was **frustration about a lack of strategic policy direction from government.**

- Changes to a more sustainable way of operating have been taking place in the food chain for some, but are **fragmentary and uncoordinated.** Different steps are being taken at different stages in the chain.

- Sustainability can add value to a brand, and the major retailers have been important drivers of change, including among their suppliers. However, suppliers **did not feel sustainable practice was recognized or rewarded in contract negotiations**. Ultimately, the retailers' reluctance to attach commercial value to sustainable practice constrains the amount their suppliers can do, because the suppliers must continue to meet the retailers' demands on price, specification and uniformity of supply.

- The food chain's obsessive emphasis on **continuity, reliability and uniformity of supply,** whether led by or shaping consumer expectation**,** presents a barrier to arguments in favour of a less global souring system.

- However, there was a sense that **global supply chains are becoming less dependable,** as a result of the issues described in the report as the New Fundamentals

Two examples that illustrate these concerns a little further are around: plant breeding designed for UK growing conditions and the development of tree rootstocks for fruit production; and the structure and regulatory challenges of the pesticide industry upon which much of contemporary UK horticulture and agriculture is dependent.. These are briefly explained below:

Example 1: Plant breeding for UK conditions

In a trading world dominated by multinational companies, the UK represents a small market, but it is one with particular climatic and growing conditions. In recent years, there has been significant consolidation in plant breeding (as in many other sectors of the food chain), with ownership of several plant breeding companies moving or becoming headquartered abroad. For example, of the six big cereal breeders operating in the UK, none is now UK-owned. As this happens, the likelihood increases that plants and seeds will no longer be developed specifically to suit UK conditions. Cereals bred for Germany or France, say, will not do well in the UK, because of the differences in climate and soil types. Variety trials, which need to run over several growing seasons and are thus expensive and labour intensive, may no longer be conducted in the UK, a process which is crucial in identifying varieties which thrive here. In future, the UK may have to use varieties developed for larger markets, which are not tailored to suit to UK conditions. This could reduce the UK's home production and damage its comparative advantage in world markets.

Example 2: Rootstocks

The small number of root stocks on which certain tree fruits are now grown commercially was identified as a risk, in the face of unpredictable climate change. For example, commercially grown apples mainly use just three rootstocks, out of a possible 40 or 50. Research is needed to identify rootstocks that would enable fruit trees to better withstand the possible effects of climate change – including both drought and soil water- logging. Research needs to identify stocks that will suit particular sets of growing conditions, including those in the UK.

These insights from stakeholders are necessarily selective, rather than comprehensive, but serve to illustrate further the vulnerabilities of the UK's food supply as currently governed. A re-thinking around the appropriate policy approaches to UK national food security will need to embrace these types of concerns.

Conclusion: Rethinking UK food security

Many questions have been raised by this report:

- Why produce food?
- How self-sufficient is the UK and how do we measure food self-sufficiency?
- Why is national food security back on the political agenda?
- Who is speaking out on national food security and what are they saying?
- How will food production be reshaped by the 'New Fundamentals' of environmental and natural resource limits and change?
- How can food production be made intrinsically sustainable?
- How can the competing pressures be integrated, not traded off?
- What should land be used for and how?

There are no simple or quick answers to these questions but a number of lines of thought emerge.

Ongoing Debate

Open debate is essential. Compared to even a year ago, there is now a vibrant debate in the UK about food security. This is very much to be welcomed. It should be encouraged and opened still further. Much of that debate is occurring among specialists and interests who sense a common purpose around food production. But ultimately, the food system should operate for the benefit of the people who eat the food. If it is going to have to change – almost definitely dramatically and rapidly – that process must be opened up further and democratised if it is to result in sustainable policies.

Sustainable food security

The term food security deserves to be reworked. It means different things to different people: food nationalism, food defense, community food security, food democracy, food sovereignty, food risks, food resilience, food capacity. All these carry connotations and have their own as well as overlapping literatures, yet are in the policy discourse. We have

ourselves championed the notion of capacity. It is useful in policy to indicate links between productive capacity (can we grow it?), environmental capacity (what is the impact?) and social capacity (are the skills and cultural bases supportive; are the appropriate foods being produced and consumed for a healthy society?).[145]

Appropriate production

We believe that there is a case for all nations to improve their food capacity but not at all costs or in ways which shift burdens onto the environment or society. In a world where food systems will be framed by the New Fundamentals (see the section earlier), it will be immoral not to use land appropriately. But the key word is 'appropriate'. The UK needs to clarify what is and is not appropriate. This needs to be done by addressing all the criteria for sustainability, not favouring some over others.

Government Leadership

The role of the State remains paramount, not as *dirigiste* or top-down controller but as facilitator, the only body which can legitimately bring all actors into play. Many voices throughout the food system are calling for support and guidance. A clear new framework for food policy is urgently required. The Cabinet Office began that process but it needs to be extended and deepened on whether and what to grow in the UK.

The present government's food security policy is interpreted as too lax, too *laissez-faire*, putting too much faith in 'markets' to feed people. It assumes that the UK will always be rich enough to buy scarce resources on world commodity markets. On a precautionary basis, such a policy probably creates unnecessary vulnerabilities. The nature of the vulnerabilities society is facing in this century is complex and profound and the argument is clearly expressed in this report that new policy thinking is need for the UK government. For a country blessed with such fine growing conditions (for all their problems) as the UK, not to grow the food which it could, and to use imports as a substitute for produce which could perfectly well be grown here, is a waste of potential.

Learn for the future

The UK has a singular tradition of both damaging and resurrecting its home food supply. The long experiment with free trade following the 1846 Repeal of the Corn Laws came unstuck first in World War I then in World War II. The slow rebuilding of food production achieved much but peaked in the mid 1980s. Productionism was proven to have unwarranted environmental and fiscal costs.

The experience of the Second World War is sometimes mentioned today as an example of how the UK might respond to contemporary challenges. The system of food controls put in place from 1939 onwards, including rationing, local food committees, home growing, canteens, and war agricultural committees has been documented.[146] But that

[145] Barling D, Lang T, Sharpe R. (2008). Food Capacity: the root of the problem. *Journal of the Royal Society of Arts*, 154., 5533, 22-27

[146] Hammond, R. J. (1951). *Food: the Growth of Policy*. London, H M S O / Longmans, Green and Co

experience comes to us today from an era with different possibilities, a world which was untroubled by environmental externalities, or the need to protect eco-systems, or which understood the complexities of public health nutrition, a world moreover where the country had half the population it does today. The interventions by the state in the 1940s were harsh by neo-liberal standards but they won considerable public approval due to their overt fairness and logic at a time when the people of the UK faced a common enemy.

In 1975, the UK government again felt that a set of circumstances not unlike those confronting us today warranted a new assessment of the UK's ability to feed itself. In view of concerns about the rising cost of imports and energy, an expanding population and low global cereal stocks, and also recognizing that 'the influence of the UK as a buyer in world markets is changing', the government produced a White Paper entitled *Food From Our Own Resources*.[147] This took the view that 'a continuing expansion of food production in Britain will be in the national interest', both to reduce the national bill for imported food, and to reduce 'the risk to the economy … involved in a relatively high level of dependence on imports'.[148] The paper acknowledged that the policy implications were long-term, involving the protection of agricultural land against development, the provision of a skilled young workforce, and effective research and development. The government, it said, would 'frame their agricultural policies in the light of these conclusions' and ended on an optimistic note: the government would 'look to the agricultural and food industries, with their fine record of past achievement, to work with them in bringing about an expansion of economic agricultural production in the interests of the nation'.[149] Unfortunately, in spite of these careful deliberations and good intentions, we once again face the necessity to review our capacity and need to produce food.

In the 21st century, the UK and the world face a new set of common enemies – those described here as the New Fundamentals. Climate change, water stress, energy shortages, resource limitation, addressing social inequities and societal needs for healthy food and diet, will all reshape how progress is defined. The UK is now part of the EU and in that milieu it needs to take a lead in forging an ecological approach to sustainable food systems. Key players in the UK's food system have emergency plans – companies as well as the state. The task now is to prevent those having to be activated. This requires a peace-time mobilisation of energies, creativity, science and organisations.

[147] MAFF (1975) *White Paper on Food From Our Own Resources*. London: HMSO. National Archives catalogue ref: cab/129/182/24, p.1
[148] Ibid: 1,7
[149] Ibid: 17