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UK Food Security Assessment: Detailed analysis

August 2009

Department for Environment, Food and Rural Affairs

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Summary of the six themes and their indicators [with hyperlinks](#)

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Food Security theme	Rationale	Headline indicators	Supporting indicators	What threats and challenges do the indicators address?
<u>1. Global availability</u>	Global food supply ultimately underpins UK availability and prices. A well-functioning trading system is essential if supply is to respond efficiently to global demand.	<u>Trends in global output per capita</u>	<ol style="list-style-type: none"> <u>Yield growth by region</u> <u>Real commodity prices</u> <u>Stock to consumption ratios</u> <u>Share of production traded</u> <u>Concentration in world markets</u> <u>R&D expenditure</u> <u>Impact of animal disease</u> Growth trends (to be developed) 	<p>Population and economic growth</p> <p>Rising incomes in emerging economies</p> <p>Harvest shortages</p> <p>Trade protectionism</p> <p>Breakdown in trade</p> <p>Lack of investment</p> <p>Warming and more volatile climate</p>
<u>2. Global resource sustainability</u>	Food must be produced in a way that is environmentally sustainable or we will set up problems for the longer term.	<u>Global land-use change</u>	<p><u>CO₂ emissions (context indicator)</u></p> <ol style="list-style-type: none"> <u>Fertiliser intensity</u> <u>Water productivity of crops</u> <u>Water withdrawn for agriculture</u> <u>Global fish stocks</u> Pesticide intensity (to be developed) Seed diversity (to be developed) 	<p>Supply expansion being ultimately unsustainable because of natural resource constraints and degradation.</p> <p>Resources not correctly priced or lacking good governance.</p>
<u>3. UK availability and access</u>	Sourcing nutritious food from a diverse range of stable countries including domestically enhances security by spreading risks and keeping prices competitive.	<u>Diversity of UK supply</u>	<ol style="list-style-type: none"> <u>EU's share of UK imports</u> <u>Diversity of fruit & veg supply</u> <u>EU production capability</u> <u>UK production capability</u> <u>UK potential in extremis</u> <u>Diversity of entry ports into UK</u> <u>UK port flexibility</u> <u>Port diversity of non-indigenous foods</u> 	<p>Over-reliance on single sources of supply.</p> <p>Domestic supply failures</p> <p>Capacity and concentration at ports.</p> <p>What if non-EU trade breaks down?</p> <p>Could the UK feed itself in extreme circumstances in which trade broke down?</p>

Food Security theme	Rationale and associated risks	Headline indicators	Supporting indicators	What threats and challenges do the indicators address?
4. <u>UK food chain resilience</u>	UK food supply depends upon sophisticated and complex chain and infrastructure, and is particularly dependent upon energy supplies in their various forms.	<u>Energy dependency of the food chain</u>	<ol style="list-style-type: none"> 1. <u>Energy capacity reliability</u> 2. <u>Diversity of oil and gas imports</u> 3. <u>Business continuity planning</u> 4. <u>Retailer warehouse stocks</u> 5. <u>UK cereals stocks</u> 6. <u>Food industry diversity</u> 7. <u>Viability of large manufacturers</u> 8. <u>Strategic road network</u> 	<p>Energy intensive food chain</p> <p>Does just-in-time operation reduce resilience?</p> <p>Diversity of domestic supply chains</p> <p>Is there sufficient continuity planning?</p>
5. <u>Household food security</u>	Everyone should be able to access and afford a healthy diet.	<u>Low income households' share of spending on food</u>	<ol style="list-style-type: none"> 1. <u>Relative prices of fruit & veg</u> 2. <u>Food prices in real terms</u> 3. <u>Household access to food stores</u> 4. Self-reported food insecurity (to be developed) 	Can low income households afford nutritious food? Is physical access a problem?
6. <u>Safety and confidence</u>	Public confidence in UK food system rests primarily on food safety. Food safety stressed in Strategy Unit report.	<u>Trends in cases of food-borne pathogens</u>	<ol style="list-style-type: none"> 1. <u>Food safety inspections and incidents</u> 2. <u>Food covered by assurance schemes</u> 3. <u>Public confidence in food safety measures</u> 4. Consumer confidence in food availability (to be developed) 	<p>Do consumers have confidence in food industry and authorities?</p> <p>Is food safety improving?</p> <p>Growing role for assurance and traceability.</p>

Purpose and structure of the assessment

This paper details a framework of indicators for assessing UK food security. First proposed in Defra's 2006 analytical paper on food security, and outlined in Defra's 2008 discussion paper¹, these indicators have developed through stakeholder engagement and have benefited from expert input from various Government departments and Defra's Council of food policy advisers.

This scorecard-style assessment forms one part of Defra's wider package of work on sustainable, healthy and secure food. It sets out a structured evidence base of the range of elements of UK food security now and over the next decade. Although it is comprehensive in scope, it is not possible to cover every element exhaustively, so it can also be seen as providing signposts for areas of more in-depth investigation or further research.

The common elements of definitions of food security are *availability, access, affordability, safety* and *resilience*. We have developed these aspects into a framework of six overall themes.

- 1. Global availability**
- 2. Global resource sustainability**

Themes 1 and 2 provide the **global context** to UK food security

- 3. UK availability and access**
- 4. UK food chain resilience**

Themes 3 and 4 focus upon the **UK supply chain**

- 5. Household food security**
- 6. Safety and confidence**

Themes 5 and 6 focus upon the **consumer perspective**

Each theme consists of:

- **A headline indicator** which captures a major or representative element of the theme and provides an initial indication of the state and change in the theme. However, these should not be seen in isolation of:
- **several supporting indicators** which explore related aspects of the headline indicator or address other high-level aspects of the theme.

The indicators for each theme have been selected and developed for being:

¹ Defra, *Ensuring the UK's food security in a changing world* (July 2008) <http://www.defra.gov.uk/foodrin/pdf/Ensuring-UK-Food-Security-in-a-changing-world-170708.pdf>; Defra Food Chain Analysis Group, *Food Security and the UK – an evidence and analysis paper* (December 2006), p. 79. See also Table 10.1. <http://statistics.defra.gov.uk/esg/reports/foodsecurity/foodsecurity.pdf> See also the discussion of food security by the Strategy Unit in the Cabinet Office, *Food Matters – towards a strategy for the 21st century* (July 2008), and in its accompanying analytical report. http://www.cabinetoffice.gov.uk/strategy/work_areas/food_policy.aspx

- based on robust and authoritative data
- easy to understand and transparent.
- most importantly, relevant to the theme and relevant to a range of associated risks. These are summarised in Figure 1 below:

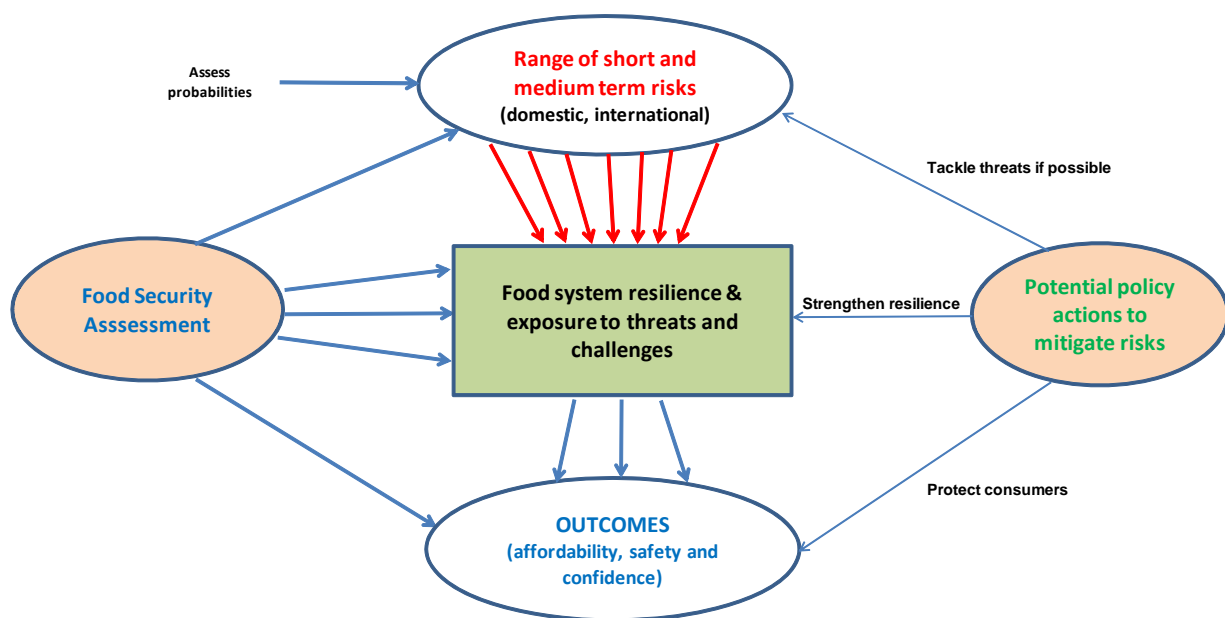
Figure 1 Typology of possible threats and challenges to UK food security in a global perspective

	Types of threats and challenges (illustrative)			
Scorecard themes	Political	Technical	Demographic & economic	Environmental
Global availability	Wars Export restrictions Bilateral land deals Bio-fuel policies	Yield growth Investment and skills	World population growth; Incomes growth	Floods, droughts Plants / animal disease Changing climate
Global resource sustainability	Wars; Institutional and policy failures	Farming practices	World population growth; Farming intensification	Water scarcities; Desertification, Soil erosion; Climate change; Ecosystems breakdown
UK availability and access	Trade embargoes, Breakdown in international trade; Breakdown in EU trade; EU Regulations	Decline in non-renewable energy; Port closures	Importance of fruit and veg consumption and imports; Sharp decline in UK competitiveness	Animal disease Coastal flooding of ports; Water scarcities; Bio-diversity risks
UK food chain resilience	Strikes / protests; Regulation	Radioactive fallouts; IT corruption Contingency planning; Just-in-time	Oil shocks; Absenteeism due to pandemic flu; Food chain concentration; Financial crises	Extreme weather events
Household affordability and access	Planning restrictions	Lack of transport	Poverty; Food inflation; Currency devaluations; Unemployment	Extreme weather events
Safety and confidence	Malicious activity; Regulatory failures	Contamination;	Increasing demand for complex processed products; Longer supply chains	Pests and diseases

Figure 2 summarises the logic of our approach. Whilst some aspects of the assessment (in particular theme 2) touch upon **longer term resource threats**, a major focus is on our food system's **exposure or resilience** against these and many other (often unpredictable) threats and challenges illustrated in the matrix above. A more complex mapping of risks to indicators is possible (involving probabilities and timescales), but to retain the simplicity of the overall assessment, this has not been included.

There are also linkages between themes: for instance, an international oil shock will affect energy prices, and, depending upon energy intensity in the food sector (Theme 3), could affect the real price, and affordability of food (Theme 5). In general, themes 5 and 6 indicators incline towards **consumer outcome** measures which cover the impact of various risks on affordability and confidence (themes 5 and 6). In time delivery-type indicators could be developed which monitor the policy measures designed to tackle specific threats or mitigate risks, strengthen some aspect of resilience or consumer protection.

Figure 2 Logical framework of the food security assessment



Format for the indicators

A **cover page for each theme** explains the rationale for the theme, provides an illustrative range of challenges and threats which are relevant to the theme, and lists the indicators. Potential indicators which are under consideration are also noted.

Rationale and associated risks

Explains why the indicator is relevant. This includes a summary of the main risks, threats and challenges covered by the indicator.

Desired outcome

States more precisely what food security “looks like” in the perspective of the particular indicator. It **does not necessarily imply a specific target**, but it is essential to identifying what a positive movement and level for the indicator would be.

Indicator data and description

The indicator data are described and summarised, usually in chart form. **Key points** are noted and analysed, where necessary using other supporting material to provide context. Data sources, whether Government or other, need to be carefully chosen to ensure they are fit for purpose. Where available, established data sources are used. In other cases indicators and their data sources need to be developed to show the full picture of food security. Data quality and reliability will also vary: for instance international data in themes 1 and theme 2 can be problematic. Most of the indicators in themes 3 to 6 necessarily use UK datasets. However, note that food policy itself is devolved and in some cases an indicator applies to England only.

Assessment

For each indicator, three assessments are made, based on “traffic lights”:

1. An overall assessment of the current position



= favourable position



= somewhat unfavourable / uncertain / mixed.



= very unfavourable position

Note that this rating is **not symmetric** – the amber light is not neutral, but “somewhat unfavourable” or “mixed”. A brief explanation is given, where necessary, for the choice of these ratings. A recent decline in an indicator may not imply an unfavourable rating of the current position if the absolute “level” is considered favourable. On the other hand, it is more appropriate to assess some indicators on the basis of their change over time rather than their absolute value, particularly when the latter is not readily interpreted.²

2. Comparison with 1990s

We also assess how the indicator has changed over time. Drawing upon the indicator data, we do this by considering, in very broad terms, whether a clear trend has emerged over the last 10-15 years i.e. the mid 1990s. Because of variation in data suitability and the need to highlight significant trends, we do not specify a particular reference year. For simplicity, we provide one of three assessments:

- an **improvement** upon the mid-1990s
- a **deterioration** compared with the mid-1990s
- broadly **similar** to the mid-1990s.

Where appropriate we also provide some explanation.

3. A judgement as to the position of the indicator in the next 5-10 years

To complement the assessment of the current position, we adopt a similar coloured assessment of what the medium-term position of the indicator is likely to be. Where this second traffic light differs from the first, it means the indicator is expected materially to improve or deteriorate over time.



= future position likely to be favourable



= future position likely to be somewhat unfavourable



= future position likely to be very unfavourable

² For instance, an official well-known indicator of domestic natural resource protection is the UK farmland bird population. This is an important indicator because it shows a long-term decline in bird populations, and it is the trend (and attempts to reverse it) rather than absolute population numbers, which is the focus.

Note that this second assessment does not explicitly state the future *timescale*. Timescales will vary according to the theme and indicator, but broadly speaking we would be considering the next 5-10 years. Where this is not the case, this should be clear from the accompanying text. **Where there is considerable uncertainty over the future position and level of an indicator, we tend to give an amber assessment and use the accompanying text to describe the degree of uncertainty.**

As with the current assessment, however, forward-looking assessments will be based upon both the likely absolute position of the indicator as well as any change relative to its current position. Current trends will also inform the judgement in relation to future movements in the indicator. For some indicators, **supporting data** are presented as integral to the overall assessment, but do not themselves constitute indicators.

Potential development

Some of these indicators are more developed than others. For those where future development is desirable and intended, suggestions are provided. All components of the assessment will be subject to review as evidence needs and sources develop.

Where appropriate, a number of key linkages between indicators and themes are noted in order to highlight the interconnected and multifaceted nature of food security. **Hyperlinks facilitate navigation around the indicators.** There is further scope to develop this aspect of the assessment.

Contributors to this assessment

This assessment has been designed, developed and compiled by an interdisciplinary team of analysts in Defra's Food and Farming Group: Colin Smith, Stuart Platt, Jim Holding, Paul McDonnell, Simone Pfuderer, Grant Davies, Robin Karfoot, Sarah McDiarmid, Jonathan Bonas, Kevin Bridge, Vicky Inness, Joanne Gardiner, Ian Lonsdale, Alex Rubin and Courtney Keane.

Box 1 The contribution of UK producers to various aspects of food security

As this assessment shows, Britain's food security involves a complex of factors and risks affecting availability, affordability and accessibility. That is why debates around food security have shifted away from a simple focus upon trends in domestic agricultural self-sufficiency. Defra's 2008 paper *Ensuring Food Security* observes: "Even if it were possible, self-sufficiency would not insulate us against disruptions to our domestic supply chain and retail distribution system. It would open up the UK to risks of adverse weather events, crop failure and animal disease outbreaks. We would continue to depend on imported fertilisers, machinery and certain foods for a balanced diet".

At the same time, this structured assessment shows the various *positive* ways in which the performance and potential of UK agriculture, and also UK food manufacturing, can and does contribute to food security:

- Through its contribution to future global supply, particularly in cereals, where UK farmers attain high and consistent yields. In 2008 the UK exported 3.5 million tonnes of cereals, mainly wheat (see Box 2) under the headline indicator in Theme 1). Whilst not directly related to UK food security, long-term issues of climate change and global food supply offers both market opportunities and productivity challenges for UK agriculture.
- Strong UK cereal production facilitates significant holdings of post-harvest cereal stocks which can provide a buffer in the event of sudden changes in markets during the following year (see [indicator 4.5](#)).
- Rising yields and access to uncropped land mean that the UK, and Europe as a whole, are well-placed to ramp up production in the event of trading relations severely breaking down with the rest of the world (see [indicators 3.3 and 3.4](#)).
- In the unlikely event of extreme isolation (as nearly occurred at times during the Second World War), the overall calorific potential of UK agriculture would be more than sufficient, assuming a very substantial reduction in livestock production ([indicator 3.5](#)).
- By continuing to reduce their dependence upon energy, UK agriculture and the food manufacturing sector, can increase their resilience to price shocks or energy shortages ([headline indicator 4](#)).
- UK producers can increase consumer confidence in food and food safety through participation in consumer assurance schemes and effectively managing disease risks, particularly zoonotic diseases. Disease outbreaks in the past have shaken public confidence in food safety (see [headline indicator in theme 6](#) and [indicator 6.2](#)).
- Where produce is less tradable (e.g because of perishability), UK production directly influences availability and affordability – this is particularly true at certain times of year for fresh fruit and vegetables (see [indicator 5.1](#)).
- Because processed food products are generally not as tradable as agricultural commodities, the resilience of UK food manufacturing (whether domestically or foreign owned) has a particular significance ([indicator 4.7](#); [headline indicator 4](#)). Business continuity planning is particularly important ([indicator 4.3](#)) whilst rising productivity in food processing has been one of the factors behind the downward trend in real food prices ([indicator 5.2](#)).

Theme 1 Global availability

Introduction to the theme

The Strategy Unit report, Food Matters, concludes that “The principal food security challenge for the UK is a global one”, and it warns against taking an isolationist approach. Defra’s July 2008 paper Ensuring the UK’s food security, echoes this: “Global food security is important for the UK because, ultimately, global stability depends on there being enough food in the world to feed everyone and for it to be distributed in a way that is fair to all.” Sufficient global food production is a precondition for global food security. For an open, trading economy like the UK, a secure global food supply ultimately underpins long term availability and prices in the UK, although it also generates risks. In particular, as the July 2008 paper concludes, “effectively functioning markets are fundamental to ensuring global food security” and in ensuring that supply responds efficiently to global demand. Trade can also foster agricultural growth in developing countries and thus foster food security in those countries. The sustainability of increased production is the focus of Theme 2.

Types of challenges and threats addressed by this theme

- *Demographic change*
- *Climate change, leading to harvest shortfalls, pests and diseases*
- *Third country protectionism and economic nationalism*
- *Sustainable productivity growth*
- *Ensuring adequate investment and applied research*

Headline Indicator

- **Global output per capita**

Supporting Indicators

- 1. Growth in cereal yields by region**
- 2. Real commodity prices**
- 3. Stock to consumption ratios**
- 4. Share of global production internationally traded**

- 5. Concentration in world commodity markets**
- 6. Agricultural research spending**
- 7. Impact of animal disease on meat production**

Other indicators under consideration

- Growth trends in demand and its components

Theme 1

Global availability

Headline indicator

Global output per capita

Rationale and associated risks

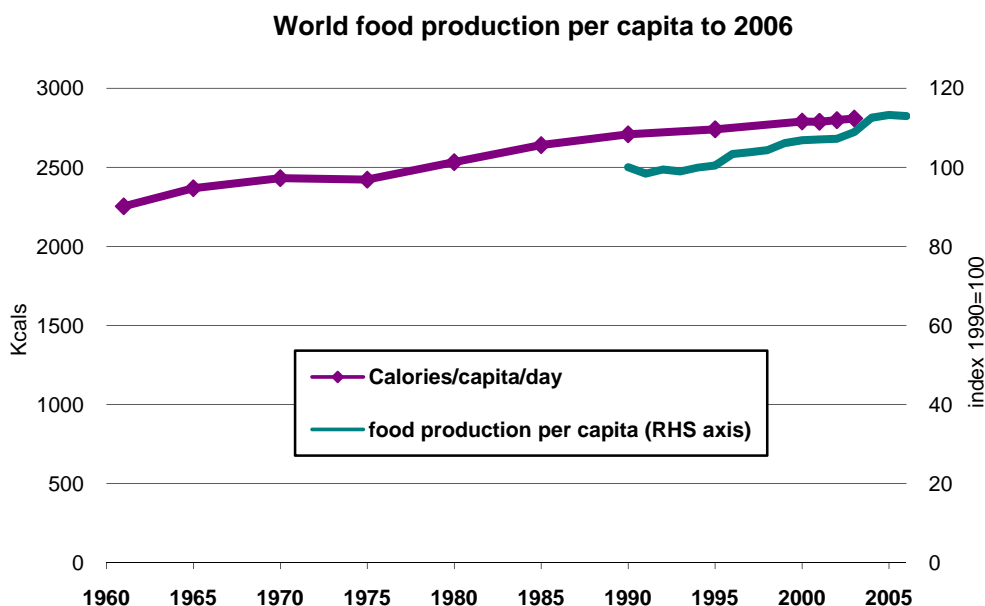
Global production of food relative to population is a fundamental indicator of global food security and is used as such in FAO analysis. Climate change, bio-fuels expansion and economic and demographic change are likely to place greater strains on world food production and the natural environment, and could lead to more expensive and more volatile food prices. This could in turn exacerbate short-term problems and food insecurity in poorer countries if major players restrict trade. Any deterioration in global availability, or associated increases in prices, will necessarily have a greater adverse impact on developing countries. For an open, trading economy like the UK, a secure global food supply ultimately underpins long term availability and prices in the UK. The FAO has suggested that global food production needs to rise by some 40% by 2030, although it is not clear what the base date is for this or whether it implies that all people will be better fed than now to meet nutritional goals.

Desired outcome

Global agricultural production continues to grow to meet the demands of a growing and wealthier global population. Sustainability implications are considered in Theme 2.

Indicator **Calories / World agricultural production per person (to date)**

Source: FAO balance sheets and FAO production indices



Notes - Calorific production (per person per day) is only available to 2003. Food production is based on gross production, i.e. without any deduction for seed and feed. Food production index base period is 1999-2001.

Key points

- **Food production measured in calories per capita per day has increased steadily since 1961.** Calorific production per person was 25 per cent higher in 2003 than in 1961. In 2003, average calorie intake was at the FAO “graduation” level of 2800 kcal/ person/day. According to the FAO, this means that “universal food security” is within reach.
- *Food production per capita* rose by 4 per cent between 2003 and 2006. Food production per capita is more up to date but is a less satisfactory measure because volumes of production of different types of food are added together in tonnes; animal feed and seed are not netted off, even though they don’t go for human consumption.
- Food production is less volatile than agricultural production since stock changes are used to compensate for fluctuation in harvests.
- Agricultural production has risen steadily since 1961 due to advances in technology and related factors (e.g. investment, education, institutions and improved farm management).
- The growth of the productive potential of global agriculture has so far been more than sufficient to meet the growth of effective demand.
- The impact of the **increasing use of cereals for animal feed** is already netted off within the calorific figures (using knowledge of the supplies of cereals used for animal feed) which represent the total volume of food supplies for human consumption.
- The figures are also **net of harvest losses** and impacts of animal disease and so will tend to understate global supply potential. But they do not net off losses further through the food chain and wastage by households and thereby overstate actual consumption per capita. A recent UNEP report³ estimated that these amounted to around 30% of food supplies – that suggests actual average consumption in 2003 was closer to 2000 kcal per capita per day. By the same token, if the level of wastage had increased since the 1960s, the increase in this indicator would be greater than the change in actual consumption. Conversely, if in future the level of wastage were to be reduced, this indicator would understate the rise in actual consumption per capita.
- The aggregate figures obscure the fact that calorie consumption is very unequal (see below).

Looking forward

According to the latest World Bank analysis, global food demand should grow less rapidly over the next 25 years with weaker growth in population and GDP. More farmed land and better yields are expected to lead to stronger agricultural production and lower prices. However, supply growth depends on public policy and investment in technology and infrastructure, and is open to risks posed by climate change and bio-fuels demand.⁴ And of course, in absolute terms, the additional output required is still substantial, particularly as diets in developing countries change.

The potential for further increases in food production (assuming the right market signals are provided) appears to be substantial. Africa alone has 23% of the world’s agricultural area but produces only 7% of the world’s cereal production (FAO statistics)

The key question is about the **environmental impact of agricultural expansion** and / or intensification. Estimates of land additional land available for agricultural production vary significantly. FAO estimate that at world level

³ UNEP, *The environmental food crisis* (February 2009) <http://www.grida.no/publications/rr/food-crisis/ebook.aspx>

⁴ World Bank, *Global Economic Prospects 2009*, pp. 79-86.

<http://web.worldbank.org/WBSITE/EXTERNAL/EXTDEC/EXTDECPROSPECTS/GEPEXT/EXTGEP2009/0,,contentMDK:22002681~pagePK:64167689~piPK:64167673~theSitePK:5530498,00.html>

around 1.5 billion ha are available for rain-fed crop production expansion. The estimates are net of current urban areas, forests and protected areas⁵. Surveying as part of the Gallagher review found between 790 and 1,125 m Ha of land as available for production, once water availability was accounted for. Other estimates from the European Environment Agency were more pessimistic - between 50 and 400 m ha.⁶ Land use is further considered in [headline indicator 2](#).

Assessment

Availability of food per person has increased in recent decades, and has not shown signs of falling. At the same time many people remain, for a variety of complex reasons, poorly nourished. FAO estimated in June 2009 that more than **1 billion people are undernourished** as they lack access to food.⁷ Yet this does not appear to be lack of overall food since the World Health Organisation estimates that, globally in 2005, **some 1.6 billion adults were overweight**; and of these at least **400 million adults were obese**. WHO further projects that by 2015, approximately 2.3 billion adults will be overweight and more than 700 million will be obese.

It should also be noted that as economies develop average energy requirements of the population fall - people do less physical work, live and work in temperature-controlled environments, and increasingly use motorised means of transport.

The recent turbulence in global markets (see supporting indicators on prices and stocks) has clearly adversely affected the short-term food security of poorer countries. In 2007/8 falling stocks and supply shocks triggered sharp rises in price in staple commodities, particularly where trade has been restricted. But availability problems should not be exaggerated, as the high prices also act as signals for producers to increase plantings and output.

The ability of international and regional markets to bring supply and demand into line is a real strength, but it does not necessarily guarantee that everyone is fed or that natural resources are sustainably used. For the medium term, the uncertain effects of climate change and the challenges facing developing countries to increase production suggest an amber rating.

Rating of current position



Comparison with mid-1990s

Improvement

Likely position in 5-10 years



⁵ OECD-FAO *Agricultural Outlook 2009-2018*, http://www.agri-outlook.org/pages/0,2987,en_36774715_36775671_1_1_1_1_1,00.html (June 2009)

⁶ *The Gallagher Review of the indirect effects of bio-fuel production* (July 2008), <http://www.dft.gov.uk/rfa/reportsandpublications/reviewoftheindirecteffectsofbiofuels.cfm> pp. 33 -4 of the full report.

⁷ 1.02 billion people hungry <http://www.fao.org/news/story/en/item/20568/icode/>
<http://www.who.int/mediacentre/factsheets/fs311/en/index.html>

Box 2 The UK's contribution to global food security

The *Food Matters* report notes that “production of cereals and other food in the UK makes a small but meaningful contribution to overall global food supply” (p. 34). In 2007, UK production of wheat and barley accounted respectively for 2.2% and 3.8% of total global production. In total UK cereals accounted for around 1% of global cereal exports. The UK also accounts for 3.7% of global sheepmeat production and a higher share of world sheepmeat trade (8%). UK cereal yields are very high by international standards, averaging over 7 t/ha, compared with an OECD average of 4.6 t/ha and a world average of 3.3t/ha (see yields indicator in this theme). This partly reflects the UK's temperate climate and the dominance of high-yielding soft wheat varieties.

Food Matters adds that “the UK seems likely to have a greater impact via its influence on international policy, diplomatic initiatives, development programmes and research efforts.” These are detailed within the covering narrative of the assessment, but in summary include:

- Leading efforts through international partnership to tackle global hunger sustainably (the Global Partnership for Agriculture, Food Security and Nutrition(GPAFSN)).
- Continuing to argue for radical reform of the CAP, rejecting trade protectionism and supporting Doha trade negotiation efforts.
- Committing, through DfID, £400m to support and improve international agricultural research, and also contributions to the International Fund for Agricultural Development (IFAD), and the Consultative Group for International Agricultural Research (CGIAR). Defra and DfID are co-sponsoring the Foresight study into long-term Global Food Security.
- Focusing world-class scientific research efforts on food security through the UK's Research Councils.
- Supporting studies at the international level to assess the state and value of ecosystems, and the pressures upon them from land-use change and other sources.

Theme 1

Global availability

Supporting indicator 1.1

Cereal yield growth rates by region

Rationale and associated risks

Improved technologies leading to increased yields (output per area) and productivity have played an important part in the increasing world supply of food. **Yields are a key outcome measure of applied research, investment and good practice** (see [indicator 1.6](#)). Without improvements in yields, more land would need to be cultivated, which could be environmentally damaging. Changing climate, pests and diseases, harvest losses and underinvestment can all hamper yields and yield growth. In the developed world, yields will reflect prevailing price and regulatory incentives as much as technology and climate, but this appears to be less the case in the developing world. Of course, yield growth itself can be environmentally damaging through use of fertiliser and water resources and generation of pollution (see [Theme 2](#)).

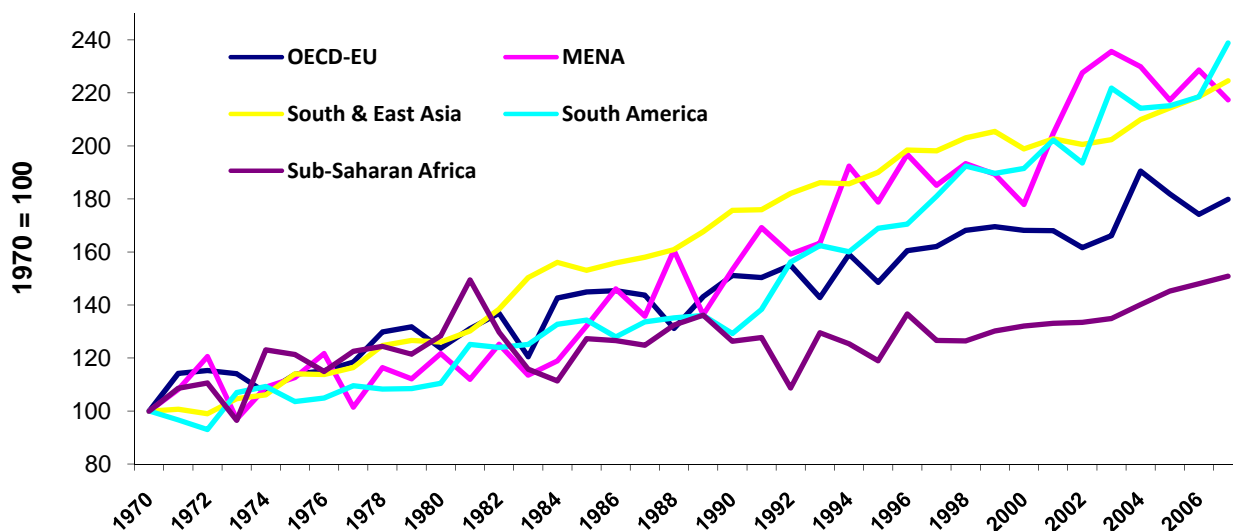
Desired outcome

Sustained and significant upward trends in yields globally, but ideally in the developing world so that developing countries become a more significant contributor in the future. However in terms of global availability of food it matters little where this food is produced given a relatively efficient world trading system and for this reason we also consider yield growth in developed countries.

Indicator Cereals yield growth rates

Source FAO datasets

Cereal yield growth rates by region, 1970 - 2007



Key Points

- Growth rates slowed in most regions during the last decade compared to the 1990s (see also table below).

- Yields in Sub-Saharan Africa are growing again, but they are still low compared to other regions and have grown by less than half a tonne per hectare since 1970.
- South American and Asian yield growth has been significant and sustained, registering the same actual yield increase (around 2 t/ha) as OECD/EU countries. In 2007 their yields were the same as those for OECD/EU twenty years ago.

	Yields (tonnes per hectare)				Growth of yields	
	1970	1987	1997	2007	1987 – 1997	1997 – 2007
World	1.77	2.54	2.99	3.35	18%	12%
OECD/EU	2.6	3.7	4.1	4.6	13 %	11 %
Developing Country Regions						
M East & N Africa	1.0	1.4	1.9	2.2	36 %	17 %
South & East Asia	1.7	2.6	3.3	3.7	25 %	13 %
South America	1.6	2.1	2.8	3.7	35 %	32 %
Sub-Saharan Africa	0.8	1.0	1.0	1.2	1.5 %	19 %

Note - Figures are rounded

Assessment

Slowing yield growth since 1997 is not necessarily a concern given that the headline indicator has improved. And **there is little evidence to suggest that yields in OECD countries are slowing due to natural resource constraints rather than market signals**; over the last 50 years supply has been more than adequate in meeting demand resulting in falling real commodity prices which in turn have dampened incentives for ever increasing yields.

The majority of the world's food is produced in those regions that have experienced strong levels of growth throughout the period 1970-2007. Most developing and middle income regions (which currently account for two-thirds of world cereal production) have yields growing faster than the OECD-EU but have still some way to go before approaching OECD yields.

Climate and resource endowments will affect the relative yield potential of different regions – thus Middle East and North Africa, lacking rain and water, can be expected to have lower yields than other regions. But even their yields are 1 t/ha greater than Sub-Saharan Africa, and the chronic poor performance of the latter remains a concern for the future.

Looking ahead, population growth is expected to ease to an average annual increase of 0.8% (about half the annual rate between 1960 and 2005), which suggests that yield growth will not need to be as great as in the past thirty years. Nevertheless, attaining the necessary yields within the constraints of a changing climate should not be taken for granted, and is dependent upon appropriate investment in technology and public policy.

Rating of current position



Comparison with mid-1990s

Similar

Likely position in 5-10 years



Theme 1

Global availability

Supporting indicator 1.2

Real commodity prices

Rationale and associated risks

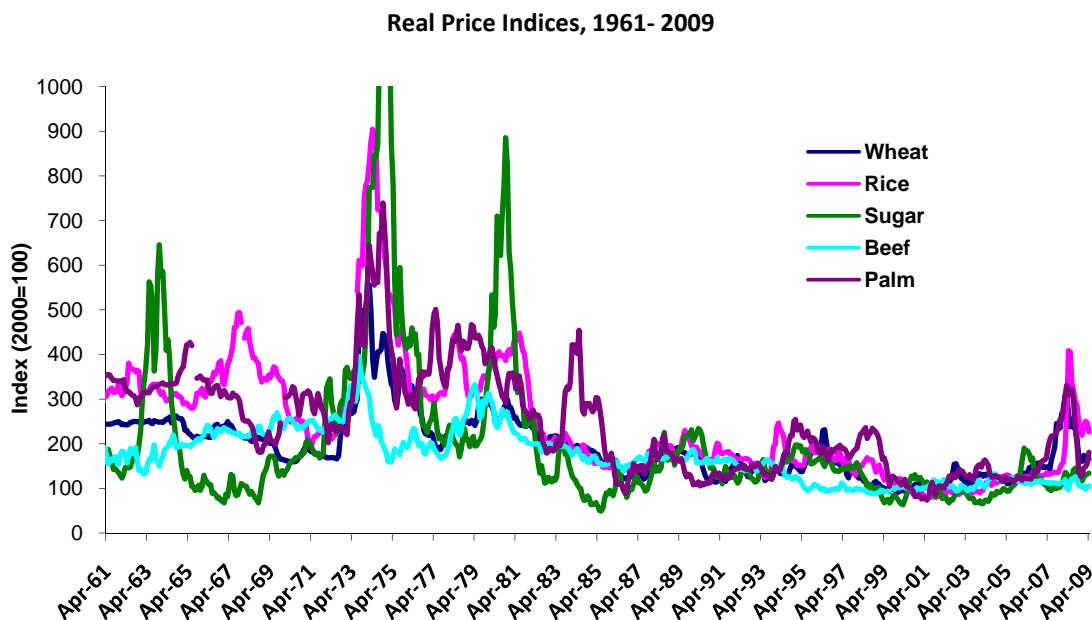
This indicator should broadly reflect the global availability of agricultural commodities. Higher prices signal relative shortages, whilst falling prices signal improved supply or even oversupply. Higher prices give an incentive for producers to increase supplies and for consumers to reduce demand. It is partly an outcome indicator of any underlying supply issues, and a leading indicator of potential price changes to consumers.

Desired outcome

In the short-term, for prices to perform their function to send the appropriate signals when the global market is over- or undersupplied. In the medium to longer term relatively affordable prices which reflect the availability of agricultural commodities.

Indicator Global Real Prices for Selected Commodities

Source UNCTAD, BEA



Key points

- Since the 1970s, real commodity prices have trended downwards as global supply capacity has outpaced global demand but since the 1990s the downward trend has somewhat levelled off.

- In 2007-8, some commodity prices (e.g. wheat, rice, palm) increased sharply followed by sharp falls in the second half of 2008. **However, even at their 2008 peak, prices in real terms stayed well below their peaks in the 1970s.** Other commodity prices, such as beef and sugar, have not seen any major increase.⁸
- All agricultural commodity prices have seen sharp falls from their peak levels. With the exception of rice, the prices are similar to the price levels seen over the last two decades. However, the rice price remains significantly above the average price over the last two decades.

Assessment

In 2007-8, a range of commodity prices increased sharply but have now fallen sharply as a favourable supply response comes on stream. The 2008 global price situation has clearly been very unfavourable for a range of developing and middle income countries where food accounts for a large share of household budgets. A year ago this would have been given a red light rating but commodity prices are back at generally affordable levels. The specific impact on UK citizens is considered under the affordability theme.

There are suggestions that the longer term downward trend has come to an end but it is hazardous to assess how prices will develop in the medium term. The question is whether the prices which bring supply and demand into balance are likely to be affordable, particularly to the poorest, and how they impact on research and investment and thus on future supply capacity. The OECD-FAO 2009 medium-term projections, made in the light of last year's price movements, indicate a resumption of the downward trend in real commodity prices. However, average cereal and livestock prices in the coming decade are projected up to 20% higher than in the decade prior to the price spike. The recent World Bank outlook also expects real commodity prices to decline to 2030, reflecting the combination of weaker food demand growth and the potential for cultivation of unused land together with further productivity improvements. This is after factoring in temperature rise and water challenges.⁹ This would suggest a favourable medium-term rating, but the potential for climate-related volatility in any given year suggests a more cautious amber rating.

Rating of current position



Comparison with mid-1990s

Similar. Real prices were lower in the late 1990s than in 2008/9. But cereal prices also spiked in 1995/6, giving rise, as in 2008, to longer-term concerns.

Likely position in 5-10 years



Potential development

- Include soybean prices
- Commentary on the extent to which global prices are transmitted to domestic prices in different regions
- Text box summarising the causes of the 2007-8 price surge.

⁸ The prices quoted here are based on US dollar denominated prices. Due to exchange rate movements the effects in other currencies are different. For example, prices in Euro or in Brazilian Real have experienced significantly smaller increases

⁹ World Bank, *Global Economic Prospects 2009*, pp. 85-6.

Theme 1

Global availability

Supporting indicator 1.3

Stock to consumption ratios

Rationale and associated risks

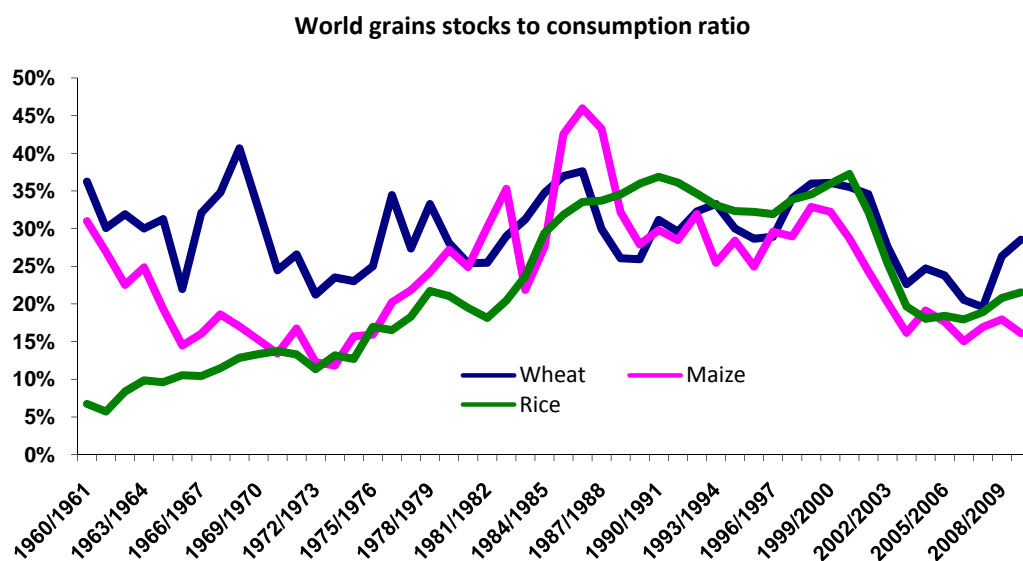
Stocks to consumption ratios function as an early indicator of the changing balance of markets over time, and an indicator of the impact of future supply and demand shocks on prices. Especially for crops, supply shocks are a regular feature of the market. Therefore, this indicator focuses on cereals.

Desired outcome

Sufficient stocks levels to provide the market with some resilience to supply (or demand) shocks without rising to levels that indicate structural oversupply of markets. However, it is difficult to identify an “optimal” stock ratio, and changes in the ratio require careful interpretation (e.g. see below).

Indicator Global Stocks to Consumption Ratios for Cereals

Source USDA

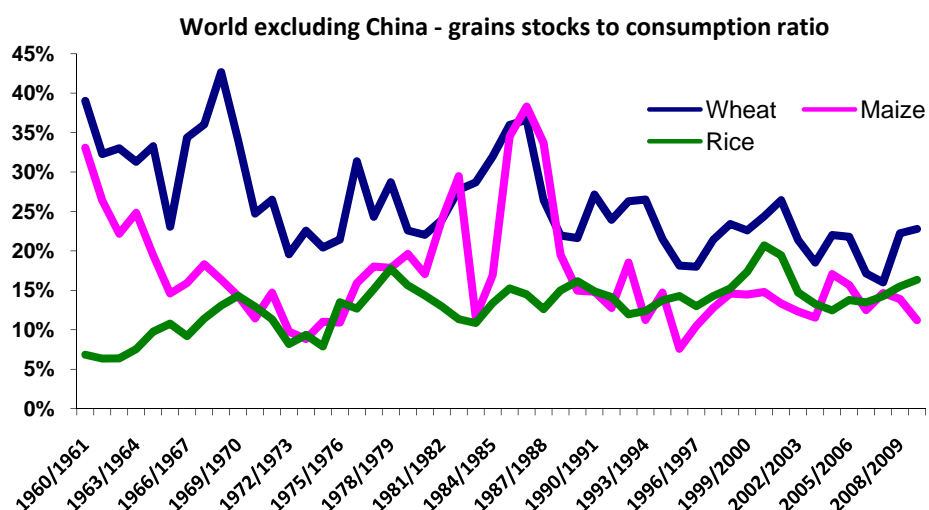


Key points

- Stock ratios have been significantly lower in the 2000s than in the previous two decades.
- Following a record global harvest of wheat, wheat stocks are forecast to increase significantly during this marketing year. The wheat stocks to consumption ratio is forecast to increase to the highest level since 2002/03. For rice and coarse grains small increases are forecast.
- The significant fall in the stock to consumption ratios between 1999 and 2005 is in large degree due to the **reduction in stocks in China**. USDA estimate, for example, that between 2000 and 2005, Chinese wheat stocks decreased by more than 60 million tonnes. To put this into perspective, current global wheat stocks are estimated to be around 90 million tonnes. Recent analysis, among others by FAO¹⁰, suggest that the more

¹⁰ FAO Agricultural Development Economics Division, *The Unimportance of “Low” World Grain Stocks for Recent World Price Increases* (working paper, February 2009) <ftp://ftp.fao.org/docrep/fao/011/aj989e/aj989e.pdf>

relevant stocks figures are global stocks without China. This is due to the fact that China does not generally enter the world market for cereals. China's stock management therefore does not impact on world market trends nor is it influenced by them.



- Other policy changes have contributed to reduced stock levels e.g. in the EU, a reduction in the cereals intervention price.
- Everything else being equal, more global trade reduces the need for large stocks as national production shortfalls can be filled by imports more easily.

Assessment

In recent years, cereal stocks declined to levels significantly below those seen in previous decades. In this situation, markets became sensitive to supply shortfalls, which has magnified the price response. However, other factors have also reduced stocks, especially changes in policy aimed at reducing economically inefficient levels of stocks. The most dramatic change was the reduction in stocks in China which was almost completely independent of world market trends. Global stocks without China have not been particularly low recently.

The record global harvest in the marketing year 2008/09 has increased grains stocks, particularly wheat. But maize stocks are relatively low. And reduced maize plantings following the sharp fall in prices at the end of 2008 are likely to lead to a reduction in production and stocks in 2009. In the medium term, stocks are expected to stay at a comfortable level, but consecutive harvest failures still have the potential to lead to low stocks. The effect of the current stock levels will to some degree depend on the markets' assessment of the importance of Chinese stocks. In the meantime the markets might remain more vulnerable to shocks. Hence the amber ratings.

Rating of current position



Comparison with mid-1990s

Deterioration. Abundant, but probably excessive and economically inefficient (inc. public) stocks in 1990s

Likely position in 5-10 years



Theme 1

Supporting indicator 1.4

Global availability

Share of global production internationally traded

Rationale and associated risks

A well functioning international trading system is necessary if the UK, Europe, and indeed the world, is to be food secure. Whilst trade is not without its costs and externalities, particularly in developing countries, in general more specialisation and trade is needed to:

- spread the risks of supply shortages in individual countries;
- incentivise production where comparative advantage exists, thus enhancing resource efficiency;
- allow supply to respond readily to international price signals, and
- facilitate the spread of new technologies and economies of scale.

In this case a rising proportion of production would be traded. On the other hand, thinly traded international markets can reflect substantial trade protectionism, an increase in bilateral trade deals (although these can boost productivity¹¹), but also the costs of transporting goods between countries and the limited adaptability of agricultural produce to different climates. In such markets, even relatively limited supply shocks in a significant producing country, or restrictions on exports, can have a proportionately greater impact on the balance between international demand and supply. Note that this indicator does not concern *the composition or concentration* of trade (see [indicator 1.5](#)), only the aggregate *extent* of trade.

Desired outcome

Increasing or stable trends in the percentage of commodities internationally traded to strengthen the resilience of the global commodity markets.

Indicator **Share of global production internationally traded**

Source FAO datasets, F.O. Lichts (for sugar)

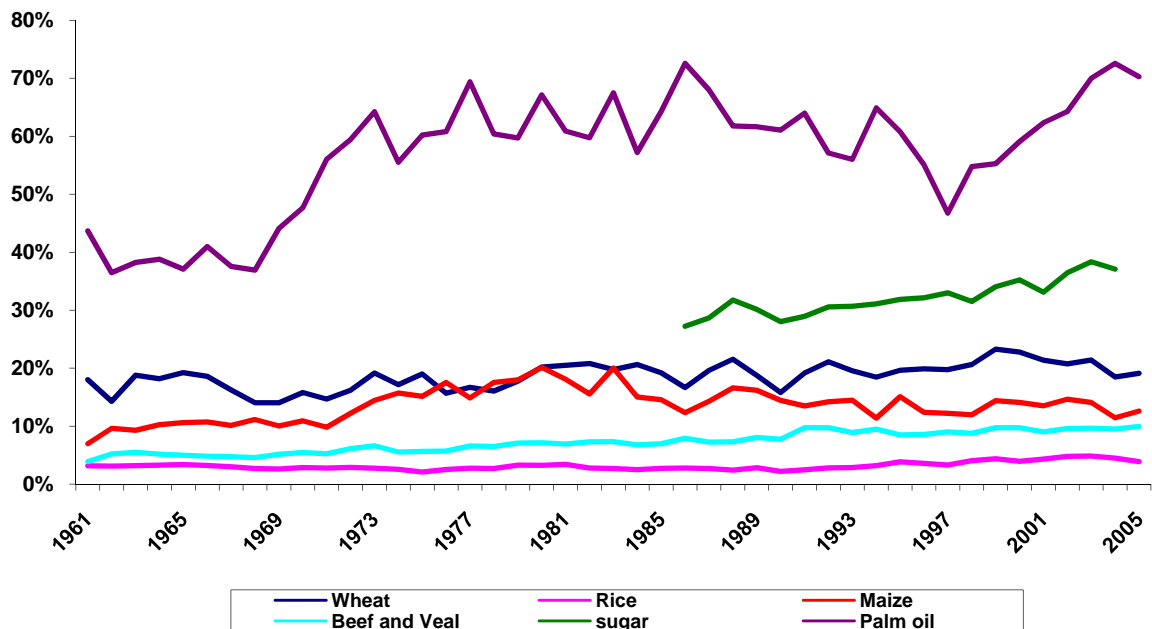
Key points

- The proportion of wheat traded has slightly increased since 1961 but there is significant year-on-year variation.
- At around 15-20%, the proportion of wheat and maize traded is fairly high whilst the international rice market (4%) is fairly thin.
- The proportion of trade in beef and veal has increased as well. The figures include carcase meat and boneless meat trade. However, they exclude processed food. Processed food trade has increased more than bulk trade but it is difficult to include figures as the percentage of primary product in processed food would need to be estimated. Therefore the extent of trade in meats will be understated by the raw commodity figures.
- Due to data limitations for vegetable oil, only palm oil is included in the chart. Total vegetable oil production and trade would be more appropriate.¹² A very high percentage of palm oil is traded.

¹¹ See FAO, Economic and Social Perspectives Policy Brief, *From land grab to win win* (June 2009) <http://www.fao.org/economic/es-policybriefs/detail/en/?uid=21523>

¹² Unlike palm oil, other vegetable oils are traded largely in their primary, oilseed, form.

Percentage of global production internationally traded, 1961-2006



Assessment

Significant shares of wheat and maize, sugar and palm oil are traded internationally. The international rice market is thin and therefore more vulnerable to disruptions in individual exporting countries, although from a UK perspective, rice is not a staple and therefore less of an issue. The share of primary meat products traded is a lot lower but is increasing. For products such as meat and oilseeds where a significant proportion of trade is in semi-processed and processed goods, it is more difficult to construct a robust indicator than it is for cereals and sugar.

However, there is a question about how genuinely free and open some of the trade in agricultural products is – preferential and bilateral deals can limit the risk-spreading benefits that open trade brings. Further multilateral trade liberalisation through the Doha Round (currently stalled) remains key to ensuring that a significant and increasing share of production is traded. Further CAP reform is also an essential part of this process.

Rating of current position



Comparison with mid-1990s

Similar

Likely position in 5-10 years



Potential development

- Closer monitoring of bilateral trade deals
- Include trade in fertilisers

Theme 1

Global availability

Supporting indicator 1.5

Concentration in world commodity markets

Rationale and associated risks

A well functioning international trading system should be diverse and competitive. Market power in any market can have economically harmful effects on prices and supplies. If exports are heavily concentrated in one or two countries, overall market supplies could be vulnerable to country specific supply shocks. They are also vulnerable to economically or politically motivated national actions such as export restrictions, creating large price spikes or even actual shortages. This risk remains even where a large share of global production is internationally traded (see indicator above). However, it is important to bear in mind that countries which export large surpluses are in turn dependent upon buyers for their economic wellbeing (e.g. West African exports of cocoa or bananas).

Desired outcome

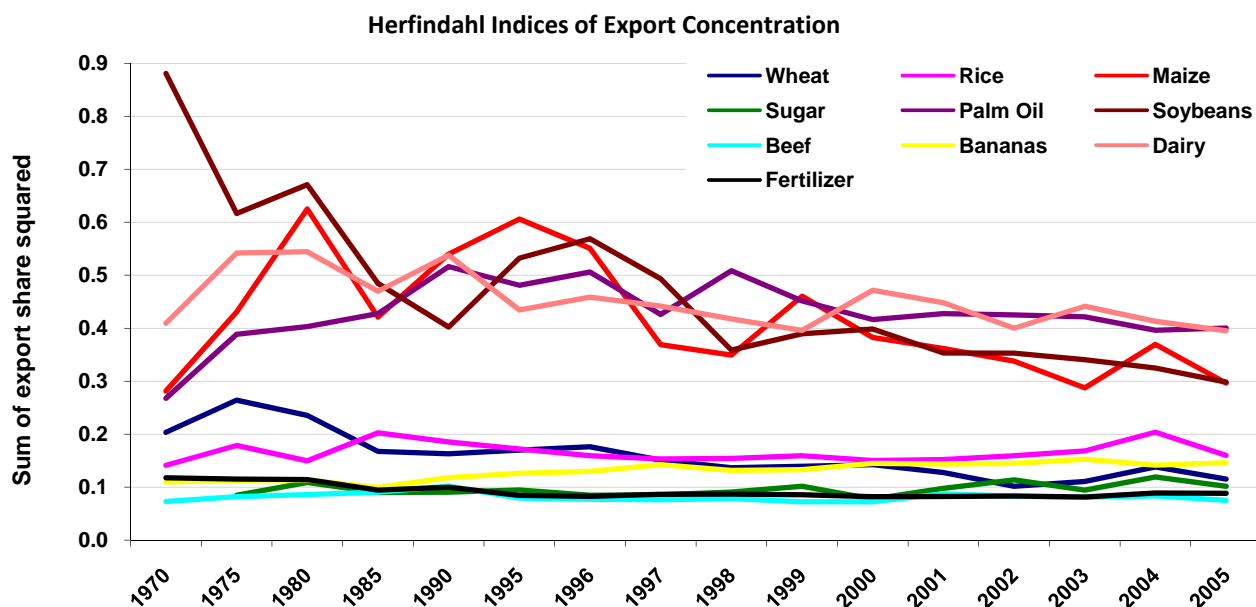
Good diversity of supplying nations for the main commodities. Attempts by individual countries to restrict export supplies, for whatever reason, would not result in any substantial, sustained increase in prices or actual shortages.

Indicator Herfindahl index of export concentration for various commodities.

Source FAO datasets, F.O. Lichts

The Herfindahl Index (HI) measure of market concentration is often used by competition authorities but it also provides a measure of export market concentration. This is considered a better measure than, say the concentration ratio of the top 3 or 5 suppliers because it accounts for the shares of all suppliers, and it is affected by the split of the market between the largest suppliers. In the HI, each suppliers' market share is *squared* (so higher market shares get a heavier weighting) and these are summed - where s_i is the market share of country i :

$HI = \sum_{i=1}^n s_i^2$ Thus a market completely dominated by one country / firm would give a HI of 1.0. If all top 20 suppliers had equal shares, the index would be $1/20 = 0.05$.



Key points

- Broadly speaking, concentration has been in gradual decline since the 1970s.
- Soybeans and palm oil have similar 3 firm concentration ratios but palm oil has a much higher HI than soybeans
- Rice trade appears to become less concentrated than wheat and sugar using the 3 firm concentration ratio, but is more concentrated using the HI
- The HI shows more variation in maize, palm oil and soybeans

The following table details the shares of the leading supplier countries (the EU is counted as a single trading bloc) in 1995 and 2005. Most leading suppliers can be considered stable trading partners, and in some cases the EU itself is a leading supplier.

Commodity		1995		2005	
		Top 3 Exporters	share of global trade	Top 3 Exporters	share of global trade
Wheat	1	USA	32%	European Union	28%
	2	European Union	31%	USA	23%
	3	Canada	17%	Canada	12%
Rice	1	Thailand	27%	Thailand	25%
	2	India	22%	Viet Nam	18%
	3	USA	15%	USA	15%
Maize	1	USA	77%	USA	50%
	2	European Union	10%	Argentina	16%
	3	Argentina	8%	European Union	14%
Beef	1	European Union	59%	European Union	75%
	2	Ukraine	11%	Australia	5%
	3	Canada	6%	Belarus	4%
Sugar	1	European Union	22%	Brazil	35%
	2	Brazil	14%	European Union	17%
	3	Australia	12%	Australia	8%
Palm Oil	1	Malaysia	67%	Malaysia	50%
	2	Indonesia	16%	Indonesia	39%
	3	China	3%	Papua New Guinea	1%
Soybeans	1	USA	72%	USA	39%
	2	Brazil	11%	Brazil	34%
	3	Argentina	8%	Argentina	15%
Bananas	1	Ecuador	27%	Ecuador	29%
	2	Costa Rica	15%	Philippines	12%
	3	Colombia	10%	Costa Rica	11%
Dairy	1	European Union	65%	European Union	61%
	2	New Zealand	9%	New Zealand	12%
	3	Australia	5%	Australia	5%
Fertilizer	1	Canada	18%	Russia	19%
	2	Russia	13%	Canada	17%
	3	United States	15%	United States	10%

The USA remains the main exporter of maize and soybeans, but has seen its share of trade reduced significantly between 1995-2005. Global trade in palm oil remains heavily concentrated, but the balance between the main two exporters has become more equal between 1995 – 2005. Brazil has replaced the EU as the leading exporter of sugar. The EU has a large presence in the world dairy market. In 2005, Russia was the world's largest exporter of fertilizer.

Assessment

Whilst some commodity markets are quite concentrated (maize, soybeans, palm oil), concentration in these has fallen over the last 20 years, and other commodities remain relatively unconcentrated, with HI figures below 0.2. Additionally, a number of the leading suppliers would be considered stable trading partners and therefore pose a lower risk in terms of politically motivated shortages. The possibility of substituting commodities (both in production and in consumption) in the event of a market shortfall by a leading suppliers should also be recognised.

This favourable position is unlikely to deteriorate in the coming years. Several interlinked factors are likely to affect relative patterns of trade in various ways:

- A changing climate could shift patterns of comparative advantage, perhaps in unpredictable ways. Countries in northern, temperate latitudes may increase market share.
- If Africa realises its productive potential and begins to export more, overall market concentration could be reduced
- Multilateral agreements on freer trade could reduce or increase market concentration depending upon existing patterns of trade and comparative advantage. For instance, we would expect Brazil to increase its share of world sugar exports if sugar tariffs were significantly reduced.
- The diversion of grains from export to domestic bio-fuel production esp. in the US may affect trade shares.

Rating of current position



Comparison with mid-1990s

Improvement

Likely position in 5-10 years



Potential development of the indicator

- Consider whether the role of large grain traders improves the functioning of markets or creates vulnerabilities.

Theme 1

Global availability

Supporting indicator 1.6

Agricultural research spending

Rationale and associated risks

Improved technologies leading to increased yields and productivity have played an important part in the increasing world supply of food. Equally, declines in agricultural R&D have been cited as a factor in the slowing down of agricultural production in recent years. The World Bank and others suggest that there has been significant underinvestment in agriculture and agricultural R&D since the 1990s especially in developing countries. Most of the potential to improve yields and production is in the developing world. Africa in particular has substantial unrealised potential, but has difficulty capturing spill-over benefits from research elsewhere.¹³ In general it is not clear how far and fast rich country R&D – whether funded by the public or private sector - can be beneficially transferred to poor countries.

Whilst levels of R&D expenditure have been widely cited as a key factor in slowing output growth, levels of expenditure say little about the quality of the research or the potential for its transfer. Data quality is also problematic. It is therefore likely to be a very crude indicator of future global supply potential and resilience. The indicator covers both public and private R&D expenditures. It is likely that research priorities differ between public and private institutions but we do not assess those differences materially in this indicator.

Desired outcome

Agricultural research spending acts as a leading indicator of future production potential and will assist in insuring against and adapting to climate change and other environmental challenges

Indicator **Gross expenditure on agricultural research, 1995-2000**

Source IFPRI

Key points

- In real terms, developing country spend rose by 56% over this period whilst developed country spend rose by 24% . World spend rose by 30%.
- The increase in R&D expenditures in developing countries driven mainly by large increases in spend in Asia-Pacific, the Middle East and North Africa
- Developing countries increased their share of global R&D spend by 3.6 percentage points from 1995 to 2000.
- However over ¾ of global agricultural R&D spend takes place in high-income countries. Research priorities and preferences are likely to differ between developed and developing countries.
- Research into environmental impacts rather than yield growth may be more likely in higher-income countries and there is concern that the benefits of this research may not be transferrable to lower income countries.
- The global figures mask regional variations.

¹³ E.g. see D. Johnson and R. Evenson, 'How Far Away Is Africa? Technological Spillovers to Agriculture and Productivity', *American Journal of Agricultural Economics*, 82 (August 2000)

	Total R&D expenditures (2000 international \$m)		Share of global total (%)	
	1995	2000	1995	2000
<i>Developing countries</i>				
Asia-Pacific	52,416	94,950	9.3	13.0
China	19,469	48,247	3.5	6.6
India	11,678	20,749	2.1	2.8
Latin America and the Caribbean	17,222	21,244	3.1	2.9
Brazil	9,771	12,398	1.7	1.7
Sub-Saharan Africa	3,008	3,992	0.5	0.5
Middle East and North Africa	8,626	14,893	1.5	2.0
other developing countries	19,002	21,895	3.4	3.0
Developing-country subtotal	100,274	156,975	17.9	21.5
<i>High-income countries</i>				
Japan	89,964	99,500	16.0	13.6
US	196,358	263,043	35.0	36.0
High-income country subtotal	461,367	573,964	82.1	78.5
Total World	561,641	730,939	100.0	100.0

Source: IFPRI – based on Pardey, Dehmer and El Feki (2006) using data from numerous sources.

Assessment

It is difficult to gauge the quality of the R&D being undertaken as data are limited to aggregate R&D expenditures on a global level. However given the limited evidence available, it seems that expenditures on R&D moved in the right direction from 1995 to 2000 and developing countries are increasing their share of global R&D spend, albeit from a small base. However, R&D in rich countries is increasingly orientated towards food safety and environmental quality issues rather than increasing output. This may have consequences for future spill-over potential in developing countries. Also, yields in least developed countries are at low levels, and the relatively small increase in Sub-Saharan Africa would suggest that little spill-over has occurred. We have not considered the degree to which R&D expenditures result in technological spill-overs from high- to low-income countries.

Looking ahead, the need for R&D and its application, particularly in the developing world, is critical to boosting food production in a sustainable manner. (In this regard DFID and other donor funds to CGIAR come with a reform agenda to ensure research is more focussed and relevant to smallholder farmers.) For these reasons and concern around the quality of the R&D amber ratings have been given.

Rating of current position



Comparison with mid-1990s

n/a

Likely position in 5-10 years

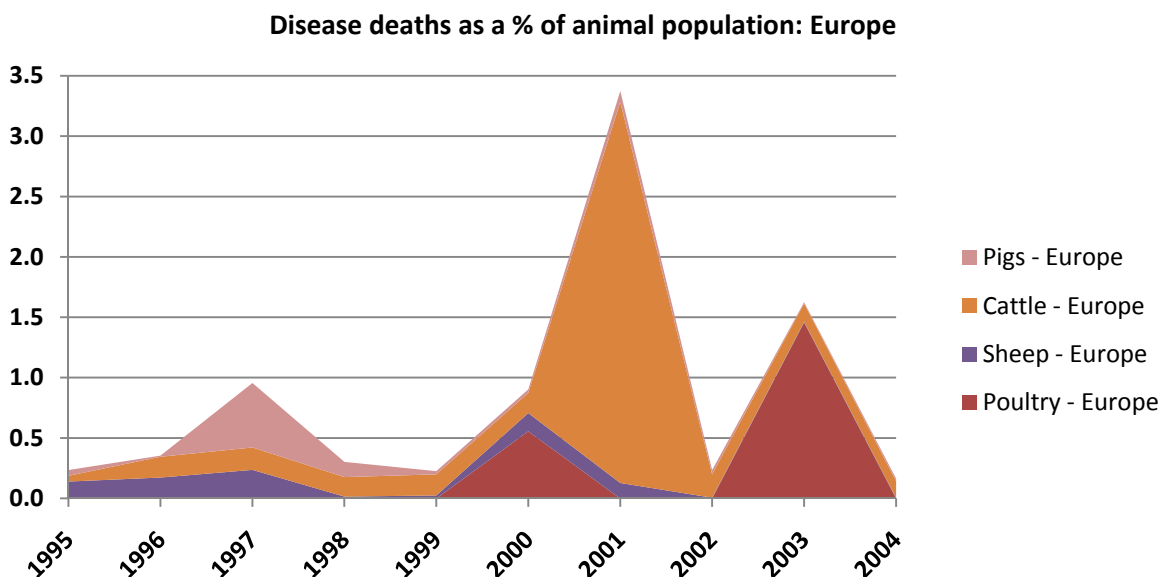


Rationale and associated risks

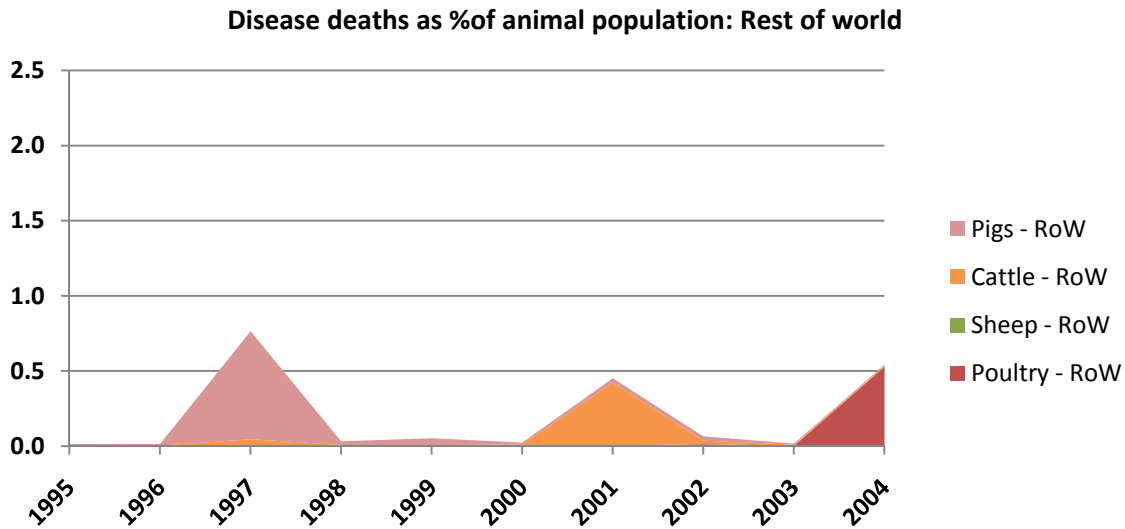
Animal diseases carry a potential threat to the supply of meat and livestock related foods. A number of animal diseases result in either the animal's death as a direct result of the disease, or the animal being slaughtered for the purpose of disease control. This indicator measures the proportion of the European and the Rest of the World livestock populations, that either die or are slaughtered because of animal disease. The diseases included are those that are identified as List A and List B diseases by the World Organisation for Animal Health (OIE). Animal diseases carry associated risks, both in terms of zoonotic diseases which have the potential to transmit to the human population, and also the impact that animal disease outbreaks can have on consumer confidence in animal sourced foods (see [headline indicator 6](#)). From a UK perspective, the impact on EU populations of animal disease is particularly relevant.

Indicator**Proportion of livestock lost to animal disease****Source**

Livestock populations – FAO. Animal disease data - OIE

**Key points – Europe**

- The sporadic nature of disease outbreaks, and their varying levels of impact, means that sharp peaks in deaths can be seen over the period.
- Cattle deaths in Europe exceeded 3% of the European cattle population in 2001 as a result of the Foot and Mouth disease outbreak in the UK.
- The impact of Highly Pathogenic Avian Influenza (HPAI) outbreaks in Italy in 2000 and the Netherlands in 2003 can be seen in the poultry data series.



Key points – Rest of the World

- It can be seen throughout the years shown, that at no time has animal disease accounted for the loss of more than 1% of the population for each of the species shown.
- The peaks in deaths shown, are as a result of Foot and Mouth Disease in China (Pigs – 1997), FMD in Kazakhstan (Cattle – 2001) and HPAI outbreaks in Vietnam, Thailand, Canada and Indonesia (Poultry - 2004).

Assessment

Although disease outbreaks can have a dramatic impact to animal populations within individual countries, it can be seen that the impact on European and global animal populations is not significant. It can therefore be concluded that there has been no threat to the European or global food supply as a result of animal diseases over the period. HPAI has emerged as a greater global threat in recent years, so it remains to be seen the impact that this disease might have on the poultry population in the future.

Looking ahead, whilst it is difficult to predict disease outbreaks and losses, losses are currently at a low level relative to production, any increase in the incidence of disease would still be expected to have only a limited impact on production and food supply. Hence we give a green rating.

Rating of current position



Comparison with mid-1990s

Deterioration FMD and AI outbreaks since 2000 have lead to greater losses than in the mid 1990s, but that losses still remain at relatively low levels

Likely position in 5-10 years



Theme 2 Global resource sustainability

Introduction to the theme

Defra's July 2008 paper on food security states, "Food must be produced in a way that is environmentally sustainable or we will set up problems for the longer term ... We need to feed a growing world population in a way that does not degrade the natural resources on which farming and food production ultimately depend". If global production expands at the clear expense of the natural environment, this would not be considered sustainable. The International Assessment of Agricultural Science and Technology for Development (IAASTD)¹⁴ responds to the realization that despite significant scientific and technological achievements in our ability to increase agricultural productivity, we have been less attentive to some of the unintended social and environmental consequences of those achievements. Such degradation in developing countries, combined with governance failures, in turn exacerbates poverty and insecurity, and undermines productivity.

However, it is difficult to measure the environmental (and indeed social) effects of global production through a narrow range of indicators. Such indicators would not be sufficiently forward looking or regionalised, and would not cover the complexity of the issues. Hence the components of this theme provide only a flavour of the evidence that is relevant to this longer-term question. We focus upon salient indicators of global resources which, if found to move unfavourably, would materially affect the world's ability to produce food in the near or medium term. In-depth analysis of the longer term challenges is being undertaken by the Government Chief Scientist's Foresight project into future (2050) global food supply. It may in time be possible to capture some of the conclusions from these analyses into suitable indicators.

In addition to global natural resource issues, other significant environmental and social side-effects of achieving food security (including within the UK) and specific issues of sustainable consumption within the UK would be monitored in our wider set of sustainable food indicators where any trade-offs can be identified.

Types of challenges and threats addressed by this theme

- *Climate change*
- *Agricultural intensification and expansion (including bio-fuels)*
- *Population growth*

¹⁴ IAASTD, <http://www.agassessment.org/>

Contextual indicator

- Global carbon dioxide emissions

Headline Indicator

- Global land use change

Supporting Indicators

1. Fertiliser intensity
2. Water productivity of crops
3. Water withdrawal
4. Global fish stocks

Other indicators under consideration, which may require further research

- Soil quality
- Pesticide intensity
- Seed diversity

Contextual indicator**Global carbon dioxide emissions****Rationale**

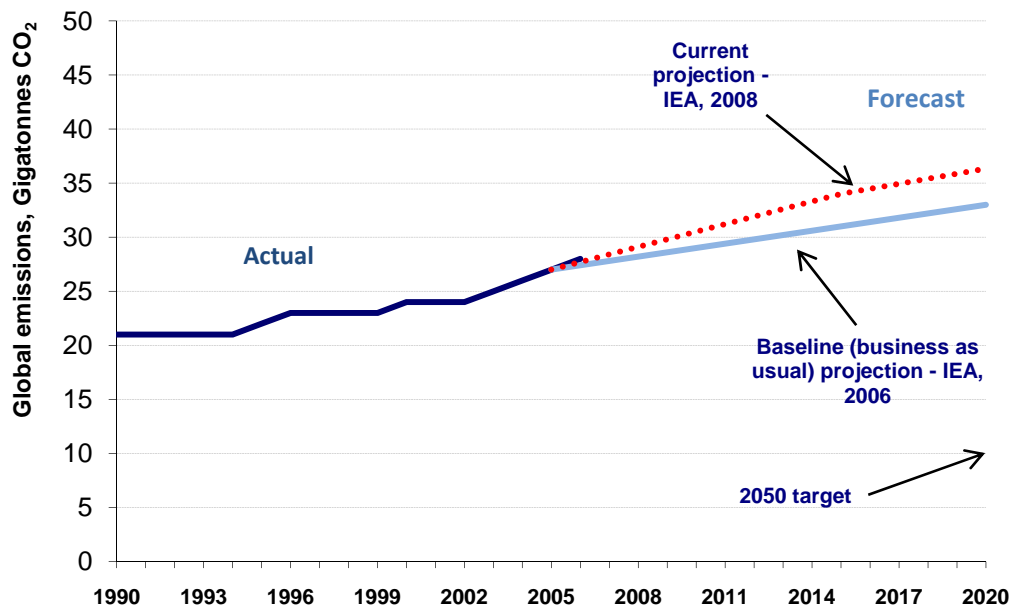
A warming and changing global climate will pose new challenges for agriculture around the world. Whilst in the short term, productivity in temperate zones may increase with modest rises in temperature, more tropical regions are likely to encounter greater natural constraints. More significant rises of temperature are also likely to affect yields (other things being equal) around the world.

Human activity results in the emission of three long lived GHGs that contribute to anthropogenic warming at the global level: Carbon Dioxide (CO₂), Methane (CH₄) and Nitrous Oxide (NH₄).

Contextual Indicator Global CO₂ emissions from fossil fuel combustion

Source DECC

DECC uses this indicator for reporting on global emissions for its Public Service Agreement (PSA) on Climate Change. This is not quite the same as total global greenhouse gas emissions but it can be used as a proxy because both the actual and predicted emissions are regularly updated and it is produced by a major international organisation. The International Energy Agency (IEA) produce the actual emissions figures once a year in the summer and update the forecast every two years.

**Key Points**

- Global GHG emissions due to human activities have grown since pre-industrial times, with an increase of 70% between 1970 and 2004. The rate of growth of CO₂-equivalent emissions was much higher during the most

recent 10-year period between 1995 and 2004 (0.92GtCO₂-eq/year) than in the previous period spanning 1970-1995 (0.42 GtCO₂-eq/year)¹⁵.

- The largest growth in GHG emissions has come from energy supply, transport and industry which together accounted for 58% of emissions in 2004. GHG emissions from agriculture made up 13.5% of the total.
- The **agricultural sector** contributes to land use change through the clearance of forest and the subsequent use of this land for cattle and crop production (see headline indicator). Earlier IPCC reports estimate that **deforestation** accounted for as much as 20-25% of annual atmospheric CO₂ emissions in 2001¹⁶. However, it is very likely that agriculture is predominantly responsible for the observed increase in global nitrous oxide and methane levels, two other GHGs that cause anthropogenic warming of the planet.
- The **food supply chain** accounted for 13.5% of global GHG emissions in 2004. 6.6% of global emissions were attributable to agriculture, 2% to food manufacturing and 2.3% to transport (local and overseas).
- The effect on global emissions of the decrease in global energy intensity (-33%) between 1970 and 2004 has been smaller than the combined effect of global income growth (77%) and global population growth (69%). The long term trend of declining CO₂ emissions per unit of energy supplied reversed after 2000.
- Global CO₂ emissions represented 77% of total GHG emissions in 2004. Global forecasts estimate that emissions of carbon dioxide will treble by 2050 compared to 1990. A collective, global target to reduce CO₂ emissions by 50% on 1990 levels has been signed by members of the Kyoto Treaty (Check: Is this Europe or Kyoto target). Estimates suggest that this target will be missed.
- The Energy Information Administration and the Oil & Gas Journal estimate that known reserves of oil and natural gas have more than doubled since 1980. The reserves to production ratio, which measures the remaining amount of the exhaustible resource has trended upwards since 1980 suggesting that there is no evidence of reserves being severely depleted any time soon (see Box 4).

¹⁵ IPCC (2007) *Climate Change 2007: Synthesis Report, Intergovernmental Report on Climate Change*,

¹⁶ IPCC (2001) *Climate Change 2001: Synthesis Report, Intergovernmental Report on Climate Change*

Box 3 Climate Change and Food Security

The links between climate change and global and UK food security are complex, uncertain and varied. Some of the threats and challenges posed by a warming and more volatile climate are noted in the risk matrix table (Figure 1). Climate change impacts are captured by, or will have implications for, a number of the themes and indicators, for example:

- Greater risks to harvests from variable weather, drought and pests, leading to potentially more volatile supplies and prices – (see Theme 1 indicators)
- Rising temperatures generally are likely to improve yields in the shorter term in the northern hemisphere, but threaten yields in other, developing regions (see indicator 1.1)
- Greater incidence of animal diseases affecting meat supplies. Although indicator 1.6 shows these to be very small at EU and global level; continued vigilance of food safety is needed.
- Increased climatic stress on natural resources (particularly water) and biodiversity threatens productivity in various regions of the world. For instance, productivity of horticulture could be affected in water-stressed regions such as the Middle East and North Africa (indicators 2.2 and 2.3)
- Ocean acidification adding to pressure on marine stocks (indicator 2.4)
- More frequent extreme weather events in the UK will test business continuity planning and infrastructure resilience (theme 4 indicators). Coastal flooding can affect ports and agricultural land use (theme 3 indicators).

We also need to monitor food and agriculture's own impact on climate change and bio-diversity e.g. through forest displacement and energy intensive fertilisers and production processes. Policies to mitigate climate change means we will need to rely less on fossil fuels in an energy intensive food system (Headline indicator theme 4).

Theme 2

Global resource sustainability

Headline indicator

Global land use change

Rationale and associated risks

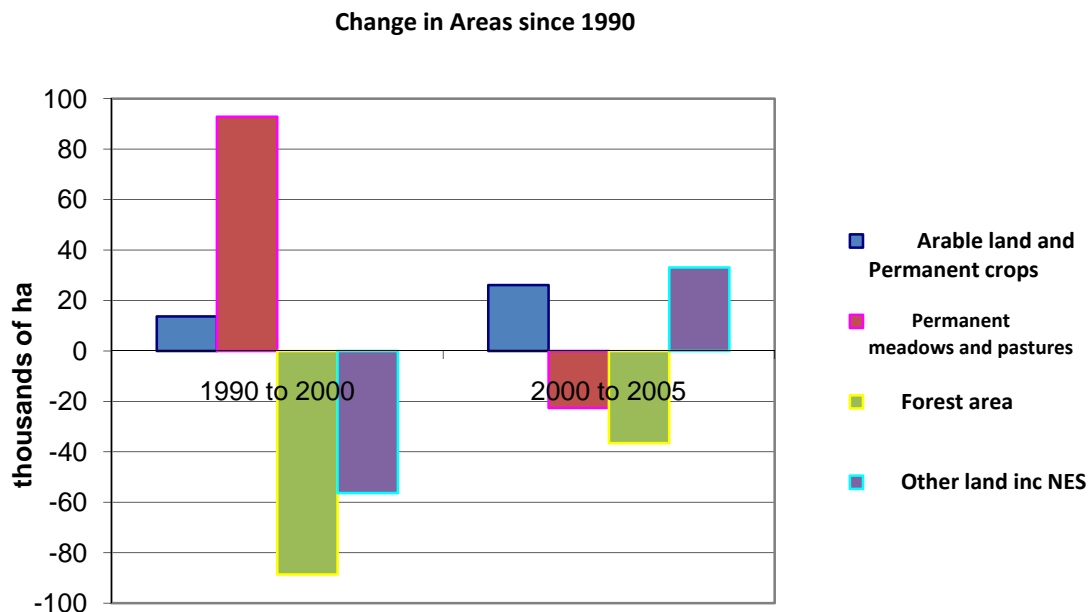
World agricultural production can be increased by converting more land to farmland rather than by increasing productivity. FAO estimate that globally around 1.5 billion ha are available for rain-fed crop production expansion. These estimates are net of current urban areas, forests and protected areas, but any expansion would put further pressure on ecosystem services and biodiversity. In reality though, some forests and protected areas are also converted to farmland. Bearing in mind the impact that land use change has on the overall carbon balance as well as biodiversity and rainforest (see the *Gallagher Review* of bio-fuels) land availability and utilisation are key indicators of natural resource constraints. However, data on these can be problematic, ambiguous and difficult to interpret.

Desired outcome

Agricultural production increases without significant loss to critical natural capital and eco-system services associated with land expansion.

Indicator **Global land use change**

Source FAO



Key points

- Between 1990 and 2000 agricultural area grew, as the amount of forest area/other land declined
- Between 2000 and 2005 the areas of arable/permanent crop land and other land grew, with pasture/meadows and forest areas in decline
- Between 1990 and 2005 the amount of forest area in the world fell by 3.2% (around 0.2% per year).

- There was notable variation in the changes in forest areas across, and even within continents. The largest drop in forest areas was in Central America, at 23% (around 2% per year). The largest growth in forest areas was in East Asia, at 15% (around 0.9% per year). The European, Western/Central Asia and North American forest areas saw little changes.

Assessment

Most of the expansion in food production in the second half of the twentieth century is attributable to growth in yields rather than area. **Whereas food production increased by 150% in the forty years after 1961, overall land use increased by 11%.** Land expansion has also been relatively small since 1995, rising from 4.94 bn ha to 4.97 bn in 2005.¹⁷ Nevertheless,, the indicator shows that forest area has declined in the last fifteen years apparently at the expense of arable and pastureland. Some of this land is likely to include ecologically valuable land (though this is not shown separately in the data). However, it is likely that this trend will to some extent continue, further reducing the area of natural forest and the aggregate level of ecosystems services provided.

Unfortunately, there is little or no reliable data series on the loss of critical natural capital due to food production. It is difficult to measure the lost area reliably on a global level and even more difficult to establish a direct causal link between food production and these changes. Other factors such as illegal logging for tropical woods or other uses also play a part.

Given the desired outcome of **no additional loss of critical natural capital**, we give amber for the present. Since **the trend in the reduction of forest areas is likely to continue**, we give a red rating for medium term .

Rating of current position



Comparison with mid-1990s

Uncertain / deterioration

Likely position in 5-10 years



But there are also **value judgements** to be made here as to some extent there is a trade-off, at least in the short and medium-term between reducing food poverty and maintaining environmental goods and services.

It should also be noted that **the small time series does not enable this conclusion to be drawn reliably**. The correlation between different land areas does not necessarily give any clear idea as to the drivers of forest area decline (for example timber felling or natural events could clear forest areas with the land later being used for agriculture). A report undertaken as part of the Gallagher Review¹⁸ cites a number of sources suggesting that forest area decline has historically been linked to timber extraction. Referring to Brazil, there has been a decline in forest areas in order to rear cattle. Referring to India, the report shows detailed data between 1950/51 and 1999/2000, showing increasing forest areas (India aims to bring one third of land area under forests). Increases in agricultural land areas in India were a result of declines in barren land. There are also non-food pressures on land use clearance, such as the production of palm oil for a range of non-food products.

¹⁷ FAOstat.

¹⁸ http://www.renewablefuelsagency.org/db/documents/Themba_Local_land_use_change_impacts_and_opportunities.pdf

Theme 2 Global resource sustainability

Supporting indicator 2.1 Fertiliser intensity

Rationale and associated risks

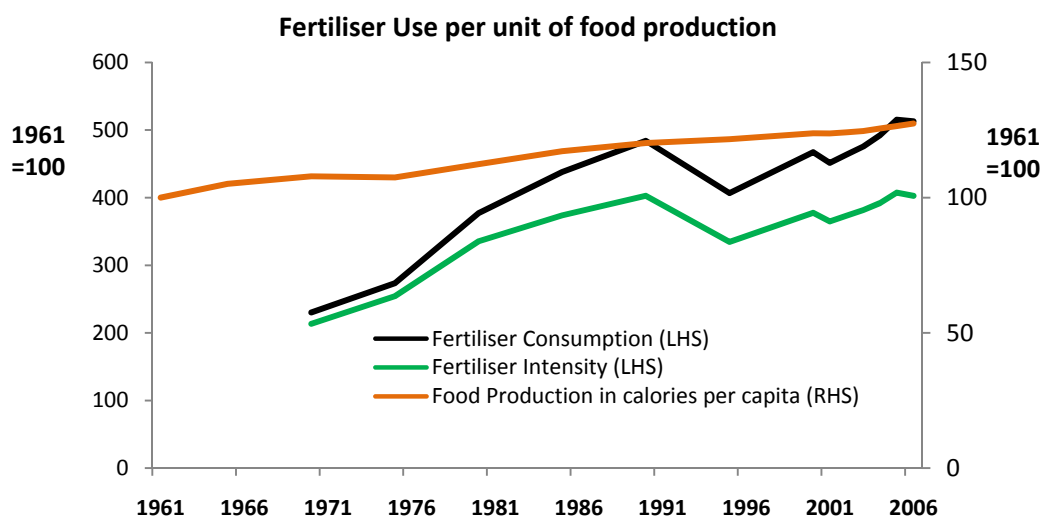
Agriculture is a major user of energy, especially through fertiliser usage and its manufacture.¹⁹ In addition there are environmental concerns arising from fertiliser application such as nitrogen run-off (diffuse pollution), emissions of nitrous oxide (a powerful greenhouse gas), and negative impacts on soil quality and sustainability. (The overall energy intensity of UK food production we consider explicitly in [Theme 4](#).) World fertiliser use per unit of *food production per person* (in calories) – see [Headline indicator, Theme 1](#) – represents a relatively strong measure of the sustainability of fertiliser use because it focuses on the final output of global agricultural production and incorporates population growth and crop production used for animal feed.

Desired outcome

Increasing output generally requires increasing yields, and fertiliser usage has been closely linked to yield growth. As overall global food demand continues to grow over the coming decades, we would want to see a decoupling of output growth and fertiliser usage.

Indicator Ratio of global fertiliser use to per capita food production (calories per capita)

Source International Fertiliser Industry Association www.fertilizer.org/ifa/statistics.asp.



Key points

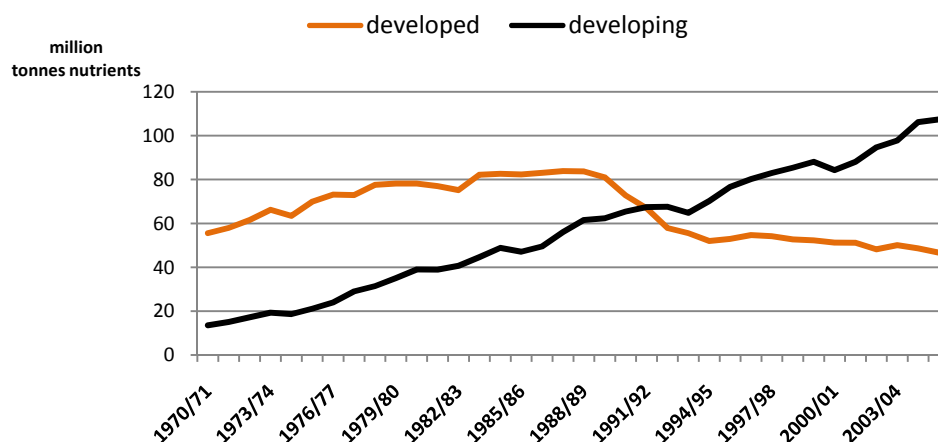
- An upward slope in the chart means that fertiliser consumption is growing faster than per capita food production. A downward slope means that fertiliser consumption is growing less fast than per capita food production.
- The indicator was 89% higher in 2006 than in 1970, reflecting strong yield growth. The fastest growth in the indicator came between 1970 and 1980 (5% p.a.), before slowing in the 1980s (2% p.a.) and becoming

¹⁹ Agricultural Industries Confederation, Mineral Fertiliser Manufacture, http://www.agindustries.org.uk/document.aspx?fn=load&media_id=2159&publicationId=248

negative (-3.5% p.a) between 1990 and 1995. Since 1995, fertiliser consumption has grown faster than per capita food production, the ratio growing by about 1.7% per annum to 2006.

- There has been a notable difference between actual fertiliser consumption in developed and developing countries (see chart below). Whilst developed countries have reduced total fertiliser consumption since 1990 by some 40%, developing countries have increased usage by around 70%. (Note that these series sum to give the total fertiliser consumption in the first chart.) On latest figures developing countries accounted for 55% of total world cereal production (including rice) with 70% of world fertiliser usage whereas developed countries are producing 45% of world cereals with only 30% of world fertiliser usage.²⁰

Fertiliser Consumption in developed and developing countries



Assessment

Growth in overall global fertiliser food production intensity has slowed since the 1970s, which appears to reflect better management practices and regulation, and increased knowledge around efficient fertiliser application in the developed world, particularly Europe (although we are currently verifying the robustness of the underlying statistics). In this decade, however, the food production intensity of fertiliser has increased again, reflecting growth in usage in developing countries. Looking to the future, developing countries appear to have substantial scope for increasing the productivity of fertiliser usage and bring usage back down towards developed country levels. Higher (and more volatile) fertiliser prices over the last year or so should provide incentives for producers to invest in reducing fertiliser use per unit of food production. Better regulation is needed too.

Rating of current position

Comparison with mid-1990s

Likely position in 5-10 years



Deterioration at the global level



Potential development

The indicator does not take account of land-use changes: overall intensity of fertiliser use by hectare may be more closely linked to the externalities, but this is likely to vary by product and region (although we do assess overall yield growth). As data series develop we may seek to monitor a fuller measure of global energy use by agriculture.

²⁰ FAO Food Outlook (Nov 2008) <http://www.fao.org/docrep/011/ai474e/ai474e14.htm> , table A1.

Rationale and associated risks

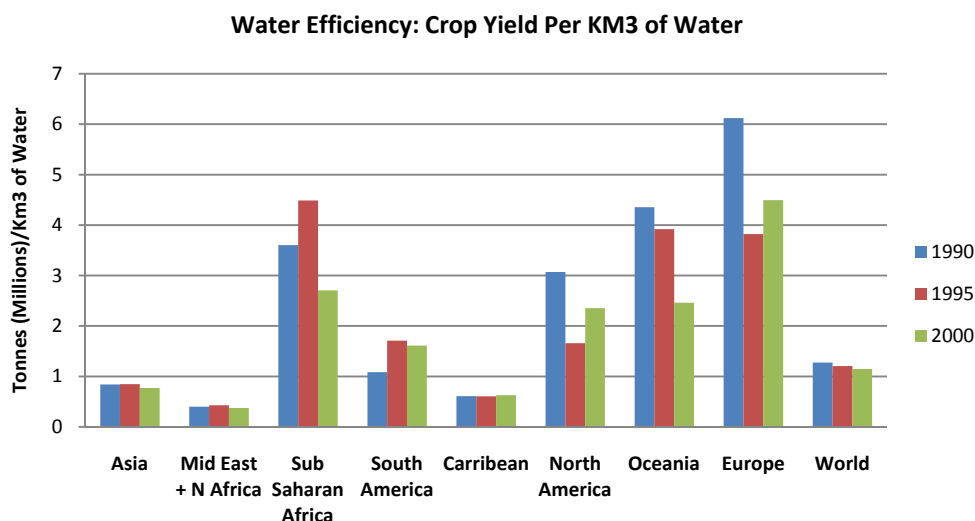
Two indicators in this theme are dedicated to the critical natural resource of water: the next indicator focuses upon irrigation, whilst this indicator considers water efficiency more generally. If cereal yields are to continue rising, more efficient use will need to be made of water, even as the climate changes and warms. The concept of water productivity (Crop yield per unit of water) is recognised as a means of measuring performance in agricultural water use. However, water is only one input into the production process and agricultural production is dependent on a range of factors combining to produce a given level of output.

Desired Outcome

Crop yield per unit of water increases and the gap in water productivity between different regions decreases.

Indicator Water Productivity of crop production

Source World Resources Institute (WRI) ²¹, FAO Statistics

**Key points**

- The chart shows significant regional fluctuations in crop yield per unit of water used, which will in part reflect annual variations in weather and crop performance in individual years. But it will also reflect the water demands of the crops grown and geographical factors. Yet the global figures give a reasonable gauge of overall water productivity. **Global water productivity expressed as crop yield per unit of water used fell by 11% between 1990 and 2000.**
- Asia continues to be a concern in terms of water usage and efficiency, recording very low levels of yield per km³ of water used (0.77 million tonnes per unit of water used, 2000). In 2000, Asia accounted for two-thirds of all water withdrawn globally by agriculture but only produced 44% of global crop production (see table).
- Europe has the highest water productivity, producing 4.5 million tonnes of crop for every km³ of water used in 2000. Europe accounted for nearly 20% of worldwide food production but only used 5% of global water

²¹ See <http://earthtrends.wri.org/datatables/index.php?theme=2>

withdrawn for agricultural purposes. The Middle East and North Africa region has the lowest water efficiency which in part reflects the high rates of evapotranspiration from excessive temperatures. It would seem to make sense for these countries to import food from more water productive regions.

- Whilst this will partly reflect geographic constraints and seasonality of rainfall, it suggests significant variation in the efficiency of water use between different regions.

Supporting data - water withdrawal and global food production in 2000

Continent/Region	Agricultural Water Withdrawal	Share of global water withdrawal by agriculture	Total Agricultural Production	Regional Food Production as a % of Global Production
	km ³ /year	%	Million Tonnes	%
Asia	1739	66	1339	44
Mid East + N Africa	278	10	104	3
Sub Saharan Africa	98	4	266	9
South America	112	4	180	6
Caribbean	75	3	47	2
North America	200	8	470	15
Oceania	19	1	46	2
Europe	132	5	594	19
World	2654	100	3047	100

Assessment

Water productivity globally is relatively low and not showing signs of improvement. Low and declining rates of water efficiency in Asian agriculture is a concern given its share of global production (mainly rice) - a sudden depletion in water resources there could increase Asia's demands upon world markets and the UK would not be unaffected. This suggests an amber light.

Looking ahead, food demand in 2030 is expected to be 55% higher than in 1998, with crop production growing mostly in the developing world, 80% of which is expected to be driven by higher yields and cropping intensities.²² In meeting growing demand for food, farming faces major challenges to use less water per unit of output and so minimize the external costs of water abstraction. Hence the future (10 years) position is given a red light.

In a more positive light, the variation between regions suggests **scope for improvements in water efficiency with better governance and pricing of water**. If Asia improved water use efficiency by 10%, then the region could potentially produce an additional 103 million tonnes of food using the same volume of water. This figure equates to 6% of the additional food needed to meet demand by 2030.

According to the FAO, irrigated cropping (accounting for 5.7% of world agricultural land) is expected to become modestly more water efficient in the coming years. UNESCO points to the need for improvements in infrastructure, irrigation management, governance and trade, particularly in developing countries, as means of improving overall water productivity.

Rating of current position



Comparison with mid-1990s

Deterioration between 1990 and 2000

Likely position in 5-10 years



²² UNESCO, *Water, a shared responsibility*, pp. 251-2, which also projects that in 2030, irrigated agriculture in 93 developing countries would account for over 70% of the projected increase in cereal production.

Rationale and associated risks

The principal sources of water resources for agriculture are rainfall and “stored” sources, mainly surface water (rivers and lakes) and groundwater (shallow and deep aquifers). The UN reminds us that “the bulk of world agriculture is rain-fed, not irrigated. Claims that agricultural production is threatened by global water shortages usually fail to note that most of the world’s food production does not rely on freshwater withdrawals at all and does not necessarily accelerate the naturally occurring rates of evapotranspiration”.²³ However, irrigation for agriculture has trebled over the last 50 years and has been a key contributor to the increase in food production over this period, particularly in certain regions. Whilst this indicator looks at withdrawal from *total* water resources, but irrigated agriculture also accounts for some 70% of *freshwater withdrawal*, much greater than domestic (10%) and industrial (20%) purposes; and urbanisation can increase competition with traditional agricultural usages with impacts on supply and quality.²⁴ Importantly, **the relative importance of irrigation varies widely between regions**: North America and Europe consistently use a lower proportion of water for agricultural purposes than Asia, South America and Sub-Saharan Africa. Looking ahead, continued growth in world food production will need to make sustainable use of water for irrigation, both to reduce environmental impacts and to sustain the level of food production in the face of a changing climate.

Few countries have mechanisms in place to allocate and price water optimally or consistently. As a result, the full economic, environmental and social costs of water withdrawal are often not valued, which can lead to excessive withdrawal of surface and groundwater, increasing the risk of water stock depletion. Declining water levels may provoke expensive and inefficient strategies of well-deepening that lower regional water levels and increase water costs. This can cause irreversible effects such as land subsidence and saline water intrusion that compromises the quality of water resources and increase the likelihood of crop failure and poorer yields. In poorer economies this can aggravate poverty and inequality.

Many water stress problems will be regionalised around river basins and qualitative in character, rather than simply global and quantitative. So the indicator here provides only a very broad-brush overview of the sustainability of current trends in global agricultural production. FAO also notes data quality problems regarding water withdrawal in many regions, and there are no figures beyond 2000.

Desired outcome

According to the FAO, regions using at least 40% of “stored” water resources for agriculture represents a situation that may be interpreted as *critical*, whereas a threshold of 20% suggests impending water *scarcity* and can also be considered unsustainable in the long term. Any region approaching or surpassing this figure would be a concern.

Indicator Water Withdrawal for use by Agriculture as a % of Total Internal Renewable Water Resources

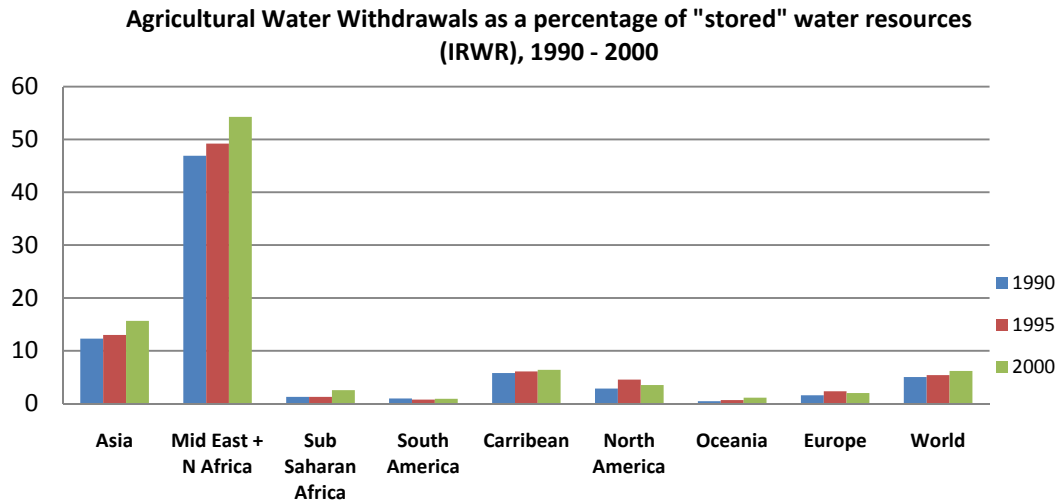
Total Internal Renewable Water Resources (IRWR) is the sum of surface and groundwater resources minus overlap. It includes the average annual flow of rivers/lakes and the recharge of groundwater (aquifers) generated from precipitation falling within the region’s borders. It does not include precipitation directly used by agriculture.

Source World Resources Institute (WRI)²⁵

²³ UNESCO, 2nd World Water Development Report: *Water, a shared responsibility* (2006). See chapter 7, p. 250 http://webworld.unesco.org/water/wwap/wwdr/wwdr2/table_contents.shtml

²⁴ UNESCO, *Water, a shared responsibility*, pp. 254-5.

²⁵ See <http://earthtrends.wri.org/datatables/index.php?theme=2>



Key points

- Water used for food production accounted for 6.2% of total “stored” water resources globally (surface water plus groundwater) in 2000, rising significantly from 5% in 1990.
- Use of surface water and groundwater for agriculture is approaching unsustainable levels in Asia and arid regions such as the Middle East and North Africa, where agriculture’s demand has increased from 47% in 1990 to 54% in 2000. In contrast water abundant South America (a region which holds 29% of global stored water resources) uses only 1% of internal water resources for food production.

Assessment

The relatively low proportion of water withdrawn globally for agriculture (6.2%) means that **there is little risk of worldwide scarcity**. But the figure has been rising. Looking ahead, the FAO (see UNESCO report) estimate that irrigation water withdrawal needs to increase by 14% by 2030 to meet growing cropping demands, and whilst from a global perspective this appears feasible, there are likely to be increased stresses in certain regions, particularly the Middle East, North Africa and parts of Asia. That could have implications for the future sourcing of certain types of fruit and salad vegetables for the UK market. It might mean more frequent seasonal supply problems in parts of the UK market, leading to volatile or rising fruit and vegetable prices (see [indicator 3.2](#) and [indicator 5.1](#)). Drought in big exporting or importing countries can also have notable effects on commodity markets, particularly where those markets are thin or concentrated (see indicators in [Theme 1](#)).

Good water governance is central to sustainable water use. That suggests that risks of water shortage and scarcity lie disproportionately with developing countries which have weaker institutions in place to regulate and manage agricultural water use. Research by the FAO monitoring irrigation water withdrawal found that whilst many of the 90 developing countries surveyed had low irrigation demand relative to freshwater resources, 19 countries used more than 20% of their internal water resources for irrigation in 2000.

Rating of current position

Comparison with mid-1990s

Likely position in 5-10 years



Deterioration between 1990 and 2000



Rationale and associated risks

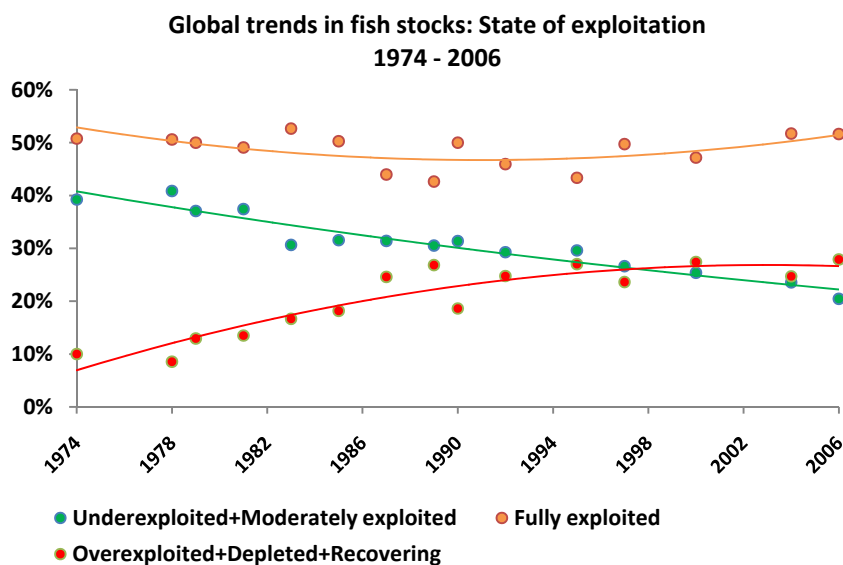
Fish protein represents 15% of animal protein supply globally - and for developing countries, a much higher share - but the lack of incentives to conserve fish stocks threatens the sustainable use of an open-access renewable resource.²⁶ Beyond certain biological limits, stocks collapse and become unavailable for consumption. As well as over-fishing, water pollution and high nitrogen concentrations in coastal waters can lead to eutrophication and algal blooms which harm biological productivity and threaten fish stocks.²⁷

Desired outcome

The market for fish and shellfish is served through a mix of sustainable aquaculture and sustainable marine capture practices.

Indicator Share of marine fish stocks under or moderately exploited

Source FAO, *State of World Fisheries and Aquaculture* (2007)²⁸; Eurostat agriculture and fisheries.



Key Points

²⁶ FAO (2008) *The State of World Fisheries and Aquaculture*, p. 3: "Overall, fish provided more than 2.9 billion people with at least 15 percent of their average per capita animal protein intake". <http://www.fao.org/docrep/011/i0250e/i0250e00.HTM>

²⁷ UNEP (2007) *Global Environment Outlook: Environment for Development*, Box 4.2 Increasing frequency and area of harmful algal blooms in the East China Sea, see Figure 4.9 in the water chapter, <http://www.unep.org/geo/geo4/media/>

²⁸ <http://www.fao.org/docrep/009/A0699e/A0699E05.htm#5.1.1>

- In 2006, only 3 % of stocks were reported as under-exploited and 20% were described as moderately exploited. There has been a steady decline since the 1970s when the figure was around 40%.
- Although world marine fishery resources have remained fairly stable over the last 10-15 years, the FAO reports that 52% of global stocks are fully exploited and therefore producing catches that were at or close to their maximum sustainable limits. One quarter of stocks were classified as over exploited (17%), depleted (7%) or recovering from depletion (1%).

Assessment

The global state of exploitation in major fishing areas has remained relatively stable over the last 10-15 years. Unsustainable fishing practices in the 1970s and 1980s led to the widespread depletion of stocks and although international government co-ordination has brought this trend under control there is little evidence of aggregate stocks recovering. A green paper studying reforms to the Common Fisheries Policy (reforms enacted in 2002) in Europe finds that as far as conservation is concerned, the policy has not delivered sustainable exploitation of fisheries resources. Many stocks remain outside safe biological limits.²⁹

The growth in consumption of fish and seafood against the backdrop of over-fishing suggests **a greater role for aquaculture in meeting future demand** and ensuring the future security and sustainability of global fish stocks. The *State of World Fisheries and Aquaculture* 2008 report cites aquaculture as the fastest growing animal producing sector, having maintained an average global growth rate of 7% year on year since the early 1950s.³⁰ Global aquaculture as a proportion of total fishery production has risen from just over 5% in 1974 to approximately 33% in 2007, leading to speculation that aquaculture will overtake capture fisheries as the major source of fish food worldwide.³¹ One concern about aquaculture is the heavy concentration (80%) of global output in the North West Pacific region. Another is the need to feed carnivorous fish. Sustainability certifications schemes can signal to both consumers and producers which fish species are more or less scarce.

The **outlook for global fish stocks** remains finely balanced. UNEP estimates that over the next three decades there will be a 10-20 percent global increase in river nitrogen flows to coastal ecosystems, continuing the trend of an increase of 29 percent between 1970 and 1995³². Despite interventions, natural supplies of fish will not be sufficient to meet rising demand. This will place more emphasis on aquaculture to meet rising demand and the need to embed sustainable fishing practices.

Rating of current position



Comparison with mid-1990s

Deterioration

Likely position in 5-10 years



Potential development

- Incorporate more evidence on trends and trade in aquaculture

²⁹ European Commission (2003) *Green Paper on the Future of the Common Fisheries Policy*
http://ec.europa.eu/fisheries/publications/reform/green_paper_en.htm

³⁰ <http://www.fao.org/docrep/011/i0250e/i0250e00.HTM>

³¹ http://epp.eurostat.ec.europa.eu/portal/page/portal/statistics/search_database

³² UNEP (2007) *Global Environment Outlook: Environment for Development*, Section B: State and Trends of the Environment, Ch.4 Water <http://www.unep.org/geo/geo4/media/>

Theme 3 UK availability and access

Introduction to the theme

The Strategy Unit (July 2008), proposes that a strategic UK policy objective should be to secure “fair prices, choice, access to food and food security through open and competitive markets”. Sourcing nutritious food from a diverse range of stable supplying countries, including domestically, enhances food security.³³ As Defra’s papers of 2006 and 2008 argue, trade spreads risks, encourages productivity growth and other economies, keeps prices competitive and increases diversity of supply. As climate change makes agricultural output in any region more volatile and affects it in different and unpredictable ways, the ability to switch sources of supply quickly is critical. However, whilst trade enhances food security, it is not without risks, such as disruptions to ports and shipping. We also need to consider less probable scenarios, such as trade with third countries breaking down, and even trade within Europe.

Types of challenges and threats addressed by this theme

- *Breakdowns in trade*
- *Domestic agricultural supply failures*
- *Disruptions to the domestic food chain*
- *Disruption to ports and shipping*

Headline Indicator

Diversity of UK food supply

Supporting Indicators

- 1. EU’s share of imports into the UK**
- 2. Diversity of fruit and vegetable supply**
- 3. EU-wide production capability**
- 4. UK production capability**
- 5. Potential of UK agriculture in extremis**
- 6. Number and diversity of entry ports into the UK**
- 7. Flexibility of ports in handling sea-borne imports**
- 8. Port concentration for non-indigenous foodstuffs**

³³ The original, in-depth analysis is given in *Food Security and the UK*, sections 6, 8.

Theme 3

UK availability and access

Headline indicator

Diversity of UK food supply

Rationale and associated risks

As described in the introduction to this theme, sourcing nutritious food from a diverse range of stable supplying countries, including domestically, enhances food security. As *Ensuring Food Security* notes, “Maintaining a range of supply sources means that any risk to our total food supply is spread, lowering the impacts of any unforeseen disruptions involving any particular trading partner or from within our domestic agriculture sector.”

Excessive dependence upon individual country suppliers can expose the food chain to sudden shortages in the event of natural, technical or political shocks. Trade is dependent upon good international relations and institutional and regulatory frameworks. In the case of world commodity shortages, experience shows that some exporting countries can react by curtailing their supplies to the world market. Embargoes have also been used historically as a political weapon.

Whilst around half domestic consumption (in *unprocessed* terms) is supplied by domestic *agriculture*, this itself can be a significant source of risk because of the potential for domestic animal disease, floods, crop failures, radioactive fallouts, boycotts and so on. Domestic agriculture is also exposed to breakdowns in trade as it is itself dependent upon imports of feed, fuel, machinery and fertiliser.

On the other hand, were another single country to have the sort of overall market share supplied by UK producers that could raise concerns. That is not to say that domestic agricultural supply is any more or any less vulnerable than the production of other individual countries. Rather, on the assumption that the risks to the agriculture supply of each country, including the UK, are broadly the same, then the more diverse are our sources of accessible supply, the better for food security.

Desired outcome

Disruptions, whether accidental or malicious, to one or more sources of supply (including domestically) do not have a major impact on available supplies to consumers – they are made up by increased sourcing from alternative suppliers. Such disruptions may nevertheless result in a temporary loss of consumer choice of specific product lines.

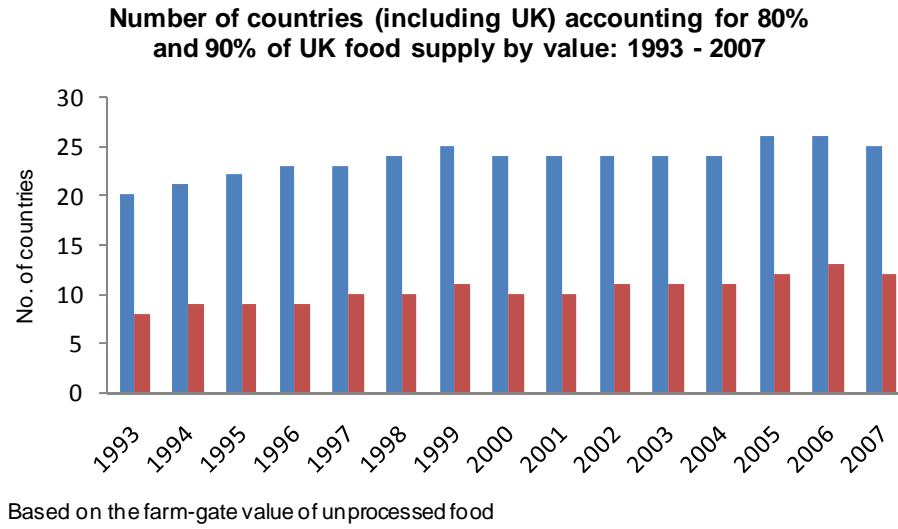
Indicator	Number of countries accounting for 80% and 90% of UK food supply
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Source	Defra analysis of trade statistics
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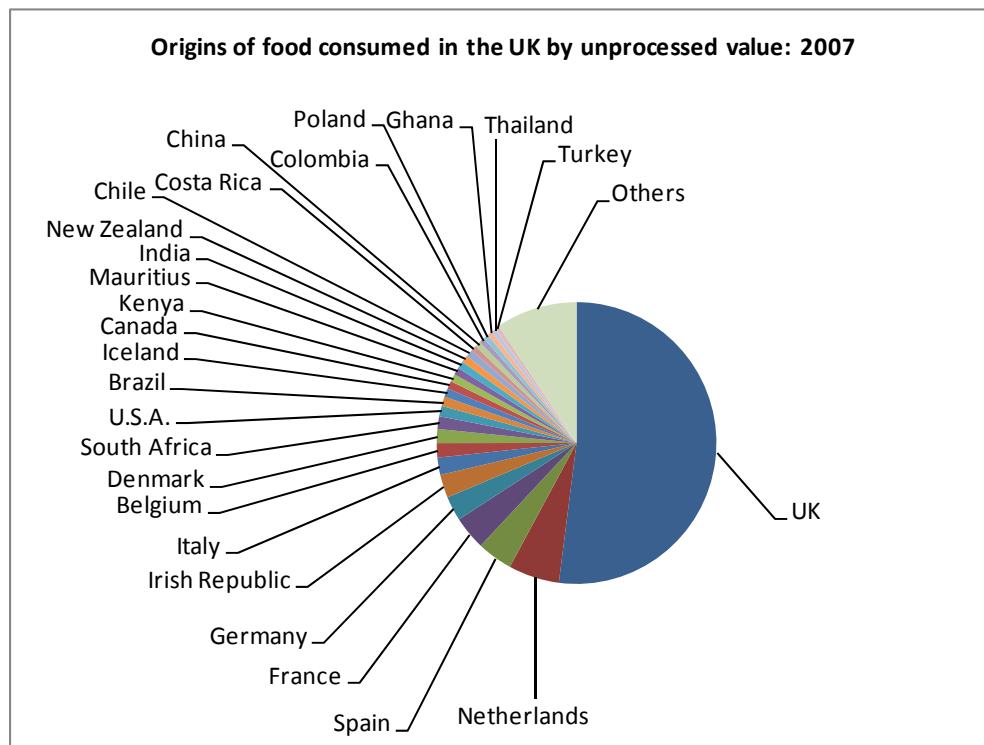
Key points

- In 2007, 25 countries together accounted for 90% of UK food supply, up from 20 countries in 1993
- Just over half of this was supplied domestically within the UK
- After the UK, the leading suppliers were the **Netherlands, Spain, France, Germany and Ireland**, all members of the EU and close trading partners.
- Varying the threshold to assess diversity does not alter this general picture. In 2007, 12 countries together accounted for 80% of UK food supply, up from 8 countries in 1993. In 2007, the UK and five other European countries accounted for around 70% of total UK food supply.
- All other suppliers accounted for less than 2.5% of UK food supply.

- The distribution of UK imports at continental level has changed relatively little over the last 15 years.



Supporting data



- This supply diversity varies somewhat across broad sectors. For example, in 2007:
 - four countries supplied the UK with 90% of all its meat and meat preparations - the UK supplied 80% (based on the farm-gate value of unprocessed food).

- for dairy products and birds eggs three countries supplied 90% of consumption – the UK supplied 84%.
- for cereals and cereal preparations (including rice) 10 countries supplied the UK with 90% of consumption – the UK supplied 50%.
- 24 countries supplied the UK with 90% of its fresh fruit and vegetables – the UK supplied 19% (see indicator 3.2).

Assessment

The UK's openness to trade has brought a very impressive diversity to UK food supply. CAP and trade reform have strengthened this diversity over the last fifteen years. The UK imports from a vast array of countries, though in value terms, most imports come from within the EU. This openness ensures that UK food supply is very resilient to supply interruptions from specific countries and also from within the UK. In particular retailers and large food service operators are able to switch sources of supply rapidly if required (as demonstrated during the BSE and FMD crises). Even where the volume of trade is relatively small with certain countries, the indicator highlights the potential to import in the event of shortfalls domestically or in other trading partners.

The continued stability and development of EU market integration and progress in multilateral trade negotiations should ensure that this strong position is sustained into the future. A failure to agree further WTO liberalisation would only increase future risks if it led to a major sustained relapse into protectionism around the world.

It is possible to consider diversity not just by country, but by region or continent. This might be relevant if it was thought that certain risks were correlated across groups of countries e.g. reliance on the same port or climate. Other than the notable share of European countries (see next indicator), however, there does not appear to be any significant clustering.

The benefits of diversity need not be “traded off” against **sustainability** concerns. Life cycle analysis of food production shows that it is incorrect to assume that imported food has greater environmental impact. It is typically production system, rather than distance transported, that is the key determinant of environmental impact, and supplying countries, including the UK, have a variety of production systems and land requirements.³⁴

Rating of current position



Comparison with mid-1990s

Similar

Likely position in 5-10 years



³⁴ Foster, C., Green, K., Bleda, M., Dewick, P., Evans, B., Flynn, A., Mylan, J, *Environmental impact of food production and consumption*, Research report for Defra (2007)
<http://randd.defra.gov.uk/Default.aspx?Menu=Menu&Module=More&Location=None&ProjectID=14071&FromSearch=Y&Publisher=1&SearchText=EV02007%20&SortString=ProjectCode&SortOrder=Asc&Paging=10> ;

AEA Technology, *Comparative life-cycle assessment of food commodities procured for UK consumption through a diversity of supply chains*, Research report for Defra (September 2008)
<http://randd.defra.gov.uk/Default.aspx?Menu=Menu&Module=More&Location=None&ProjectID=15001&FromSearch=Y&Publisher=1&SearchText=FO0103&SortString=ProjectCode&SortOrder=Asc&Paging=10#Description>

Supporting indicator 3.1**UK food imports from other EU countries****Rationale and associated risks**

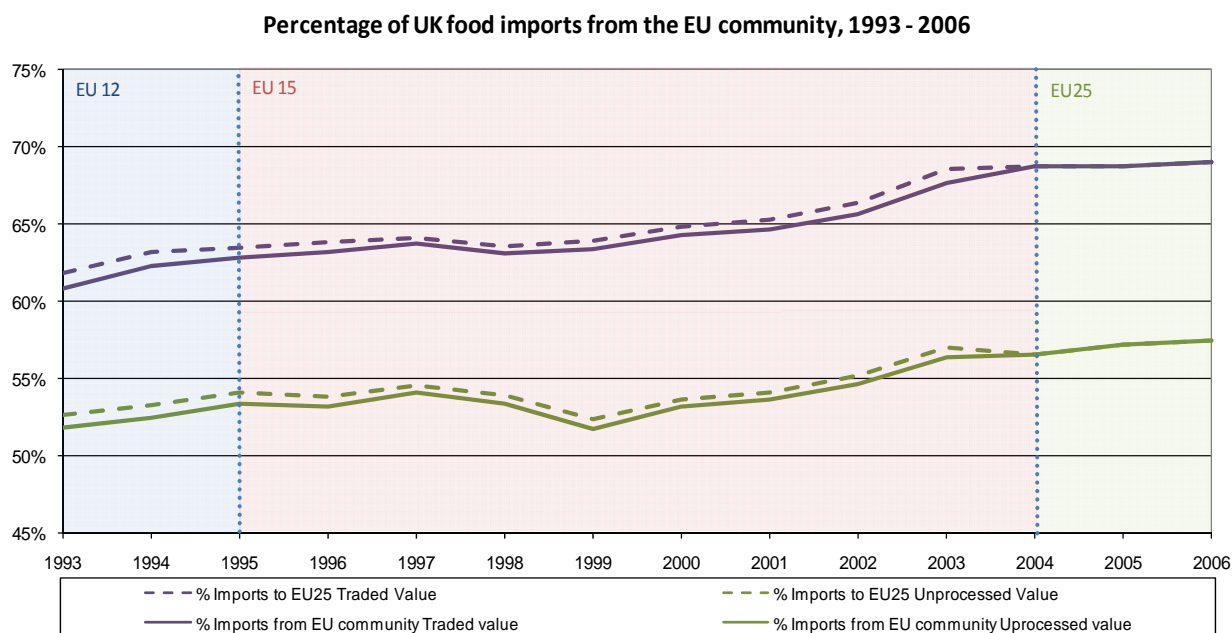
Trade is dependent upon good international relations and institutional and regulatory frameworks. In the case of world commodity shortages, experience shows that some exporting countries can react by curtailing their supplies to the world market. Embargoes have also been used historically as a political weapon. The institutional and political framework of the European Community and the Single Market provides a strong and secure basis for UK trade. Whilst the UK has well established trading relations with a vast range of countries, including Commonwealth countries and North America, the proximity, diversity and institutional stability of the Single Market should be seen as a particular source of security for UK food supplies.

Desired outcome

The EU remains a secure and substantial supplier to the UK market (as well as a market for our own food exports). A decline in the share would not necessarily be considered a problem if alternative third country suppliers were considered to be equally secure and reliable.

Indicator Share of total UK food imports sourced from other EU countries³⁵

Source Defra analysis of trade statistics



³⁵ Some food imports from the EU will have origins outside the EU, however the EU is currently estimated to be over 90% self-sufficient in food. Additionally, some trade is incorrectly recorded as having origins in the EU. Such errors are referred to as asymmetries in recorded trade (also known as the 'Rotterdam effect') though these are relatively small – HMRC estimated a discrepancy of around 1% in 2004 see

http://www.uktradeinfo.co.uk/pagecontent/documents/edicom_report_bilateral_analysis.doc.

Key points

- The non-UK countries comprising what became the EU25 in 2004 have accounted for a high and increasing share of UK food imports since the 1990s, up from 53% in 1993 (unprocessed value) to 57% in 2006.
- In traded value terms, the share has increased from 62% to 69% over the same period. This higher figure reflects the fact that the UK tends to import more added value goods from the EU than elsewhere.
- Note that we include all the non-UK EU25 countries for the whole series. The EU expanded from 12 countries to 15 in 1995 and to 25 countries in 2004. As the EU has expanded the share of UK food imports sourced from other *member states of the EU* will have grown even more significantly, reflecting the lower EU12 base in 1993.
- Food imports from the EU25 have in fact risen faster than overall imports since 1993.
- It is also worth noting that the EU accounts for a high (80%) share of UK food exports. Although overall exports are only around a third of imports, it underlines the extent of the UK's market integration with other EU countries.

Assessment

Trade statistics show that the majority of our imports are sourced, not from countries perceived to be distant or unreliable, but from other member states of the European Union. This trade constitutes a diverse range of meat, cereals, fruit and vegetables.

In addition to the UK's openness to trade and diversity of suppliers, it is clear that the UK is highly and, since the creation of the Single Market in 1992, increasingly integrated into European markets, for both imports and exports. The Single Market has prompted an increasing number of food manufacturing firms to expand and find efficiencies by adopting a European scale of operations. Improvements in transport links as well as cross-border deregulation has made it easy for retailers to source from other European countries, although as we have seen the leading suppliers are those European countries closest to the UK. It would appear that the UK's decision not to join the single European currency has not been a significant barrier to integration.

The benefits of the EU single market are not to be confused with the subsidy-based and economically inefficient CAP of the last two decades. For instance, there is a highly integrated intra-EU trade in pigmeat, which has been an unsubsidised sector under the CAP. And it is also possible that reform of the Common Agricultural Policy would increase intra-EU trade e.g. through the abolition of national sugar and dairy quotas. Liberalisation of the multilateral trading system might result in a higher share of UK food imports coming from outside the EU.

Theme 1 has shown that UK food security should be first set in a global context. This indicator shows that UK food supply should also be considered in a European context.

Rating of current position

Comparison with mid-1990s



Improvement

Likely position in 5-10 years



Supporting indicator 3.2

Diversity of UK fresh fruit and vegetable supply

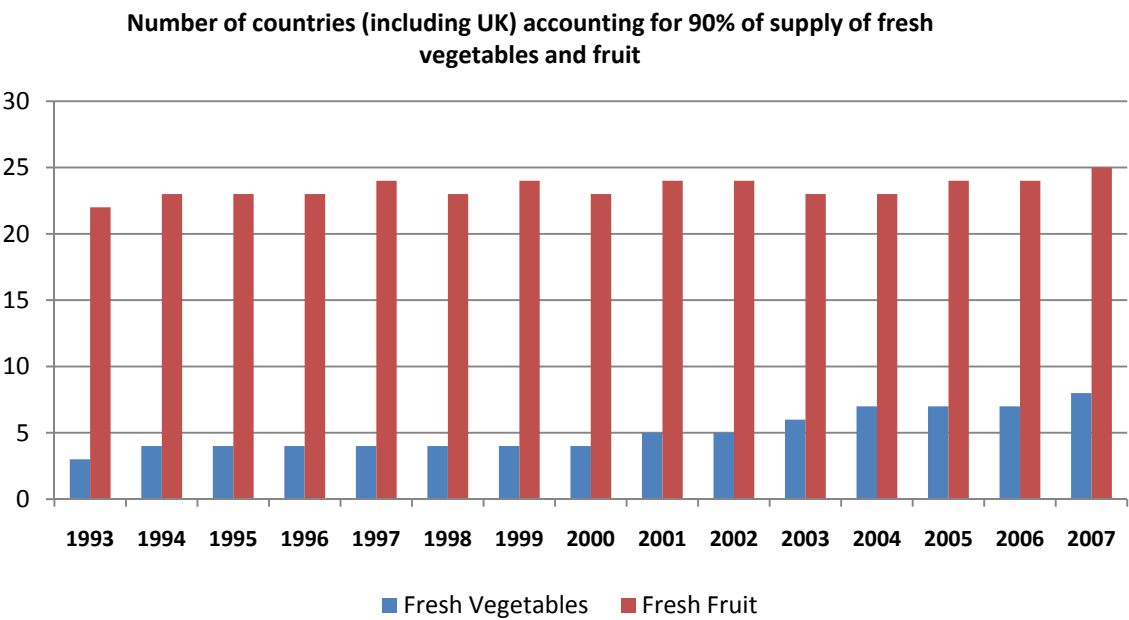
Rationale and associated risks

A large proportion (nearly 40% by volume) of UK food imports are fresh or preserved fruit and vegetables. Non-indigenous fruits from a variety of both EU and Non-EU countries, such as citrus and bananas, are now well established in the average UK diet. Imports have played a major role in the growth in fruit consumption over the last thirty years. The nutrients found in fruit and vegetables (particularly when consumed fresh) are important to overall health. But supply disruptions are common. Whilst some types of fruit and many root vegetables can be cold stored for several months, many are extremely perishable and need to be transported both swiftly and in the correct conditions. Where the domestic seasonal production window is relatively small, adverse unseasonal weather (especially heavy rain) can ruin crops. Canned and frozen vegetables are less vulnerable to these sorts of risks – hence we focus here on fresh produce.

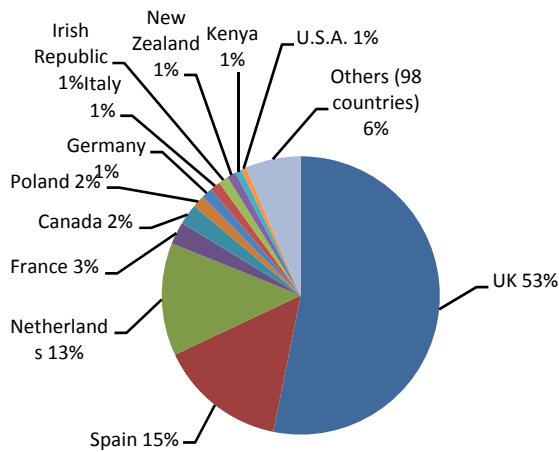
Desired outcome

Disruptions, whether climatic, accidental or malicious, to one or more sources of supply of vegetables and fruit (including domestically) do not have a major aggregate impact on consumers – they are made up by increased sourcing from alternative suppliers or of alternative varieties. Such disruptions may nevertheless result in a temporary loss of consumer choice of specific varieties.

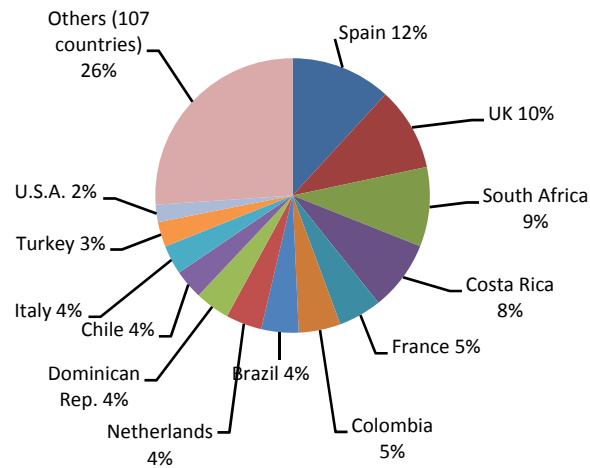
Indicator	Number of countries accounting for 90% of UK imports of fresh fruit and vegetables
Source	Defra analysis of trade statistics



Origins of UK supply of fresh vegetables, 2007



Origins of UK supply of fresh fruit, 2007



Key points

- In 2007, 8 countries together accounted for 90% of the UK supply of fresh vegetables by volume, up from 3 countries in 1993, as trade has become more open across Europe and beyond. In 1993, the UK supplied 77% of UK vegetables, compared with 53% in 2007.
- After the UK, the leading suppliers of vegetables were Spain, the Netherlands and France, all members of the EU and close trading partners.
- In 2007, 24 countries together accounted for 90% of UK supply of fresh fruit by volume, up from 22 countries in 1993. For example the current supply of apples is fairly secure because there are a wide variety of substitutes from locations both home and abroad, with differing growing seasons.
- The leading suppliers of fruit were Spain, the UK, South Africa and Costa Rica. UK production accounted for around 10% of total supply.
- Many, if not most, varieties of fruit and vegetables are seasonal, which is to say they are grown and harvested in a particular season of the year. The season can vary in size between only a couple of months, and most of the year, depending of the type. Seasonality can be beneficial where different countries have different growing seasons for the same fruit or vegetable, so that a reasonable supply can be maintained throughout the year by importation. However, overreliance by consumers on the supply of 'out of season' types (such as strawberries and salad vegetables) can put pressure on the level of imports of these required.

Assessment

The diversity of the supply of fresh fruit in the UK is demonstrated by the range of countries which supply the UK each of which do not have a significant individual contribution. This provides flexibility in sourcing in the event of disruption to supply. The wide variety of fruits and seasons, together with the possibilities for substitution by consumers, enhances this resilience.



The supply of fresh vegetables is more concentrated, with around half of those consumed being home produced. This poses the potential risk of shortages in the case of a poor domestic harvest, but other EU sources such as Spain, the Netherlands and France could help make up the shortfall as UK indigenous vegetables tend also to be indigenous in similar Northern / Central European countries. However, consequently they might also suffer poor harvests at the same time.

Any supply disruptions are therefore more likely to give rise to sharp rises, and / or temporary shortages for particular fruits or vegetables, rather than widespread shortages. And it is relatively easy for consumers to substitute away from produce which is in short supply.

As with the headline indicator for this Theme, concerns are raised about the **sustainability** of fresh produce imports, particularly where these are **air-freighted**, which has a disproportionate and accelerating, carbon impact. Air freight is important for some perishable fresh fruit and vegetables from overseas (e.g. leguminous vegetables from Kenya). Defra's publication *Food Transport Indicators to 2006* reports an 11% increase in the UK's Air Food Kilometres between 2005 and 2006, giving an increase of 72% between 1997 and 2006.³⁶ Environmental pressure and any dis-incentivising of freight planes, could force a reduction in long-haul air trade, reducing the supply of these particular commodities.

Despite this increase, the proportion of air freighted fresh produce is still relatively small (accounting for around 7% of total UK fruit and vegetable imports from non-EU countries) and is likely to remain relatively niche. Fruit such as bananas and oranges, which together account for 45% of all imported fruit by volume, tend to be transported by sea. And as we noted in the headline indicator, transport is not the only, or even most important, factor in the life-cycle: Kenyan production, for instance, would not need artificial heating or lighting.

There is a separate question about other externalities of horticultural production in water stressed countries, particularly around the Mediterranean and Middle East.³⁷ Many of the most stressed countries supply only very minor shares of the overall UK market, but as the leading supplier of fruit to UK consumers, the economics of water in Spain warrant further investigation.

Rating of current position	
Comparison with mid-1990s	Improvement
Likely position in 5-10 years	

³⁶ <https://statistics.defra.gov.uk/esg/statnot/FoodTransportIndicatorsSN2007.pdf>. See also an analytical note by Defra on air-freighted fresh produce from Africa: <https://statistics.defra.gov.uk/esg/reports/Final%20Africa%20trade.pdf>

³⁷ See water indicators above, and the FAO interactive map <http://www.fao.org/nr/water/art/2008/flash/aquastatmaps2/gallery1.html>

Rationale and associated risks

The UK's close trading and political relationship with the 26 other countries of the European Union suggests that concerns over global food availability would be dealt with first at European level – as has been the case with the decision to suspend set-aside. This indicator helps us understand the scope that exists for the EU's agricultural sector to respond to shortages in agricultural markets. For example, some stakeholders have raised the unlikely possibility of a severe disruption to trade between Europe and the rest of the world.

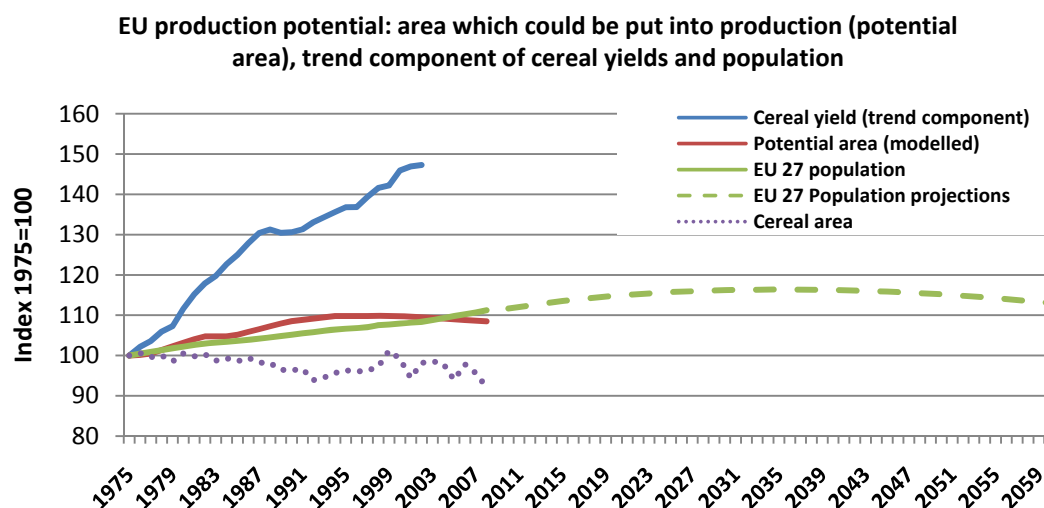
Europe is currently over 90% self-sufficient in agricultural products, although this itself is not the best indicator of supply *potential* at the EU level.³⁸ This is roughly calculated as production divided by consumption (minus exports + imports) and based on the farm gate value of production. A significant amount of EU exports are added value products (the unprocessed value of exports are estimated to take half of the traded value).

Desired outcome

Continued strong trading relationship between UK and rest of the world. Should trading relationships between the EU (or UK) and the rest of the world break down the EU has the potential to meet UK and other member states' demands in a timely and sustainable way responding to very strong market signals.

Indicator EU agricultural production potential per capita

Source Eurostat, FAO, Coceral – Defra analysis.



Note: the trend component of cereal yields is a 9 year moving average of annual cereal yields; potential area is modelled from harvested areas of all crops (cereal, industrial and horticultural) and assumes losses and gains are gradual.

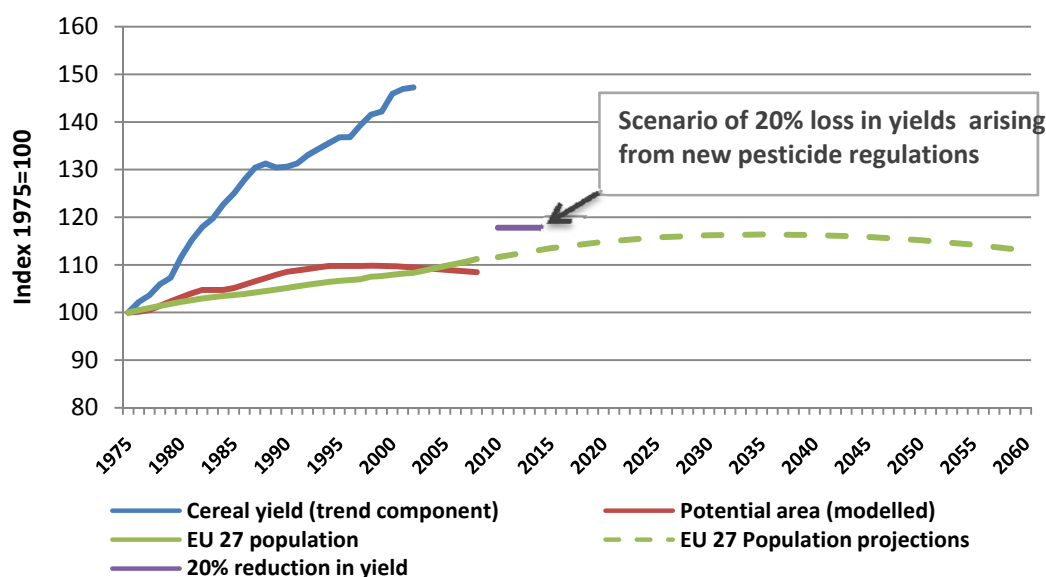
³⁸ Note that **self-sufficiency becomes more relevant to food security the wider the region is defined**. Thus at one extreme self-sufficiency for, say, London would be meaningless, whilst at the other global “self-sufficiency” is essentially what Theme 1 is addressing. Within this spectrum, UK self-sufficiency is at the less meaningful end of the spectrum. Overall EU self-sufficiency has more relevance, but would still not be capturing many of the risks within EU supply chains.

Key points

- Cereal yields have increased rapidly relative to the EU population and potential area which could be put into production since the 1970s. This trend demonstrates the rise in productive potential within the EU.
- Potential area is much more stable than harvested (cereal) area. This shows how EU production could step up (responding to market signals) to offset any disruption between Europe and the rest of the world.

Scenario – New EU pesticides regulation hitting cereal yields by 20%

Concerns have been raised regarding the agronomic implications of the hazard-based approach in the new EU pesticide regulation. Yield losses of up to 20% (depending upon which substances are banned) have been estimated. The chart below shows that, at present yields, were this to be correct across the EU, such an impact would be significant but would still leave yields higher than the 1970s and early 1980s. It is also possible to envisage such regulations being relaxed were the EU really to come under pressure to maximise its productive potential e.g. in the event of trade breaking down elsewhere.



Assessment

The secure institutional trading arrangements plus the productive potential of Europe provide a means to deal with food availability were trading relations with third countries ever to break down radically. The agricultural productive potential of the EU is in a favourable position. It is enhanced by improvements in yields since the 1970s and access to uncropped land which can be put back into production. With yield growth exceeding population growth, the future position is also favourable. The new EC pesticide authorisation regulation may result in significant yield reductions from current levels. However, yields would still be above the levels of the 1970s.

Rating of current position



Comparison with mid-1990s

Slight improvement as yields have increased

Likely position in 5-10 years



Rationale and associated risks

The UK's close trading and political relationship with the 26 other countries of the European Union suggests that concerns over global food availability would be dealt with first at European level – as has been the case with the decision to suspend set-aside. This indicator can be viewed as a sub indicator of EU production capability indicator and in the same way this helps us understand the scope that exists for the UK's agricultural sector to respond to shortages in agricultural markets. Again for example, stakeholders raised the slim possibility of a severe disruption to trade with the rest of the world.

Whilst current self-sufficiency levels are poor indicators of UK food security, *capability* remains relevant to monitor. This is also linked to concerns that coastal inundations and urban expansion will irreversibly erode our ability to produce food. As the OECD points out, a low-input extensive agriculture maintains productive capability without necessarily requiring artificially high levels of current production.³⁹

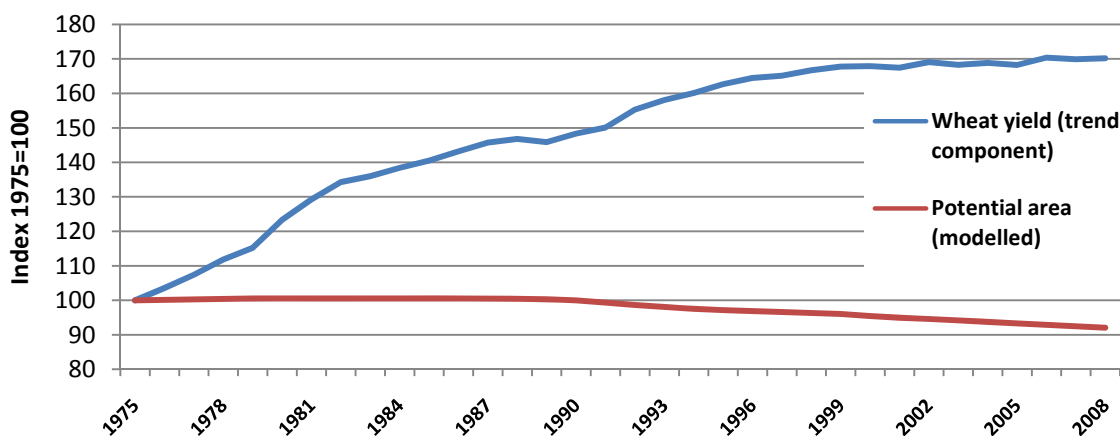
Desired outcome

Continued strong trading relationship between UK and rest of the world. The UK has the potential to contribute to the UK and other member states' demands in a timely and sustainable way.

Indicator UK agricultural production capability

Source Defra statistics and analysis

UK production capability: area which could be put into production (potential area) and trend component of wheat yields



Note: the trend component of cereal yields is a 9 year moving average of annual cereal yields; potential area is modelled from croppable areas and assumes losses and gains are gradual.

³⁹ OECD, *Multifunctionality* (2001), p. 48.

Key points

- Since the 1970s cereal yields have increased rapidly relative to the potential area which could be put into production. This trend demonstrates the rise in productive potential within the UK.
- Slowing of yield growth since the mid-1990s will reflect weak economic incentives arising from cuts in CAP support prices and the strength of sterling, rather than a lack of technological potential.
- Potential area is much more stable than harvested area. This shows how UK production could step up in response to market signals.
- Land availability and yield potential are not the only elements of capability. Adequate physical and human capital are also needed, as is access to other inputs such as fertilisers. However, statistics on these are more difficult to interpret and, as indicators, could be misleading. For instance, a decline in the fixed capital stock or labour force may simply reflect more efficient use of resources (through restructuring) or improvements in technology and productivity (It is efficient use of high quality inputs which are important for farming competitiveness).

Assessment

The secure institutional trading arrangements combined with the productive potential of Europe provide a means to deal with food availability were trading relations with third countries ever to break down radically. The agricultural productive potential of the UK is in a favourable position to play its part. It is enhanced by improvements in yields since the 1970s and access to uncropped land which can be put back into production.

Rating of current position



Comparison with mid-1990s

Similar

Likely position in 5-10 years



Potential development

- Further breakdown of land use trends over time

Rationale and associated risks

History and analysis point to the critical role of international trade with respect to food security. In response to stakeholder concerns, we have explored the implications for the UK in the face of an extreme event, or set of events (however unlikely) that forced the UK to feed itself totally from its own resources, without any possibility for trade. It is important to note that even in the Second World War this scenario did not fully pertain. Despite a range of international crises in the last fifty years, Europe, and OECD countries generally, have been remarkably free from food security problems. But in short, “Could the UK feed itself without imports?”

Of course, UK agriculture is itself reliant upon imported energy, fertiliser, seeds and machinery. So even if the scope for trade was ever completely removed, domestic agriculture itself would be deprived of essential inputs, which is one reason why national self-sufficiency figures are a misleading indicator of food security.

Desired outcome

A radical and prolonged breakdown in European and international trade or shipping would not undermine the UK’s fundamental ability to produce enough nutritious food for the population, albeit with much simpler diets.

Indicator **Calorific potential of UK agriculture**

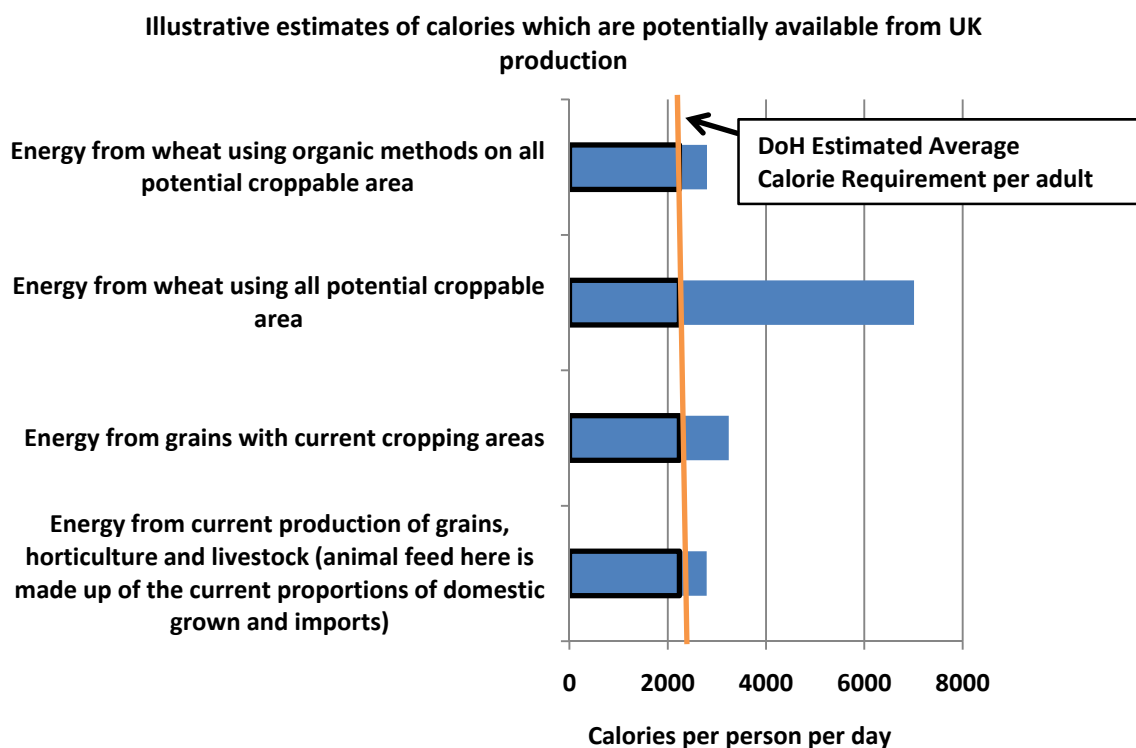
Source Various Defra statistics and analysis

For the purpose of this indicator, we assess in broad terms how many calories UK agriculture could optimally produce in extremis. The chart on the next page reflects the stylised calculations as to how the UK optimum utilisation of UK agricultural production compares with the energy requirements of the population.

Key points

- Maximising calorie production would require a dramatic reduction in livestock production with all crop production used for human food where possible instead of animal feed.
- With 21 million tonnes of animal feed used annually in the UK (of which around one half is primarily home grown cereals), the use of crops for human consumption rather than animal feed would suggest that the productive potential of the UK is likely to exceed the needs of the national population, particularly if this extreme scenario included a reduction in the level of food waste.
- However, it would remain a highly restricted, if sufficiently nutritious, diet. Whether there would be any effects upon obesity would depend upon the nature and length of the scenario and other factors.
- Sufficient levels of nitrogen and potash fertiliser could be produced domestically given sufficient levels of energy and the potential use of green manures. Phosphate fertiliser would present more of a challenge given there are no indigenous sources of rock phosphate in the UK
- This indicator, like the EU indicator above, would also cover trends in agricultural land and the extent to which this declines in the face of other competing demands for land use, particularly urban housing.
- Total UK agricultural area has fallen by around 2% over the last 20 years whilst cereal yields have risen over this period. This suggests an increasing trend in this indicator despite a rising population and increased housing

- The chart below shows some illustrative scenarios of calories per person which are available from current croppable areas in the UK. These scenarios do not represent optimal production to achieve a balanced diet but illustrate the potential calories per person which the UK could potentially achieve.



Assessment

Preliminary estimates (not set out here) show that, if necessary, UK agriculture could feed itself with a changed diet. This capability has not changed since mid 1990s, and in general this would be a relatively stable indicator as little land is lost out of agriculture and yields are increasing over time which will offset the impact of rising population. Earlier work by Kenneth Mellanby, recently updated by Simon Fairlie who extended the analysis to consider different production systems including organic, is in line with our initial work and concluded that the UK could produce more than enough food to feed itself with a much changed diet.⁴⁰

Rating of current position



Comparison with mid-1990s

Similar

Likely position in 5-10 years



⁴⁰ http://www.ukwatch.net/article/can_britain_feed_itself

Supporting indicator 3.6**Number and diversity of entry ports into the UK****Rationale and associated risks**

Food security is enhanced by the diversity of supply – both domestic production and that sourced from overseas. Food supply from overseas is enabled by the UK's international gateways. As 91% of food imports arrive by ship, it is essential to assess the resilience of UK ports.

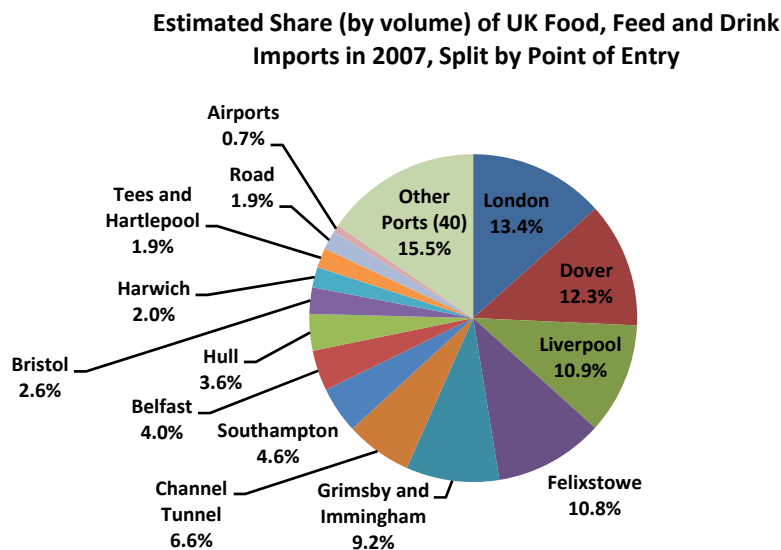
Food security may be compromised where risks are not spread between a sufficient number of points, or where there is excessive reliance on one or two ports, and there is lack of flexibility in switching between ports should the need arise. The points at which food imports enters the UK are also subject to a variety of risks that may be geographically correlated. Coastal flooding, tidal surges and disease epidemics are three examples of extreme events that could create more disruption to food supply than would be the case if points of entry were spread more evenly around the UK's coastline. Food security will be better the more points of entry are spread across the UK, although some consideration should be given to population levels in each region.

Desired outcome

A ports sector which is geographically diverse and allows substitution of traffic between ports spreads the risk of any disruption. Such disruptions may temporarily restrict consumer choice, but will not result in panic buying or any other major consumer impact.

Indicator Estimated diversity of UK food imports by point of entry and region

Source Defra analysis of DfT port statistics⁴¹

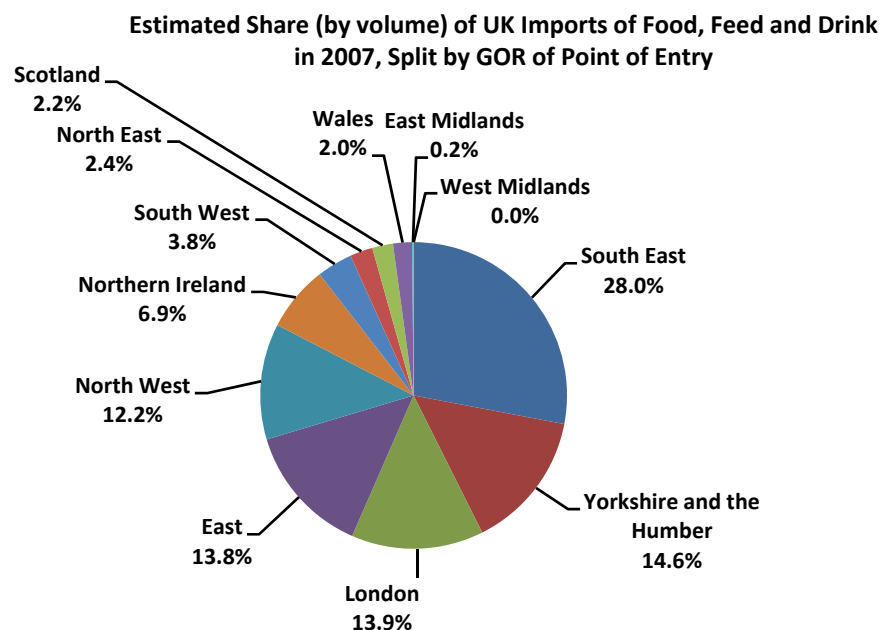


⁴¹ The model behind the charts in this indicator is reliant on several data sources. We are currently considering other data sources held by the Department for Transport, and these figures may be revised in order to ensure we have the most accurate and suitable indicators.

Key Points

- Ports account for 91% of UK food, feed and drink (FFD) imports.
- The ports of London (13.4%), Dover (12.3%), Liverpool (10.9%) Felixstowe (10.8%), and Grimsby and Immingham (9.2%) are the most important points of entry in the UK for food, feed and drink.
- A significant proportion (15.5%) of food, feed and drink imports arrive in small quantities through forty smaller ports.
- The Channel Tunnel is the most important non-port point of entry with a 6.6% share of FFD imports.
- FFD imports by air across the whole of the UK account for only 0.7% of import volume, 78% of which is handled by Heathrow airport.
- To estimate the port shares of food imports we use constant factors for food as a proportion of container and RORO traffic - micro data by port on the importation of foodstuffs from the EU is not available.

We have also grouped ports by Government Office Region (GOR):

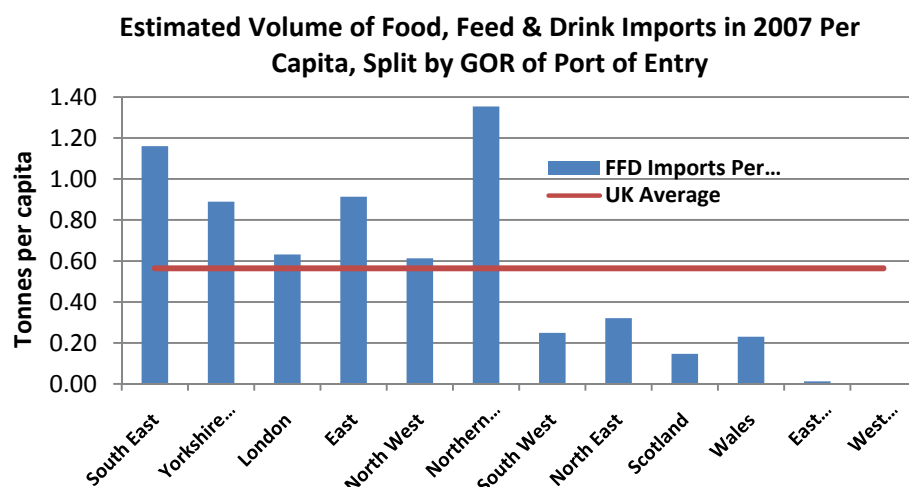


- The South East region (28.0%) has the largest share of FFD imports whilst the Yorkshire and Humber (14.6%), London (13.9%), East (13.8%), and North West (12.2%) regions all have significant contributions. Each of these top 5 ports is in a different Government Office Region.
- Because of their geographic position, the East and West Midlands have virtually no port facilities.
- Northern Ireland includes all the imports via road (1.9% of UK total), across the Irish border.

The next chart compares these regional volumes with regional population:

- The South East, Yorkshire & Humber, East and Northern Ireland regions have FFD imports per capita well above the UK average. Assuming that consumption of imported food is not geographically sensitive, these regions can be identified as gateways on which other regions depend for imported foodstuffs.
- Despite having a large share of food, feed and drink imports, the imports per capita for the London and North West regions are only just above the UK average.

- Northern Ireland only accounts for 6.9% of UK food, feed and drink imports, but this is much greater than its share of the UK's population.



Assessment

Food, feed and drink imports in aggregate are well spread across a fairly large number of points of entry, with no port having a dominant share. Port flows for certain commodities are less diverse than this suggests (see [indicator 3.8](#)) because the types of food entering each port will not be uniform, with ports such as London and Liverpool being important for bulk products whereas Dover's traffic is almost entirely RORO. Air freight, being suitable only for high value, perishable goods, is very small in volume terms, although in *value* terms 9% of 2007 food imports from outside the EU came through airports.

The concentration of imports entering the south eastern corner of England (second chart) highlights the importance of EU trade, either by ship or through the Channel Tunnel. The SE, East and London regions have a combined 56% share of food, feed and drink imports and their geographical proximity suggests they could share some risks (such as coastal flooding). However, additional options in this area are provided by the Channel Tunnel and Heathrow Airport. The Tunnel is designed to allow up to 576 train journeys per day⁴² in each direction and at present 168 slots are used for RORO traffic and 5 or 6 for freight through-trains. RORO volumes appear to be near capacity at Folkestone and Coquelles, but current freight train volumes represent only 12% of the 10m tonnes that the Tunnel was designed for (although there is a question about the availability of specialist wagons).

Although there is clear reliance on the English Channel for food imports, the points of entry are sufficiently diverse so that it would take a catastrophic event affecting several ports before the disruption could be described as being serious enough to materially affect UK food security.

Rating of current position



Comparison with mid-1990s

Similar

Likely position in 5-10 years



⁴² DfT, *Roll-on roll-off freight: end-to-end journey - An analysis of freight through the UK international gateways* (22 December 2008), p. 12 <http://www.dft.gov.uk/about/strategy/transportstrategy/tasts/userexperience/>

Supporting indicator 3.7**Flexibility of ports in handling sea-borne imports****Rationale and associated risks**

Continuous operation of the UK port network is crucial for imports, which make up 50% of the food consumed in the UK (by raw value). If a port becomes inoperable then food imports will need to be rerouted through other ports along the UK coastline to ensure continuous supply. The ease with which this can be managed will depend on the physical mode in which food is imported.

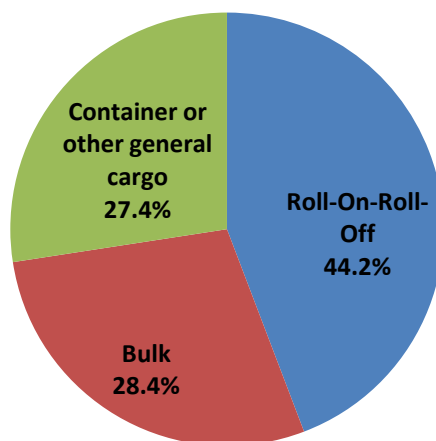
Desired outcome

Disruptions to ports do not have a major impact on available supplies to consumers. Such disruptions may temporarily restrict consumer choice, but will not result in panic buying or any other major consumer impact.

Indicator Flexibility of ports in handling seaborne food imports

Source Defra analysis of DfT port statistics⁴³

Estimated Share (by volume) of UK Imports of Food, Feed and Drink by Sea in 2007, Split by Mode of Appearance

**Key Points**

- Roll-On-Roll-Off (RORO) accounts for the most imports of food, feed and drink with bulk and containers also both responsible for large shares.
- Most major ports import using a mixture of the three modes, although often one of these is dominant - of the 13 ports estimated to have imported over 500 thousand tonnes of food, feed and drink in 2007:
 - six have more than 60% of import traffic as RORO,

⁴³ The model behind the chart in this indicator is reliant on several data sources. We are currently considering other data sources held by the Department for Transport, and these figures may be revised in order to ensure we have the most accurate and suitable indicators.

- three have more than 60% of imports as containers
- three have more than 60% of imports as bulk.

Assessment

The implication of different modes of seaborne transport is their ability to be handled by different ports.

- The mobile and self-contained nature of its cargo makes **RORO** relatively flexible, allowing alternative routes to be reached. However RORO ferries and ports are not necessarily compatible with each other.
- **Container traffic** also is not completely flexible, with some arriving on giant 'post-Panamax' vessels that for now can only be handled effectively by two UK ports. For this reason, it is possible that disruption to Felixstowe could seriously affect direct food imports from the Far East. In addition, some containers require connection to an external power supply when stored port side which will limit suitable berths. On the other hand, the dimensions of almost all containers are covered by just a few standard sizes, which increases the likelihood of cross-port compatibility.
- **Bulk food commodities** are fairly inflexible, requiring specialist handling and storage facilities port-side. Agri-bulks require silo accommodation, and, in the case of meat, dairy products, fruit and vegetables, the close proximity of cold storage.

A further obstacle to re-routing imports is the availability of **spare port capacity** in order to accept extra traffic. There is currently insufficient knowledge in this area, but a current DfT investigation into port capability should prove valuable. If no suitable UK port could be found for redirected traffic, then an option might exist on the continent with the food then entering the UK by RORO or on smaller (and therefore more easily accommodated) cross-channel vessels.

Looking ahead, UK container freight is forecast to grow by a further 178% and RO-RO freight 112% by 2030⁴⁴, continuing the strong trend of the past three decades, whereas the rise in bulk traffic has been very gradual. If the trend for bulks continues and the forecasting applies to food imports, then the result by 2030 will be a relative switch from bulk to containers, with only a small increase in RORO, which should increase overall flexibility. In addition, port development is expected to allow further ports to handle post-Panamax vessels, which would increase the flexibility of containerised imports. However, given the uncertainty in this area, we retain the amber rating for the medium term.

Rating of current position



Comparison with mid-1990s

Similar

Likely position in 5-10 years



Potential development

Incorporate latest DfT data on port capacity.

⁴⁴ DfT, *Roll-on roll-off freight: end-to-end journey* (December 2008), p. 6
<http://www.dft.gov.uk/about/strategy/transportstrategy/tasts/userexperience/>

Theme 3

UK availability and access

Supporting indicator 3.8

Port concentration for non-indigenous foodstuffs

Rationale and associated risks

As noted in indicator 3.6, if imports of a particular commodity can only be handled by a small concentration of ports, then their availability may be at risk if one of these key ports becomes inoperable. Ensuring secure import routes is more vital for some foodstuffs more than others. For this analysis, these foodstuffs have been selected on the basis of three “vulnerability” criteria:

1. UK consumer demand must be substantial. All of the selected commodities had imports into the UK valued at over £100 million in 2007.
2. A large proportion of imports must come from outside the EU. Some non-EU imports are known to be transported in giant ‘post-Panamax’ ships which it is thought can only be accommodated by a small number of UK ports. In contrast, much of the imports from the EU arrive by ‘roll-on roll-off’ ferries, which have a higher degree of flexibility with regards to switching ports. For all of the selected commodities, at least 75% of the 2007 imports into the UK came from outside of the EU.
3. UK production is not possible – foodstuffs are non-indigenous. Where the UK is totally reliant on imports for supply, the security of import routes becomes more important.

Desired outcome

Disruptions to ports do not have a major impact on available supplies to consumers. Such disruptions may temporarily restrict consumer choice, but will not result in panic buying or any other major consumer impact.

Indicator Concentration of point of entry of imports of non-indigenous foodstuffs

Source Defra analysis of trade and port statistics

Eight commodities meet all three criteria above. These are presented below, along with the proportion of all imports (non-EU and EU) that arrived at the UK port accepting the highest total value of the commodity in 2007.

Commodity	Total Imports (£m)	Share of imports from outside EU	Leading Port	Leading port's share of total imports
Soya beans	155	85%	Liverpool	78%
Cane or beet sugar and chemically pure sucrose, in solid form ⁴⁵	493	80%	London (Inc Tilbury)	74%
Tea	153	94%	Felixstowe	68%
Cocoa beans	153	94%	Hull	45%
Bananas fresh or dried	364	89%	Portsmouth	35%
Coffee not roasted not decaffeinated.	240	58%	London (Inc Tilbury)	26%
Tunas skipjack & Atlantic bonito	203	90%	Unknown	Unknown
Grapes fresh or dried	400	75%	Felixstowe	25%

⁴⁵ Most imports will be raw cane sugar, which is non-indigenous. A fraction of raw sugar imports will go for direct consumption (e.g. Demerara sugar). See text below.

Key Points

- The majority of imports in three commodities (raw cane sugar, tea and soya beans) are each received through an individual port.
- A substantial share of cocoa, coffee and bananas (35-45%) arrive through a single port.
- Because of single market rules, we are not able to identify point of entry for EU imports. It is likely that some will be pass through the leading ports listed above.

Assessment

Considering the wide array of foodstuffs consumed in the UK, there are not many commodities which meet the vulnerability criteria. But the importation of those identified above are concentrated on individual ports to the extent that supply would be seriously affected if disruption to that port prevented its share of imports from reaching the UK market.

In that event, one or more of the following mitigating factors are likely to emerge:

- Traffic is switched to another port (See [indicators 3.6 and 3.7](#)). There would be strong pressure from retailers to ensure key items such as bananas reached market. On the other hand, switching may be limited because of the absence of specialised harbour equipment or nearby storage/processing plants. In the example of soya beans, Tilbury has the facilities to handle soya beans in addition to Liverpool, although there might be reluctance to accept soya imports into Tilbury which might result in GM contamination of dock-side equipment.
- Close substitutes are found to make good the supply. Beet sugar, which is indigenous to the UK and mainland Europe can substitute for raw cane sugar. The 2005 EU sugar reforms have cut EU support prices and quotas, but beet sugar is likely to remain the dominant supplier of the market. Because of the EU quota system, there may be limited scope for increased production or trade within the EU.
- Consumers find substitutes e.g. a wide range of other fruits could be seen as alternatives in the absence of grapes.

Rating of current position



Comparison with mid-1990s

Similar

Likely position in 5-10 years



Theme 4 UK food chain resilience

Introduction to the theme

UK food supply depends upon a sophisticated and complex chain and infrastructure, and is particularly dependent upon energy in its various forms. This complex chain has many strengths. Defra's July 2008 paper notes that the resilience of the overall food supply chain is underpinned by "the number of different supply chains and manufacturing and retail businesses." It states that food resilience is about "ensuring that critical elements of our food supply chain work. This includes maintaining communication, transport and energy networks."

However, it also warns that the food system "has the potential to be significantly vulnerable to interruptions in energy supplies used for agriculture, food processing and refrigeration, food transport, and in food retailing." Recent years have seen a wide range of potential threats and disruptions to the food chain, and whilst in general the food chain has proved remarkably robust, business continuity planning is becoming more important.

Types of challenges and threats addressed by this theme

- *Energy supply disruptions and oil price surges*
- *Pandemic flu*
- *Extreme weather events and transport disruptions*
- *Disruptions to the domestic food chain*
- *Economic risks to the food industry*

Headline Indicator

- **Energy dependency of the UK food chain**

Supporting Indicators

- 1. Energy capacity reliability**
- 2. Diversity of oil and gas imports**
- 3. Business continuity planning**
- 4. Retailer warehouse stocks**
- 5. UK cereal stocks**
- 6. Food industry diversity**

7. Profitability of large food manufacturers

8. Strategic road network

Other indicators under consideration

- R&D expenditure in the food industry (may be covered by sustainable food indicators)

Theme 4

Food chain resilience

Headline indicator

Energy dependency of the UK food chain

Rationale and associated risks

The production, processing, packaging, distribution, transport, retailing and consumption of food – the food chain - depends directly and indirectly upon energy and power: electricity, gas, fuel, fertilizer and oil. **Energy security is vital to the functioning of the whole economy.** Food is a prime example. Energy intensive industries like food are exposed to energy supply disruptions and/or higher energy prices. If our energy is not secure, nor will our food chain be.

As UK indigenous reserves of gas decline and the UK becomes more dependent on imports, the UK has greater exposure to world energy markets, although risks to suppliers from specific regions are mitigated by the UK's diversity of import routes and sources (see [indicator 4.2](#)). Actual *shortages* of energy or power would probably have a greater impact on food supplies than *rising prices* (although when supplies are short or are expected to be short, prices will rise). Shortages could result either in food production stoppages (resulting in potential shortages at the consumer end) or sharp rises in prices – with **impacts upon affordability and household food security** (see [Theme 5](#)). Defra analysis suggests that the surge in energy prices in 2008 (not the rise in commodity prices) was the most important driver of retail food inflation in 2008, reflecting the pervasive use of oil, gas and fuel throughout the domestic chain. And research in 2007-8 for the Sustainable Development Commission found that a doubling of oil prices from \$50 to \$100/b would increase UK consumer food prices by an estimated 5-10%.

On the other hand, a rise in energy prices can actually increase long-term resilience if they promote incentives to invest in energy efficiency, as has happened since the 1973 crisis. Similarly, government measures to promote a diverse range of energy sources, for example by increasing the contribution of renewables and nuclear power, will provide additional resilience against increases in oil and gas prices.

Note that this indicator does not distinguish between low and high carbon energy sources. Whilst global reserves of crude oil and natural gas are rising (see Box 4) A key strategic objective set out in the *Food Matters* report is for an environmentally sustainable food chain. Shifting to lower carbon sources of energy will be a key means to this.

Desired outcome

The food chain's dependency upon energy declines over time, as industry becomes more energy efficient and makes better use of logistics. So any serious disruptions to energy supply or surges in oil or gas prices have a muted impact at the consumer level. Investing in energy efficiency throughout the food chain promotes resilience to external shocks to the supply and/or price of energy and minimises disruption to supply chains in times of tight energy markets.

Indicator

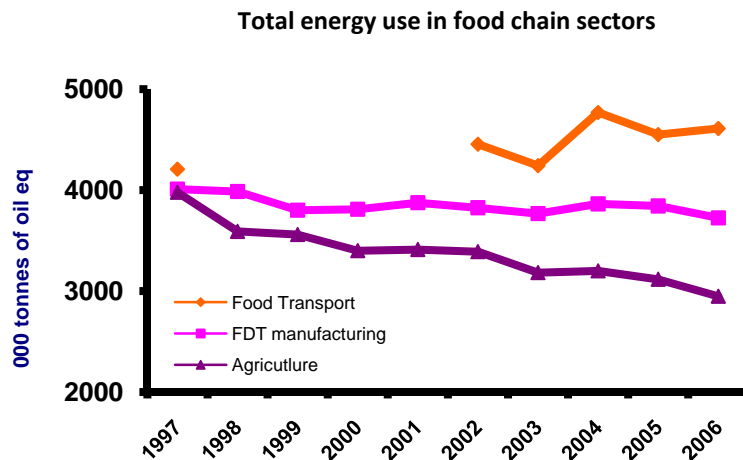
A comprehensive indicator of the energy dependency of the food chain is not feasible. However, we consider three aspects of this theme:

1. **Total energy used in:** food industry transport, agriculture and manufacturing (first chart).
2. **Energy use per unit of real output for agriculture and manufacturing** (second chart)
3. **Combined energy use in agriculture, food transport and food manufacturing per unit of real output** (third chart)⁴⁶

⁴⁶ The denominator consists of GVA for agriculture and manufacturing, but not food transport, because of data limitations.

Source

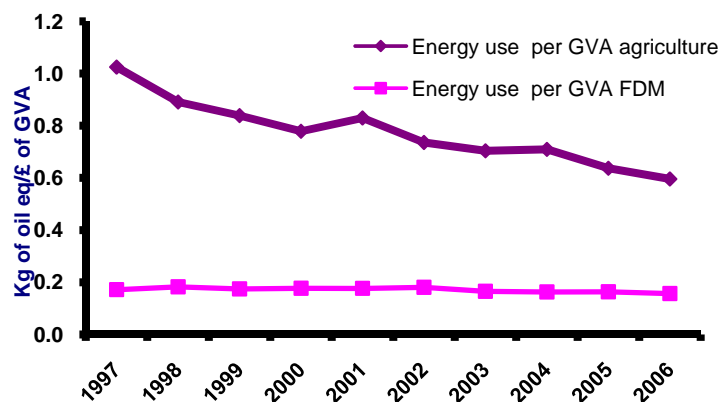
Department of Energy and Climate Change (DECC); Defra statistics



Note: 'FDT' is food, drink and tobacco

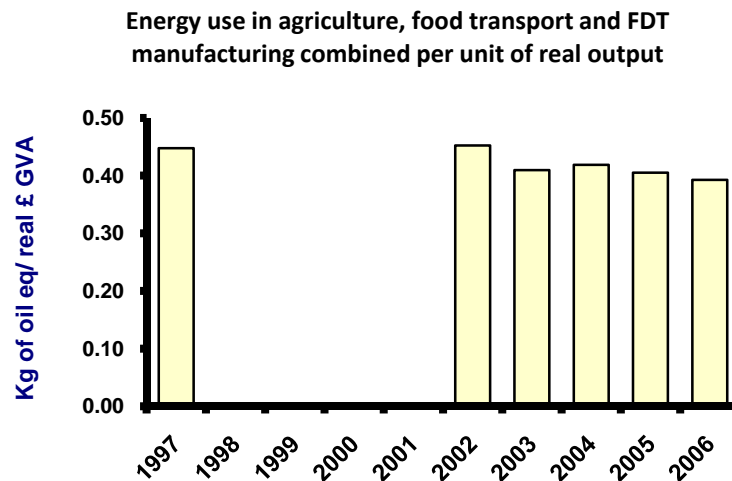
- In absolute terms energy use in the food manufacturing sector fell by 10% from 1997 to 2006; the agricultural sector saw a fall of around 30% over the same period. The energy (fuel) used in food transport has been less stable but seems to be on a rising trend since 2002.
- Around two-thirds of energy consumption in UK agriculture is in the form of indirect inputs such as fertiliser, tractors and animal feed. Reduced fertiliser use is a key driver of the overall decline.
- The downward trend in energy use in UK agriculture goes back further. Between 1985 (when figures begin) and 2006, total direct and indirect energy use in agriculture fell by 31%, although most of this reduction occurred since 1997.⁴⁷

Energy use per unit of real output in agriculture and in FDT manufacturing



⁴⁷ Agriculture in the UK 2007, Table 15.5, back data <https://statistics.defra.gov.uk/esg/publications/auk/2007/excel.asp>

- Energy intensity has also declined between 1997 and 2006 – in agriculture by 42% and in food manufacturing by around 10%.
- The energy intensity of food and drink manufacturing has been falling over a long period. DECC figures show that energy consumption per unit of output in the food, drinks and tobacco manufacturing sector fell by 25% between 1982 (from when figures are available) and 2006.



- Rising energy use in food transport has been offset by lower energy intensity in the manufacturing and agricultural sectors: overall energy intensity is 12% lower than in 1997.

Box 4 Are global energy reserves becoming scarcer?

Global proven reserves of crude oil and natural gas are in fact rising.⁴⁸ “Proved reserves” are estimates of the amount of oil recoverable from known reservoirs under current economic and operating conditions. Global proven reserves of crude oil have more than doubled since 1980. The ratio of reserves to production (a measure of the remaining amount of an exhaustible resource, typically expressed in years) has trended upward since 1980 and has oscillated around the 40 year mark since the early 1990s. The ratio for natural gas has increased from around 50 years in 1980 to 60 years. These levels reflect market incentives rather than actual reserves - so long as firms have ample “known reserves” for expected future demand, they have little incentive to find more. This dynamic has been recently highlighted by the World Bank: *“The existence of ample (and growing) reserves, and a history of significant improvements in the technology with which resources are found and extracted, suggests that supply will continue to rise in pace with demand. True resource exhaustion is unlikely not least because, as resources become scarcer, their prices rise, consumption declines, and alternatives that once may have been uneconomic are substituted for the scarce (and expensive) commodity”*.⁴⁹

⁴⁸ Energy Information Administration (EIA) and Oil & Gas Journal. As a convenience to the public, the EIA makes available foreign fuel reserve estimates from other sources, but it does not certify these data

⁴⁹ World Bank, *Global Economic Prospects 2009*, p.74

Assessment

The domestic food chain is necessarily a heavy user of energy, second only to chemicals and metals manufacturing. Nevertheless, energy intensity is falling and absolute energy use is declining in agriculture and manufacturing. The surge in energy prices in 2007-8 and their continued uncertainty can be expected to increase the incentives to reduce energy intensity along with pressures for lower carbon production and distribution. We therefore expect these favourable trends to continue into the future.

So as far as energy intensity is concerned, the UK economy is more insulated from external energy shocks today than it was during the 1973 oil crisis. Whilst the oil price inflation of 2008 was a reminder of the importance of energy costs to food, the impact on food prices would have been much greater without these improvements. Actual fuel shortages or power outages remain a risk whatever the level of energy intensity (although again, we would expect a bigger impact where energy intensity is greater). Those risks are addressed in the next two indicators.

Rating of current position



Comparison with mid-1990s

Improvement

Likely position in 5-10 years



Potential development

- Include low carbon sources of energy. However, this may be dealt with directly by Defra's sustainable food indicators.

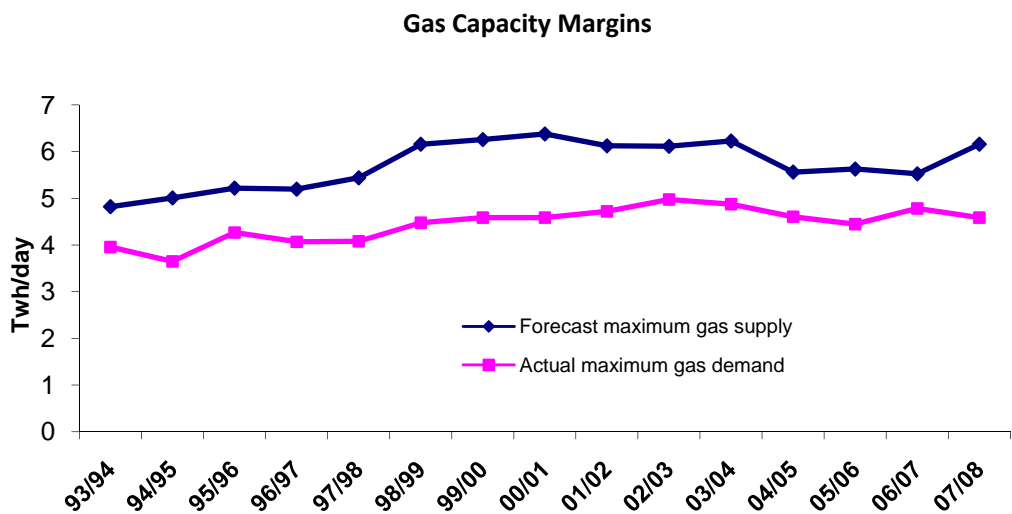
Rationale and associated risks

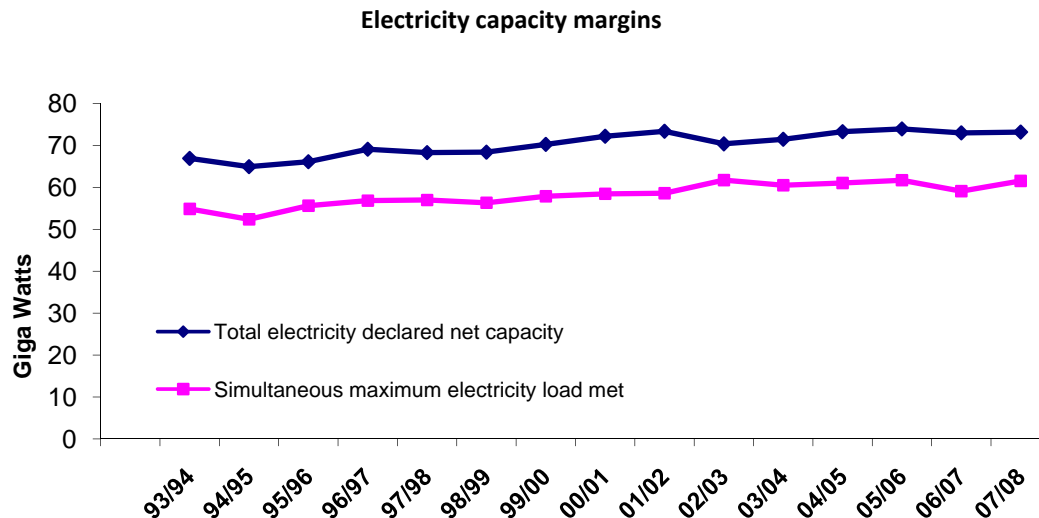
The headline indicator directly addresses the energy dependency of the food chain. Underlying this, however, is the broader question of energy security or “energy reliability”. This is a highly complex subject and DECC have developed a wide range of energy reliability indicators. It would be misleading to capture “energy reliability” in a single indicator. But deterioration in indicators of energy reliability would clearly represent a warning for the food chain. DECC’s analysis suggests that the most important influence on security of energy supply is the overall balance between gas and electricity demand and **physical supply capacity**. This represents the safety margin between likely demand and the industry’s physical ability to supply enough energy to meet that demand. The food chain is dependent upon gas and electricity: they are needed to process, refrigerate, prepare, package, retail and cook food.

Desired outcome

The food industry is able to access adequate power and energy even at times of high demand (i.e. cold winters) and potential supply shortages. Were this not to happen, domestic food manufacturing in certain energy dependent sectors could be held up, and shortages at retail level would appear (which could be made worse by panic buying). Household power shortages would also increase food safety risks as storage and cooking would be affected. Fears of upcoming shortages can also have a direct impact on wholesale gas and electricity prices (as occurred with gas in Spring 2006) with associated impacts on food prices.

Indicator Gas and electricity capacity margins
Source DECC, *UK Energy Sector Indicators 2007*





Key points and assessment

Gas capacity, according to DECC's figures, currently exceeds demand. DECC states: "In terms of capacity, on the assumption that facilities currently under construction are completed to target, new import capacity should more than offset declining indigenous production until around 2015. Gas supplies to the UK will therefore not be constrained by physical capacity until this time (although prices may need to rise to attract supplies to the UK.) Further investment will be needed to avoid physical capacity constraints from around 2015."⁵⁰

Electricity cannot currently be economically stored in meaningful quantities. Consequently, electricity has to be generated at the same time as it is consumed. To ensure that demand can be met at all times, therefore, it is necessary to have available enough generating capacity to meet "peak" demands. Whilst in the near term the ability of the network to meet demand does not seem to be challenged, DECC cautions that "there are uncertainties around future levels of electricity demand and new electricity build as well as the exact timing and sequence of plant closures".⁵¹

We therefore provide a favourable rating for the current position. The amber rating looking forward would apply more to electricity. The outlook for gas capacity is more favourable.

Rating of current position



Comparison with mid-1990s

Similar

Likely position in 5-10 years



Potential development

- Incorporate latest outlook material from DECC on projected gas and electricity demand and supply

⁵⁰ DECC, *Energy Markets Outlook* (October 2007), p.42 <http://www.berr.gov.uk/files/file41995.pdf>. See also http://www.decc.gov.uk/en/content/cms/what_we_do/uk_supply/markets/outlook/outlook.aspx

⁵¹ DECC, op. cit, p. 37.

Supporting indicator 4.2**Diversity of oil and gas imports****Rationale and associated risks**

Given the reliance of the food industry upon gas and fuel, and the UK's increasing dependence upon imports of these, we also propose to include one of DECC's supporting reliability indicators – the **diversity of oil and gas imports**. UK production of gas and crude oil from the North Sea is in general decline.⁵² Imports of gas and oil are considered to carry far more strategic risk than imports of food and drink, reflecting the specialised infrastructure involved, the lack of substitutes available and the consideration that some producing regions have unstable governments (see Box 5).

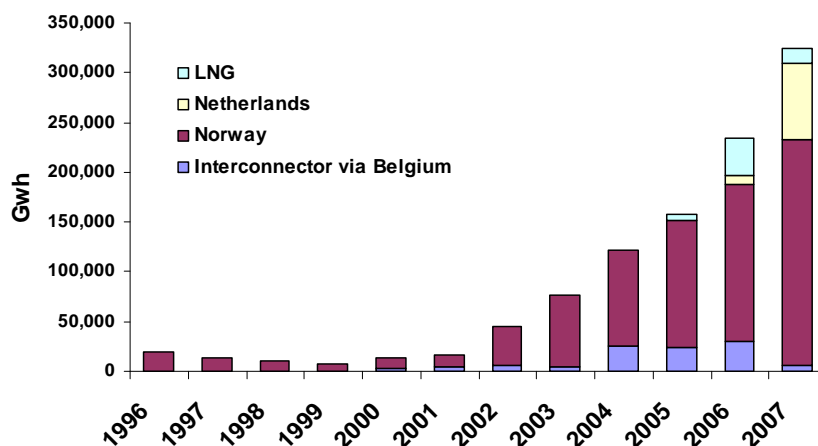
Desired outcome

UK imports of oil and gas become more diverse, as markets develop, so that the UK does not become dependent upon one or two unstable suppliers. A lack of diversity in import routes and sources would expose the UK to the risk of shortages if one or more of the main sources of supply, for whatever reason, fell short. Given the energy dependency of the UK food chain, this would have potentially wide-ranging adverse effects on domestic agriculture, food manufacturing and retail distribution – i.e. on availability and access.

Indicator **Diversity of UK gas and oil imports**

Source DECC

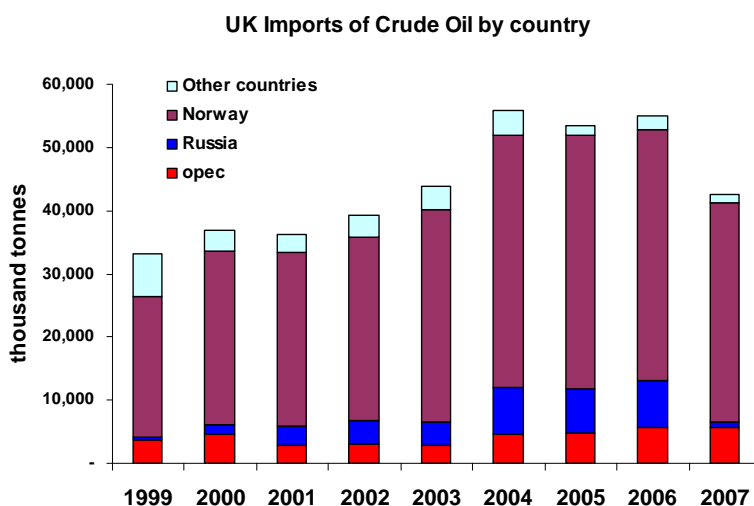
Diversity of UK Gas Imports

**Key points – gas imports**

- Despite imports being constrained by existing pipeline infrastructure, the diversity of UK gas imports in the last decade has increased.

⁵² DECC does not use UK oil self-sufficiency as an indicator because crude oil is not homogenous, with the UK exporting light sweet crude (used for transport fuels) and importing heavier crudes (which have chemical applications).

- In the 1990s, Norway was virtually the only source of imported gas. Now the UK receives gas also from the continent through two key pipelines via Belgium and the Netherlands. This gas may be originally sourced from within the EU or from outside it, for example from Russia or Algeria by pipeline, or from further afield by liquefied natural gas (LNG).⁵³
- Imports of LNG shipped directly to the UK in tankers also contribute to the supply mix. Since these imports do not depend upon existing pipelines their role is forecast to increase in the future. DECC analysis indicates that that by 2016/17 LNG import capacity in the UK could represent some 23% of total peak supply capacity. According to DECC, “The UK has been supplied largely by Algeria to date, followed by Egypt and Trinidad & Tobago, but as we expand our LNG import facilities, our LNG is likely to come from a greater number of countries”.⁵⁴



Key points – oil imports

- The majority of UK crude oil imports come from Norway as the close proximity of UK and Norwegian oil fields allow them to use the same pipeline infrastructure. Norway’s import share increased from 67% in 1999 to 81% in 2007 as the share of minor suppliers (‘other countries’ such as Mexico) declined. OPEC’s share has oscillated around 10% since 1999 but doubled since 2003. The reduction in Russia’s import share is attributable to classification issues.⁵⁵
- Imports from OPEC and Russia are considered to be more ‘risky’ than imports from elsewhere due to geopolitical factors, and global oil reserves are becoming more concentrated in the Middle East.
- This evidence suggests UK imports of crude oil have become slightly less diverse over recent years.

⁵³ LNG can be transported in gaseous form by ship to the UK from places such as Qatar and Algeria. Once it reaches LNG terminals at deep water locations such as Milford Haven and the Isle of Grain it can then be transported inland via pipelines.

⁵⁴ BERR, *Energy Markets Outlook* (October 2007), p. 52, <http://www.berr.gov.uk/files/file41995.pdf> ; BERR, *LNG imports in your area* (August 2007), p. 3, <http://www.berr.gov.uk/files/file40537.pdf> .

⁵⁵ The majority of imports from Russia have now been classified as *oil products* rather than conventional crude oil. This explains the large drop in Russia’s share from 2006 to 2007.

Assessment

UK gas imports are becoming more diverse as the UK draws upon both European and non-European supplies. UK gas supply appears to be increasingly integrated into the continental European market but there continues to be growing reliance upon a single country Norway.

Crude oil resources are geographically concentrated which significantly limits import diversity, although crude oil is a relatively well established global market compared with the more regionalised natural gas markets. Importantly, DECC notes: "Although the UK only quite recently became a net oil importer, we have long been active on the global oil market and therefore already have in place much of the infrastructure, contractual arrangements and commercial relationships needed to acquire our oil needs from external sources"⁵⁶.

The increasing need of the UK to import gas and oil in future years is likely to make diversity more important.

Rating of current position



Comparison with mid-1990s

Similar. Import diversity of crude oil has slightly deteriorated since the late 1990s whilst gas imports have seen a significant rise in import diversity over the same period.

Likely position in 5-10 years



⁵⁶ *Energy Markets Outlook*, Chapter 7- Oil, p. 88 (Oct 2007) <http://www.berr.gov.uk/files/file42002.pdf>

Box 5 How food security differs from energy security

The issues of energy security and food security are related but distinct. Global oil production for export is concentrated far more than food production for export. Oil producing countries have the ability to operate in collusion (OPEC), and several are politically influenced by governments. The case of food is very different, and to some extent the reverse, as many oil and gas exporting countries are also food importers (e.g. in the Middle East).

There is more scope for substitution on the demand and supply sides between different foodstuffs than between sources of energy, especially in the short term. Supply of energy involves single large physical networks (e.g. gas and electricity), and there are little alternative means of sourcing energy if these networks are interrupted.

Unlike food, many sources of energy can be stored for long periods (though electricity storage is limited). Potential volatility of demand, for instance during very cold winters, means that storage is commercially desirable as well. Food demand can surge during periods of 'panic buying' but these tend to be short-lived, and overall food consumption levels generally remain predictable (including seasonal demand surges).

Energy provision is much more capital intensive than food provision. It requires expensive and long-term investment decisions that become 'sunk costs' (e.g. on extraction, power generation and storage), and in which delay can make supply vulnerable to shortages. The potential for national and local government interference in this sector can also adversely affect incentives to make these investments. On the other hand, Government also has an enabling role through legislation around market framework, and facilitating the provision of critical infrastructure.

High energy costs also have particular impacts on groups of elderly people who, during cold winters, may struggle to keep warm and risk serious illness by keeping heating down in order to save on bills (according to DECC, a household is said to be in "fuel poverty" if it needs to spend more than 10 per cent of its income on fuel to maintain a satisfactory heating regime). Rising food costs are particularly likely to harm large, low income households, although we are doing further research in this area.

Differences apart, there are themes common to both food security and energy security, notably the diversity and reliability of supplies and supply routes; the role of market incentives in facilitating supply and managing risks; the importance of international market liberalisation and integration.

Rationale and associated risks

Given the wide range of potential shocks and disruptions that might occur within the food chain – whether affecting energy, labour, agriculture, raw materials or transport – government and industry need to be confident that adequate continuity and contingency planning is in place. The 2009 swine flu outbreak is a good example. Commercial confidentiality remains an issue here, and it may not be possible to construct a robust quantitative indicator, so for now we provide a broad qualitative assessment.

Desired outcome

Through wider uptake of business continuity planning, spread of best practice, better planning for future risks, appropriate BS standards, participation in government sponsored exercises and dialogue with government (giving assurance that government knows how to respond), the food industry is prepared to deal effectively with a wide range of disruptions to supply chains, with the minimum of impact upon consumers, although depending upon the nature of the shock, there may be some loss of consumer choice.

Key points

Research by Cranfield University for Defra in 2005-6 explored the current scope and state of existing business continuity management (BCM) in key sectors of the food and drink industry.⁵⁷ The research involved some of Britain's leading supermarket chains, wholesalers, food and drink manufacturers, their suppliers and transport providers, as well as a number of industry associations. Although over sixty senior managers participated, the study was qualitative. It does not offer quantitative estimates of the extent of BCM, but its comprehensive in-depth coverage of industry practice revealed a number of significant findings:

- Business continuity is widely recognised as a rising discipline and a growing concern but it could be much more integrated into normal business practice.
- Most businesses were pursuing wider operational risk management programmes, particularly with regard to corporate governance, food safety and health and safety purposes. Quoted companies are obliged to do more than unquoted companies.
- But for many BCM is still in its early stages of implementation, often for reasons of resource constraints and lack of expertise. Most organisations conceded they were not in the vanguard of current best practice and some managers were not aware of the existence of BCM tools.
- All organisations had some form of IT-related continuity planning and disaster recovery in place
- Retailers are typically very resilient, seeking to protect “mission critical activities” and brand reputation, but they also look to their suppliers to provide logistical flexibility in exceptional circumstances.
- Food processors and packagers in turn use the ability to “flex” production between manufacturing sites as their main form of contingency. However, as spare capacity declines (because of pressures to reduce costs, consolidate and offshore), the risk focus shifts towards transport, communications and the supporting infrastructure. Companies were reluctant to invest in costly preventative measures or redundant capacity “just in case”.

⁵⁷ H.Peck, *Resilience in the food chain: a study of business continuity management in the food and drink industry* (July 2006), Research report for Defra

<http://randd.defra.gov.uk/Default.aspx?Menu=Menu&Module=More&Location=None&Completed=0&ProjectID=13607>

- Commercial incentives – the wellbeing of customers, employees and shareholders - motivate companies to do BCM.
- Multinational food processors, with their experience of the varied risks facing global supply chains, tend to have more formal BCM procedures than their UK-only counterparts.

Broadly speaking, the research showed that larger food companies tend to do more in this area, and that lessons from the past (e.g. fuel blockades; limitations of “just in time” practices) were being learned, but that there was potential for improvement.

Separately from this study, Defra’s latest **biennial survey of the food industry sector** (a voluntary and confidential survey carried out on our behalf by IGD) shows that:

- the large Retailers, with at least 92% by market share of the grocery market, have Business Continuity Plans (BCPs) that are tested once or twice a year.
- At least 41% by market share of Wholesalers (including cash & carry) have BCPs, but only half of these actually test their plans on a regular basis. (The actual figure may be higher in this sector as it is categorised by a large number of companies and only a sample completed returns.)
- UK Food Manufacturing is a more complex sector to assess due to its size and the range of products. However, five of the companies in the top ten with the biggest annual turnovers and a further four companies in the top twenty have BCPs that are tested either once or twice a year (the other eleven did not respond to the survey) with another 72 Companies regularly testing their plans.

A new survey will be conducted during 2009.

Assessment

Businesses are becoming increasingly aware of the need for contingency planning, and of the risks of operating in a globalised world. It appears that businesses have learned a lot in the last ten years regarding the risks to their operations, supplies and reputations, and these lessons are likely to be reinforced, rather than forgotten, going forward. However, there is also clearly more that could be done in integrating BCM into commercial operations, and the risk remains that increased pressures of competition and the drive for lean operations may work against this.

Rating of current position

Comparison with mid-1990s



Improvement

Likely position in 5-10 years



Potential development

- Monitoring of company websites
- Improved biennial IGD survey returns for Defra
- Participation in government sponsored exercises

Theme 4

Food chain resilience

Supporting indicator 4.4

Average retailer grocery stocks

Rationale and associated risks⁵⁸

As distribution systems have become more sophisticated over the last two decades, retailers and others in the supply chain have increasingly adopted **Just-In-Time** (JIT) principles of operation - sourcing supplies in small quantities at frequent intervals to provide continuous availability to consumers. This reduces storage costs and facilitates efficient customer response and quality management. Where, however, the drive for efficiency and JIT has reduced the role of stocks and 'contingent capacity', so risks have shifted towards transport-related disruptions. Even a short delay in supplies can have an impact on particular fast-moving lines, although in most cases shoppers would not notice this, and have alternative choices. But where many or all deliveries are blocked for some reason, shelves could go empty, and this could be exacerbated by panic buying, which could worsen availability for those consumers less able to respond quickly.

Stocks can provide a short-term buffer against against severe disruptions upstream in the supply chain. Whilst research suggests that business continuity planning is becoming mainstream among larger firms and JIT encourages proactive retailer chain management, it remains a relevant question whether the commercial pressures facing retailers and their suppliers provide adequate incentives to ensure that the distribution system is sufficiently resilient to upstream disruptions.

But it is important to recognise the benefits that JIT brings, and that, as far as resilience goes, stockholding is not itself sufficient, and much will depend upon the nature of the threat and how nimbly industry can respond (e.g. stockholding may not provide protection if there is disruption at the retail end of the chain). Part of this will be captured in the business continuity planning indicator, as well as in this theme's headline indicator of energy dependency.

Desired outcome

Retailers (and their suppliers) strike the right balance between efficiency and resilience. In the event of a temporary, but significant interruption to upstream supplies (for whatever reason), retailers are able to continue to replenish stores with sufficient food lines. For instance, the fuel blockades of 2000 highlighted the dependence of the retail food sector upon frequent transport of foodstuffs around the country.

Indicator **Average retailer warehouse stock levels (days) by grocery category**

Source IGD *Retail Logistics*. We have previously shown this chart in our 2006 food security paper (Figure 7.4). Note that stocks are held in warehouses rather than stores. The figures are average company stock levels. In general, fresh and chilled produce categories do not have a warehouse stock-holding, particularly across the multiple grocers, but are cross-docked directly from the supplier out onto store deliveries. Hence these categories are not reported below. Retailers will differ in their stock levels reflecting different approaches to logistics.

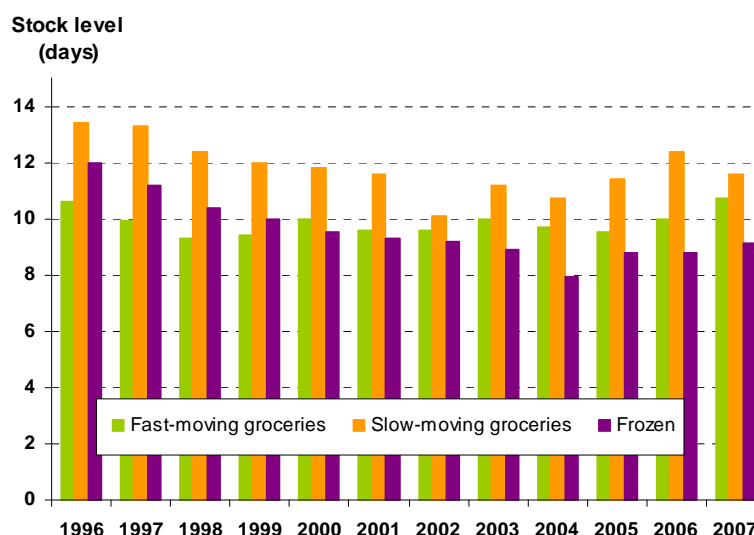
Key points

- Since 1996, warehouse retail stock levels have been in decline in frozen lines and ambient slow moving groceries (SMGs). Between 1996 and 2007, stock levels of SMGs fell by 13% and frozen goods by 24%.

⁵⁸ See also, *Food Security and the UK*, section 7.

However, stock levels of fast moving goods (FMGs – such as bread, milk etc) have been broadly stable (10-11 days cover) over this time.

- Although we are unable to calculate weighted averages of these different categories of groceries, it appears that the declining trend in stocks since 1996 has reversed since 2004/5 with all three categories recording increases by around 1 day.
- There was a notable reduction in 2007 of stock levels in slower moving ambient grocery lines and those ambient lines which generally represent the largest share of throughput volumes across all the UK retailers and wholesalers.



Assessment

JIT is typically more marked in frozen and fast-moving categories, where replenishment or shelf costs are important. We would expect stocks to decline as retailers invest more in leaner supply chains and efficient logistics (which will have had positive effects on consumers' affordability of food). However, retailers' decisions to hold more stock in recent years may be an indication of their willingness to insure against future disturbances to the upstream supply chain and commercial incentives to provide continuous supply to consumers. Whilst stock levels appear to have stabilised, stocks are broadly at 2000 levels, the time of the fuel crisis. This suggests an amber rating.

Looking ahead, sharply increased energy and fuel costs since 2006 may serve to limit the application of JIT (which has grown as a result of falling transport costs) as logistics account for a relatively more significant element of cost than in the past. On the other hand, the continued, and potentially increased strength of competition amongst retailers in the years to come may reduce the incentives to hold stocks to cover against supply disruptions.

Rating of current position

Comparison with mid-1990s



Deterioration

Likely position in 5-10 years



Supporting indicator 4.5

UK cereal stocks

Rationale and associated risks

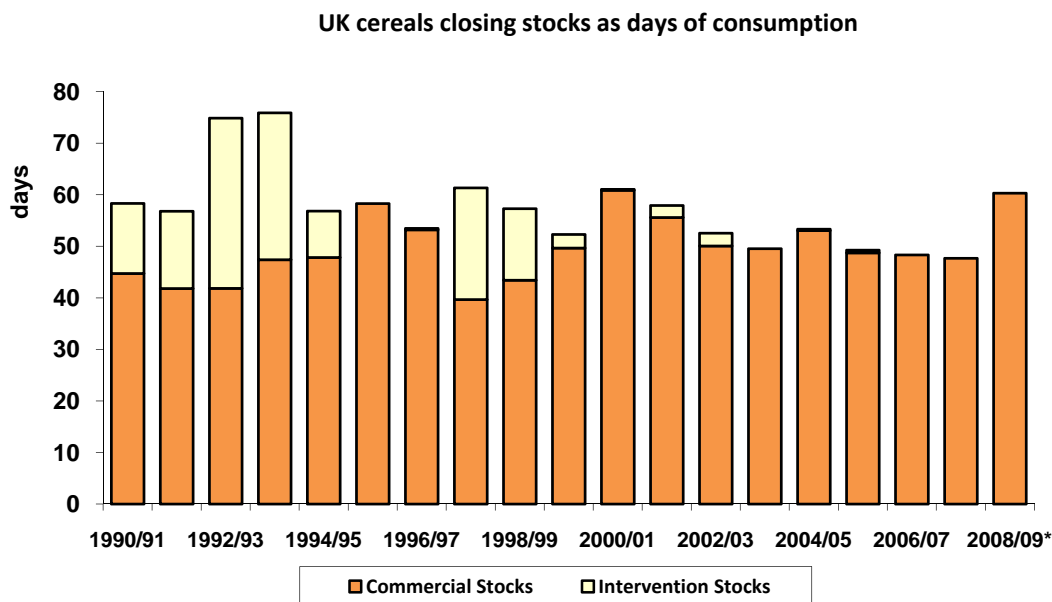
End of crop year stocks are viewed by the industry as the “buffer” stocks that are available to accommodate increases in demand or reductions in supply in the following year. Domestic end of crop year stocks can be used to assess the level of resilience of the UK food chain to disruptions in cereal supplies (e.g. through disruption to international trade) or any sudden surges in demand at the time just prior to harvest when the impact would be greatest. Low stocks would increase the impact of any disruption. For other commodities, either data is not available, or stocks would not be an appropriate indicator (e.g. livestock can be slaughtered; most fruit and veg is perishable).

Desired outcome

Sufficient stocks provide the market with some resilience to shocks of reduced supply and increased demand without stock levels that indicated structural oversupply of markets. However, an economy that has access to functioning international markets need lower contingency stock levels than would a closed economy.

Indicator UK Cereal Stocks as Days of UK Consumption

Source Defra, HGCA



* Provisional estimates

Key points

- Total cereals stocks levels expressed in days of consumption in the UK increased in the early 1990s and have seen a downward trend since then. The downward trend is far less pronounced for commercial stocks.

- The high stock levels in the early 1990s can be linked to the intervention system and resulting oversupply in the UK and wider EU market.
- In the current 2007/8 marketing years, stocks at the end of the year are estimated at some 2.75 mt of cereals, representing around 50 days of consumption for that year.
- Cereals available for consumption in the following year are a combination of stocks, the domestic harvest and imports.

Assessment

Stock levels expressed in days of consumption have not changed significantly over the last few years but have been lower following the CAP reforms of the 1990s. Stock levels are likely to increase following the 2008 harvest.

Rating of current position



Comparison with mid-1990s

Similar

Likely position in 5-10 years



Supporting indicator 4.6**Diversity within the food industry****Rationale and associated risks**

Diversity is essential to security, not only in terms of trade in agricultural commodities, but also within the domestic supply chain, which consists of retailers, food manufacturers and wholesale and food service operations. High levels of concentration in specific parts of the food chain may make the chain more vulnerable to temporary supply shortages, which could be exacerbated by panic buying. If one major supply chain or company were to fail, for whatever reason (e.g. some radical IT or power failure), there could be a potentially major impact on availability and access of food, if other chains were not able to help to fill the gap.

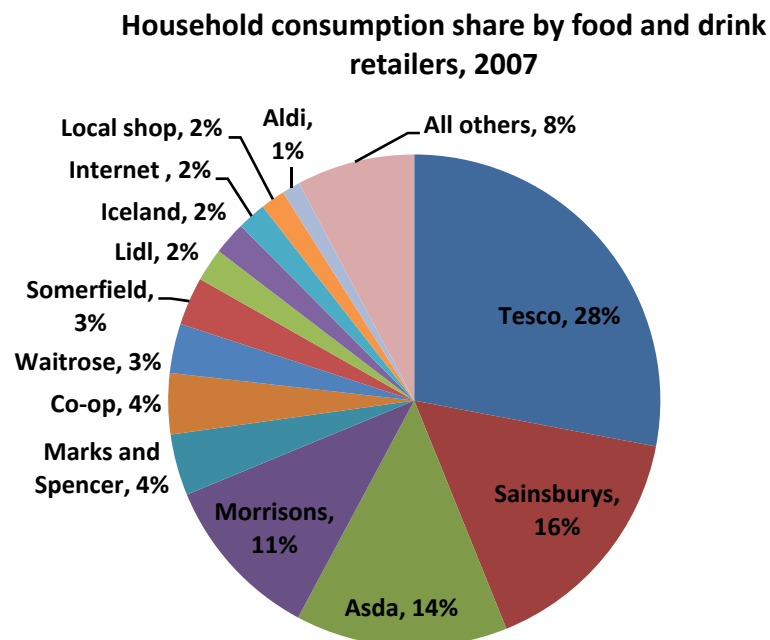
Desired outcome

Major operational failures in the domestic food manufacturing sector can be made up for by:

- other suppliers filling the gap, or:
- increased imports of processed food, particularly where multinational companies are concerned; though may not be possible or easy for perishable or bulky goods (e.g. bread; milk).

Indicator **National food retailing and manufacturing market shares**

Source Expenditure and Food Survey; Mintel

**Key points (Retail shares)**

- According to the EFS, The leading three supermarkets account for 58% of total household food consumption

- At least ten supermarket chains could be said to be nationwide operators
- There is likely to be more concentration in certain regions
- Internet shopping provides additional options for consumers
- In 2009, the Co-op acquired Somerfield, thus becoming the fifth largest retailer
- According to IGD's *Retail Logistics 2008*, the largest 7 UK food retailers operated around 50 large Regional Distribution Centres which channel food supplies between factories and stores. These are supplemented by a range of other distributional centres spread around the country. Wholesalers and freight distribution companies also operate a number of distribution centres.

Food manufacturer shares

As there are a wide range of foodstuffs, there are a wide range of manufacturers, so a single indicator is not possible. According to Mintel market reports, notable degrees of concentration can be found in the sectors listed in the table (we list only those major categories in which the leading three suppliers account for 75% or more of the market – we also include salt mining). However, as the table suggests, concentration figures alone do not capture overall resilience as in most cases, were one operation suddenly to cease, scope for additional supply (particularly imports) or the alternative options open to consumers would mitigate the overall impact. Even where this is limited, particularly in the very short term after a disruption, the impact would be on consumer choice or sharp price rises on specific product lines, rather than a more fundamental question of availability and access.

Sector	3-firm market share	Scope for alternative supply	Scope for demand substitution	Comment
Salt	95% (2005)	Medium	Medium	Salt has many uses. Food and food processing accounts for 30% of UK white salt usage. Imports possible. Table salt not a fast moving good.
Liquid milk processing	94% (2007)	High	Medium	Half of milk processed goes to liquid market; processed dairy products can be imported
Margarines, spreads	83% (2007)	High	High	Butter is an obvious substitute
Sugar refining	79% (2006)	Medium	Medium	Most sugar consumed in processed goods; quota system may limit flexibility. See also indicator 3.8
Baby food, milks and drinks	76% (2008)	High	Medium	Around a third is imported
Eggs	75% (2007)	Medium	Medium	Some redirection from processor to retailer sector possible

Source for market shares: Mintel reports. Salt evidence comes from the Competition Commission http://www.competition-commission.org.uk/rep_pub/reports/2005/505britishsalt.htm Market shares are by value except for liquid milk processing, eggs and salt.

Assessment

The fact that the UK has several large retail and wholesaling operations suggests that we have a reasonable balance between economies of scale and diversity. The large number of distributional centres and routing options provides resilience against widespread distributional failure (see also [indicator 4.8](#)). In addition, the scope for substitution on the supply and demand sides increases resilience.

Smaller and more regionalised supply chains can also add to the diversity of supply and consumer choice. On the other hand, size and a degree of concentration particularly enhance resilience, because of:

- greater resources and nation-wide infrastructure to respond flexibly to or absorb shocks (as demonstrated in the Gloucestershire floods of 2007);
- greater resources to invest in research and development and in-depth continuity planning;
- easier communication across the supply chain;
- reputational incentives to ensure continuity of supplies.

These advantages are to some extent captured separately in the earlier indicator on business continuity planning and [indicator 4.3](#) in this theme (viability of large manufacturers).

Retailer market shares are generally well-known, but they take on new meaning when put into a food security perspective. This links to the question of households' access to food stores ([indicator 5.3](#)).

At the **regional level**, there can be less diversity, something which the Competition Commission has explored, although for reasons of competition and consumer choice, rather than resilience. This is an issue which regional authorities may wish to explore. **Competition policy** has become stronger in the UK and has demonstrated a commitment to maintaining competition within domestic food supply chains. EU competition policy for EU-wide market issues is also becoming influential.

Rating of current position



Comparison with mid-1990s

Similar

Likely position in 5-10 years



Potential development

- Potential use of IGD biennial survey data on industry sites.
- Include wholesaling and foodservice sectors
- Trends in retailer market shares
- Regional retailer market share indicators

Supporting indicator 4.7**Profitability of large food manufacturers in the UK****Rationale and associated risks**

Food manufacturers turn agricultural raw materials into a range of consumable and processed products and play a key role in securing food supply to consumers, whether through famous brands, supermarket own-labels or the food service sectors. The ability to trade and source many processed products, particularly at short notice, is much weaker than with farm products. Therefore the overall economic resilience of food manufacturing operations in this country (whether they are UK or foreign owned), is particularly important.

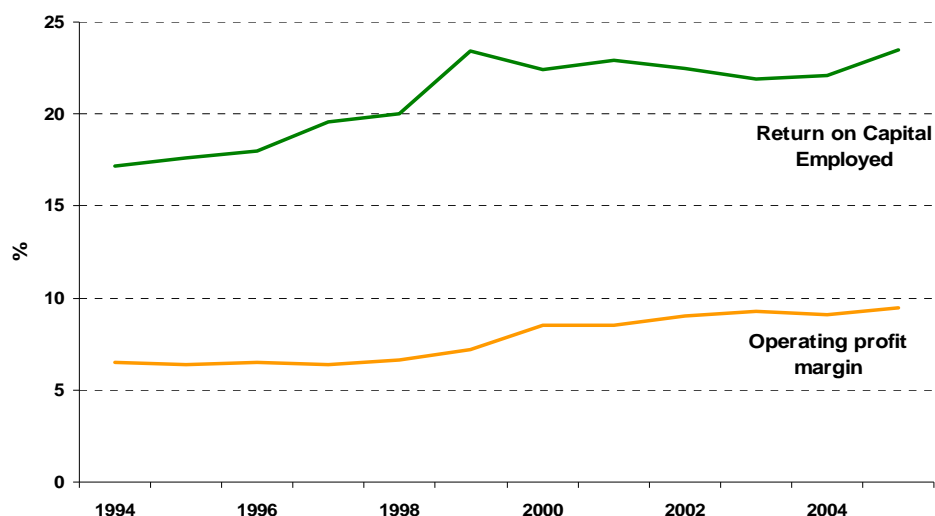
Whilst large companies regularly sell or buy specific food operations so as to cut losses or increase turnover, the industry as a whole has to deal with wider economic pressures such as input costs, credit availability, regulation and competition. Naturally, not all companies would be making profits – where firms do not successfully meet demand, profits fall and they go out of business or sell their assets to other firms. In general, however, profitability is a significant indicator of the resilience of the industry to a range of economic shocks, particularly on the supply side. Large profitable companies also face strong reputational incentives to maintain continuity and safety of supply and are also better able to engage in business continuity planning and facilitate communication with other parts of the chain.

Desired outcome

A diversity of large and resilient food and drink suppliers maintain sufficient profitability to maintain and enhance operations and so are able to provide safe and nutritious products to consumers and are resourced to absorb shocks to the system. If individual companies become weak, others have the ability and desire to take over their assets without temporary loss of supply. A deterioration in this indicator would suggest a need to focus more on other indicators in the theme.

Indicator Profitability of the top 150 food suppliers in the UK market

Source *The Grocer* / OC&C Index of top 150 suppliers



Key points

- The top 150 suppliers account for over 80% of the industry, with turnover ranging from £58m to £8 bn
- Profitability for the largest firms in the sector has been stable in recent years, and higher than in the 1990s. As these are averages, there will be a range with some firms with low profitability and more vulnerable to shocks.
- The Grocer/OC&C Index reports that, for the largest 150 FDM firms, 'after a 10 year growth in **operating profit margins** last year (2006) they declined from 8.6% to 8.4%'. Although a small change in percentage terms, this has meant that 'less than half of the 150 improved their margins in 2006, and the number of loss makers grew from seven to 12'.
- A longer-run measure of profitability – **Return on Capital Employed (ROCE)** – averaged 29.7% for branded and 17.6% for own label products in 2006. ROCE is calculated as the net operating profit divided by the company's capital assets. It indicates how profitably a firm is using its assets and provides a useful guide to long-run profitability.

For the 2008 version of the 'Grocer Top 150', OC&C altered the way in which they provided the data slightly, disaggregating the industry into branded, own-label and commodity food and drink manufacturers.

	Operating margins in 2007	Return on Capital in 2007
Branded	fell from 10.4% in 2006 to 9.7% in 2007	fell from 25.2% in 2006 to 24.4% in 2007
Own-label	fell from 4.3% to 3.8%	fell from 16.9% to 14.9%
Commodity	rose from 4.7% to 6.9%	rose from 9.8% to 15.4%

This mixed picture would not suggest any material change in the aggregate series.

Assessment

Despite the falls for non-commodity manufacturers in 2007, these are healthy indicators. They significantly exceed those found in grocery retailing (though the two sectors are not directly comparable). Returns on capital also tend to be greater for food and drink manufacturers than manufacturing generally.⁵⁹ The cost inflation and credit pressures of 2008-9 have exposed some companies with tight margins or those who have stretched their balance sheets with heavy borrowing, but the industry has remained surprisingly resilient to date. Many of the largest food and drink manufacturers in the UK are part of wider European operations which operate in various geographical and product markets and this can also spread risks.

Rating of current position

Comparison with mid-1990s



Improvement

Likely position in 5-10 years



⁵⁹ The 'Rate of return' for the entire UK manufacturing sector is a key performance indicator for Government. It varies between 6 and 12%, which, the DTI acknowledge, appears very low, DTI (2007).

Theme 4

Food chain resilience

Supporting indicator 4.8

The strategic road network

Rationale and associated risks

The UK road transport network plays a strategic role in connecting UK ports, factories, farms, retailers, food service providers and consumers. The emergence of “just-in-time” supply chains with minimal stocks has placed greater emphasis on the role of road transport within the supply chain. Within the UK most foodstuffs are transported by road. Indeed food, drink and tobacco accounted for 28% of goods moved by GB registered Heavy Goods Vehicles (HGVs) in Great Britain in 2007. In order for the consumer to have guaranteed access to food on supermarket shelves, deliveries need to be made on a regular, predictable basis. Food security would only be threatened by widespread significant delays resulting from flooding, severe weather events, malicious attacks or any other accidental or malicious disruption affecting multiple points on the network.

Note that this indicator draws upon a range of data and evidence in order to assess overall resilience.

Desired outcome

Disruptions to different parts of the strategic transport infrastructure do not have a major impact on available supplies to consumers or on consumer confidence. Such disruptions may however result in a temporary loss of consumer choice of specific product lines.

Indicator Resilience of road network

Source Department for Transport *Road Statistics* and various surveys; Highways Agency

Average vehicle delay by time of day for all journeys and the slowest 10% of journeys: baseline (Aug 04 – Jul 05) and target years (Apr 07 – Mar 08), England.

Period	Weekdays				Weekends	Week
	AM peak (7am-10am)	Off peak (10am-4pm)	PM peak (4pm-7pm)	All periods (6am-8pm)	All periods (6am-8pm)	All periods (6am-8pm)
ALL Journeys						
Baseline ¹	1.75	1.19	1.57	1.38	0.50	1.17
Target Period	1.84	1.25	1.75	1.49	0.52	1.25
Percentage Change	5.2	5.1	11.5	7.8	5.6	7.1
10% slowest Journeys						
Baseline ¹	4.94	3.95	4.77	4.22	2.38	3.78
Target Period	5.14	4.01	5.18	4.43	2.46	3.95
Percentage Change	4.2	1.6	8.7	5.0	3.3	4.4

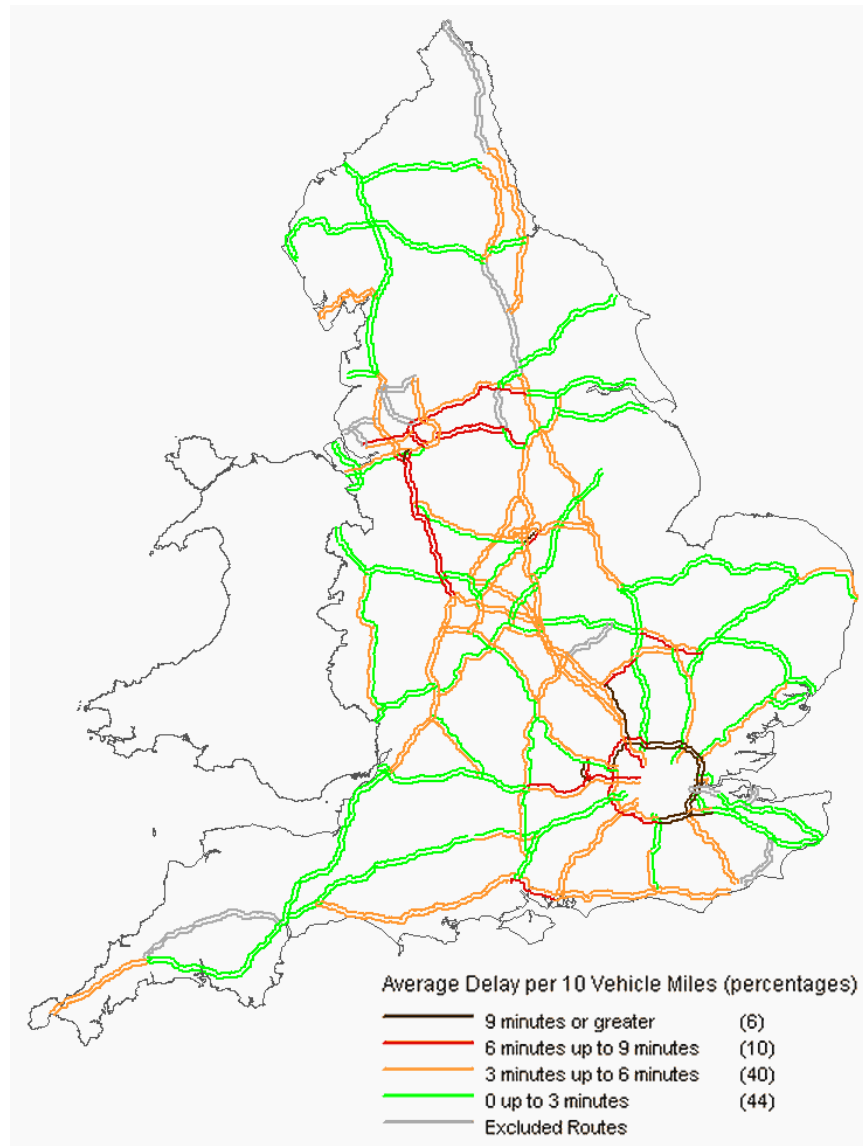
¹ The baseline period is later for 7 of the 91 routes due to data quality considerations.

Source: Table 4.2 *Road Statistics 2007*

Key Points

- At route level, the average vehicle delay on the slowest 10% of journeys tends to be highest in the south east around London and in the north west around Manchester, including the M25 and the M6. (*Road Statistics 2007*, p. 52.)

Average vehicle delay per 10 miles for the slowest 10% of journeys (on each route) in England: year ending March 2008.



Source Figure 4.2 Road Statistics 2007

- The London orbital M25 connects the eight motorways and many trunk roads that terminate in London.
- The M25, which falls into the highest congestion band is used by traffic from several major ports such as London, Medway and Dover to reach the East Midlands region where there is a high concentration of food chain regional distribution centres.
- In 2007, 96% of goods lifted and moved domestically by GB registered HGVs occur Monday to Friday. Levels were very similar across the five weekdays. (Table 1.22 *Road Freight Statistics 2007*)
- In 2007, 56% of food, drink and tobacco lifted (tonnes) domestically by GB registered HGV did not leave the Government Office Region in which it began its journey. (Source: DfT *Continuing Survey of Road Goods Transport, Great Britain.*)

- In 2007, the average length of haul for Food, Drink and Tobacco transported domestically by GB registered HGV was 75 miles, compared to 53 miles for all goods. (Source: Table 1.13c, *Road Freight Statistics*.)
- Over the period April 2007 to March 2008, the average delays experienced on the slowest 10% of journeys on observed routes in England were 4.43 minutes per ten miles 6am-8pm during the week. This was an increase of 5% on the period from August 2004 to July 2005.
- Food for UK consumption moved by Light Goods Vehicle (LGV) in 2006 represented just 7% of that moved by HGV, however LGV use is set to increase significantly by 2025.
- Very substantial sums are invested in the continuous development of the UK strategic road network. In 2006/7, total expenditure on new construction/improvement and structural maintenance for motorways and trunk roads in England was £1.6 bn. Between 1997/8 and 2007/8, new construction and improvement of motorways and all purpose trunk roads in England totalled 407 miles, contributing to a 5% increase in the length of motorway in Great Britain between 1997 and 2007.⁶⁰

Assessment

Congestion and resulting delays are widely experienced across the UK's Strategic Road Network and are worst on weekdays, when most HGVs are active. However the levels commonly seen during rush hours are not significant enough to interrupt the availability of product lines to the consumer and definitely not to the point where food security is reduced. Delays can be factored in to planning to ensure continuous supply, and availability will only be affected by unanticipated delays following unexpected events e.g. accidents, blockades, severe weather. **These tend to be localised and the breadth of the UK road network allows alternative routes to be taken without long delays.** Supermarkets receive on average 1.5 deliveries of fresh produce per day⁶¹, so delays would have to run to many hours before any gaps were seen on supermarket shelves and this would only be for a small selection of fresh goods with very short shelf-lives. Delays of this length are exceptional and only caused by freak events such as the floods which affected much of the UK in July 2007, closing several sections of motorway and leaving some vehicles stranded. Despite this there was no material impact to the availability of food.

The **Highways Agency** is responsible for managing, operating and improving the motorway and trunk road network in England. It has stated that: "To ensure that the network is resilient we have invested in work to address the most severe disruptive challenges both natural and man-made. We have contingency plans for all hazards at a national, regional and local level. We have extensive plans to deal with severe weather and flooding. There is a department devoted to winter maintenance (i.e. gritting) and the Severe Weather Group meets monthly. We have recently invested in replacing all of the Agency's 500 'gritters'. The network has been assessed for its vulnerability to terrorist attack, and we have examined and classified over 6,000 of our structures. We also work with DfT TRANSEC to ensure our contingency plans fit in with the Governments 'Concept of Operations' Plans. We have also worked with DEFRA on the coastal flooding project, and have an MOU with the EA (Environment Agency) for flooding data."

In addition to the mitigation work of the Highways Agency, deliveries of food throughout the UK are controlled by highly sophisticated logistics companies which are focussed on reducing disruption to the supply chain when obstacles occur.

The stretches of road connecting major UK ports with the rest of the strategic road network will carry a disproportionately high volume of food. The effect of disruption to the smooth operation of these links would be essentially identical to disruption to the ports themselves, which is considered in indicator 3.6.

⁶⁰ Department for Transport, *Transport Statistics 2008*, tables 7.6, 7.13, 7.16

⁶¹ A. McKinnon, *Life without lorries* (2004), p. 9.

Future position

Forecasting by DfT suggests that congestion is set to worsen steadily between now and 2025, with the average delay to all vehicles in England increasing by 37% between 2003 and 2025. However the predictions for HGVs are less severe with delays on motorways estimated to increase by 12% for Rigid HGVs and 20% for Articulated HGVs. These projected rates would not pose a major problem to the ability of retailers to continue stocking their stores because the delays are caused by excess road use which can be modelled.⁶²

One of the four strategic aims of the Department for Transport (DfT) is 'to sustain economic growth and improved productivity through reliable and efficient transport networks'. In order to realise this, DfT is currently monitoring congestion closely and designing measures to combat it. Because the road network and road users are subject to significant government control, the government has the ability, in exceptional circumstances, to implement measures to reduce disruption to the food supply chain. As a result we should expect this indicator to remain in a favourable position in the future.

Rating of current position



Comparison with mid-1990s

Similar Vehicle flow per day (number of vehicles) has increased from 3.2 million vehicles per day in 1997 to 3.5 in 2007, but overall resilience not affected.

Likely position in 5-10 years



⁶² See Department for Transport, *Road Transport 2008 Forecasts – tables*, table 1.

Introduction to the theme

Food security is ultimately about people acquiring and consuming food. Defra's 2008 Food security paper, defines food security as "consumers having access at all times to sufficient, safe and nutritious food for an active and healthy life at affordable prices." Given that there is enough food in the country everyone should be able to access and afford have a healthy diet. The indicators in this theme are largely outcome-based and focussed upon consumers.

Of course, having the opportunity to afford and consume a healthy diet does not necessarily mean that consumers actually make healthy choices. The challenge of making healthier dietary choices is therefore not strictly a food security issue if the opportunities are there but are not "taken". However, dietary choices would be a key element in a broader assessment of a sustainable food system.

Although choice may be more important than price in determining diet, it is important that price is not a barrier to purchasing healthy food. It is important from a food security perspective to monitor food prices as rises will ultimately lead to greater pressure on the household budget.

Types of challenges and threats addressed by this theme

- *Rising food prices (the consequence of tighter supplies of energy and commodities or other prolonged supply disruptions – see earlier themes)*
- *Economic recession and unemployment*
- *Widespread closure of food stores e.g. because of pandemic flu*

Headline Indicator

- **Low income households' share of spending on food**

Supporting Indicators

- 1. Relative prices of fruit and vegetables**
- 2. Food prices in real terms**
- 3. Household access to food stores**

Other indicators under consideration, which may require further research

- Self-reported food insecurity, from the Low Income Diet and Nutrition Survey

Theme 5

Household food security

Headline indicator

Low income households' share of spending on food

Rationale and associated risks

The aim of the headline indicator is to monitor the impact of price rises on the affordability of food, where affordability is measured by share of spending on food.

There is a focus on **low income households** because they naturally have less money to spend on food. The effect of the recent rise in food prices has not had a disproportionate effect on low income households in terms of how much their expenditure on food has risen compared to other households.⁶³ Having said this it is clear that price rises will place a greater pressure on the household budget of lower income households.

Affordability is affected not just by prices but also by income. Historically incomes have risen faster than food prices, although not so at the present time. Trends in the percentage of household expenditure on food show the pressure exerted by food on the household budget in comparison to other outgoings such as housing and fuel. In general lower income households will have a higher percentage spend on food. If income rises faster than prices then households become better off and expenditure can increase on less essential items such as luxury and leisure goods but a sustained rise in the price of food could significantly affect the purchasing power of lower income households and their quality of life.

It is important to note that the share of household spending on food has been declining since the 1960s. And compared to households elsewhere in Europe and particularly in developing countries, UK households devote a low share of their spending to food and non-alcoholic drinks. In 2005 the share in the UK was 10% and in the whole of the EU it was 15% (Germany 12%; Ireland 13%; France 14%; Spain 18% and Italy 19% - Eurostat estimates from the 2005 household budget surveys). These differences may suggest scope for spending more on food in the UK, but our concern here is in whether food is becoming more or less affordable in Britain over time and not in cultural attitudes towards food.

This indicator, as currently constructed, does not consider the nutritional quality of food spend (see [indicator 5.1](#)).

Desired outcome

Assuming no change in the British culture towards food a fall in this indicator means food is more affordable and vice versa. As this happens people have an increasing ability to buy better quality produce and to take the healthier options which may be more expensive.

Indicator

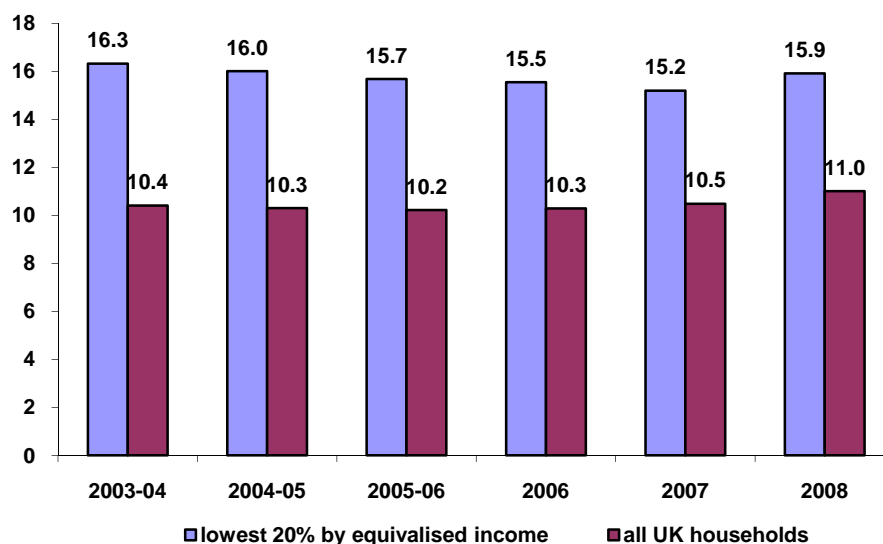
Spending on household food as a percentage of total spending by low income households

Source ONS, Expenditure and Food Survey, *Family Spending* reports. It is preferred to focus on total expenditure rather than total income of the household because good quality comparable data is available from the Family Food Survey on all forms of expenditure. This has the benefit of avoiding the complexities of measuring disposable income. This indicator is restricted to affordability of food bought into the household. Affordability of food not brought into the home is excluded because (a) data is less reliable, (b) it only covers 10-20%⁶⁴ of calorific consumption and (c) eating out may be considered by some to be a luxury and not representative of affordability of food.

⁶³ Defra / ONS Family Food Survey & Retail Price Index data

⁶⁴ According to Family Food in 2007 11% of calories were derived from food not brought into the household. According to the FSA's National Diet and Nutrition Survey food eaten out of the home accounted for 20% of calorific intake in 2001.

Spending on household food and non-alcoholic drink as a percentage of total spending



Source: Defra / ONS Family Food Survey / ONS Family Spending reports. 2008 is a projection.

Key points

- The percentage spend on food by low income households in 2008 (defined as the lowest 20% by equivalised income) is estimated (based on average changes in food price inflation since 2007) to have returned to around 2004 levels at 15.9 per cent, indicating that the pressure food is exerting on the household budget is increasing.
- Food and non-alcoholic drink prices for low income households started to rise in real terms (ie food inflation has been greater than general inflation) in August 2007. By December 2008 food and non-alcoholic drinks prices for low income households had risen by 12.5 per cent in real terms.
- The percentage spend on food in all households was stable between 2003-04 and 2007 when food prices were falling, which suggests people were spending the same and getting more food for their money. For 2008 when food prices rose, we project that the percentage expenditure on food will have risen to a higher level. However, this assumes that consumers continue to purchase the same basket of goods. Substitution to lower priced goods will mitigate the impact on affordability.
- In the period for which data is available, spending on food by low income households as a percentage of all spending declined steadily from 16.3 per cent in 2003 to 15.2 per cent in 2007, before rising in 2008.
- Whilst food price rises hit lower income households hardest, they are not having a disproportionate effect in terms of the basket purchased by low income households: since January 2007 food and non-alcoholic drink price rises have increased the cost of the low income basket by much the same as the cost of the average all household basket.⁶⁵
- Low income households spend a lower proportion of their food bill on meat & bacon, vegetables and fruit. They spend a higher proportion of their income on bread and cereals, tea, coffee and soft drinks, milk, cheese and eggs, sugar and confectionery and butter and margarine.

⁶⁵ Defra / ONS Family Food Survey & Retail Price Index data

Assessment

The share of spending on food in the UK has declined in recent years. Assuming as we are that there is no short term change to the British attitude to food it can be deduced that food is becoming more affordable. However, in response to the food inflation of 2007-8 it is estimated to have returned to its 2004-05 level for low income households. Recent food inflation has brought a material deterioration to lower income households – hence the amber rating.

However, a resumption of economic / real income growth and an easing of food inflation over the coming years, should result in the share of spending continuing to decline and return to 2005-6 levels.

Rating of current position



Comparison with mid-1990s

Improvement. We do not have data for before 2003/4, but falling real food prices and rising real incomes between the mid 1990s and 2003 suggests that food's share of spending would have been higher in the 1990s.

Likely position in 5-10 years



Potential development

Include supporting data on incomes growth / trends in poverty, possibly as a separate indicator.

Rationale and associated risks

The aim of this indicator is to monitor trends in the cost of a healthy diet as a measure of the affordability of a healthy diet. The focus is on price because although choice is known to be the most important factor in determining a healthy diet choice is not strictly part of food security.

There is a focus on low income households because they tend on average to have a poorer diet. Family Food 2007⁶⁶ concludes that “The percentage of energy from non-milk extrinsic sugars is strongly dependent on income, decreasing as income rises” and that “In general purchases of fruit and vegetables increase [gradually] with income”. The FSA’s Low Income Diet and Nutrition Survey (LIDNS, 2001)⁶⁷ concluded that “for many foods the types and quantities eaten by people on low income appear to be similar to those of the general population” but that “generally, those on low income were less likely to eat wholemeal bread and vegetables ... to drink more soft drinks (not diet drinks) and eat more processed meats, whole milk and sugar”. LIDNS also reported that although the diet of low income households does tend to be poorer, there is little variation in the quality of diet in the low income group itself, and choice (often linked with education for example), plays a large part in explaining this.

Box 6 Defining a healthy diet

Defining a healthy diet is complex. The Food Standard Agency’s key recommendation for a balanced healthy diet is presented as “**the eatwell plate**”. It recommends the following:

- Plenty of ‘fruit and vegetables’ (33%).
- Plenty of ‘bread, rice, potatoes, pasta and other starchy foods’ (33%).
- Some ‘milk and dairy foods’ (15%).
- Some ‘meat, fish, eggs, beans and other non-dairy sources of protein’ (12%).
- Just a small amount of ‘foods and drinks high in fat and/or sugar’ (8%).

It is important that the average healthy diet is realistic in terms of what people currently consume and what can be produced by the food industry. In the absence of a fully developed indicator on the cost of healthy diets, we simply focus upon **fruit and vegetables**, which account for one-third of the eatwell plate, but figures show that actual consumption is significantly less than this. Eating more fruit and vegetables is considered to be a primary way to improve the diet with less food high in fat or added sugar. They are high in nutrients and carbohydrates and increasing consumption will displace consumption of less healthy foods. Currently the government recommendation is for a minimum of five 80 gram portions of fruit and vegetables per person per day, known as 5 A DAY. Purchases of fruit and vegetables by all households need to increase substantially to meet government recommended levels for a healthy diet.

⁶⁶ Defra, Family Food 2007, Chapter 4 Demographic Comparisons

⁶⁷ LIDNS sampled households in the bottom 15% of the population in terms of material deprivation.

Some healthy foods cost more and so are less accessible to low income households. On a calorific basis, fruit and vegetables are relatively expensive compared to pasta and chocolate biscuits, costing about five times as much per calorie.⁶⁸ Conversely some healthy foods are comparatively less expensive. For example, we are eating too much food that is high in saturated fatty acids and non-milk extrinsic sugars and not enough food that is high in complex carbohydrates such as wholegrain bread. Making this switch could reduce the cost of the diet and reveals that food choices are important.

This indicator tracks whether fruit and vegetables are becoming cheaper relative to other foods. This provides a partial indicator of the changing affordability of an essential element of a nutritious and varied diet, which is particularly important for poorer households. The affordability of fruit and vegetables can be affected by:

- Poor harvests at home and abroad (this will tend to have seasonal effects)
- A fall in the value of sterling which pushes up the costs of imported fresh produce
- Competition between retailers

Price changes in foods clearly have a direct impact on affordability. However, the evidence of the extent to which food price rises affect dietary habits is limited, particularly the impact of prices rises on a healthy diet as people may switch to cheaper, often lower quality but not necessarily lower nutritional value, versions of the foods they currently buy. Analysis on **'own price elasticities'** from the National Food Survey (NFS, 2000)⁶⁹ indicates that demand for cereals and cereal products (not including bread), fresh fish, vegetables and processed fruit products (mainly fruit juices) is particularly sensitive to rises in prices. Evidence from the NFS on 'cross price elasticities' about people switching to other types of food in response to a rise in the price of fruit and vegetables is inconclusive. However, there is some evidence that although a rise in price of fresh vegetables could cause a rise in demand for processed fruit products such as fruit juice, and there is also evidence that it could cause a rise in demand for sugars and preserves. There is stronger evidence to suggest that a rise in the price of processed fruit products such as fruit juice may cause a rise in demand for fats.

Although the evidence of the impact of price rises on the choice of healthy foods is inconclusive it remains important from a food security perspective to monitor the price of healthy foods as rises will ultimately lead to greater pressure on the household budget.

Desired outcome

A decline in the indicator, which means that fruit and vegetables are becoming more attractive in terms of price as part of the average diet, particularly in the case of low income households.

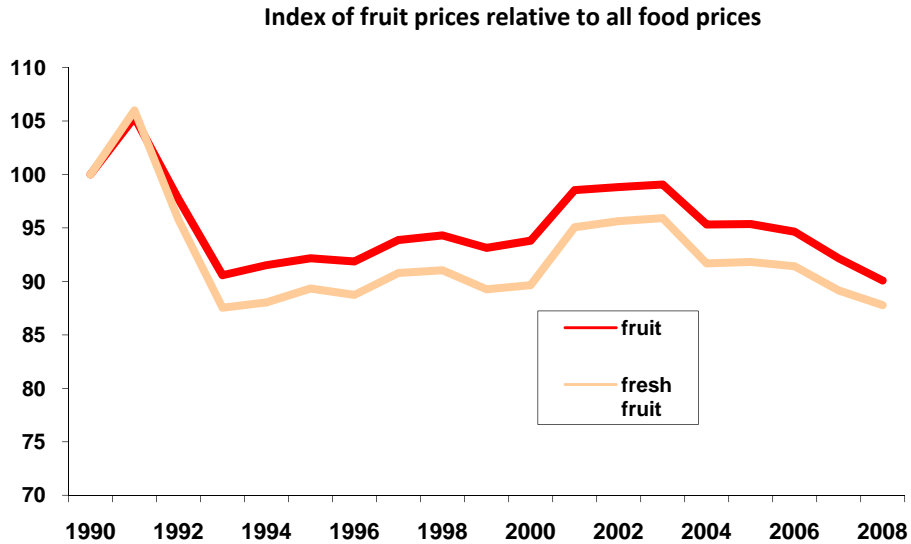
Indicator	Index of fruit and vegetable prices relative to all food
Source	ONS Retail Price Index (deflating fruit and vegetable prices by RPI food price index)

Key points

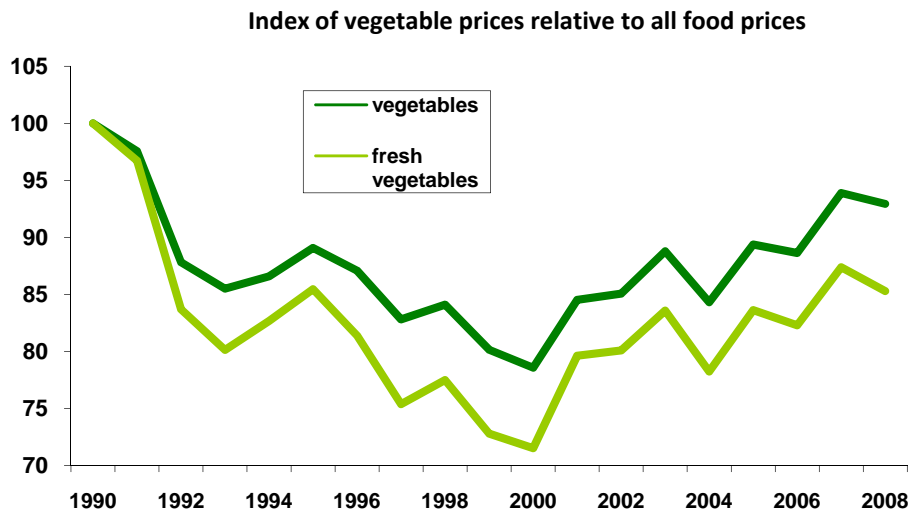
- **Fruit** (see chart below) has become about 10 per cent cheaper compared with other foods since 1990 making it a more attractive option in the diet. Fresh fruit has become cheaper still and has helped to drive increasing consumption.
- Since 2003 fruit prices have been declining relative to all food prices and continued to fall during 2008 when food prices rose substantially.

⁶⁸ Note this is clearly only one way to measure the cost of individual foods. Also the reasons why people choose different foods are wide ranging, of which calorific contribution to the diet is only one.

⁶⁹ Former version of the Family Food Survey



- **Vegetables** - Between 1990 and 2000 vegetables became over 20% cheaper relative to other foods and, despite the recent rises, are still cheaper relative to other foods than in 1990.
- However, since 2000 vegetable prices have been gradually becoming more expensive compared to other foods.



Assessment

In the last two decades, fruit and vegetables have become relatively cheaper than other foods. This reflects the increased tradeability of fresh produce compared to other processed foods, increasing availability and price

competitiveness. In particular, since 1990, imports of fresh fruit into the UK have risen by over 60%.⁷⁰ There is also evidence that purchases of fruit and vegetables have been rising slowly over this time period.

Moreover, both fruit and vegetables became relatively cheaper in 2008 when food prices rose sharply. However it is a concern that vegetable prices have been rising relative to other foods since 2000. Whether fruit and vegetable prices will fall relative to other food prices over the next decade will depend upon a number of factors, which are uncertain:

- the path of exchange rates (a weakening pound will tend to push up the relative price of tradable produce)
- the degree to which growth in value-added in other foodstuffs exceeds that for fruit and veg.
- the ability of UK producers to extend seasons, increase efficiency and provide continuous supply that complements imported supplies. This is relevant for fresh perishable produce at particular times of the year when the market depends more upon UK supply.
- tariff reductions on fresh produce imports. For instance, we estimate that in recent years tariffs have added 30% to imported banana prices and 15% to imported spinach. Most fruit and vegetables are subject to the Entry Price System in which tariffs are varied according to the import price in order to maintain a specific minimum price within the EU.

We give this indicator a green rating because although vegetables prices are rising in price relative to other foods, current evidence of the impact of price rises on dietary choices is inconclusive. Should prices rise to a level where the impact is visibly evident then this indicator would become more sensitive.

Rating of current position

Comparison with mid-1990s



Similar / mixed. Slight improvement for fruit; deterioration for vegetables.

Likely position in 5-10 years



Potential development

Ideally we would like to identify a minimum cost average diet that meets the health requirements and is as close to the current diet as possible with the view to tracking the cost of this diet over time. Households spending less than this could be considered to be at risk of “food poverty”. This is a non-trivial task and may be the subject of further research. Other groups, aside from low income households, may also have lower access to healthy food and may be the focus of further work. Any work in this area would acknowledge that the change in price of a healthy diet may not directly impact on consumption; in fact an interesting secondary analysis would be to track consumption of the minimum cost healthy diet alongside price.

⁷⁰ *Agriculture in the UK*, datasets <https://statistics.defra.gov.uk/esg/publications/auk/2007/excel.asp> Table 5.12

Theme 5

Household food security

Supporting indicator 5.2

Food prices in real terms

Rationale and associated risks

The aim of this indicator is to monitor overall food prices in real terms as a general indicator of affordability of food in terms of other goods. This indicator is aimed at revealing long term trends in food prices and has particular significance for households without rising real income e.g. those not in employment.

This indicator would pick up the short-term consumer impact of surges in commodity prices or world market problems ([theme 1](#)), or energy costs ([theme 4](#)).

Desired Outcome

Food inflation to be less than general inflation. This would indicate that food prices are becoming cheaper in real terms in households where income remains constant.



Key points

- Between 1956 (when data begins) and the late 1970s, food prices rose largely in line with general inflation – food prices did not fall in real terms in this period.
- From the late 1970s, food inflation began to fall behind general inflation. And between 1987 and 2006 food prices fell gradually in real terms by over 20 per cent.
- In real terms from August 2007 throughout 2008 and early 2009 food prices rose. In February 2009 they peaked, and in real terms are now back at 1997 levels.

Assessment

A wide range of factors are behind the twenty year decline in real food prices:

- The **decline in real commodity prices** (see indicator 1.2);
- A **strong currency, low energy prices** and increasing energy efficiency (headline indicator 4) since the mid-1990s has kept cost pressures down in food
- Increasing food chain **productivity**; technological innovation.
- The **expansion of trade** and in particular further integration of the Single European market (headline indicator 3);
- Price **competition** between the major retailers
- A **shift in consumer spending** towards service sectors where productivity is more difficult to increase than in food, so that the relative price of non-food increases.

In 2007 and 2008 food inflation has exceeded general inflation exerting a negative effect on the ability of low income households to buy. The key drivers have been the surge in energy prices between 2007 and 2008, combined with sharp rises in global commodity markets. Real food prices continued to rise in late 2008 and early 2009 because of the inflationary pressure on traded commodities resulting from the slump in sterling.

Food inflation is falling during 2009 as these cost pressures abate. However, general inflation is expected to remain very low as the recession and credit crunch restrict consumer spending. Therefore the scope for food inflation being lower than general inflation appears limited in the short term.

Looking ahead over the next 5-10 years, we would expect that real food prices would continue to resume their downward path, but this would be from the present relatively high level and the decline from that peak is likely to be slower than in the past. An amber rating reflects the fact that a number of factors would need to be favourable for real food prices to return to 2007 levels over the coming years:

- Real agricultural **commodity prices** do not trend strongly upwards (see Theme 1). Note that on average farmgate sales represent around a quarter of retail sales (*Agriculture in the UK*, chart 7.7), so this is not the only factor.
- Real **oil and gas prices** remain at 2009 levels. A study by the Sustainable Development Commission found that a rise in oil prices from \$50 to \$100/ barrel would increase retail food prices by 5-10%. On the other hand, rising oil and gas costs can be offset by continued increases in energy efficiency across the food industry (see headline indicator 4).
- **Food industry productivity** rises over time, particularly as a result of better use of technology.
- Continued strong **price competition** between retailers – this can be expected.
- The **exchange rate** remains relatively stable.
- **Regulatory burdens**, and labour costs, remain within limits.
- Domestic food **demand growth** remains relatively modest (this links to the prospects for population growth and net migration)

Rating of current position

Comparison with mid-1990s



Similar – Following a sustained, real food prices are now back up to 1997 levels, though still lower than in the early 1990s.

Likely position in 5-10 years



Rationale and associated risks

Household food security is not only dependent on affordability, consumers must also have adequate *physical access* to food stores. Potentially vulnerable are those households without access to a car or means of private transport as well as less mobile individuals such as disabled people or the elderly. There may also be issues surrounding travel distances in rural areas reflecting a more dispersed population as recognised by the Competition Commission in 2000.⁷¹ Household access to food stores is recognised as a core indicator of national accessibility by the Department for Transport, and in general terms, households without access to a car are potentially vulnerable to social exclusion.

Desired Outcome

All households, including those without cars, have adequate physical access to food stores.

Indicator **The number and percentage of households within 15 and 30 minutes of a supermarket/food store by public transport/walking and by cycling⁷²**

Source Department for Transport, *Core National Accessibility Indicators 2007*⁷²; FSA Low Income Diet and Nutrition Survey 2007.

The number of households within 15 and 30 minutes of a supermarket or convenience store has been calculated at national, transport authority, local authority and LSOA levels. Supermarkets are defined as food retailers above 5000 square feet, any retailer below this floor area is defined as a convenience store. Food retailers overall are defined by main retail business activity and would not include stores such as newsagents and off-licences. The figures do not allow for frequency of public transport services or waiting times. Data is available at local authority level. The national figures are given below:

	within 15 minutes		within 30 minutes	
2005	number	%	number	%
Households	19478400	92.2	21057430	99.7
0 car Households	5369549	94.5	5670178	99.8
2007				
Households	20612889	97.8	21021884	99.8
0 car Households	5588462	98.9	5647927	99.9

Key points

- Virtually all households (99.8%) are within 30 minutes of a food store (by public transport/walking/cycling). This figure is slightly higher for households without a car.

⁷¹ Competition Commission (2000), *Supermarkets: A report on the supply of groceries from multiple stores in the United Kingdom*, para 13.113, available at http://www.competition-commission.org.uk/rep_pub/reports/2000/446super.htm#full

⁷² <http://www.dft.gov.uk/162259/162469/221412/221692/368506/accessibilityreport2007.pdf> ;
<http://www.dft.gov.uk/pgr/statistics/datatablespublications/ltp/coreaccessindicators2007>

- Since 2005 there has been a significant increase in the proportion of all households within 15 minutes of a food store (by public transport/walking/cycling), rising from 92.2% to 97.8%.
- Since 2005 there has been a significant increase in the proportion of no car households within 15 minutes of a food store (by public transport/walking/cycling), rising from 94.5% to 98.9%.
- Households without a car tend to have a higher level of accessibility. This is intuitive as such households would tend to locate in areas where a car is less required.

This evidence is complemented by the Food Standard Agency's **Low Income Diet and Nutrition Survey**, which surveyed the bottom 15% (approximately) of the population in terms of material deprivation. It found that 80% of respondents "shopped mainly at large supermarkets. A private car was used for shopping in about half of households, with others walking, cycling, or using a bus, train or taxi; in most cases, the travelling time was less than 30 minutes. There were few obvious or significant differences in food consumption or nutrient intake according to the main shop used. However, *women in households that shopped at a large supermarket consumed significantly higher amounts of fruit and vegetables compared with other women.*" It also reported that "Those living in urban areas and those living in the most deprived areas (which were often associated) tended to consume less food (on a weight basis) and have lower nutrient intakes compared with those in suburban (including rural) areas."⁷³

Assessment

DfT figures show that physical food accessibility does not appear to be a problem across the general population. However, we do not have a breakdown between larger and smaller stores, and there may be questions over the quality of the food *offer* from convenience stores. The improvements seen between 2005 and 2007 most likely reflect new opening of convenience stores by leading supermarkets such as Tesco Express and Sainsbury's Local. Moreover, insight from FSA studies (the Low Income Diet and Nutrition Survey (2007) and other food access research does not suggest that access to shops is at present a significant factor in diet, although there was a positive link between supermarkets and fruit and vegetable consumption by women (see above).

There appears to be little scope for the accessibility figures to increase materially in the future because there will always be a sub-set of the population who *choose* to live in isolate, rural areas which are a significant distance from food stores and other amenities. Further investigations may be appropriate at regional and local levels.

Rating of current position



Comparison with mid-1990s

Improvement

Likely position in 5-10 years



⁷³ Food Standards Agency, *Low Income Diet and Nutrition Survey (2007), Summary of key findings*, pp. 42-3. Emphasis added. <http://www.food.gov.uk/multimedia/pdfs/lidnssummary.pdf> The fieldwork was undertaken mainly during 2004.

Theme 6

Safety and confidence

Introduction to the theme

The Strategy Unit report on food observes that public confidence in the UK food system rests primarily on food safety. Food safety legislation goes back to the nineteenth century, and contamination incidents as well as animal disease outbreaks such as BSE and Foot and Mouth have at times shaken public confidence in food safety. This has opened up a role for assurance schemes and traceability which have sought to rebuild consumer confidence in food. Whilst some of these concerns will be subjective and culturally conditioned, consumers perception of the security and safety of the food system remains important: without consumer confidence, the food system would be undermined.

Whilst food safety is not strictly the same as security of supply, the distinction in people's minds may not be great. (In areas of life and policy outside food, security and safety are almost synonymous.) For instance food safety and animal diseases are often bracketed together, and safety scares often result in large quantities of product being withdrawn from sales.

There are particular difficulties in measuring food safety because health effects cannot easily be attributed to food safety incidents and often the effects will only become apparent in the long term. Such was the case with BSE where the connection to food safety did not become apparent for a number of years. Another case is very low levels of genotoxic carcinogens in food which have the potential to cause cancer by damaging the genetic material in the cell. Presently no attempt is made to measure longer term health effects within the indicators although evidence can be brought to bear in the discussion and assessments.

Types of challenges and threats addressed by this theme

- *Standards of hygiene in food industry establishments*
- *Pests and diseases esp. in domestic agriculture*
- *Complex and global supply chains*
- *Public perception of food safety*

Headline Indicator

- **Trends in cases of illness due to food-borne pathogens**

Supporting Indicators

- 1. Food safety inspections and incidents**
- 2. Amount of British food covered by assurance schemes**
- 3. Public confidence in food safety measures**
- 4. Public confidence in food availability**

Theme 6

Safety and confidence

Headline indicator

Trends in cases of illness due to food-borne pathogens

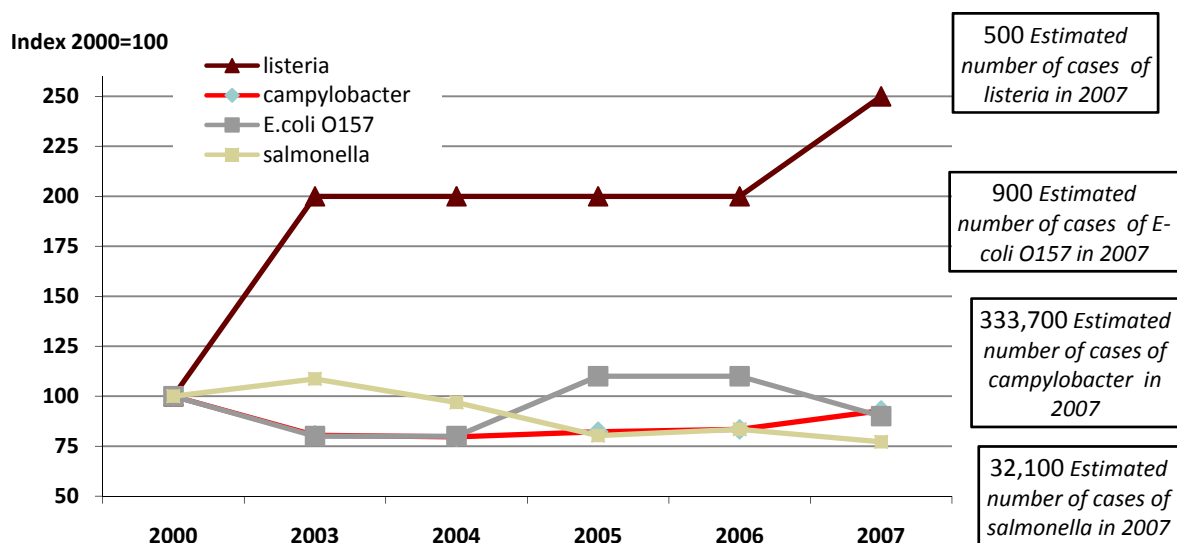
Rationale

A direct measure of food safety needs to monitor trends in health that can be attributed to changes in food safety. This can be very difficult to assess as some health effects cannot easily be attributed to food safety incidents and often the effects will only become apparent in the long term. However there are some short term health effects that can be attributable to food safety, namely the cases of food poisoning caused by the key food-borne pathogens salmonella, listeria, E.coli O157 and campylobacter.

Monitoring cases of food-borne pathogens says nothing about the cause of the contamination which in some cases may be due to poor preparation and storage within the home but in other cases due to the food businesses. For causes that are the responsibility of the food industry the supporting indicator on inspections is relevant.

Indicator Trends in estimated cases of illness due to listeria, campylobacter, E.coli O157 and salmonella in England and Wales

Source FSA /Health Protection Agency



Notes:

- (a) Estimates for the burden of disease in 2001 and 2002 are not available.
- (b) Estimates calculated using methods and data sources described in: Adak GK, Long SM and O'Brien SJ. Trends in indigenous food-borne disease and deaths, England and Wales: 1992 -2000. Gut 2002; 51:832-841
- (c) The estimates have been rounded (to the nearest ten or hundred)

Key points

- Estimated cases of listeria have more than doubled since 2000 with marked increases in 2001 and 2007. Although listeria is a less common cause of food poisoning compared to other pathogens, it can be life-threatening. It is estimated that there are as many deaths from listeria alone as those from salmonella and E.coli O157 combined.

- There were an estimated 333,700 cases of campylobacter in 2007 making it the most prevalent food-borne illness. Cases of campylobacter are slightly lower than in 2000.
- In 2007 there were an estimated 32,100 cases of salmonella, 23% fewer than in 2000. Since 2000 salmonella contamination of UK-produced retail chicken has reduced by 50%.
- There were an estimated 900 cases of E.coli O157 in 2007, 10% fewer than in 2000 and 18% lower than in 2005 and 2006.

Assessment

The modest reduction in estimated campylobacter cases since 2000 is important since it is the dominant problem in terms of the number of cases and so affects the overall trend. However, the estimated rise in the number of cases of listeria is also significant as it results in the largest number of deaths.

In their corporate plan up to 2010 the Food Standards Agency states that “The core purpose of the Food Standards Agency is to protect public health and reduce food-borne illness”. Developments are taking place on food safety with a new EC Food Hygiene Regulation, which came into force in January 2006, on hygiene standards. The Food Standards Agency is carrying out survey work to assess the impact of the new legislation and the data will help to improve procedures, for example, the data can also be used by local authorities to develop their inspection schedules. With reducing food-borne illness as a top priority of the Agency we can expect that cases will reduce over the next decade.

Rating of current position



Comparison with mid-1990s

n/a

Likely position in 5-10 years



Theme 6

Safety and confidence

Supporting indicator 6.1

Food safety inspections and incidents

Rationale

The best way to ensure and improve food safety is by setting and enforcing high standards of food hygiene for all establishments involved in food production.

There is a legal requirement for all non-farm food businesses to put in place, implement and maintain procedures based on food safety management (HACCP) principles. Legislation requires farmers to improve hygiene on the farm and to ensure that human health is not put at undue risk through what is fed to animals. Vigilance is also essential for imported foodstuffs.

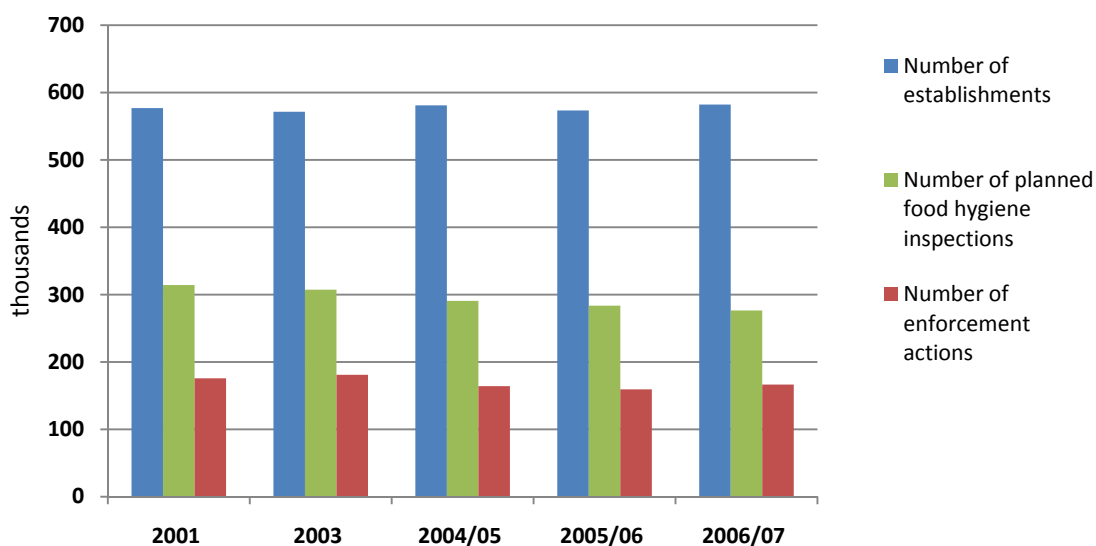
Local Authorities deliver enforcement activities for food law on behalf of the Food Standards Agency. The Food Standards Agency sets and monitors standards and audits local authorities' activities.

Indicator

Inspections and enforcement actions of food businesses

Source

FSA Board paper on monitoring of food law enforcement activity, February 2009



Key points

- Local Authorities have maintained their levels of planned inspections of food businesses, and formal enforcement action from previous years, with highest risk (category A) food hygiene establishments receiving at least one inspection during 2007.
- The total number of food establishments under Local Authority control at 31 December 2007 was 583,101 – showing no significant change from the number at 31 March 2007, at 582,125;
- Based on the nine month period to end of December 2007 163,399 planned inspections for food hygiene were completed. Given above average level of activity in the final quarter in previous years, the Food Standards Agency's assessment is that 2006/07 inspection levels were being maintained;

- Primary food hygiene inspections have declined by 12% since 2001. Under the current code of practice Local Authorities are allowed to use alternative enforcement strategies for premises in the lowest risk category and not rely on primary inspection.
- Total enforcement (remedial) actions covering food hygiene inspections and food standards inspections increased in 2006/07 to 166,513.
- Some 95% of all enforcement actions were written warnings. The total number of prosecutions and formal cautions was 754 in the nine months to December 2007, compared to 804 in 2006/07.

Assessment

It is difficult to assess whether establishments are improving in terms of hygiene and food safety because methods for reporting on inspections are currently changing and improving. While there is evidence that the number of food hygiene inspections has declined the number of enforcement actions increased in 2006/07. This suggests that visits may be being better targeted. In general the improvements in reporting incidents are likely to have a beneficial effect in the long run as the evidence becomes more transparent.

Numbers of reported contamination incidents are increasing (the total number of reported contamination incidents⁷⁴ increased from 421 in 2000 to 1,344 in 2006), but this is not necessarily evidence of a decrease in food safety but of improvements in reporting and recording systems for incidents. While Local Authorities are important in managing food safety an increasing number of reports come directly from industry in relation to their statutory responsibilities under Food Law, rather than as a result of issues arising from food safety inspections.

Rating of current position



Comparison with mid-1990s

n/a

Likely position in 5-10 years



⁷⁴ Covers both environmental contamination incidents and food contamination incidents

Supporting indicator 6.2**Amount of food covered by assurance schemes****Rationale**

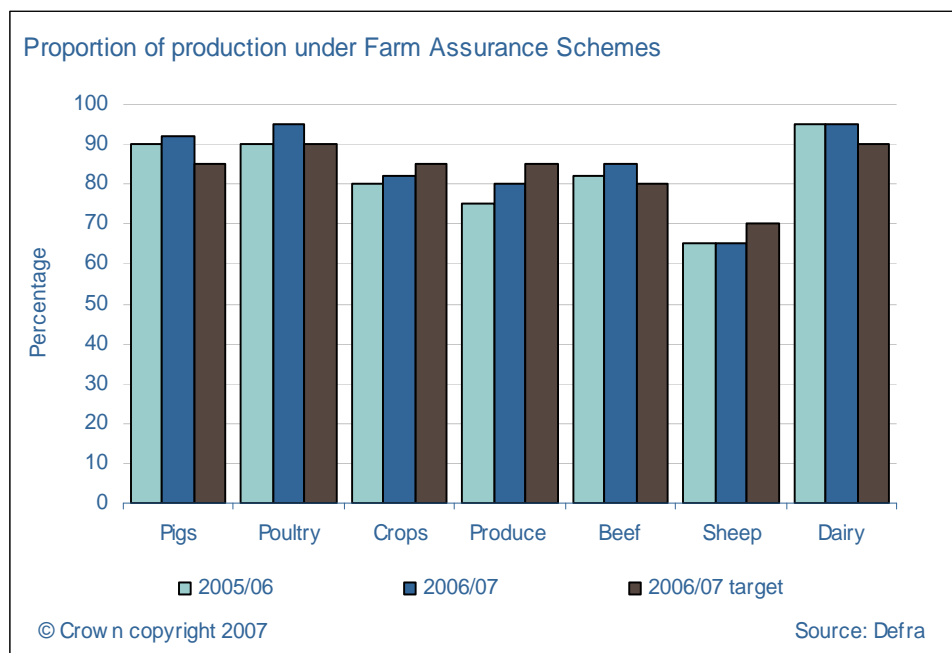
Confidence in food safety is important in its own right because without confidence consumer demand can fluctuate severely to the detriment of the industry. Since the BSE / CJD scares in the 1990s, Britain's farming and food industries have worked hard to increase consumer confidence through certification and traceability schemes. These are not limited to health and safety issues, but span a range of consumer concerns, such as standards for animal welfare and the environment. Through these schemes, suppliers become increasingly committed to securing the needs of retailers and consumers, and in particular the consumer need for confidence in the safety of the produce.

This indicator shows the proportion and retail value of domestic agricultural production which is covered by farm assurance schemes (Assured Food Standards AFS) and the value of food covered by the "Red tractor" logo. Available data typically relates to domestically produced food.

We recognise a direct tension between this indicator and food affordability because an increase in farm assurance scheme products marketed as 'premium brand' would reduce affordability by reducing availability of lower priced products.

Indicator Proportion of British production covered by Farm Assurance Schemes

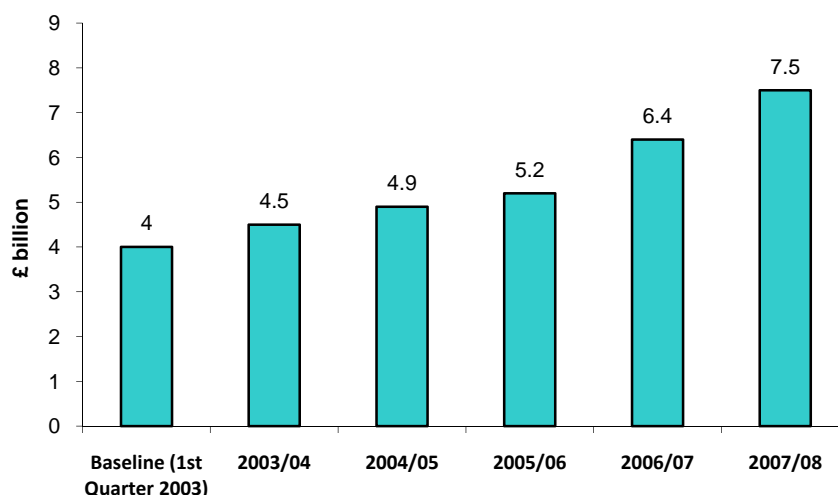
Source Assured Food Standards based on information from the schemes it administers or has contractual arrangements with.

**Key points**

- In 2006/07 most sectors showed an increase in assured production compared to 2005/06 with both poultry and produce showing a 5% increase. The exceptions were sheep and dairy which showed no change;

- The poultry and dairy sectors have the highest proportion of assured production at 95% with the pig sector at 92%;
- There were targets for farm assured production to reach the following levels by 2007: Pigs: 85%; Poultry: 90%; Crops: 85%; Produce (Fruit & vegetables): 85%; Beef: 80%; Sheep: 70%; Dairy: 90%. In 2006/07 the Pig, Poultry, Beef and Dairy sectors exceeded the target for the proportion of production covered by assurance by production volume.

Supporting data – the value of food packed under the Red Tractor logo (RTL).



Source: Assured Food Standards

- 2007/08 saw the value of food packed under the RTL reach £7.5 billion.
- 2006/07 saw the value of food packed under the RTL reach £6.4 billion, an increase of 22% from the 2006/07 target figure £5.24 billion.
- Since the 1st quarter 2003 baseline value of £4 billion there has been a year on year increase in the value of sales.

Assessment

Most domestic farm production is now covered by farm assurance schemes with 95% of dairy covered and over 90% of pigs and poultry. The one problem area is sheep production where only 65% of production is covered and there is no sign of an increase. In terms of retail the amount of produce with the red tractor logo continues to increase strongly.

Rating of current position

Comparison with mid-1990s

Likely position in 5-10 years



Improvement evident although no data available.



Potential development – investigate data availability for imported foods

Theme 6

Safety and confidence

Supporting indicator 6.3

Public confidence in food safety measures

Rationale and associated risks

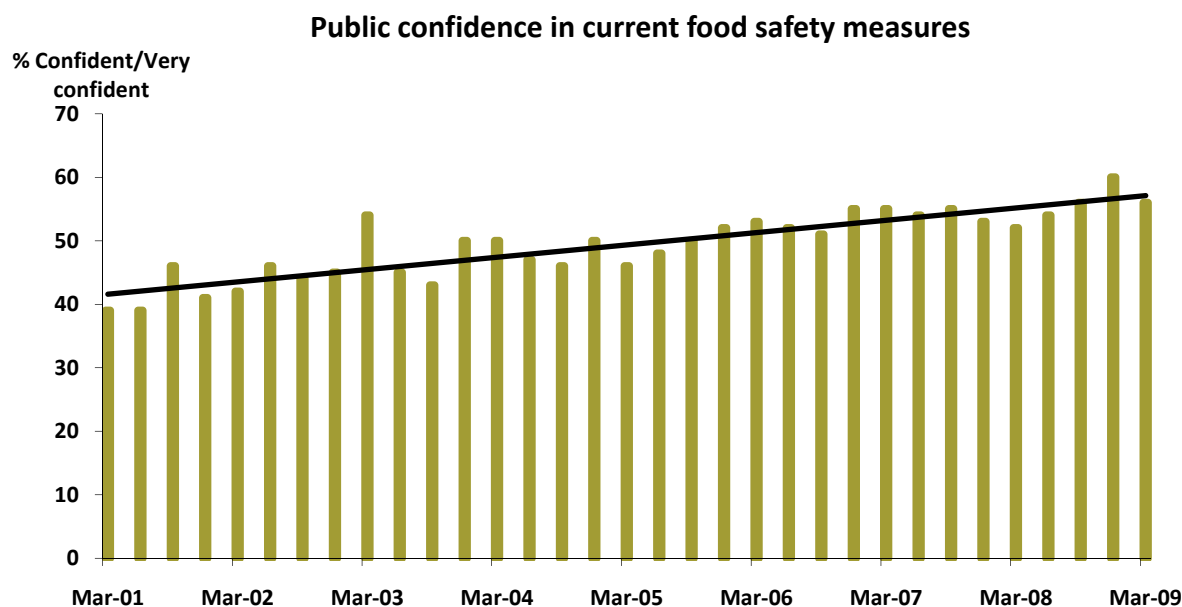
For people to eat a healthy diet the food in the shops has to be safe to eat and consumers have to have confidence that it is safe to eat. Public confidence in food safety will be affected by animal health incidents, statistics on cases of food related illnesses, research linking types of foods with long term illnesses, perceived hygiene standards in food businesses and perceived vigilance taken with imported foods. The aim here is for a general measure of public confidence in the safety of food available for purchase in UK shops.

Desired outcome

The public are increasingly confident that the food in the shops is safe to eat.

Indicator Public confidence in current food safety measures

Source Food Standards Agency: *Quarterly Public Tracker - March 2009*



Question: How confident are you about the current measures taken by all organisations involved in protecting your health with regards to food safety? Base : All respondents (% confident / very confident)

<http://www.food.gov.uk/science/socsci/surveys/publictrackingsurvey>

Key points

- Confidence in the food safety measures of all organisations decreased significantly in the three months to March 2009 from 60% to 56%. Confidence in food safety measures is now at a similar level to September 2008 and throughout 2007.

- The biggest decrease in confidence was in the 66+ age group, although it is not clear why this is.
- Since 2001 confidence has increased from 39% in March 2001 during a major foot and mouth outbreak to 56% in March 2009.

Assessment

Consumer confidence in food appears to be improving since the era of concerns over BSE, but as the Strategy Unit stresses in its *Food Matters* report, there is no room for complacency. Food safety incidents and animal disease outbreaks by their nature can happen unexpectedly, although it would seem that these would need to be major to have an impact on confidence in the overall food system, or on say, the relative confidence between British and imported food. Current animal disease issues such as Avian Influenza and Blue tongue seem to have been understood by consumers as not having a health risk, but this could change (e.g. if someone who worked with poultry in the UK contracted AI). Hence we give an amber future rating to reflect this uncertainty and the fact that this is a lagging, rather than leading, indicator.

Rating of current position



Comparison with mid-1990s

Improvement

Likely position in 5-10 years



NB – This indicator is under development

Rationale and associated risks

A secure food system should be one in which consumers have confidence. Where consumer confidence collapses, panic buying and other socially disruptive behaviour can occur. This can also lead to localised shortages of food with the result that not all consumers have access to the food they need for a healthy diet. This indicator will seek to measure public confidence in the continuing availability of food in the shops and it could be a proxy for the risk of disruptive panic buying.

We are commissioning social and attitudinal research to get a better insight into consumer perceptions of food security and whether we can develop a meaningful indicator of confidence. This indicator is unlikely to be forward-looking but rather reflecting consumer experiences in the present or in the wake of any particular incident (see also [indicator 6.3](#)) or change in other indicators e.g. real food prices; retailer diversity. It will also be a measure of perception rather than the reality of the system, and we would need to be careful not to confuse consumer perceptions of food security and confidence in availability with other attitudes about food that are not a question of availability.

We could seek to measure sudden changes in consumer behaviour which would signal a change in confidence of food availability (i.e. panic buying). However, these would only be observable with more sudden changes in consumer confidence in availability. An alternative approach would be to measure consumer confidence in food availability directly through some attitudinal survey.

Assessment

The current assessment is likely to be favourable.

Rating of current position

