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# UK Food Security Assessment: Detailed Analysis

**August 2009; updated January 2010**

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Department for Environment
Food and Rural Affairs

## Department for Environment, Food and Rural Affairs

# UK Food Security Assessment:

# *Detailed analysis*

**(**August 2009; updated **January 2010)**

The table of contents contains hyperlinks to each section.



Text boxes in the document provide additional analysis and context around the indicators.

## Summary of the six themes and their indicators with hyperlinks

The one-page summary scorecard can be accessed via www.defra.gov.uk/foodfarm/food/security/index.htm

Click on the hyperlinks to jump to individual indicators

| Food Security theme | Rationale | Headline indicators | Supporting indicators | What threats and challenges do the indicators address? |
|---|---|---|---|---|
| **1. Global availability** | 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. | **Trends in global output per capita** | **Demand growth trends (contextual)**<br>1. **Yield growth by region**<br>2. **Real commodity prices**<br>3. **Stock to consumption ratios**<br>4. **Share of production traded**<br>5. **Concentration in world markets**<br>6. **R&D expenditure**<br>7. **Impact of animal disease** | Population and economic growth<br>Rising incomes in emerging economies<br>Harvest shortages<br>Trade protectionism<br>Breakdown in trade<br>Lack of investment<br>Warming and more volatile climate |
| **2. Global resource sustainability** | Food must be produced in a way that is environmentally sustainable or we will set up problems for the longer term. | **Global land-use change** | **$CO_2$ emissions (context indicator)**<br>1. **Fertiliser intensity**<br>2. **Phosphate rock reserves**<br>3. **Water productivity of crops**<br>4. **Water withdrawn for agriculture**<br>5. **Global fish stocks**<br>Pesticide intensity (to be developed) | Supply expansion being ultimately unsustainable because of natural resource constraints and degradation.<br>Resources not correctly priced or lacking good governance. |
| **3. UK availability and access** | Sourcing nutritious food from a diverse range of stable countries including domestically enhances security by spreading risks and keeping prices competitive. | **Diversity of UK supply** | 1. **EU's share of UK imports**<br>2. **Diversity of fruit & veg supply**<br>3. **EU production capability**<br>4. **UK production capability**<br>5. **UK potential in extremis**<br>6. **Diversity and flexibility of ports**<br>7. **Port diversity of non-indigenous foods** | Over-reliance on single sources of supply.<br>Domestic supply failures<br>Capacity and concentration at ports.<br>What if non-EU trade breaks down?<br>Could the UK feed itself in extreme circumstances in which trade broke down? |

| Food Security theme | Rationale and associated risks | Headline indicators | Supporting indicators | What threats and challenges do the indicators address? |
|---|---|---|---|---|
| **4. UK food chain resilience** | UK food supply depends upon sophisticated and complex chain and infrastructure, and is particularly dependent upon energy supplies in their various forms. | **Energy dependency of the food chain** | 1. **Energy capacity reliability**<br>2. **Diversity of oil and gas imports**<br>3. **Business continuity planning**<br>4. **Retailer warehouse stocks**<br>5. **UK cereals stocks**<br>6. **Food industry diversity**<br>7. **Viability of large manufacturers**<br>8. **Strategic road network** | Energy intensive food chain<br>Does just-in-time operation reduce resilience?<br>Diversity of domestic supply chains<br>Is there sufficient continuity planning? |
| **5. Household food security** | Everyone should be able to access and afford a healthy diet. | **Low income households' share of spending on food** | 1. **Relative prices of fruit & veg**<br>2. **Food prices in real terms**<br>3. **Household access to food stores**<br>Self-reported food insecurity (to be developed) | Can low income households afford nutritious food? Is physical access a problem? |
| **6. Safety and confidence** | Public confidence in UK food system rests primarily on food safety. Food safety stressed in Strategy Unit report. | **Trends in cases of food-borne pathogens** | 1. **Food safety inspections and incidents**<br>2. **Food covered by assurance schemes**<br>3. **Public confidence in food safety measures**<br>4. Consumer confidence in food availability (to be developed) | Do consumers have confidence in food industry and authorities?<br>Is food safety improving?<br>Growing role for assurance and traceability. |

## Purpose and scope of the Assessment

**This paper details a framework of indicators and analysis for assessing UK food security**. First proposed in Defra's 2006 analytical paper on food security, and outlined in Defra's 2008 discussion paper[1], the 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 (originally published in August 2009) forms one part of the Government's Food Strategy on **sustainable, healthy and secure food ('Food 2030')**, published in January 2010. That wider Food Strategy incorporates a suite of indicators to measure progress against objectives, some of which are drawn directly from this Assessment of UK Food Security.

This Assessment is not simply a suite of indicators that measure progress against defined policy objectives. Rather it sets out the various dimensions of how we understand UK food security, and then brings together a range of evidence, many in classic indicator form, to **inform** and **communicate** an assessment 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 Assessment looks backwards (to the 1990s) and forwards (to 2015/20) in order to put our current position in a dynamic context. Whilst the discussion of certain indicators looks further forward to 2030 and 2050, this is not a long term or horizon scanning assessment. That challenge is being taken up by the UK Chief Scientific Adviser's **Foresight project** which addresses the question "*How can a future global population of 9 billion people all be fed healthily and sustainably*?" The project looks out to 2050 and takes a global view of the food system, considering issues of demand, supply and the environment and drawing on a wide range of international expertise.[2] The project's findings are due in October 2010, and it may be possible to capture some of these into future editions of this UK assessment.

## The framework

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** | Themes 1 and 2 provide the **global context** to UK food security |
| **2. Global resource sustainability** | |
| **3. UK availability and access** | Themes 3 and 4 focus in upon the **UK supply chain** |
| **4. UK food chain resilience** | |
| **5. Household food security** | Themes 5 and 6 focus upon the **consumer perspective** |
| **6. Safety and confidence** | |

Each theme consists of:

[1] Defra, *Ensuring the UK's food security in a changing world* (July 2008); Defra Food Chain Analysis Group, *Food Securityand the UK – an evidence and analysis paper* (December 2006), p. 79. See also Table 10.1. https://statistics.defra.gov.uk/esg/reports/foodsecurity/default.asp. 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

[2] http://www.foresight.gov.uk/OurWork/ActiveProjects/FoodandFarmingFutures/FoodandfarmingProjectHome.asp

- **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:

- 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:

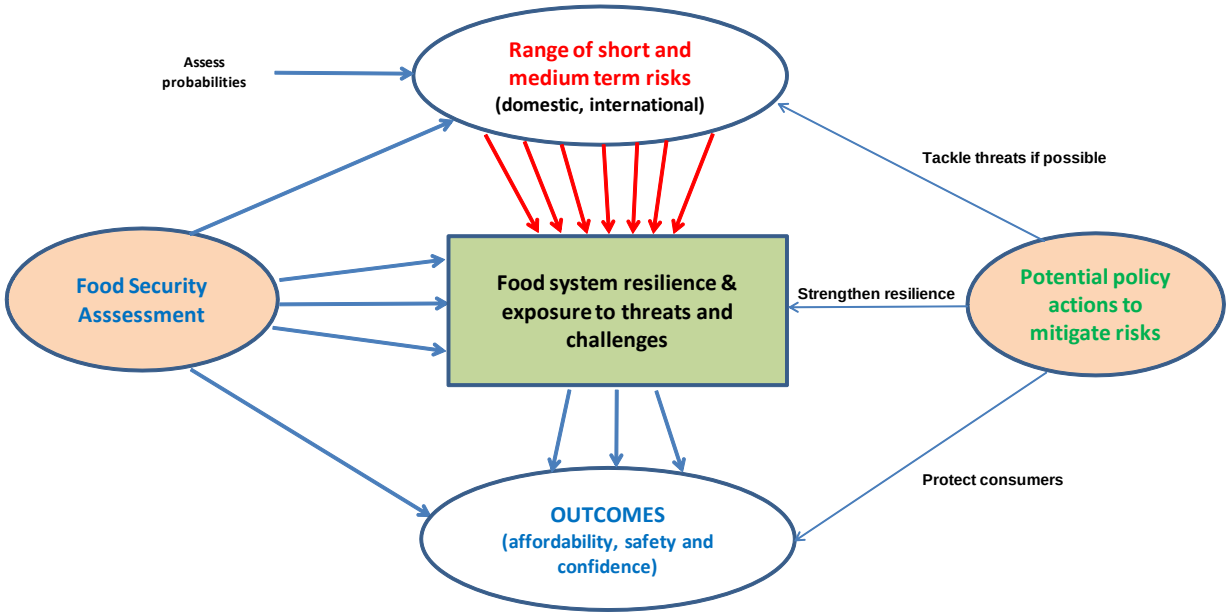
**Figure 1 Typology of possible threats and challenges to UK food security**

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

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 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.[3]

**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] 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.

**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

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.

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.

## Amendments and updates to the August 2009 publication

This UK Food Security Assessment was originally published in August 2009 as part of Defra's consultation package on secure, sustainable and healthy food. We are now taking the opportunity of the launch of the Government's Food Strategy in January 2010 to issue this updated and refined version of the detailed analysis which reflects further evidence gathering and feedback from stakeholders and other Government Departments. Whilst these refinements flesh out and update the Assessment and its associated evidence base, **they do not amount to a "new" or "second" Assessment.** Indeed, the August version noted a number of ongoing evidence gaps throughout the six themes and the latest changes reflect progress on some of these. As in the original version, we provide suggestions for where future development of new or existing indicators is desirable. All components of the assessment will be subject to review as evidence needs and sources develop.

The amendments to the Assessment include:

- data and minor textual updates to a number of indicators, where appropriate and feasible;
- new text boxes to provide additional analysis and context on specific issues, but for which indicators would not, or not yet, be appropriate (see table of contents);
- one additional contextual indicator and one additional supporting indicator (see below).

Specifically, by theme, the main amendments are as follows:

**Theme 1 – Global availability**

- Box 2 takes a closer look at the FAO 2050 projections. This accompanies a new contextual indicator on demand trends to 2050, describing the three main drivers of demand: population growth, increase in calories consumed per person, and dietary change. As this is a "scene setting" indicator to the theme, there is no traffic light assessment.
- Box 4 summarises the issues around the diverse phenomenon of large-scale land deals, and the G8 Leaders' Declaration on responsible practices.
- Soybeans are added to the indicator 1.2 and soymeal and vegetable oil to 1.3

**Theme 2 – Global resource sustainability**

- New indicator ( on phosphate rock reserves and extraction. Phosphate is an essential fertiliser component, but uniquely, comes from a finite mineral supply.
- Box 6 summarises FAO evidence on the genetic diversity of seeds and their conservation.

**Theme 3 – UK availability and access**

- Two of the original three indicators on UK - Diversity of entry ports and their flexibility - are now treated as a single indicator (indicator 3.6). Whereas the original pair of indicators were given two green ratings and two amber ratings, the merged indicator is given one pair of amber ratings.
- Box 7 takes a look at the global diversity of seeds suppliers. This recognises that some risks could affect a range of countries simultaneously and therefore not be dissipated by having a diverse range of supplying countries the UK.
- Box 8 summarises the issues around EU approvals of GM crops.

**Theme 4 – UK food chain resilience**

- Indicator 4.1 (energy capacity) is now updated with latest DECC analysis on medium term outlook for electricity generating capacity. As a result, the forward-looking rating has been changed from amber to green.
- Box 10 includes some text on the recent World Energy Outlook by the IEA.

**Theme 5 – Household food security**

- Headline indicator (Food share of low income household spend), now includes forecasts for 2009, which show a further rise in food's share of consumer spend.
- Box 12 on consumers' response to rising food prices in 2008-9 from ONS data.
- Box 14 on the challenges in tracking the affordability of a basic healthy diet.

**Theme 6 – Safety and confidence**

- No significant changes, only data updates.

**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, Ian Mitchell, Robin Karfoot, Sarah McDiarmid, Daniele Viappiani, Jonathan Bonas, Mark Frost, Lee Dobinson, Kevin Bridge, Vicky Inness, Phil Goodliffe, 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, the UK's food security involves a complex set 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 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). 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 6.3).
- 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 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 to 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. It should be noted that the indicators in this theme would not be sufficient for assessing the food security of developing countries, which would involve a more complex set of metrics.*

### *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

### Contextual Indicator

- Components of food demand growth to 2050

### 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

**Text boxes in this theme**

- Understanding FAO projections of world food demand and supply to 2050
- The UK's contribution to global food security
- International land deals and foreign investment

## Theme 1 Global availability

## Headline indicator Global output per capita

### Rationale and associated risks

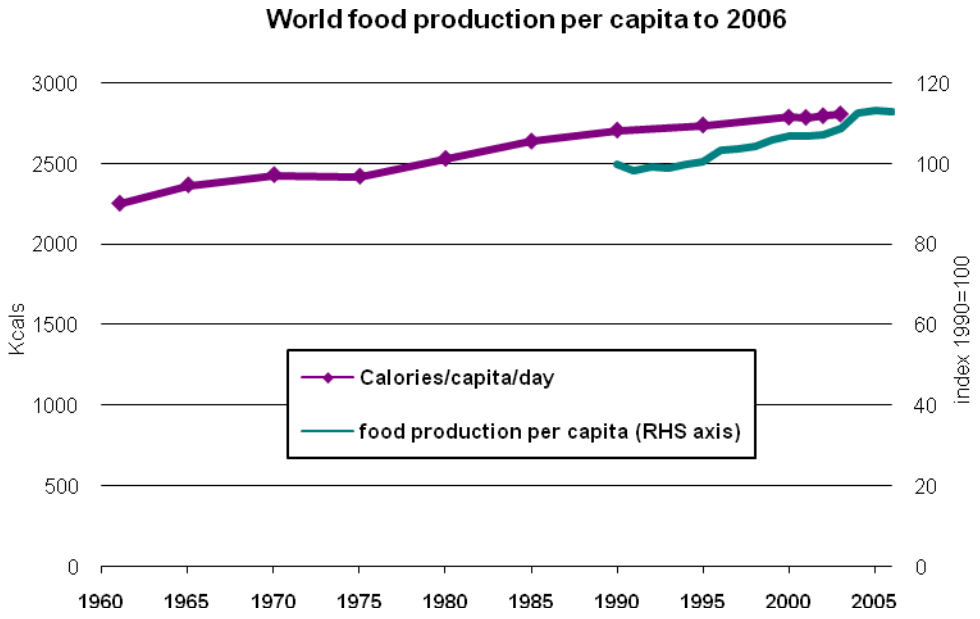
Global production of food relative to population is a fundamental indicator of global food security and is used as such in FAO analysis. Climate change, bio-fuels expansion and economic and demographic change are likely to place greater strains on world food production and the natural environment, and 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 70% by 2050, but it is important to note that such projections primarily relate to demand and nutritional goals, and they do not account for any reductions in waste which are currently very substantial (see the contextual indicator in this theme and Box 2).

### 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)**

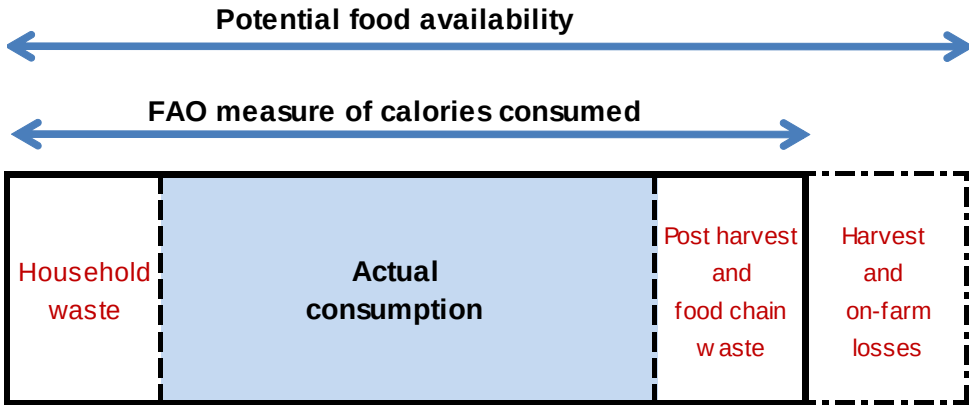
**Source:** FAO balance sheets and FAO production indices




*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*. **Reducing harvest losses would increase availability**.
- Moreover, they do not net off **losses further through the food chain and wastage by households** and thereby *overstate actual consumption*. A 2009 UNEP study reported that harvest and food chain losses amounted to around 1400 kcal per capita per day or 70% of consumption available for households, and this excludes further waste within the household.[4] The diagram below depicts in a stylized form the relationship between consumption and availability. The relative size of the components is very broadly depicted, but these are very uncertain given the lack of hard evidence and the fact that these will vary in significance between developed and developing countries.




[4] UNEP, *The environmental food crisis* (February 2009), pp. 31-2, http://www.grida.no/publications/rr/food-crisis/ebook.aspx

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 assessment 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.[5] 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 worlds' agricultural area but produces only 7% of the world's cereal production (FAO statistics). FAO's projections to 2030 and 2050 expect developing country production to increase much more than production in developed countries (see Box 2).

The key question is about the **environmental impact of agricultural expansion** and / or intensification. Estimates of additional land available for agricultural production vary significantly. FAO estimate that at world level around 1.5 billion ha are available for rain-fed crop production expansion. The estimates are net of current urban areas, forests and protected areas[6]. 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.[7] Land use is further considered in headline indicator 2.

Looking further ahead, the **Foresight Study into Global Food and Farming Futures Project** is considering the question "*How can a global population of 9 billion people all be fed healthily and sustainably*?" The project will draw upon international expertise and look out to 2050 and take a global view of the food system; considering issues of demand, production and supply as well as broader environmental issues. The project's findings are due to be launched in October 2010.[8] The findings of that project should inform future versions of this UK focussed assessment.

**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

[5] 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

[6] 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)

[7] *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.

[8] http://www.foresight.gov.uk/OurWork/ActiveProjects/FoodandFarmingFutures/FoodandfarmingProjectHome.asp

2009 that more than **1 billion people are undernourished** as they lack access to food.[9] 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, rising energy costs and supply shocks contributed to 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 on the supply side of climate change and the challenges facing developing countries to increase production suggest an amber rating.

| | |
|---|---|
| **Rating of current position** |  |
| **Comparison with mid-1990s** | **Improved** |
| **Likely position in 5-10 years** |  |

[9] *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

## Theme 1 Global availability

## Contextual indicator Components of food demand growth to 2050

### Rationale

The headline indicator on global availability will be closely associated with and driven by underlying demand. FAO projections (see Box 2) suggest there are broadly three demand factors which drive food supply:

1. **Population growth** has historically been the main demand driver and particularly at a regional level. In order to keep the same level of food consumption, growth in population has to be matched with an equal percentage growth in food availability. In his famous *Essay on Population* (1798) **Thomas Malthus** theorised that population increase would tend to outstrip food production and thus cyclically drop by the dramatic means of epidemics, famines, war, or conflict over food. Industrialisation has appeared to invalidate this theory: in the last two centuries, both world population and food consumption have been growing at unprecedented speed in human history.[10]
2. **Calories consumed** is a measure of the nutritional power of food. In those regions where average per capita calories consumption is relatively very low, or its distribution uneven, we find undernourishment (and a need to increase calories consumed); where per capita consumption is relatively very high we find obesity, ill health and waste (and a need to reduce calories consumed).
3. **Dietary change**. The production of meat and dairy products requires a higher amount of agricultural inputs (e.g. feed, water) than cereals for direct human consumption. Globally, grain is a major component of animal feed and according to the FAO, on average around 3 kilos of grain are used to produce each kilo of meat (3 kg being an average of different meats and production systems with very different requirements).[11] Therefore, diets that consume higher levels of meat and dairy will generally require a higher level of grain production (though some livestock will be largely grass-fed). This trend is associated with incomes growth particularly in developing and transitional economies.

**Indicator** **Components of global food demand to 2030/50**

**Source** FAO datasets and *World Agriculture: Towards 2030/50 Interim report* (2006). The elements of FAO's projected 70% food demand projection can be summarised diagrammatically below[12]

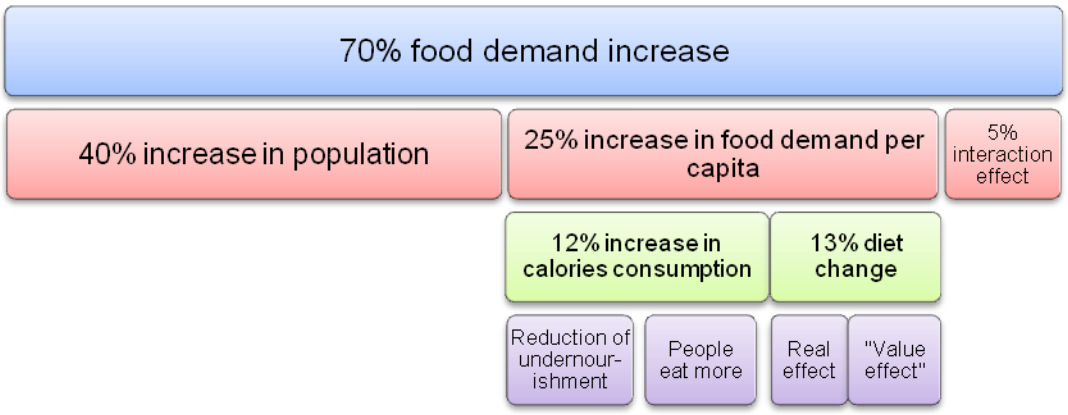
### Key Points

- **Population growth is decelerating**, from a yearly growth rate of 1.9 % in 1970s, to 1.5% in the 1990s. According to the UN medium variant, it is expected to further slow down to 0.34% growth in 2045-2050 as developing countries get richer and fertility rates there fall (in turn reflecting fertility planning and the rising opportunity costs of children). There will also be regional differences in population growth rates: most growth will occur in developing countries.

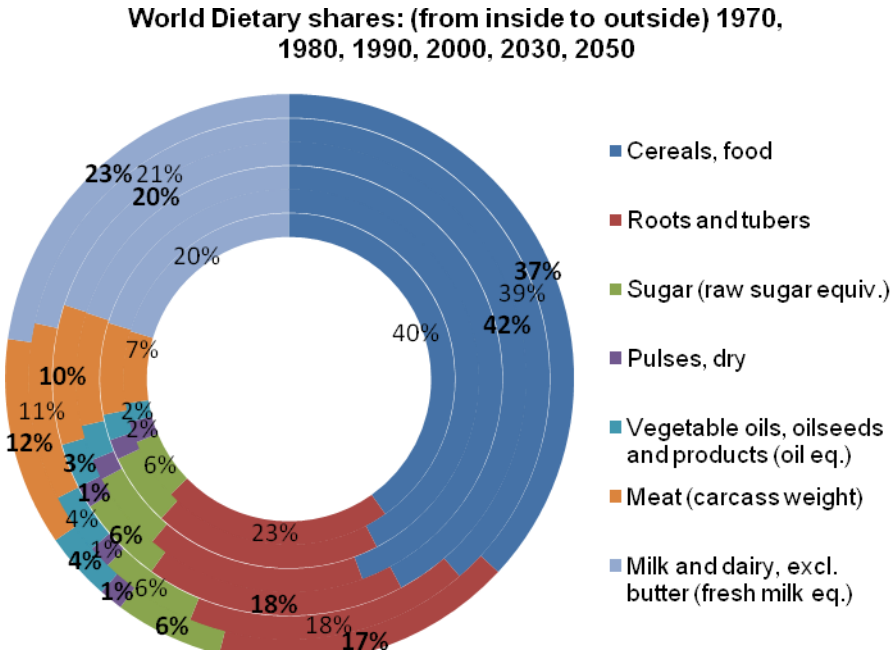
[10] At a household level and particularly in developing countries, the challenge of population "growth" becomes a question of *affordability* of feeding a larger household. This reflects Malthus' own humanitarian concern about household poverty and his advocacy (in subsequent editions of the essay) of prudence and temperance in ameliorating it.

[11] UNEP, *The environmental food crisis* (February 2009), p. 26, citing FAO, *Livestock's long shadow: environmental issues and options* (2006)

[12] Figures on food demand and population are approximate calculations as implied by yearly growth rates contained in the FAO 2030/50 report. The 12% increase in calories consumption is as reported by FAO with base period of 1999/2001.




- **Food consumption per capita growth has risen steadily** since 1961 (see headline indicator). FAO expects it to grow at a yearly rate of 0.6% between 1999/01 and 2030, and 0.4% between 2030 and 2050. Reducing the incentives to **waste** and over-consume food throughout the food chain and within households would further slow growth in calorie demand. As with population, most of the demand will come from developing countries seeking to increase per capita consumption.
- **Food consumption per capita has been growing fastest in East Asia**, mainly driven by China, and Latin America. FAO expects growth to slow down in all regions except Sub-Saharan Africa, as countries achieve high levels of food consumption. Transition countries have experienced declining food consumption. FAO expects this to revert.
- Cereals and roots have an increasingly lower importance as food in diets, while **meat and dairy have a growing importance** (see chart). E.g. in 2000, meat accounted for 10% of world diet (up from 7% in 1970), and its share is projected to rise to 12% in 2050. This tends to inflate the projections (see Box 2).
- Among developing countries, consumption of meat and dairy is lowest in South Asia and highest in Latin America. Trends in consumption of meat and dairy products will also be shaped by cultural and religious factors in different regions.




*Note: figures for 1980 and 1990 shares are not shown for sake of clarity.*

**Box 2 Understanding FAO projections of world food demand and supply to 2050**

FAO projections of world food demand and supply to 2050 have been widely cited since the 2007-8 price surge, including the need to "double" world production by 2050 to feed a population of nine billion.[13] The basis for this statement has not always been clear. A more recent FAO pronouncement[14] is that world food production would need to rise by 70% by 2050 compared to 2005/07 levels in **order to meet an expected equal increase in demand for food**. The difference between a 70% increase and a doubling is not trivial: it corresponds to more than the food production of the whole American continent in 2005.

The original technical basis for these statements is contained in FAO's report *World Agriculture: towards 2030/2050 interim report* (2006) which projects an annual increase of food *demand in value terms* of 1.5 percent until 2030 and 0.9 percent from 2030 to 2050.

A closer analysis of the FAO projections reveals the various assumptions associated with the headline figures.

- Starting with **demand projections** based on population and income growth (as in our contextual indicator), the FAO generate production projections for macro-regions, with an iterative expert-based process for allocating production to regions where it is feasible (e.g. using initial self sufficiency ratios, yields, land availability etc). Because they do not explicitly take into account the sensitivity of supply to trends in prices the projections do not model long-term equilibrium commodity prices.
- The projections assume no change in post-harvest **losses**, food chain or household **waste** or prevalence of overweight, and these are very substantial (see headline indicator). Estimates reported by UNEP imply that a halving of losses could increase consumption by as much as one-third. So the projections can be interpreted as a 70% increase in food *consumption* which can be met by a **combination of more production and less waste**. Significant reductions in agricultural and food chain losses within developing countries could occur if their infrastructure and technology improve. Reducing losses and waste will be a critical element in meeting future food demand sustainably.

The projected 70% increase in food demand is itself associated with:

- **A population of 9 billion people** in 2050, 35% above expected 2010 levels.
- **An increase in world food per capita** availability of 3130 kilocalories a day, 12% more than 1999/2001 levels. This comprises 3070 kcal in developing countries (up by 16%), 3270 in transition countries, and 3540 in industrial countries. This includes overconsumption and waste. As a result **a reduction of undernourishment is projected,** from a 2006 figure of 811 million to 290 million.
- **Dietary change.** World annual consumption in physical quantities would be

[13] See the discussion in the EFRA report, *Securing food supplies up to 2050: the challenges faced by the UK*, volume 1 (Fourth Report of Session 2008-9) pp. 8-11.

[14] See http://www.fao.org/news/story/en/item/35571/icode/ and the October 2009 briefs entitled *How to feed the world in 2050* and *Global agriculture towards 2050*. The FAO state "In order to feed this larger, more urban and richer population, food production (net of food used for biofuels) must increase by 70 percent."

composed of 35% meat and dairy products (up from 30% in 2000), 37% cereals (down from 42%), and 17% roots and tubers. The dietary shares of meat and dairy increase in all regions.

- **An "inflated" value element**. FAO measure global food demand in value terms (quantities of different foods are *weighted* by a price index), so that more expensive foods (such as meat, oils and dairy) are given a higher weight. This means that food demand in value terms will grow faster than in calorific or weight terms, when the demand for more expensive foods grows (that is because the ratio of livestock product to cereal prices exceeds the feed conversion ratio). Were the dietary share of meat weighted by the amount of feed used to produce it, rather than the price of meat, the projections of world food demand per capita would be lower by roughly 6 percentage points.[15]
- **The projected increase depends upon the base year**. The "doubling by 2050" claim would be a more reasonable approximation only if the year 2000 is taken as the base. A base year of 2010 reduces the projection to 61%. As the years pass and production increases, that figure would significantly shrink. By way of comparison, between 1960 and 2000, FAO figures show that world food production increased by about 150%.
- **Differential projected increases in food production** (in value terms) between developing (95%) and industrial (23%) countries.

In view of all these considerations, it would be incorrect to interpret the 70% projection as a set of rigid or minimum global (or national) production targets, or that failure to reach them would necessarily result in widespread shortages. Rather it would appear to indicate the upper bound for future production growth in response to demand growth, including a reduction in malnutrition.

[15] Calculation made using conversion factors provided by FAO and aggregating world food demand using as weight for meat 3 times that of wheat instead of the price of meat. The rationale for it is that according to UNEP (2009) report on the *Environmental Food Crisis*, 3 kilos of Grain are needed to produce 1 kilo of meat.

Theme 1 Global availability

## Supporting indicator 1.1 Cereal yield growth rates by region

### Rationale and associated risks

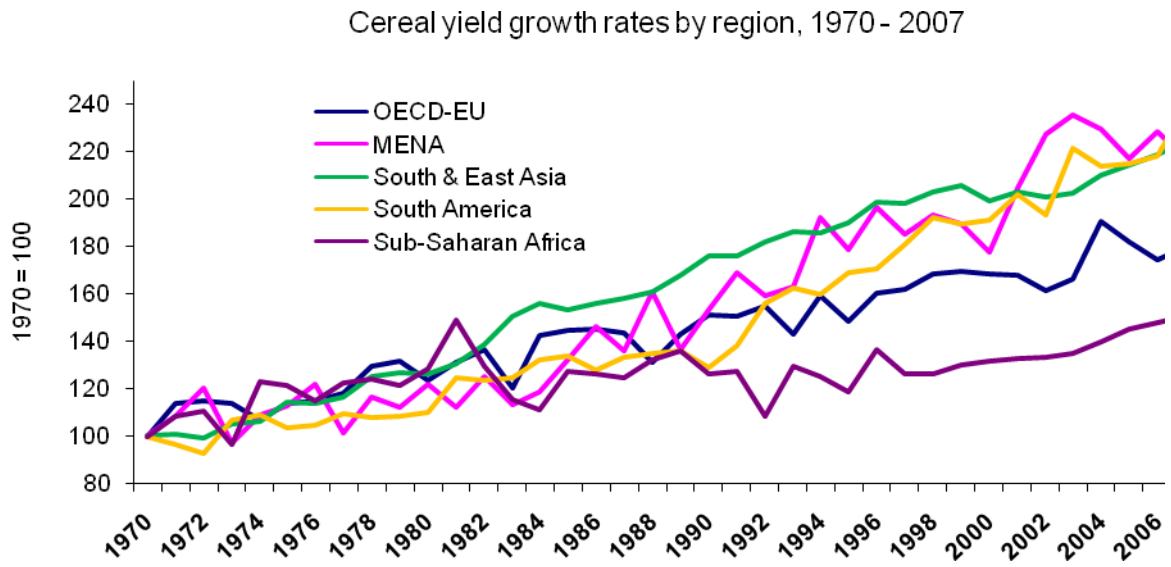
Improved technologies leading to increased yields (output per area) and productivity have played an important part in the increasing world supply of food. **Yields are a key outcome measure of applied research, investment and good practice** (see indicator 1.6). Without improvements in yields, more land 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 where market signals are less well developed. 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




### 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** 

**Box 3 The UK's contribution to global food security**

The Cabinet Office *Food Matters* report noted 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 and Food Security (GPAFS)).
- Continuing to argue for radical reform of the CAP, rejecting trade protectionism and supporting Doha trade negotiation efforts.
- Doubling investment in agricultural research for development to £80 million a year by 2013, including support to the Consultative Group for International Agricultural Research (CGIAR), alongside contributions to the International Fund for Agricultural Development (IFAD). Defra and DfID are co-sponsoring the Foresight project on Global Food and Farming Futures.
- 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 1.2 Real commodity prices

### Rationale and associated risks

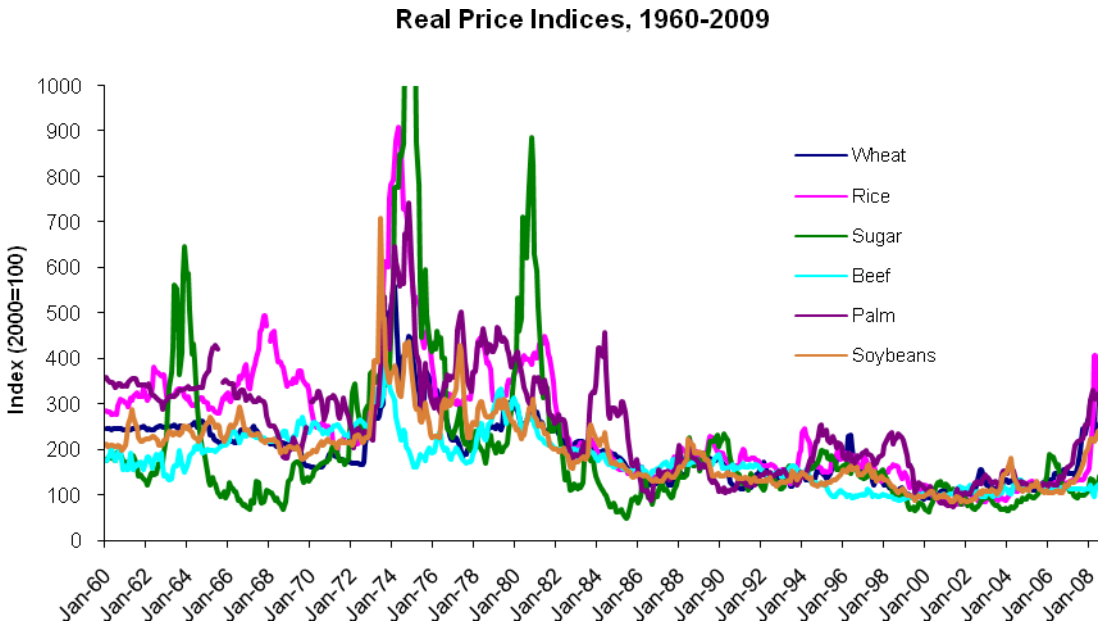
This indicator should broadly reflect the global availability of agricultural commodities. Higher prices signal relative shortages, whilst falling prices signal improved supply or even oversupply. Higher prices give an incentive for producers to increase supplies and for consumers to reduce demand. It 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, did not see any major increase in 2008.[16]
- All agricultural commodity prices have seen sharp falls from their peak levels. With the exception of rice, the prices are broadly 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 then fell sharply for a number of reasons: a favourable supply response came on stream, oil prices fell and export restrictions were relaxed. 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.[17] 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** |  |

[16] 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

[17] 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

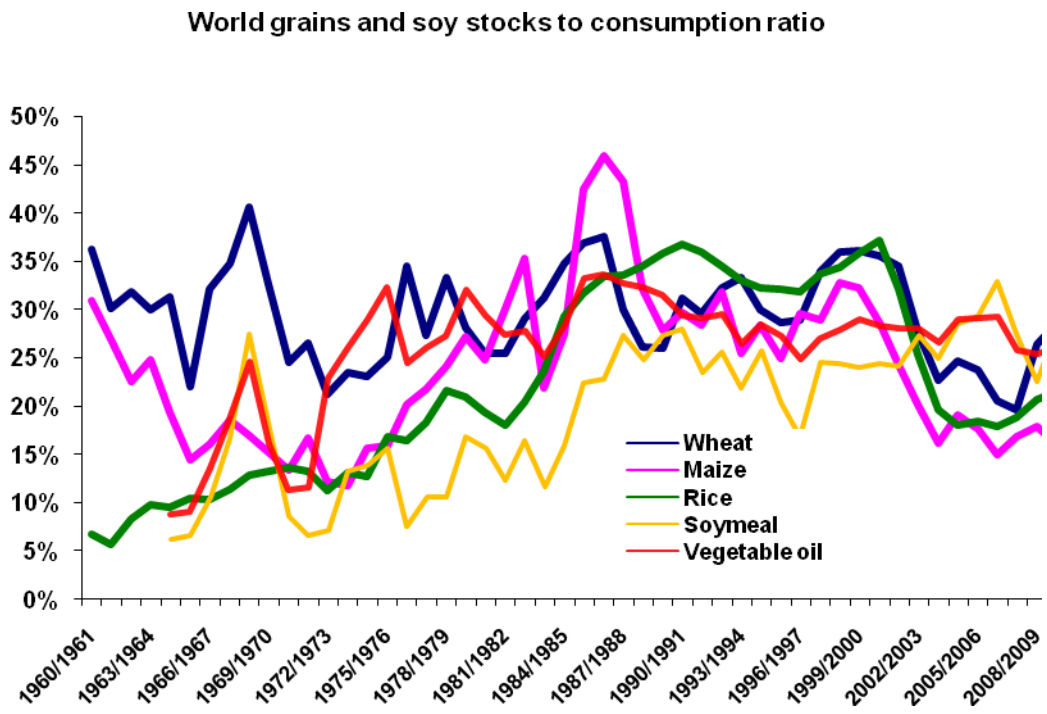
Stocks to consumption ratios function as an early indicator of the changing balance of markets over time, and an indicator of the impact of future supply and demand shocks on prices. Especially for crops, supply shocks are a regular feature of the market. Therefore, this indicator focuses on cereals.

### 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**

**Source** USDA

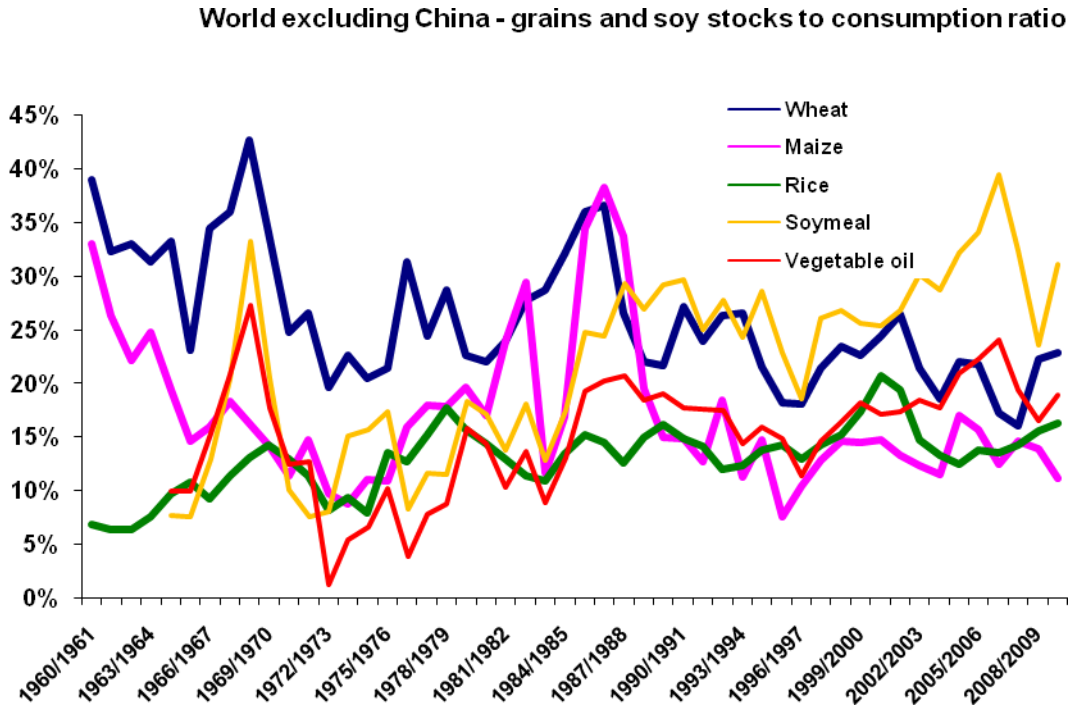



### Key points

- Stock ratios for grains have been significantly lower in the 2000s than in the previous two decades whilst vegetable oil and soymeal stocks remained at broadly similar levels.
- Following a record global harvest of wheat in 2008, wheat stocks increased significantly and are forecast to increase again in the current marketing year 2009/10. The wheat stocks to consumption ratio is forecast to

increase to the highest level since 2001/02. For rice stocks are forecast to continue their increase as well. By contrast maize stocks are forecast to fall back again after the increase in 2008/09.

- The significant fall in the stock to consumption ratios for grains 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 FAO[18], suggest that the more 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 significantly 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 (indicator 1.4) reduces the need for large stocks as national production short-falls can be filled by imports more easily.

**Assessment**

In recent years, cereal (but not vegetable oil and soybean meal) 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.

[18] 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

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** | **Deteriorated.** Abundant, but probably excessive and economically inefficient (inc. public) stocks in 1990s |
| **Likely position in 5-10 years** |  |

Theme 1 Global availability

## Supporting indicator 1.4 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 land deals (although these can boost productivity – see Box 4), 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.

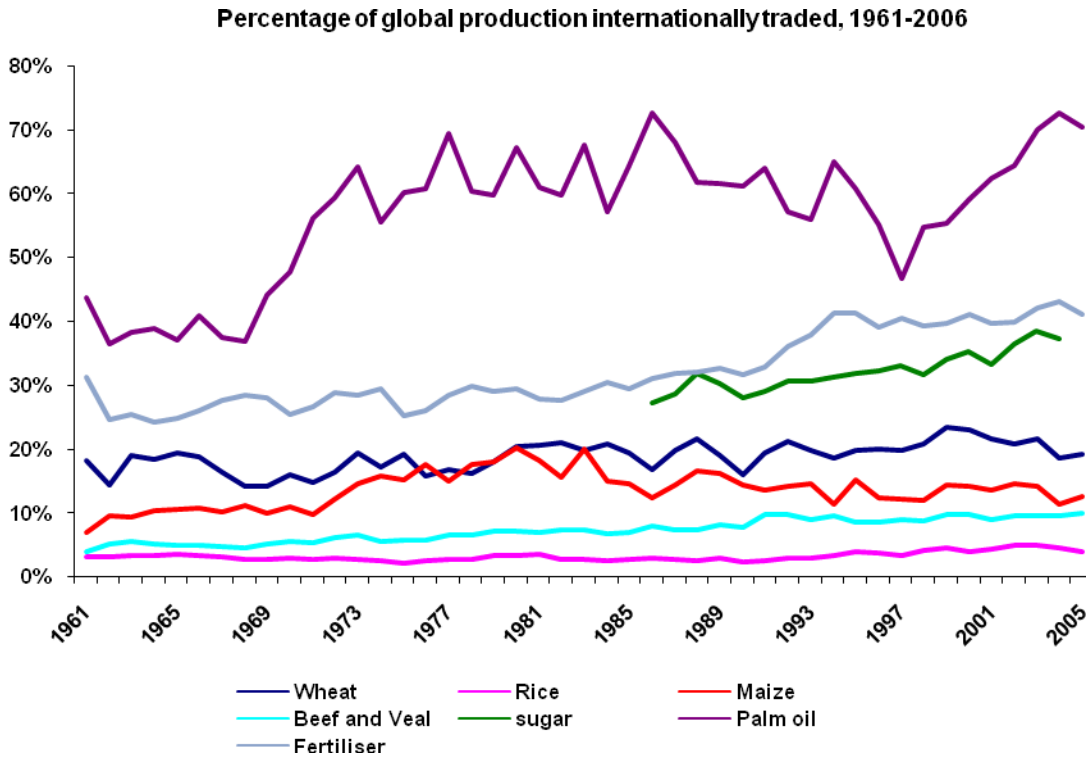
**Indicator** **Share of global production internationally traded**

**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.[19] A very high percentage of palm oil is traded.




**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** |  |

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

**Box 4 International land deals and foreign investment**

Over the past two years, the acquisition of large tracts of land in developing countries by certain developed countries has elicited widespread media coverage and concern from various civil society groups, who fear that long term leases, or on occasion outright purchase, of agricultural land will damage local rights, distort international supply chains and undermine world trade. Assessing the economic and security implications of these is rendered problematic by the highly varied nature of, and motivations for, such investments and the lack of concrete data about individual cases. What is clear is that agricultural investment in many African countries has multiplied over the last decade, and accelerated in 2007-8 (see table), whilst South East Asia has also been a target for large scale investment. Several million hectares appear to be involved.[20]

**Total Foreign Direct Investment ($m)**

| Year | 1990-2000 | 2005 | 2006 | 2007 | 2008 |
|---|---|---|---|---|---|
| **Angola** | 602 | 6794 | 6064 | 9796 | **15548** |
| **Sudan** | 119 | 2305 | 3541 | 2436 | **2601** |
| **Madagascar** | 24 | 86 | 294 | 777 | **1477** |
| **West Africa** | 2106 | 7118 | 16095 | 15934 | **25969** |
| **Africa** | **6890** | **38222** | **57058** | **69170** | **87647** |

*Source: UNCTAD*

A key concern in Africa has been the treatment of the rights of local people (predominately subsistence farmers with little or no formal legal right to the land they live on) when land agreements are drawn up between their government and another interested party. In the past, the locals who have been displaced from their land have been incorporated into the new agribusiness as labour, or moved off the land entirely. On the other hand, movement of labour can have longer term benefits for both the local community and the macro economy as larger agricultural businesses offer stable employment and incomes for many. Beneficial spill-over effects of the investment can also occur, as infrastructure and access to markets are developed.

Data is uncertain because many agreements are confidential . The Gulf States appear to play a leading role: for instance, Saudi Arabia's food security policy has stated support for production outsourcing. The South Korean Government appears to support companies engaged in land deals. Interestingly, China's motives for foreign land acquisitions are complex and not necessarily about food security.[21]

The largest share of investment in agriculture appears to stem from private sources, mainly large financial firms seeking to diversify their portfolio and profit from rising global demand growth for staple crops, to supply industry as well as food. But it is not always

[20] An authoritative account of the phenomenon in Africa is IIED, FAO & IFAD, *Land Grab or Development Opportunity? Agricultural Investment and International Land Deals in Africa* (June 2009). See also, FAO Economic and Social Perspectives Policy Brief, *From land grab to win win* (June 2009) ftp://ftp.fao.org/docrep/fao/011/ak357e/ak357e00.pdf and *The Economist*, 'Outsourcing's Third Wave', 21 May 2009.

[21] IIED, *Land Grab or Development Opportunity*, see box 2.1

clear where the boundaries lie between private and state investment. Regardless of the source, outside influence should bring technological expertise and more efficient techniques to African agriculture, which can help to increase yields.

While such investment increases output, it may not benefit the local economy. That has to some extent occurred in the past for certain commodities and minerals, particularly where governance is poor. For the future, the FAO, supported by the International Fund for Agricultural Development, is developing an international 'code of conduct' for investment in developing country agriculture, recommending business models and advice on cost and benefit sharing between the parties involved. At the G8 July 2009 conference, the **G8 Leaders' Declaration "Responsible Leadership for a Sustainable Future**" – para 113(b) "noting a growing trend of international agricultural investment, including land leasing and purchases in developing countries, we will work with partner countries and international organisations to develop a joint proposal on principles and best practices for international agricultural investment."[22]

The implications for UK food security appear slight or unclear. Investment and productivity growth in developing countries will enhance overall global food supply. Countries which are leasing large tracts of land do not account for a major part of the international supply base. Many host countries are not leading players on world markets, and if large net food importers begin to source a lot of their demand from these, demand on global markets could actually fall. There could also be impacts on regional markets. But whilst the effects of these developments on global markets remain ambiguous and uncertain, and levels and concentration of trade are unaffected (see indicators 1.4 and 1.5), we would not expect immediate concerns for UK food security. A more general concern, however, is that the growing practice of state-led, investments to "sequester" supply overseas may signal a lack of confidence in international markets and multilateral trade, and this in turn risks legitimising protectionist practices elsewhere (a kind of negative international externality).

[22] www.g8italia2009.it/static/G8_Allegato/G8_Declaration_08_07_09_final,0.pdf

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 exporter concentration for various commodities**

**Source** FAO datasets, F.O. Lichts

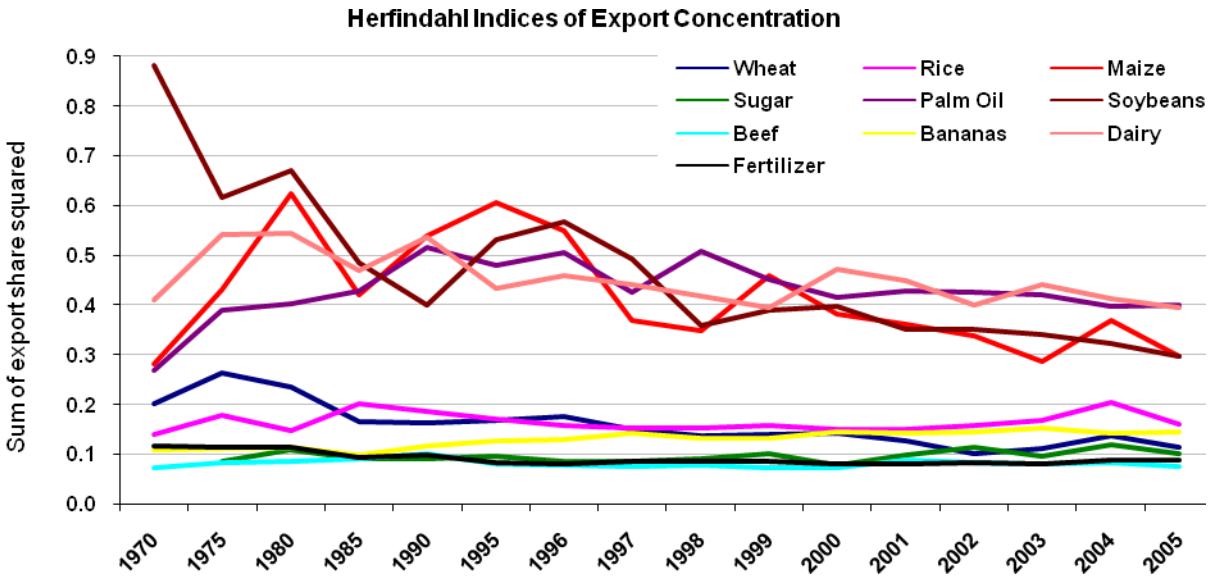
The Herfindahl Index (HI) measure of market concentration is often used by competition authorities but it also provides a measure of export market concentration. This is considered a better measure than, say the concentration ratio of the top 3 or 5 suppliers because it accounts for the shares of all 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.

Market concentration here is defined in terms of exporting *countries* rather than *firms*.

**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% |

| Commodity | | 1995 | | 2005 | |
|---|---|---|---|---|---|
| | | Top 3 Exporters | share of global trade | Top 3 Exporters | share of global trade |
| 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.

Whilst national trade policies can affect international markets, trade itself is typically conducted by multinational **trading companies.** Global grain (excluding rice) and oilseed trade is dominated by some fourteen companies, which include Cargill, Archer Daniels Midland and ConAgra among others.[23] These firms facilitate trade by organising the contracts, providing the industrial knowledge, capital and infrastructure necessary to support the bulk transportation of specific agricultural commodities.

| | |
|---|---|
| **Rating of current position** |  |
| **Comparison with mid-1990s** | **Improved** |
| **Likely position in 5-10 years** |  |

[23] *Financing normal levels of commercial imports of basic foodstuffs*, FAO (2003), available at ftp://ftp.fao.org/docrep/fao/006/y5109E/y5109E00.pdf

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.[24] 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 and 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 is 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.

[24] 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)

- The global figures mask regional variations.

| | Total R&D expenditures (2000 international $m) | | Share of global total (%) | |
|---|---|---|---|---|
| | **1995** | **2000** | **1995** | **2000** |
| *Developing countries* | | | | |
| **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** |
| *High-income countries* | | | | |
| ***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** |
| **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** |  |

Theme 1 Global availability

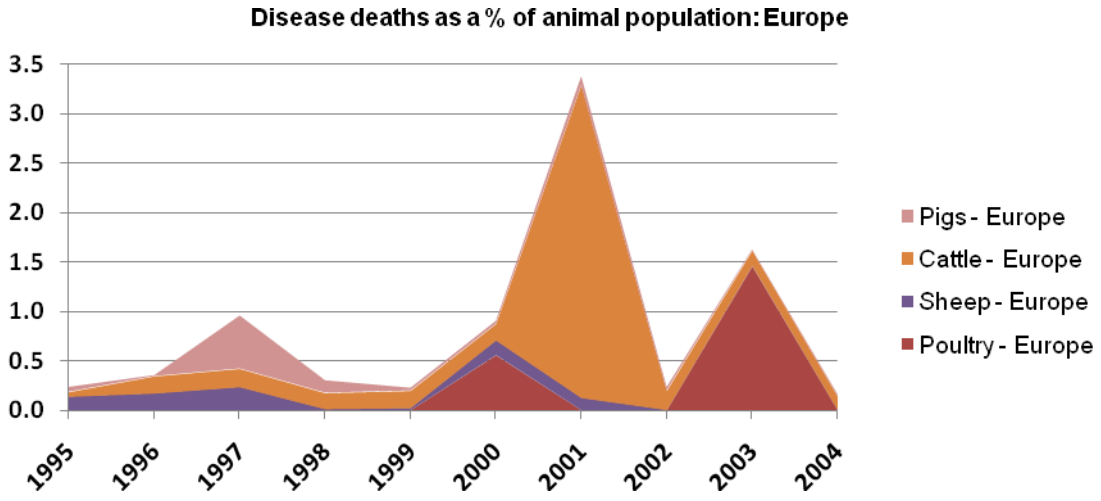
## Supporting indicator 1.7 Impact of animal disease on meat production

### 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.

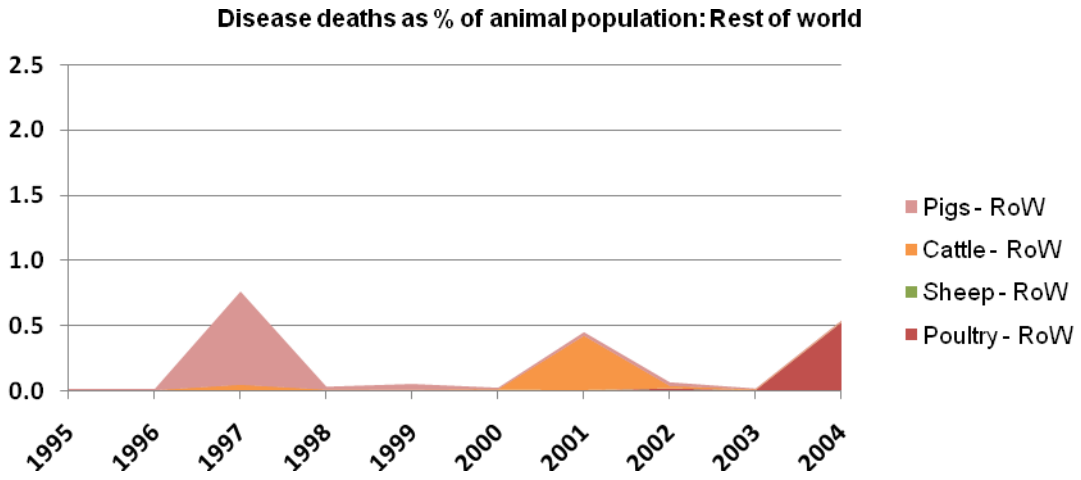
**Indicator** **Proportion of livestock lost to animal disease**

**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 (FMD) 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.
- Peaks in deaths shown, reflect FMD in China (Pigs – 1997), FMD in Kazakhstan (Cattle – 2001) and HPAI outbreaks in Vietnam, Thailand, Canada and Indonesia (Poultry - 2004).
- Figures since 2004 are unavailable, but whilst some diseases e.g. avian flu have increased, overall food supplies have not been significantly threatened.

**Assessment**

Although disease outbreaks can have a dramatic impact on 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** | **Deteriorated** 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** |  |

**Potential development**

The indicator reports the key diseases, but we would like to include all diseases reported by the OIE.

## 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)[25] 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*

[25] IAASTD, http://www.agassessment.org/

**Contextual indicator**

Global carbon dioxide emissions

**Headline Indicator**

Global land use change

**Supporting Indicators**

1. Fertiliser intensity
2. Phosphate rock reserves
3. Water productivity of crops
4. Water withdrawal
5. Global fish stocks

**Text boxes in this theme**

- Climate change and food security
- Safeguarding genetic plant diversity

**Other indicators under consideration, which may require further research**

- Soil quality
- Pesticide intensity

Theme 2 Global resource sustainability

## Contextual indicator Global carbon dioxide emissions

### Rationale

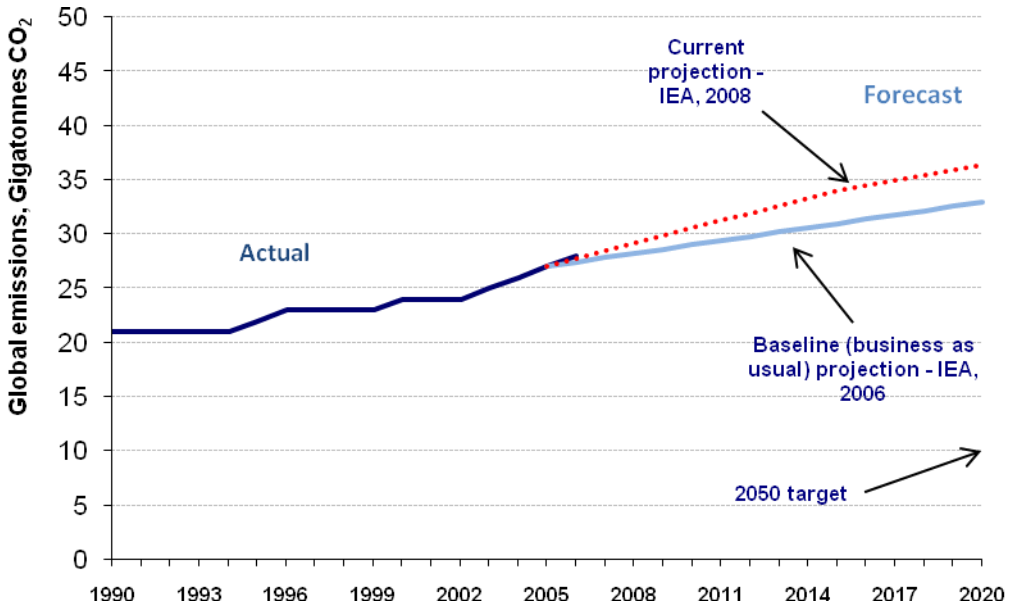
A warming and changing global climate will pose new challenges for agriculture around the world. Whilst in the short term, productivity in temperate zones may increase with modest rises in temperature, more tropical regions are likely to encounter greater natural constraints. More significant rises of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

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

**Contextual Indicator** **Global $CO_2$ emissions from fossil fuel combustion**

**Source** Department for Energy and Climate Change (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)[26].

- The largest growth in GHG emissions has come from energy supply, transport and industry which together accounted for 58% of emissions in 2004.
- 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 2001[27]. 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. Reducing these GHGs over the coming decade will add to the challenge agriculture faces in increasing output.
- 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. Under the 1997 Kyoto Protocol, industrialised countries committed to cut their combined emissions to 5% below 1990 levels by 2008 - 2012. Estimates suggest that for many countries this target will be missed. The EU15 block is forecast to reduce its own total emissions by 11.3% by 2012 compared to 1990.[28]
- In December 2009, the Copenhagen Summit recognised the need to stop global temperatures increasing by more than 2 degrees celsius, but agreed no legally binding framework to reduce greenhouse gas emissions.
- 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. The constraint on production appears to be more environmental (i.e. the imperative to reduce emissions) than geological (see Box 10).

[26] IPCC (2007) *Climate Change 2007: Synthesis Report, Intergovernmental Report on Climate Change*,

[27] IPCC (2001) *Climate Change 2001: Synthesis Report, Intergovernmental Report on Climate Change*

[28] For a brief overview of the Kyoto Protocol, see *http://europa.eu/rapid/pressReleasesAction.do?reference=MEMO/02/120&format=HTML&aged=0&language=EN&guiLanguage=en*

**Box 5 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 1.7 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 2.3 and 2.4)
- Ocean acidification adding to pressure on marine stocks (indicator 2.5)
- 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

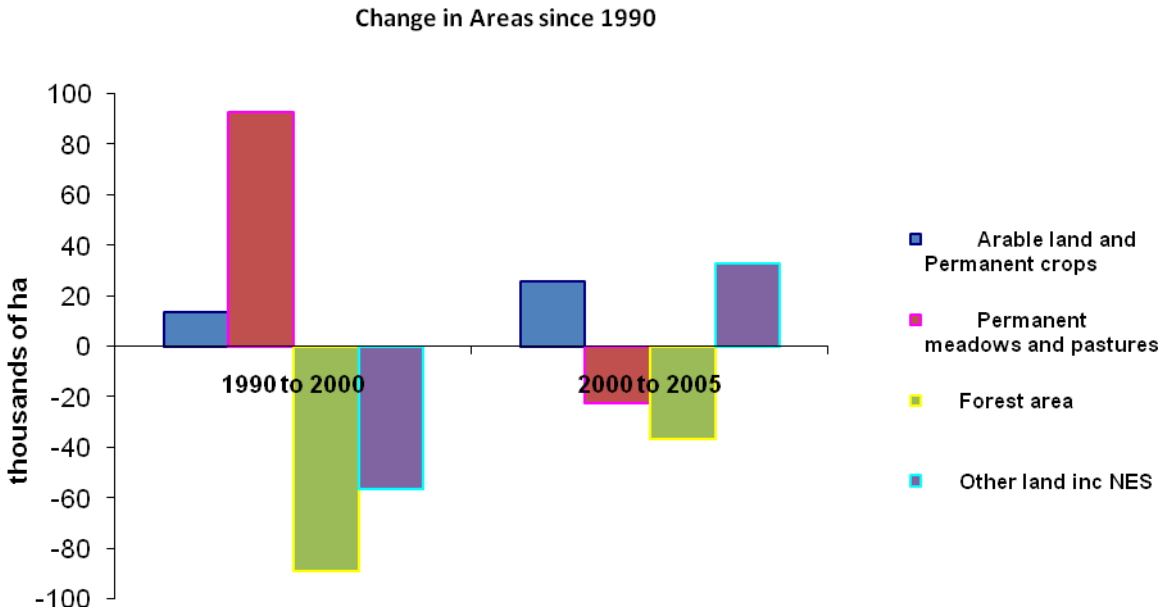
World agricultural production can be increased by converting more land to farmland rather than by increasing productivity. FAO estimate that globally around 1.5 billion ha are available for rain-fed crop production expansion. These estimates are net of current urban areas, forests and protected areas, 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 indirect effects 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 agricultural 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.[29] 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. The creation of pasture for cattle and the production of animal feed crops are closely associated with deforestation in the Amazon but 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 Review[30] 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.

[29] FAOstat.

[30] 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 usage

### Rationale and associated risks

Of the many elements needed to sustain plant growth, nitrogen, phosphorus and potassium are the major three, being needed in the largest amounts. Nitrogen forms 80% of the air we breathe and its supply is inexhaustible; but it must be converted into a form that plants can use either biologically or via energy intensive chemical processes.[31] There are major 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, which can in turn affect future productive potential. (The overall energy intensity of UK food production we consider explicitly in Theme 4.) In addition to trends in overall fertiliser consumption we also consider:

- In the context of growth in overall food demand per capita (Headline indicator, Theme 1)
- Trends in developed and developing countries.

The indicator does not take directly consider the intensity of fertiliser applications. Overall intensity of fertiliser use by hectare may be more closely linked to the externalities, and this is likely to vary by product and region. Indicator 1.1 provides evidence on yield growth by region.

### 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 as the latter becomes more efficiently and effectively used, and ultimately a decline in overall fertiliser consumption. This is therefore a strong measure of sustainability.

**Indicator** **Global fertiliser usage**

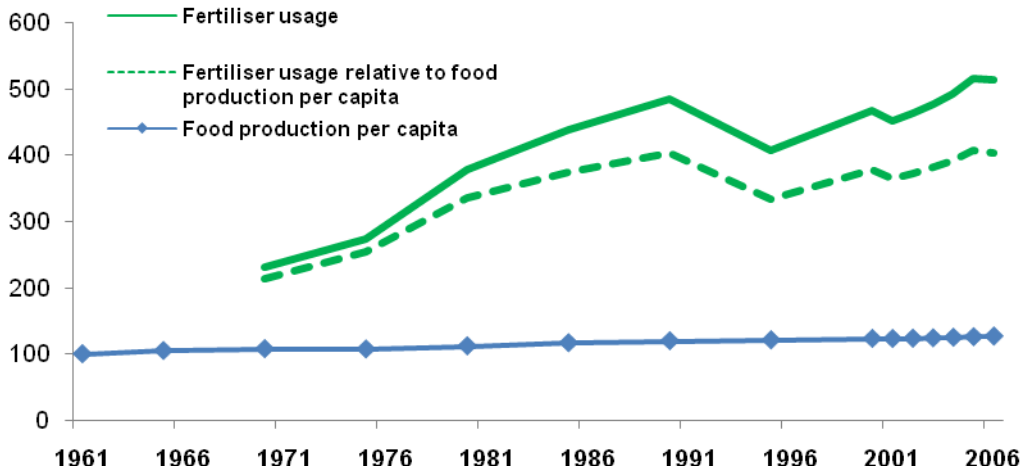
**Source** International Fertiliser Industry Association www.fertilizer.org/ifa/statistics.asp.

### Key points

- Total fertiliser usage more than doubled between 1970 and 2006. However, this was a period in which overall global food demand more than doubled, yields grew strongly, and per capita food production increased by 18%. The fastest growth in the indicator came between 1970 and 1980, before slowing ni the 1980s and actually falling in the first half of the 1990s. Since 1995, fertiliser consumption has grown again, and grown faster than per capita food production.
- An upward slope in the dashed line 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.

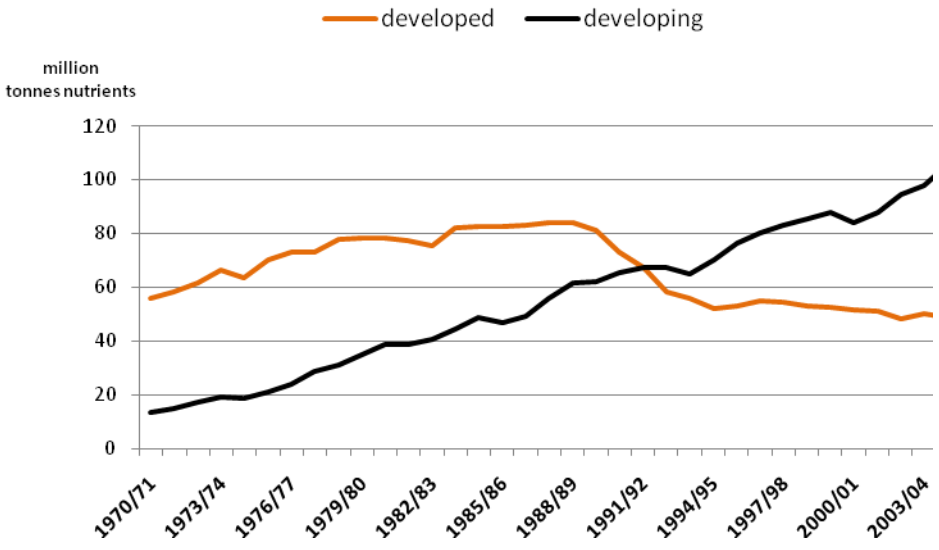
[31] Agricultural Industries Confederation, Mineral Fertiliser Manufacture, http://www.agindustries.org.uk/document.aspx?fn=load&media_id=2159&publicationId=248

**Fertiliser usage and food production per capita (1961=100)**




- There has been a notable difference between total 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.[32] There will also be notable differences between developing countries.

**Fertiliser Consumption in developed and developing countries**




[32] FAO Food Outlook (Nov 2008) http://www.fao.org/docrep/011/ai474e/ai474e14.htm , table A1.

**Assessment**

Growth in overall global fertiliser usage, particularly in relation to food demand per capita, 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** | **Deteriorated** at the global level |
| **Likely position in 5-10 years** |  |

**Potential development**

As data series develop we may seek to monitor a fuller measure of global energy use by agriculture.

Theme 2 Global Resource sustainability

## Supporting Indicator 2.2 Phosphate rock reserves

### Rationale and associated risks

As well as the environmental impacts of fertiliser that can affect future productive potential, there is the issue of non-renewable resources. Phosphorus is an essential nutrient for all life, second only to nitrogen as the most limiting element for plant growth.[33] Food production everywhere is dependent on the availability of phosphate in soil. It is traditionally added to soil through inorganic fertiliser or recycled via animal manure. A deficiency of phosphate lowers crop yield and quality. Unlike nitrogen, phosphorus cannot be fixed from the atmosphere biologically. Phosphate rock minerals are the only significant global resources of phosphorus, and these are finite. Concerns have been raised that reserves of phosphate will be on a declining trajectory as consumption increases, leading either to shortages or sharply rising fertiliser (and hence food) prices. The regional concentration of these reserves (especially in Western Africa) may also potentially raise issues, but we do not address those here.

### Desired outcome

Phosphate rock is a geologically finite resource; therefore it is desirable in the short and medium term to see the implied lifetime of the resource increase and extended for as long as possible, and for market prices to provide the right signals. Whilst it is not possible to extend the life of a finite resource infinitely, technology can improve the efficiency, and decrease the cost, of extraction thereby expanding the total viable supply base, even as consumption grows. But as phosphate rock is ultimately a finite resource, ways to recycle phosphate ($P_2O_5$) in a more efficient way would need developing in the longer term. Currently available methods of recycling can be also practised more widely.

**Indicator** **Phosphate rock reserves relative to production**

**Source** US Geological Survey[34]

The US Geological Survey defines global reserves as **Reserves**, referring to the world supply which can be profitably extracted with present technology and prices, and **Base Reserves**, which is the total quantity of known phosphate deposits, regardless of whether or not it can be profitably extracted at present. However, there is no accepted worldwide system for classifying phosphate rock reserves and resources, so those summarised here should not be taken as definitive.[35] Apart from the reserves / base reserves distinction, data does not differentiate reserves according to cost-effectiveness of extraction; suffice it to say that the higher the price of phosphate, the more economical it becomes to invest in extracting less accessible reserves (i.e. a supply curve).

[33] http://www.plantphysiol.org/cgi/content/full/127/2/390

[34] http://minerals.usgs.gov/minerals/pubs/commodity/phosphate_rock

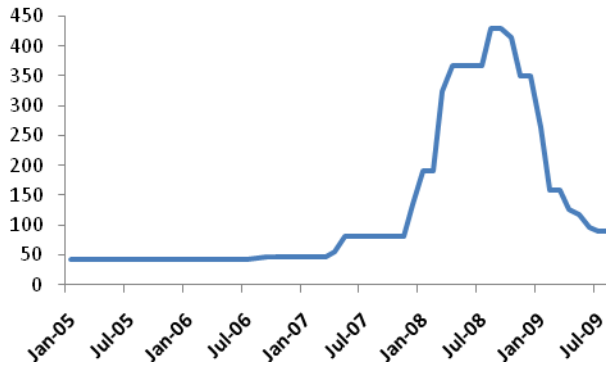
[35] In *The use of phosphate rocks for sustainable agriculture* (2004), the FAO notes: “There is no accepted worldwide system for classifying PR reserves and resources. A system developed in the United States of America (U.S. Bureau of Mines and U.S. Geological Survey, 1981; U.S. Geological Survey, 1982) defines reserves as "identified resources of a mineral that can be extracted profitably with existing technology and under present economic conditions" (Brobst and Pratt, 1973). Reserve estimates may be stated as the total amount of minable rock in the ground or as the amount of recoverable product. Many authors do not distinguish between reserves and non-economic resources when reporting the size of deposits. Thus, substantial differences in reserve and/or resource estimates may exist between various sources.” http://www.fao.org/docrep/007/y5053e/y5053e07.htm

| | Production (000 t) | | | Reserves (000 t) | | | Reserve Base (000 t) | | | Global share 2008 (%) | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1995 | 2008 | Change (%) | 1995 | 2008 | Change (%) | 1995 | 2008 | Change (%) | Production | Reserves |
| **World** | **137** | **167** | **22** | **11000** | **15000** | **36** | **34000** | **47000** | **38** | | |
| **USA** | 46 | 31 | -32 | 1200 | 1200 | 0 | 4400 | 3400 | -23 | **19** | **7** |
| **Brazil** | 4 | 6 | 54 | 330 | 260 | -21 | 370 | 370 | - | **4** | **1** |
| **China** | 27 | 50 | 85 | 210 | 4100 | 1852 | 210 | 10000 | 4662 | **30** | **21** |
| **Russia** | 9 | 28 | 229 | n/a | 200 | n/a | 1000 | 1000 | - | **17** | **2** |
| **Morocco/ W Sahara** | 20 | 11 | -45 | 5900 | 5700 | -3 | 21000 | 21000 | - | **7** | **45** |
| **Jordan** | 5 | 6 | 10 | 90 | 900 | 900 | 570 | 1700 | 198 | **4** | **4** |
| **South Africa** | 3 | 2 | -20 | 2500 | 1500 | -40 | 2500 | 2500 | - | **1** | **5** |
| **R of W** | 24 | 33 | 38 | 770 | 1140 | 48 | 4950 | 7030 | 42 | **20** | **15** |

**Key Points**

- Since 1995, deposit discoveries and advances in technology have increased the total phosphate rock reserve base by some 38% and of extractable reserves by 36%, whilst global production (and consumption) of phosphate rock has increased by 22% over the same period.
- Recently, phosphate rock prices have risen and fallen dramatically (see chart). The spike is correlated with similar spikes in energy and food commodity prices, and may also reflect a sharp increase in demand for fertiliser.[36]
- This Reserve Base data does not include off-shore deposits, for example off the coasts of Mexico and Namibia, though the USGS notes that recent high prices have ignited interest in them.

**Phosphate Rock Price $/t** Source: UNCTAD




**Assessment**

The FAO observes that 'in the past 100 years, phosphate has been discovered at a rate that exceeds the rate of consumption'.[37] And since 1995, global demand growth for phosphate rock fertilisers has been outstripped by the ability to produce it, reflecting the interplay of market forces and better geological technology. Currently

[36] For instance, see http://www.cruonline.crugroup.com/FertilizersChemicals/MarketForecasts/PhosphateRockTenYearForecast/tabid/248/Default.aspx

[37] http://www.fao.org/docrep/007/y5053e/y5053e07.htm

accessible global reserves have grown from a notional lifetime of 80 years in 1995 to 89 years in 2008 (assuming 1995 and 2008 prices and technology are constant respectively). The global Reserve Base has grown faster than Reserves, implying that the notional lifetime increased from 248 years (1995) to 281 years (2008).[38] The recent price spike in phosphate appears to be a temporary phenomenon, reflecting strong derived demand for agricultural commodities worldwide (and , rather than sharply dwindling reserves.

Looking further ahead to 2030, it is unclear to what extent **increasing food production** will lead to growth in phosphate consumption (and, other things being equal, tend to reduce the notional lifetime of reserves). In recent decades, there have been substantial regional differences in phosphate consumption trends. Whereas Western European consumption of phosphates halved in the period 1961-2002 (and cereal production nearly trebled), phosphate consumption growth in East Asia and South America far exceeded growth in cereal production. (See also the differential trends in overall fertiliser consumption in indicator 2.1). For the world as a whole phosphate consumption grew by more than global cereal production during that period.

At any rate, if increased extraction in the medium term was to lead to rising phosphate rock prices to reflect scarcer reserves, it would also increase incentives for further exploration and possibly more efficient use. In addition, other possibilities come into play:

- exploration of **offshore deposits** in the Pacific and the Atlantic. For instance, the offshore Namibian deposit, which is actively being considered by the mining industry, is substantial.[39] At some 1.58 million tonnes, it would increase the current Reserve Base by 3.4%.

- more and better **recovery (recycling) of phosphate** from sewage treatment plants, incineration ashes and animal manure. There is already an additional and strong environmental sustainability motivation to do this because phosphate is recognised as one of the major nutrients contributing to the worldwide increase in eutrophication through run-off from P-loaded soils.[40] Whilst there are unsolved disadvantages to each recycling process, the high fixed cost of infrastructure investment is likely to act as a barrier whilst phosphate rock prices remain relatively low.[41]

Favourable ratings are given despite the relatively concentrated nature of phosphate rock reserves across the globe. Production appears to be less concentrated than reserves. There is little evidence that existing geographic patterns of production and reserves are affecting availability, although a relative lack of diversity and responsiveness on the supply side may have been a factor in phosphate rock price volatility in 2008. This may be something to develop in a future Assessment.

| | |
|---|---|
| **Rating of current position** |  |
| **Comparison with mid-1990s** | **Improved** |
| **Likely position in 5-10 years** |  |

[38] The International Fertiliser Association tends to report slightly higher consumption figures than the US GS, which would imply correspondingly shorter notional lifetimes. But the year-on-year trends are very similar.

[39] www.minemakers.com.au/projects-namibia.php

[40] Defra, Advisory Committee on Hazardous Substances (ACHS), *Review of the feasibility of recycling phosphates at sewage treatment plants in the UK* (January 2009) http://www.defra.gov.uk/environment/quality/chemicals/achs/index.htm

[41] Defra, *Review of the feasibility of recycling phosphates at sewage treatment plants in the UK* , p. 26.

Theme 2 Global resource sustainability

## Supporting indicator 2.3 Water productivity of crop production

### Rationale and associated risks

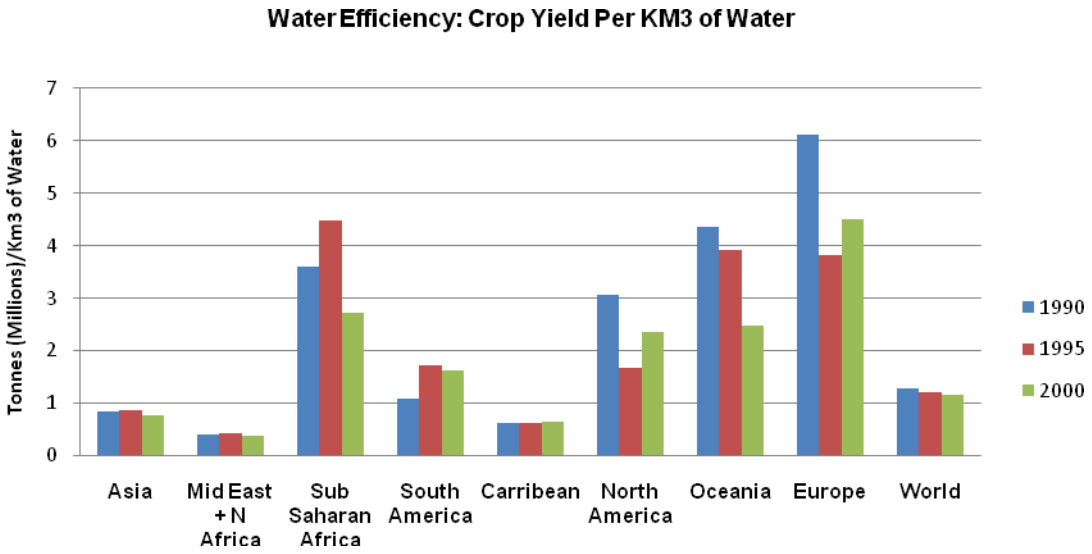
Two indicators in this theme are dedicated to the critical natural resource of water: the next indicator focuses upon irrigation, whilst this indicator considers water efficiency more generally. If cereal yields are to continue rising, more efficient use will need to be made of water, even as the climate 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) [42] , 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**.

[42] See http://earthtrends.wri.org/datatables/index.php?theme=2

- Asia continues to be a concern in terms of water usage and efficiency, recording very low levels of yield per $km^3$ 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 $km^3$ of water used in 2000. Europe accounted for nearly 20% of worldwide food production but only used 5% of global water 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.[43] 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

[43] 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.

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** | **Deteriorated** between 1990 and 2000 |
| **Likely position in 5-10 years** |  |

Theme 2 Global resource sustainability

## Supporting indicator 2.4 Water withdrawal by agriculture

### 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". [44] 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, 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.[45] Importantly, **the relative importance of agriculture for water demand 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.

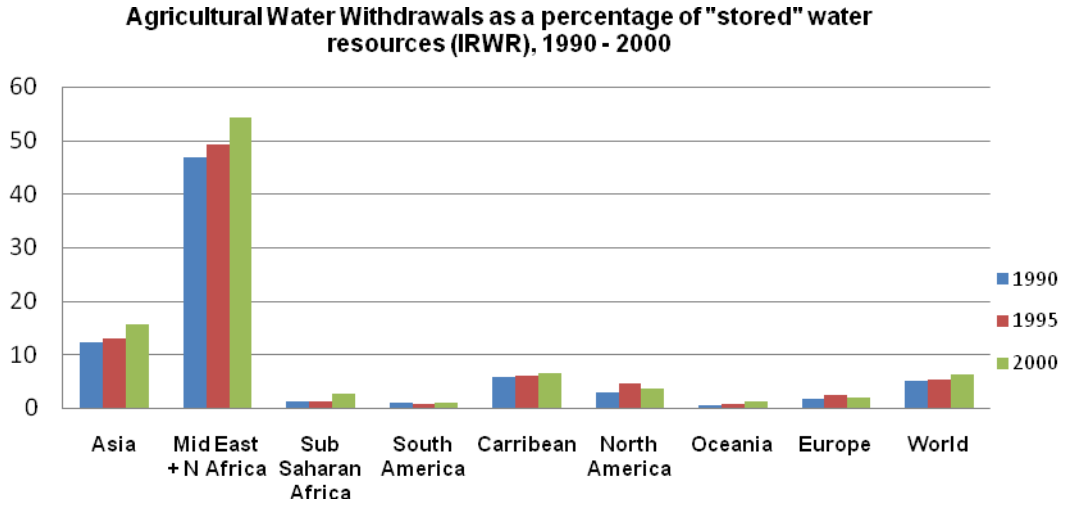
**Indicator** **Water Withdrawal for use by Agriculture as a % of Total Internal Renewable Water Resources**

[44] 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

[45] UNESCO, *Water, a shared responsibility*, pp. 254-5.

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)[46]




**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

[46] See http://earthtrends.wri.org/datatables/index.php?theme=2

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** | **Deteriorated** between 1990 and 2000 |
| **Likely position in 5-10 years** |  |

Theme 2 Global resource sustainability

## Supporting indicator 2.5 Global fish stocks

### Rationale and associated risks

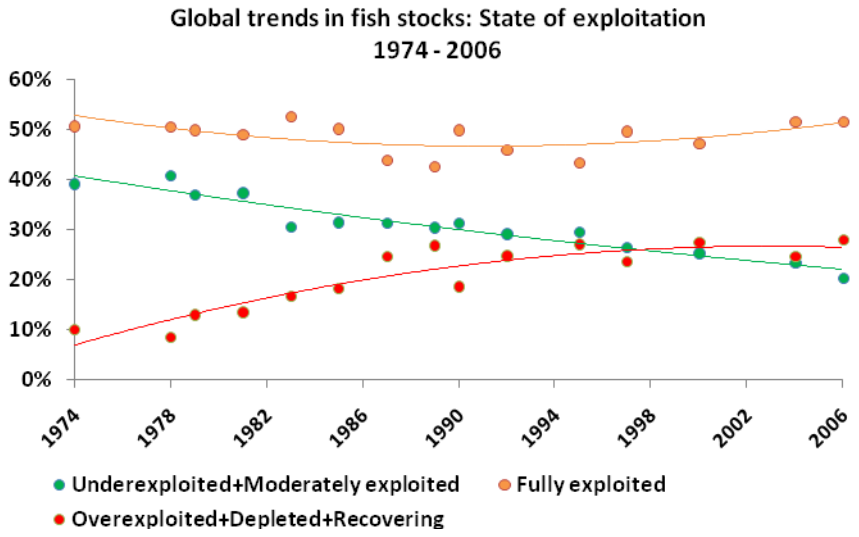
Fish protein represents 15% of animal protein supply globally - and for developing countries, a much higher share - but the lack of incentives to conserve fish stocks threatens the sustainable use of an open-access renewable resource.[47] Beyond certain biological limits, stocks collapse and become unavailable for consumption. As well as over-fishing, water pollution and high nitrogen concentrations in coastal waters can lead to to eutrophication and algal blooms which harm biological productivity and threaten fish stocks.[48]

### 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)[49]; Eurostat agriculture and fisheries.




### Key Points

[47] 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

[48] 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/

[49] 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.[50]

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.[51] 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.[52] 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 1995[53]. 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** | **Deteriorated** |
| **Likely position in 5-10 years** |  |

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

[51] http://www.fao.org/docrep/011/i0250e/i0250e00.HTM

[52] http://epp.eurostat.ec.europa.eu/portal/page/portal/statistics/search_database

[53]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/

**Box 6 Safeguarding genetic plant diversity**

The following draws upon FAO's reports *The State of the World's Plant Genetic Resources for Food and Agriculture* (1996, 2009) and the FAO factsheet, *Plant genetic resources: use them or lose them.*[54]

Of 30,000 known edible species, about 30 crops account for 95% of human food consumption and four (maize, potato, rice, wheat) for over 60%. Yet there can be immense variation within these species. At regional level other crops are nutritionally and culturally important (e.g. cassava in Central Africa), including wild species. This diversity is lessened by 'genetic erosion', wherein individual genes, combination of genes, varieties or species become extinct. Various indicators have been proposed to estimate its magnitude, but none is generally accepted. The main causes reported are the replacement of local varieties by modern or commercial varieties and land clearing. Other causes are pests, weeds, diseases, environmental degradation, overgrazing and urbanisation (1996 report, p. 34). Three economic values of genetic diversity can be identified (1996 report, p. 24):

a) *portfolio value*, which reduces the risk of yield loss due to crop/variety failure;

b) *option value*, which provides insurance from future adverse conditions; and

c) *exploration value*, which represents an asset for research and development of potentially valuable but unknown resources.

Genetic diversity allows cultivation of crops across different regions and can be valuable in addressing future challenges such as climate change adaptation, disease outbreak and the expansion of food demand. Diversity is therefore important for the productivity and adaptability of crops as well as the maintenance and delivery of ecosystem functions.

Efforts to maintain genetic diversity have focused on *in situ* conservation (of ecosystems and species in their natural surroundings) and *ex situ* artificial conservation (outside the natural environment). *In situ* conservation is particularly important for those species that are difficult or impossible to conserve *ex situ*, such as many Crop Wild Relatives (which have become increasingly important in crop genetic improvement with the development of new biotechnological methods). According to FAO's latest assessment:

- There are now 1,750 gene-banks worldwide, up from 1308 in 1996. There are also substantial *ex situ* collections in 2,500 botanical gardens around the world.
- The global number of accessions to conserved gene banks (*ex situ*) has increased by 20% since 1996, from 6 to 7.4 million, though less than 30% of these are estimated to be distinct accessions. Advances have been made in both national and international collections, but many countries still lack adequate resources to meet their needs and obligations.
- Neglected and under-utilised species remain under-represented in collections, although awareness of the importance of conserving them has increased.
- *In situ* conservation of wild species of agricultural importance occurs mainly as an unplanned result of the creation of protected areas, while less attention has been given to conservation elsewhere. Protected areas in the world have risen from 56,000 in 1996 to 70,000 in 2007 and the area covered has enlarged from 13 to 17.5 million $km^2$.

[54] http://www.fao.org/agriculture/crops/core-themes/theme/seeds-pgr/sow/en/; http://www.fao.org/fileadmin/templates/nr/documents/CGRFA/factsheets_plant_en.pdf

## Theme 3 UK availability and access

### *Introduction to the theme*

*The Strategy Unit (July 2008), proposed 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.*[55] *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

- EU's share of imports into the UK
- Diversity of fruit and vegetable supply
- EU-wide production capability
- UK production capability
- Potential of UK agriculture in extremis
- Diversity and flexibility of entry ports into the UK
- Port concentration for non-indigenous foodstuffs

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

**Text boxes in this theme**

- Diversity of global seed supplies
- EU approval of GM feed crops
- Alternative entry options to the Port of Dover

## 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**

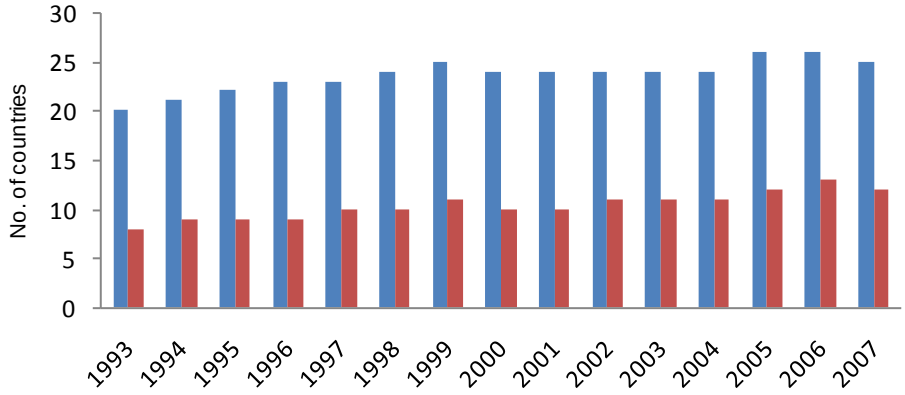
**Source** Defra analysis of trade statistics

### 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.

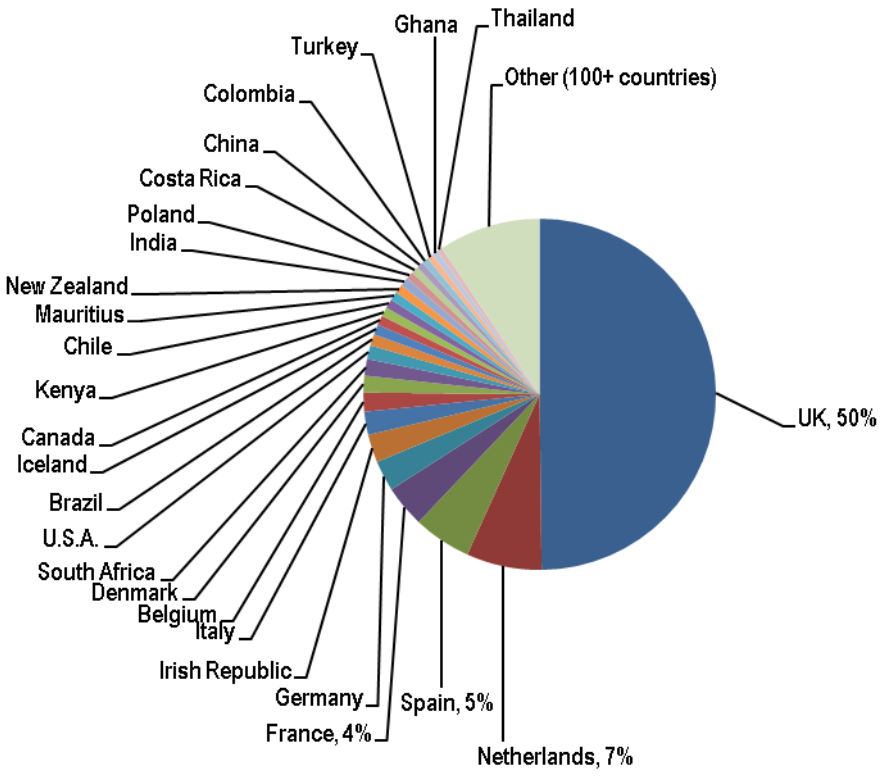
**Number of countries (including UK) accounting for 80% and 90% of UK food supply by value: 1993 - 2007**




Based on the farm-gate value of unprocessed food

## Supporting data

**Origins of food consumed in the UK by value: 2007**




Based on the farm-gate value of unprocessed food

- 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.[56]

| | |
|---|---|
| **Rating of current position** |  |
| **Comparison with mid-1990s** | **Similar** |
| **Likely position in 5-10 years** |  |

[56] 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

**Box 7 Diversity of global seed supplies**

It is possible there are some risks that could impact a range of countries simultaneously and therefore not dissipated by having a diverse range of countries supplying the UK market. One of these concerns relates to whether the global supply of seeds is itself sufficiently diverse. Multi-national companies operate globally in supplying seeds to farmers across countries and any risk to the supply of seeds could therefore impact across a range of countries exporting to the UK as well as to the UK itself. High levels of concentration may make the supply of seed more vulnerable to temporary supply shortages. If one major company were to fail there could be a potentially substantial impact on availability of seeds.

A full investigation of available data has not been possible. Research by one group estimates that the top 10 seed corporations accounted for 67% of the total commercial seed market worldwide in 2007, with Monsanto accounting for 23% of global sales, although it is difficult to assess the validity of that analysis.[57] The figures will reflect a degree of concentration within the market over time, but from a food security perspective these will still represent a relatively diverse range of seed suppliers.

In addition any short term disruption in seed supplies could be offset by an increase in the use of farmer-saved seeds as a short term measure, and over the medium term other companies in the market would be expected to expand production to restore supplies.

The current level of market concentration suggests that any risk to disruption of supplies is relatively remote. But with ongoing consolidation expected, the market concentration of the global agricultural supply sectors (in particular seeds, pesticides and fertilisers) will likely be something to monitor as part of any future assessment.

[57] ETC Group, *Who owns nature?* (November 2008). The report looks at the market shares of larger corporations across the "life" industries. http://www.etcgroup.org/upload/publication/707/01/etc_won_report_final_color.pdf

Theme 3 UK availability and access

## 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.

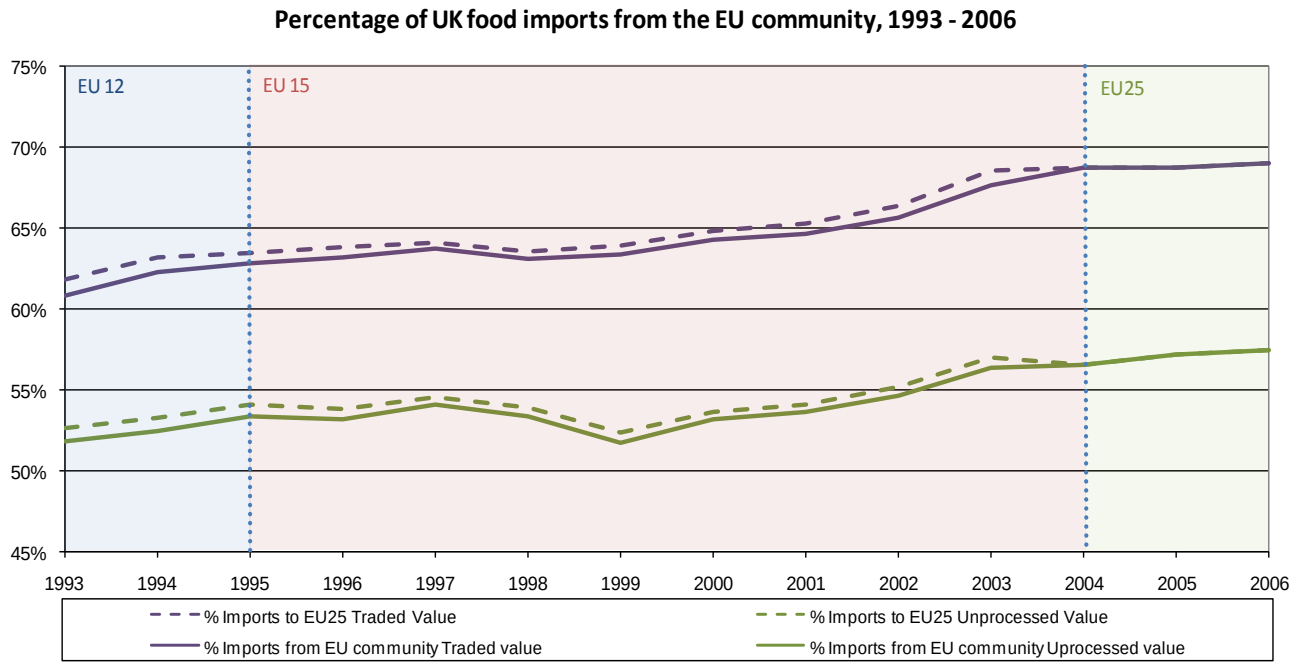
**Indicator** **Share of total UK food imports sourced from other EU countries**[58]

**Source** Defra analysis of trade statistics

### 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.

[58] 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*.




**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 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 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 Common Agricultural Policy 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 CAP 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** | **Improved** |
| **Likely position in 5-10 years** |  |

Theme 3 UK availability and access

## Supporting indicator 3.2 Diversity of UK fresh fruit and vegetable supply

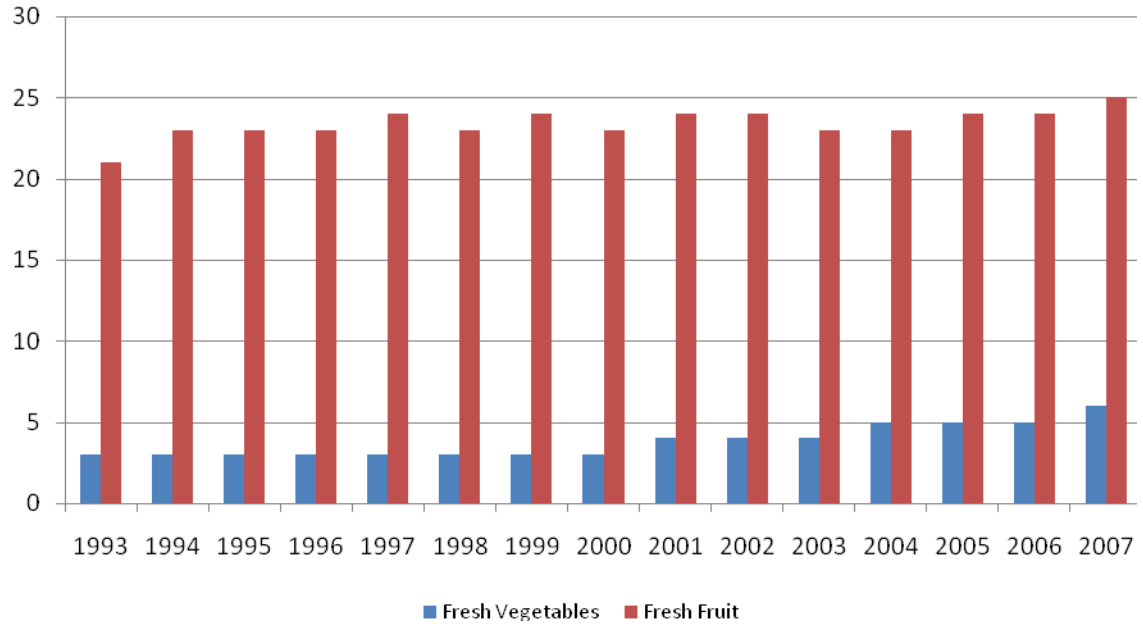
A large proportion (nearly 40% by volume) of UK food imports are fresh or preserved fruit and vegetables. Non-indigenous fruits from a variety of both EU and non-EU countries, such as citrus and bananas, are now well established in the average UK diet. Imports have played a major role in the growth in fruit consumption over the last thirty years and 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.[59]

### 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.

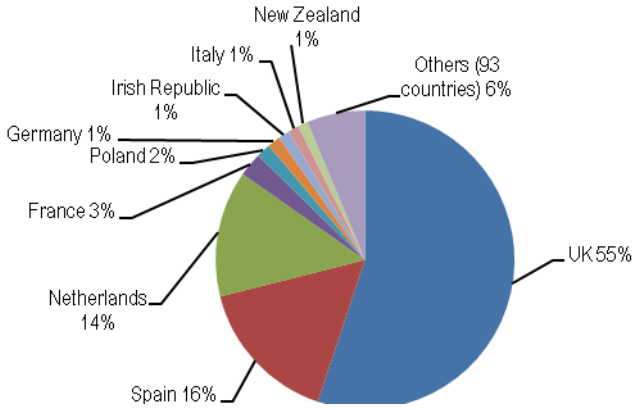
**Indicator** **Number of countries accounting for 90% of UK supply of fresh fruit and vegetables**

**Source** Defra analysis of trade statistics

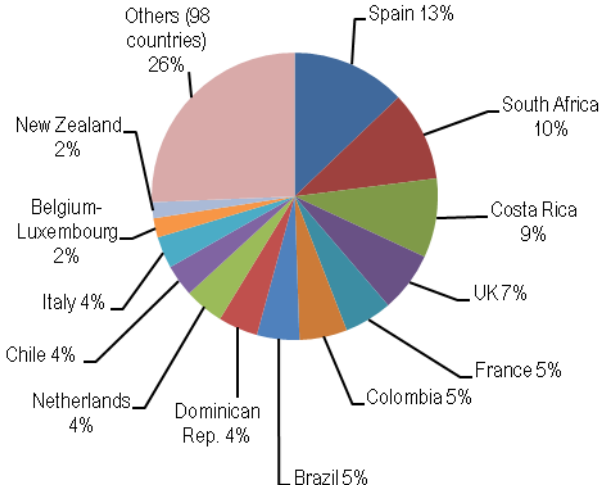



[59] 'Fresh fruit' and 'Fresh vegetables' are as defined in 'Agriculture in the UK' Chapter 5 commodity tables: https://statistics.defra.gov.uk/esg/publications/auk/default.asp

**Origins of UK supply of fresh vegetables, 2007**




**Origins of UK supply of fresh fruit, 2007**




### Key points

- In 2007, 6 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 79% of UK vegetables, compared with 55% 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, 25 countries together accounted for 90% of UK supply of fresh fruit by volume, up from 21 countries in 1993.
- The leading suppliers of fruit were Spain, South Africa, Costa Rica and the UK. UK production accounted for around 7% of UK consumption, a share which has changed little since 1998.[60]
- 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. 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.

[60] The August 2009 version included exports within UK supply, to give a "self-sufficiency" share of 11%. Here exports are excluded from UK supply to consumers. Additionally, the definition of fresh fruit and fresh vegetables has been revised slightly to be consistent with the definition used in chapter 5 of *Agriculture in the UK*.

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.[61] 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.[62] Many of the most stressed countries supply only very minor shares of the overall UK market, but as a significant supplier of fresh fruit and vegetables to UK consumers, the economics of water in Spain warrant further investigation.

| | |
|---|---|
| **Rating of current position** |  |
| **Comparison with mid-1990s** | **Improved** |
| **Likely position in 5-10 years** |  |

[61] https://statistics.defra.gov.uk/esg/transportns.htm 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

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

Theme 3 UK availability and access

## Supporting indicator 3.3 EU production capability

### 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.

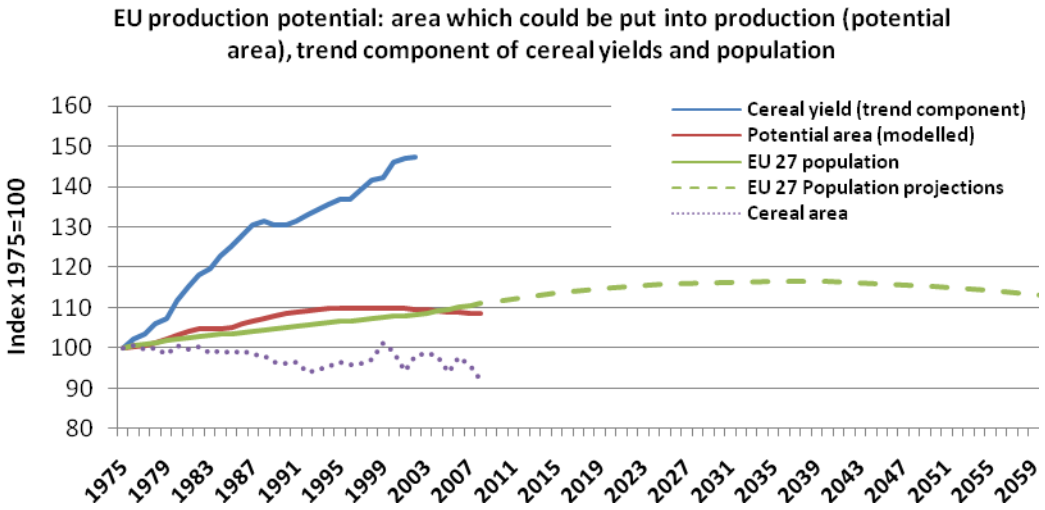
The EU is currently over 90% self-sufficient in agricultural products, although this itself is not the best indicator of supply *potential* at the EU level.[63] This is roughly calculated as production divided by consumption (minus exports + imports) and based on the farm gate value of production. A 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.




[63] 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.

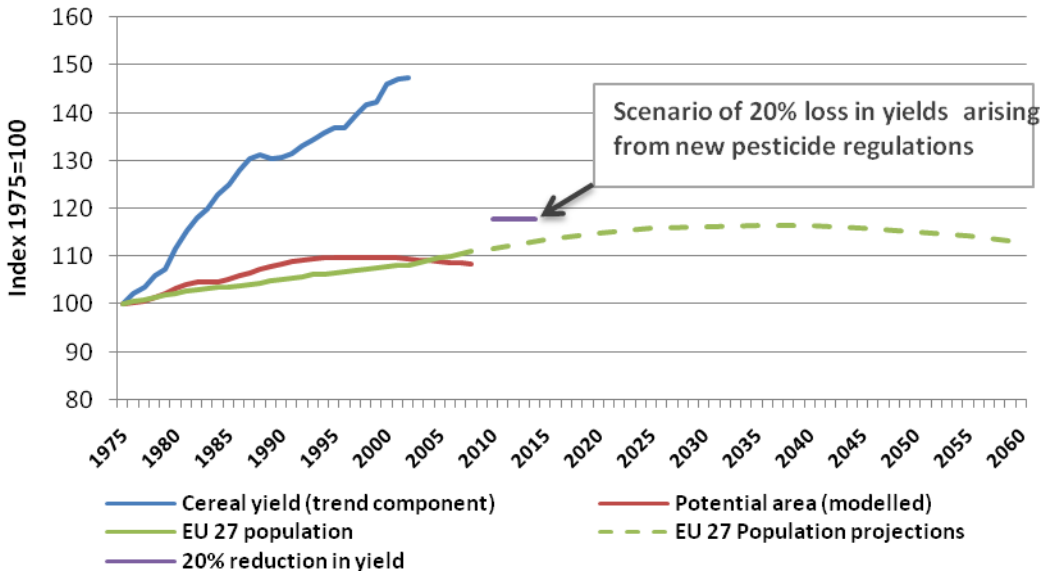
*Note: the trend component of cereal yields is a 9 year moving average of annual cereal yields; potential area is modelled from harvested areas of all crops (cereal, industrial and horticultural) and assumes losses and gains are gradual.*

**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 by the Pesticides Safety Directorate. [64] 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.




[64] *Assessment of the impact on crop protection in the UK of the 'cut-off criteria' and substitution provisions in the proposed Regulation of the European Parliament and of the Council concerning the placing of plant protection products in the mark*et (May 2008)

http://www.pesticides.gov.uk/uploadedfiles/Web_Assets/PSD/Impact_report_final_(May_2008).pdf

The actual impact will be determined by which active substances are eliminated from use in pesticides under the Regulation's new hazard criteria. Of particular importance will be the rules for endocrine disrupters, the hazard criterion which has the greatest potential to eliminate substances and thus to impact on crop protection. At present, these rules are indicative only and thus the impact assessment is necessarily provisional. The Commission has stated they expect to publish proposals for definitive rules around 2013. Once the rules are agreed a more accurate estimate of potential losses can be derived.

**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** |  |

**Box 8 EU approval of GM feed crops**

Concern has been voiced that the EU approval regime for GM products could disrupt food and, in particular, animal feed imports.[65] The UK livestock sector uses imported soya feed, and the main supplier countries of this commodity are now largely GM producers. There is concern that these countries could authorise the cultivation of new varieties of GM crop before they are cleared for import into the EU, because the EU decision-making regime for GM products is relatively slow in comparison. Combined with the EU's zero tolerance for unauthorised GM products, this threatens to create a situation where traders are reluctant to import any commodity into the EU (GM or non-GM) that might have a trace level of unapproved GM material. Defra has undertaken work to assess the situation and possible implications. A joint paper by Defra and FSA together with a number of background papers were published in August 2009 and sent to the European Commission.[66] The main findings are summarised here.

A key question is whether Argentina and, in particular, Brazil (the main suppliers to the UK), will adopt new types of GM soya crop before they are approved for EU import if the operation of the EU authorisation process for GM products remains problematic. There are different perspectives on this question, and no clear answer.

On the one hand, the EU remains a major and therefore valuable market for soya products from South America. Brazil and Argentina would not therefore lightly prejudice their ability to access the EU market, and some stakeholders and industry operators feel sure that these countries will not in fact adopt new GM soya lines unless and until EU import clearance is in place. Economic theory also suggests that changes in price differentials would militate against the use of non-EU approved GM soya lines by Brazil and Argentina. Adoption of non-EU approved varieties would be expected to create two distinct markets, for EU-approved and non-EU approved material respectively, with a price differential in favour of the EU-approved lines. This emerging price differential would reduce the incentive to cultivate non-EU approved crops, and act as a brake on their take-up.

In contrast, most industry opinion fully expects that Brazil and Argentina will in future adopt new types of GM soya before EU clearance is in place. With developing countries like China having a large and increasing demand for soya imports, the EU is no longer such a crucial market for suppliers, and therefore the EU market demand may no longer dictate what Brazil and Argentina choose to produce.

The impact on the UK livestock sector of a loss of soya imports from Brazil and Argentina would depend on the extent of the supply shortfall. Modelling presented in the August papers shows that the impact on feed prices could potentially be very substantial.

Concern in this area had been focused on the introduction of a new type of GM soya ('Roundup Ready 2'), which was grown for seed multiplication in the USA in 2008 and is expected to achieve full commercial adoption there in 2010. Towards the end of 2008 the EU approved the import of this soya, lessening the concern that there might be an

[65] See for example, Cabinet Office Strategy Unit , *Food Matters* ( July 2008) http://www.cabinetoffice.gov.uk/strategy/work_areas/food_policy.aspx, pp. 75-6.

[66] http://www.defra.gov.uk/environment/quality/gm/crops/index.htm

imminent problem with feed import supplies. Then in mid-2009 several US soya shipments to the EU were rejected because of trace findings of two types of non-EU approved GM maize. These GM maize lines were subsequently approved for EU import late in 2009, but this episode served to highlight again the risk to the vital soya import trade that could arise from the operation of the EU's GM regime

The Commission is funding a study to look in detail at the implications of "asynchronous" GM approvals for EU imports of maize and soya animal feed, and this work is expected to be completed in the second half of 2010. The Commission is also due to bring forward a 'technical solution' in 2010 which might allow for a more pragmatic interpretation of the EU's zero threshold for non-approved GM material.

Defra and the FSA will:

- continue to argue for a more streamlined EU decision-making process for GM products (without compromising on safety);
- argue for a proper consideration of the EU's policy in relation to the potential presence of low levels of non-EU approved GMOs in bulk-traded commodities, taking account of what is proportionate in safety terms and what might be pragmatic from a trade perspective;
- monitor the timetable for the potential adoption of new GM feed crops in the main supplier countries, relative to the timing of their possible approval for EU import, to gauge the risk that a supply problem might arise if no remedial action is taken.

Theme 3 UK availability and access

## Supporting indicator 3.4 UK production capability

### 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.[67]

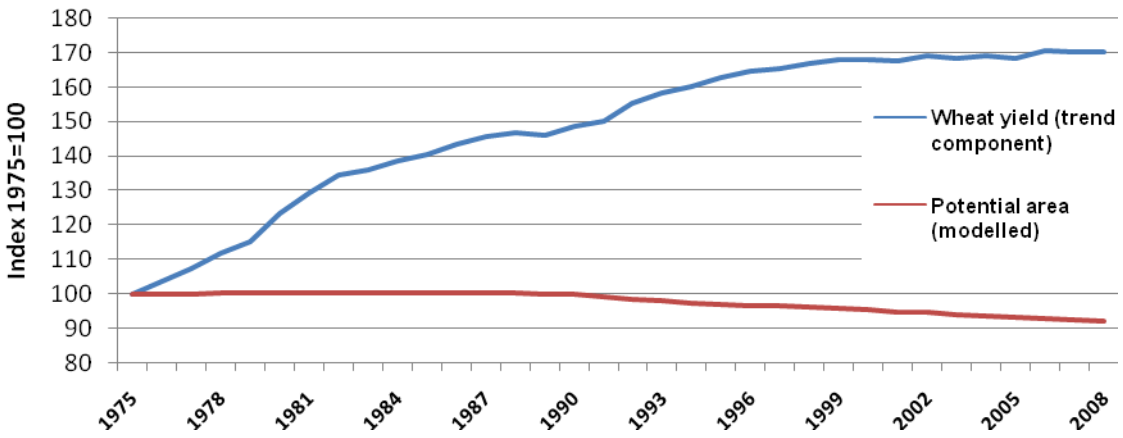
### Desired outcome

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.*

[67] 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 reflects 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. The fall in potential area since 1990 is a consequence of a decrease in grasses under five years old (considered here to be available for production were trade to be disrupted) and a subsequent increase in grasses over five years old. Grasses over 5 years old would only be considered for production under the extreme scenario of the UK needing to feed itself (see indicator 3.5.)
- **Agricultural land currently makes up around 78% of total land area** in the UK and the percentage has changed very little over the latter part of the 20th century through to the present. At present just over a third of this area could be put into production (potential area). Only a small proportion of agricultural land changes use in any given year. For example, in England over the last 20 years on average of 0.05% of agricultural land has changed use and on average 0.02% has changed to residential use.[68] These very slow moving and low level trends would suggest that **urban expansion is not a significant factor affecting capability**.
- **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 is 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** |  |

[68] Based on Department for Communities and Local Government Land Use Change statistics http://www.communities.gov.uk/planningandbuilding/planningbuilding/planningstatistics/livetables/landusechange/ and Defra Agricultural land use estimates, AUK table 3.1 https://statistics.defra.gov.uk/esg/publications/auk/2008/excel.asp

Theme 3 UK availability and access

## Supporting indicator 3.5 Potential of UK agriculture in extremis

**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**

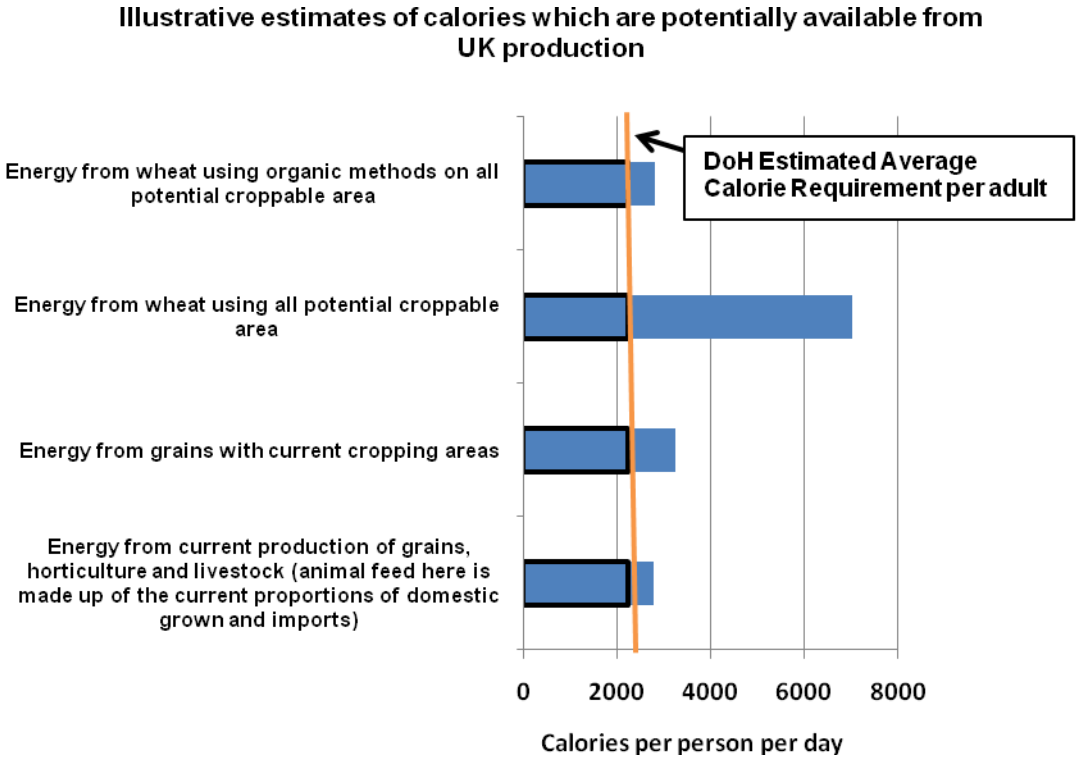
**Source** Various Defra statistics and analysis

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. [69]

| | |
|---|---|
| **Rating of current position** |  |
| **Comparison with mid-1990s** | **Similar** |
| **Likely position in 5-10 years** |  |

[69] http://www.ukwatch.net/article/can_britain_feed_itself

Theme 3 UK availability and access

## Supporting indicator 3.6 Diversity and flexibility of entry ports into the UK

**Rationale and associated risks**

Food security is enhanced by diversity of supply of both domestic and overseas production. Food, as well as feed and fertiliser inputs to domestic agriculture, from overseas is enabled by the UK's international gateways. The following analysis focuses on UK sea ports which are by far the most important gateways. 91% of food imports arrive by ship, while the Channel Tunnel and airports, particularly Heathrow, handle the remainder of the UK's food imports.

Food security may be compromised where risks are not spread between a sufficient number of ports, and where there is a lack of flexibility in switching between suitable ports, should the need arise. UK ports are also subject to a variety of risks that may be geographically correlated e.g. tidal surges. The impact of any disruption to ports would depend upon the length and scale of the disruption as well as the ability to find alternative points of entry.

**Desired outcome**

In the context of ports, food security is stronger where:

a) there is a range and diversity of entry points;

b) supplies can easily switch between ports in the event of port disruption;

c) ports are dispersed geographically.

All these would spread the risk of any disruption. Disruptions may temporarily restrict consumer choice, but would not result in panic buying or any other major consumer impact.

**Indicator** **Diversity and flexibility of UK food import traffic ports of entry**

**Source** DfT Maritime Statistics, HM Revenue and Customs, Defra analysis

UK food imports arrive at UK ports from both inside and outside the EU. Supply chains use a number of methods of shipping food cargo.[70] Department for Transport (DfT) *Maritime Statistics* no longer capture the movement of individual commodity types, and focus instead on broader cargo categories based upon the "modes of appearance" of cargo. While data on type and quantity of food imports into the UK is collected, by HM Revenue and Custom's Intrastat system, UK port of entry data for EU food imports is not collected. Therefore, estimates must be made of the ports of entry of "roll-on-roll-off" (RO-RO) and containerised food imports arriving from the EU. Relevant available data includes:

- The movement of bulk agricultural product traffic from the EU, all of which is food and feed, is accurately captured in DfT Maritime Statistics.

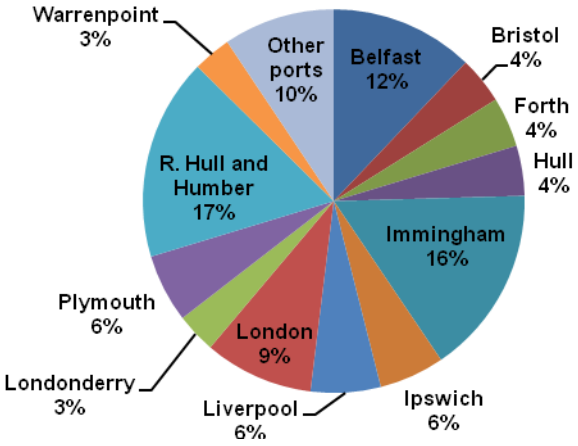
[70] These methods are referred to as the modes of appearance of cargo, and food imports are predominantly shipped to the UK as RO-RO, container and bulk traffic. RO-RO refers to roll on-roll off freight, which is freight carried in trailers onboard sea-going vessels fitted with ramps, which can be discharged without the use of cranes. RO-RO traffic can be disaggregated further into accompanied RO-RO (freight carried on trailers attached to a road goods vehicle) and unaccompanied RO-RO (freight carried on unattached trailers). Container traffic is cargo carried in 20-foot and 40-foot containers. Bulk traffic refers to the movement of agricultural commodities, such as sugar and grain.

- Data, collected by HM Revenue and Customs, on the port of entry of all non-EU food imports.

These data limitations mean that a comprehensive indicator of the number and diversity of ports handling UK food import traffic is not feasible. Instead, we consider three aspects:

1. Ports of entry for EU food imports arriving in the UK as **bulk** traffic
2. Ports of entry for EU food imports arriving in the UK as **container** and **RO-RO** traffic
3. Ports of entry for **non-EU food imports** into the UK

### 1. Ports of entry for EU food imports arriving in the UK as bulk traffic

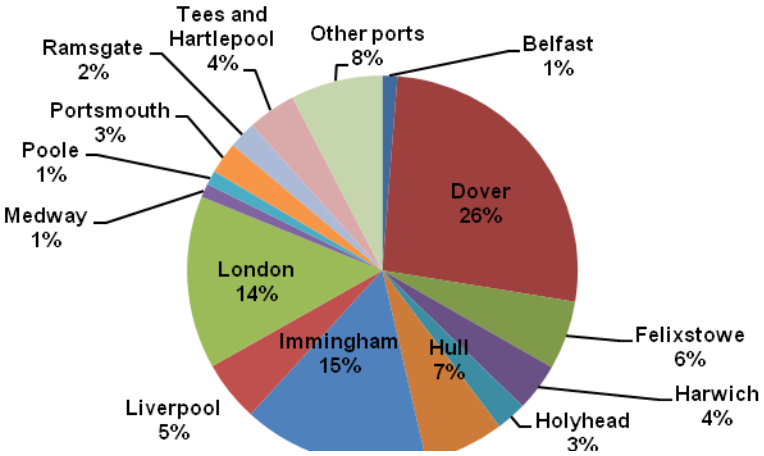



*Source* *DfT Maritime Statistics 2008*

**Key points**

- In 2008, 28 UK ports in total handled 3.3 million tonnes of bulk agricultural product traffic from the EU.
- Inland ports on the Hull and Humber (570,000 tonnes), Immingham (533,000t) and Belfast (405,000t) handled the largest volumes of bulk food import traffic from the EU in 2008.
- 16 smaller ports handled 10% of total traffic.

**2. Ports of entry for EU food imports arriving in the UK as container and ro-ro traffic**

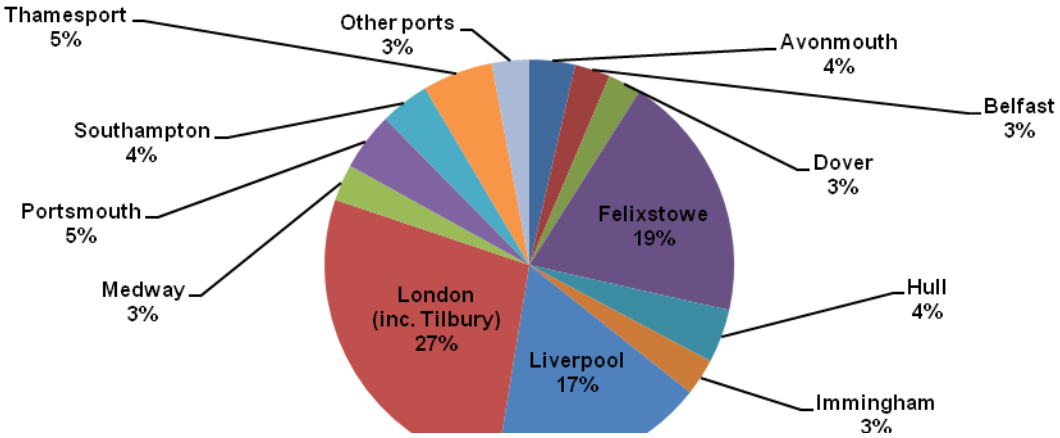



*Source* *Defra analysis of DfT Maritime Statistics 2008*

**Key Points**

- As port level data micro data on unitised (RO-RO and containerised) food imports from the EU is unavailable, we estimate container and RO-RO food import traffic volumes at individual ports, by applying constant factors (based upon published DfT assumptions) for unitised food traffic as a proportion of all container and RO-RO traffic.
- In 2008, an estimated total of 15.6 million tonnes of food import traffic arrived at UK ports as unitised traffic. 15 smaller ports accounted for 8% of this tonnage.
- Dover, specialising in accompanied RO-RO traffic, is an important unitised traffic port in the UK, handling 26% (4.1 million tonnes) of UK unitised food imports in 2008. Immingham (2.4 million tonnes) and London (2.2 million tonnes) are also key ports of entry for unitised traffic.

**3. Ports of entry for non-EU food imports into the UK**



*Source: HM Revenue and Customs CHIEF trade data (2008)*

**Key Points**

- In 2008, a total of 40 UK ports received 10.8 million tonnes of food sourced from outside of the EU in 2008. 28 smaller ports accounted for only 3% of the total.
- The ports of London (3 million tonnes), Felixstowe (2.1 million tonnes) and Liverpool (1.8 million tonnes) are the most important ports of entry for non-EU imports of food and drink into the UK.

**Assessment**

In aggregate, both EU and non-EU Food imports, across all modes of appearance, are well spread across a number of ports of entry, with no port having a dominant share. Only simultaneous disruption to several ports would be serious enough to have a material effect on UK food supplies. There are clusters of ports used for handling food import traffic, for instance in the South East and North East regions, and their geographical proximity suggests they could share some risks of disruption from extreme events (such as coastal flooding).

**However, the resilience of port infrastructure is not solely a matter of numerical diversity.** Alternative ports must be suitably equipped to receive food imports. In the event of disruption at one UK port, the ease with which food import traffic can be switched to alternative UK ports is dependent upon spare capacity at, and the configuration of, those alternative ports. A port's **capacity** and **configuration** govern both the types and size of sea-going vessels that can be received, and therefore the types and quantity of food cargo that can be discharged there (see table). The implications of port specialisation for specific commodities are discussed further in indicator 3.7 below.

| Mode of appearance | Factors affecting types and quantity of food cargo received at ports |
|---|---|
| **RO-RO traffic** | • Number and physical dimensions (e.g. quay length) of available berthing slots<br>• Availability of fixed electrical connectors and temperature-controlled storage<br>• For unaccompanied RO-RO: availability of specialist handling labour and equipment; storage space |
| **Container traffic** | • As RO-RO above<br>• Number and size of cranes |
| **Bulk traffic** | • Specialist storage and handling capacity, including tank storage capacity for liquid food bulks (such as orange juice)<br>• For commodities in food manufacture, the distance of alternative ports to processing plants is important for minimising road transport costs and time delays |

Currently, there is very little evidence on port capacity and configuration, at both the individual port and UK level, to allow for an accurate assessment of the ease with which food import traffic can be switched between ports in the event of disruption. What is clear is that i**n the event of one or more UK ports being inoperable, alternative options and modes are open to food supply chains.** For instance:

- if spare container tonnage capacity is unavailable at alternative ports, food traffic could be switched to RO-RO, or;

- if spare capacity is unavailable to receive a large Panamax-class grain carrier at alternative UK ports, the vessel could be discharged at a port in North West Europe, such as Rotterdam, and the cargo transhipped to available berthing slots in the UK using smaller feeder vessels.

These options would minimise the delay and disruption to food supplies, albeit with probably additional costs for the chain (see Box 9).[71] We know that various disruptions at ports in the past have not had a material impact on supplies to consumers, but it is important that the possibility of such disruptions is factored into business continuity planning (indicator 4.3). An additional factor in port adaptability (for all modes) is the need for sufficient capacity on inland and hinterland access roads, as food moves to retail or processing (see indicator 4.8)

**Port development**, such as that recently consented at London Gateway, is expected to increase the number of UK ports configured to receive larger post-Panamax class vessels, and so increase the number of substitute container and bulk terminals, in particular, available in the event of port disruption. On the other hand, as ships increase in size to realise economies of scale, the number of port calls made by those ships on a given journey may decrease. In response, and over time, the strategic importance of **regional port hubs**, such as A-R-A (Amsterdam-Rotterdam-Antwerp), may increase, with those hubs being used to trans-ship goods to smaller ports not serviced by post-Panamax class vessels. The resilience of regional port hubs outside the UK may therefore become a more significant consideration in the future.

**Box 9 Alternative entry options to the Port of Dover**

The Port of Dover accounted for 60% of the UK's 23 million tonnes of total UK accompanied RO-RO import traffic in 2008. While food's proportion of Dover's total import traffic is unknown (the data is not collected), its position offering the shortest and highest frequency crossing of the English Channel, makes it likely to be a key entry point for EU food imports. Were the Port of Dover ever to become inoperable, there are other potential entry points in, and methods of shipping to, the UK, such as:

- **Alternative accompanied RO-RO ports**. There are other ports in the vicinity of Port of Dover, such as Ramsgate, that handle accompanied RO-RO throughput. However, their berthing configurations mean that two-tier ferries – designed to optimise the speed of cargo and passenger discharge - which service the RO-RO trade at Dover could not be received at these ports. Additionally, the relative lack of berthing capacity at these ports suggests that they would be unable to handle all displaced traffic.
- **Alternative unaccompanied RO-RO ports.** It is possible for supply chains to switch UK food imports from Dover to ports further up the East coast, such as Felixstowe and Immingham, which normally handle unaccompanied RO-RO traffic. This would involve longer sea crossing times, and so potentially higher transport costs and longer journey times.
- **Containerised movements.** Similarly, there is scope for Port of Dover's accompanied RO-RO food import traffic to switch mode of appearance to containers. However, there are constraints to the use of container terminals to handle displaced

[71] Further costs may be imposed by disruptions to ports at the height of the business cycle, when supply and demand for shipping services is in tight balance. As the supply of shipping services is inelastic in the short run (new vessels take 2 to 4 years to build), increased demand for shipping services will result in rises in freight rates (the price of shipping services) and possible delays in chartering appropriate vessels.

RO-RO traffic: available berthing slots of appropriate dimensions, spare handling and storage capacity, as well as sufficient road access.

- **Channel Tunnel movements.** The Channel Tunnel offers a close substitute for the services offered at Dover. Displacement of Dover's RO-RO traffic could be partially absorbed by the Channel Tunnel by increasing both the frequency and load factors (utilisation of total carrying capacity per shuttle) of the freight shuttle services transiting the tunnel. While Eurotunnel's total capacity and current utilisation rate are unknown, load factors on Euro Tunnel freight services have averaged 74% since operations began.[72]

Each alternative on its own is unlikely to absorb all displaced traffic in the event of Port of Dover being inoperable, but their combination offers substantial scope for the supply chain to continue to meet consumer demands, albeit at temporarily higher cost.

In view of the uncertainties regarding the extent of port compatibility, and the evidence gaps identified, we assign an amber rating for the current position and medium terms.

| | |
|---|---|
| **Rating of current position** |  |
| **Comparison with mid-1990s** | **Similar** |
| **Likely position in 5-10 years** |  |

**Potential development**

Improve the evidence base and assessment of flexibility and resilience of ports, including those in mainland Europe. A related and relevant area of inquiry are the risks and resilience associated with shipping services to the UK.

[72] Euro Tunnel Annual Review (2008).

Theme 3 UK availability and access

## Supporting indicator 3.7 Port concentration for non-indigenous foods from outside the EU

### Rationale and associated risks

As suggested by 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 keys ports becomes inoperable. Ensuring secure import routes is more important for some 'vulnerable' foodstuffs. For this analysis, potentially insecure 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. Supply must be sourced from outside of the EU, ordinarily in large parcel sizes, and so arrive at UK ports in large bulk carrier vessels. In contrast, much UK food import traffic arrives from the EU as RO-RO traffic, and so has a higher degree of flexibility with regards to switching ports (Box 9). For all 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. Selected foodstuffs are non-indigenous. Where the UK is totally reliant on imports for supply, the security of import routes becomes more important.

### Desired outcome

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

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

**Source** Defra analysis of HM Revenue and Customs CHIEF trade data

Eight commodities meet all three criteria above. UK import trade (for 2007) in, and the ports of entry of, these commodities is presented below:

| 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 sugar and chemically pure sucrose, in solid form [73] | 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% |

[73] 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 the freedom of movement of goods within the EU, we are not able to identify point of entry for EU imports. It is likely that some will pass through the leading ports listed above.

**Assessment**

Considering the wide array of foodstuffs consumed in the UK, there are few commodities which meet the vulnerability criteria. However, the import of those identified above is concentrated at 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 come into play:

- Traffic is switched to another port or mode of appearance (see indicator 3.6). There would be strong pressure from retailers to ensure key items, such as bananas, reached market. However, the scope to switch may be limited because of the absence of specialist handling 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 meet demand. For instance, 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. Alternatively, consumers switch consumption to close 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

**Text boxes in this theme**

- Are global energy reserves becoming scarcer?
- How food security differs from energy security.

## 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 sources (see indicator 4.2). Actual *shortages* of energy or power would probably have a greater impact on food supplies than rising *prices* (though of course 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. Additionally, 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%.

However, a rise in energy prices can actually increase long-term resilience if it promotes incentives to invest in energy efficiency, as has happened since the 1973 energy crisis. Similarly, government measures to promote a diverse range of energy sources, for example by increasing the contribution of renewable 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 proven global reserves of crude oil and natural gas are rising (Box 10), 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 and GHG emissions are monitored as part of Defra's **indicators for a sustainable food system**.

### 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.

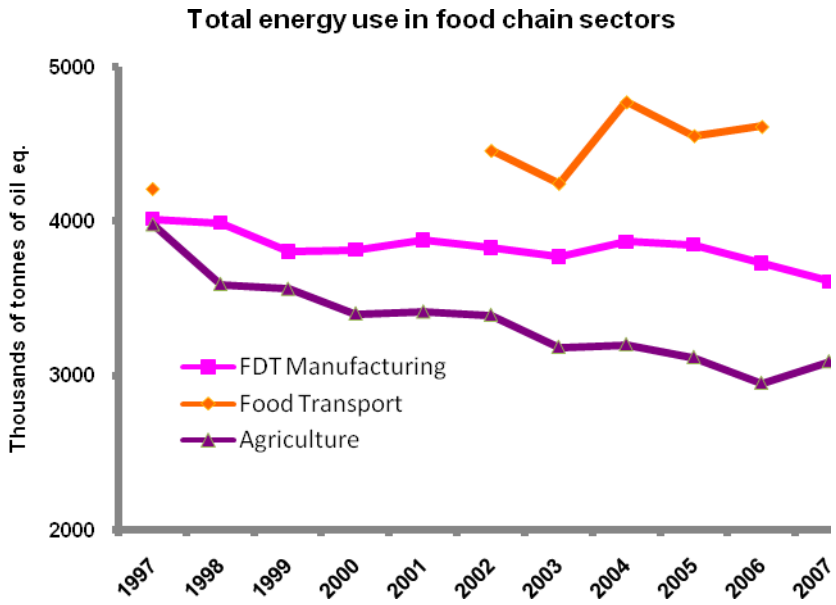
### Indicator

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 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 food transport, agriculture and food manufacturing per unit of real output** (third chart) [74]

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



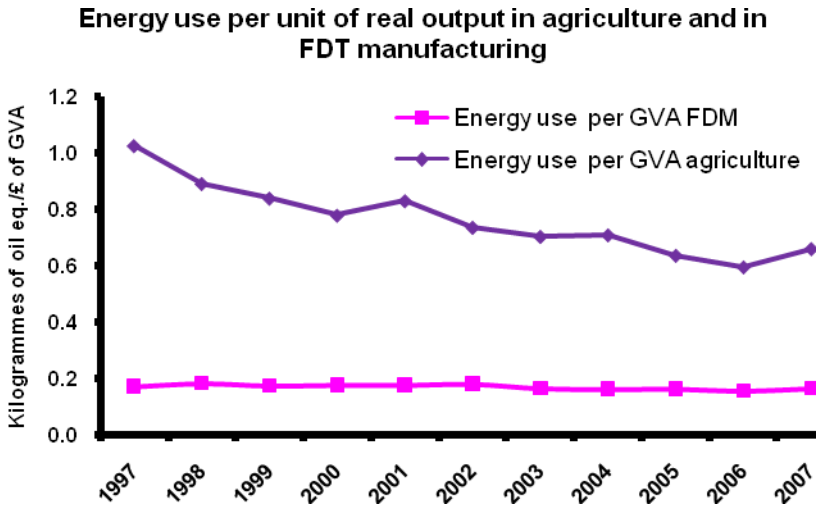

*Note: 'FDT 'is food, drink and tobacco*

**Key points**

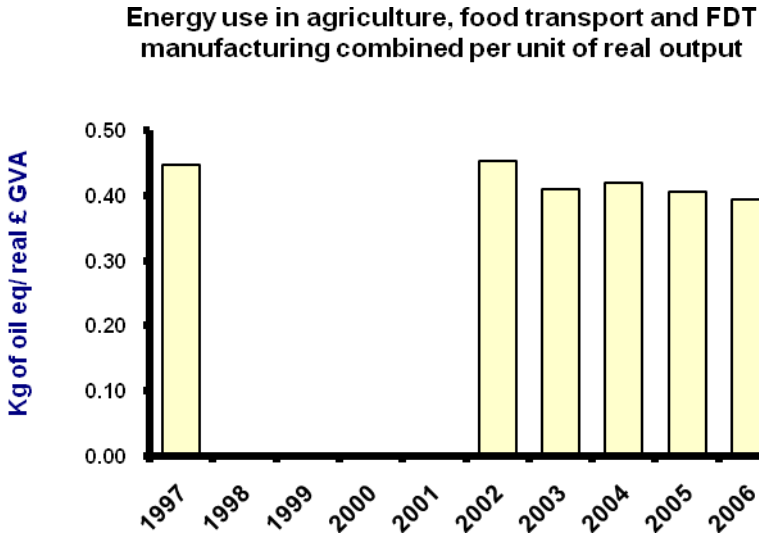
- In absolute terms energy use in the food manufacturing sector fell by 10% from 1997 to 2007; the agricultural sector saw a fall of around 22% over the same period. The energy (fuel) used in food transport has been less stable but seems to be on a rising trend since 2002.
- Around two-thirds of energy 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.[75]

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

[75] *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 in agriculture by 35%, between 1997 and 2007, but is unchanged in food manufacturing.
- However, over a longer period, the energy intensity of food and drink manufacturing has been falling. 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 30% lower than in 1997.

**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** | **Improved** |
| **Likely position in 5-10 years** |  |

**Box 10 Are global energy reserves becoming scarcer?**

**Global proven reserves** of crude oil and natural gas are rising.[76] "Proven 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".* [77]

The International Energy Agency's *World Energy Outlook* (November 2009) also highlights the importance of new gas and oil field exploration in meeting future rising demand from non-OECD countries and declining output from existing fields. But the real constraint on fossil fuel production appears to be environmental rather than geological. The Outlook's factsheet states, **"***The world's energy resources are adequate to meet the projected demand increase through to 2030 and well beyond. But these Reference Scenario trends have profound implications for environmental protection, energy security and economic development. The continuation of current trends would have dire consequences for climate change. They would also exacerbate ambient air quality concerns, thus causing serious public health and environmental effects, particularly in developing countries."* In the Outlook's "450" (carbon abatement) Scenario, world oil demand would be 16 mb/ day lower than in the Reference Scenario. [78]

[76] 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.

[77] World Bank, *Global Economic Prospects 2009*, p.74

[78] http://www.worldenergyoutlook.org/ See London press presentation by IEA Executive Director Nobuo Tanaka on 10 November 2010 http://www.iea.org/speech/2009/Tanaka/WEO2009_Press_Conference.pdf

Theme 4 Food chain resilience

## Supporting indicator 4.1 Energy capacity reliability

### Rationale and associated risks

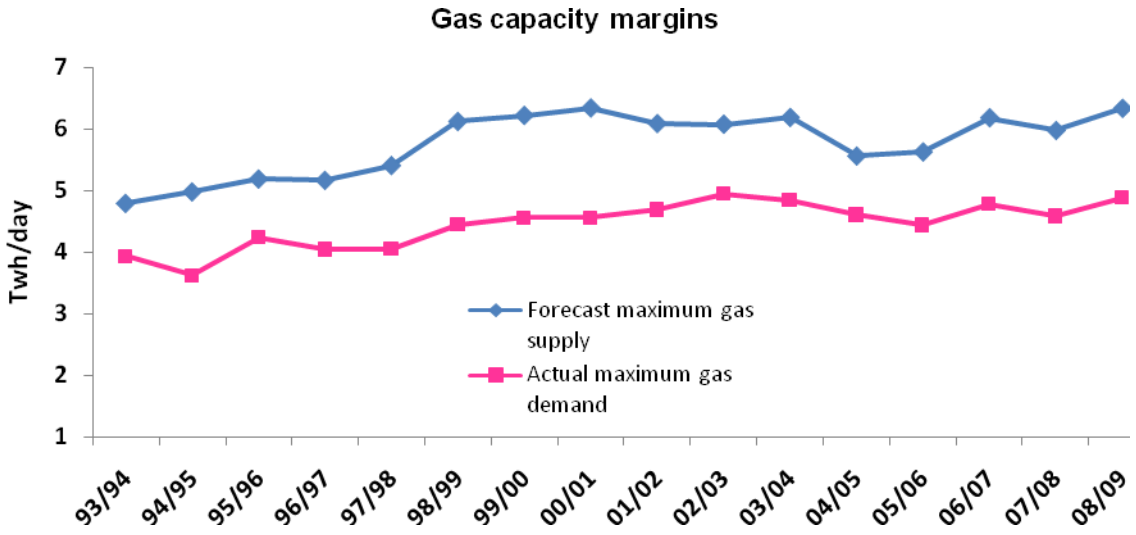
The headline indicator directly addresses the energy dependency of the food chain. Underlying this, however, is the broader question of energy security of supply. This is a highly complex subject and DECC have developed a wide range of energy reliability indicators. It would be misleading to capture energy security of supply in a single indicator. But deterioration in indicators of energy security of supply would clearly represent a warning for the food chain. DECC's analysis suggests that one of the most important influences 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 capacity 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. [79]

### Desired outcome

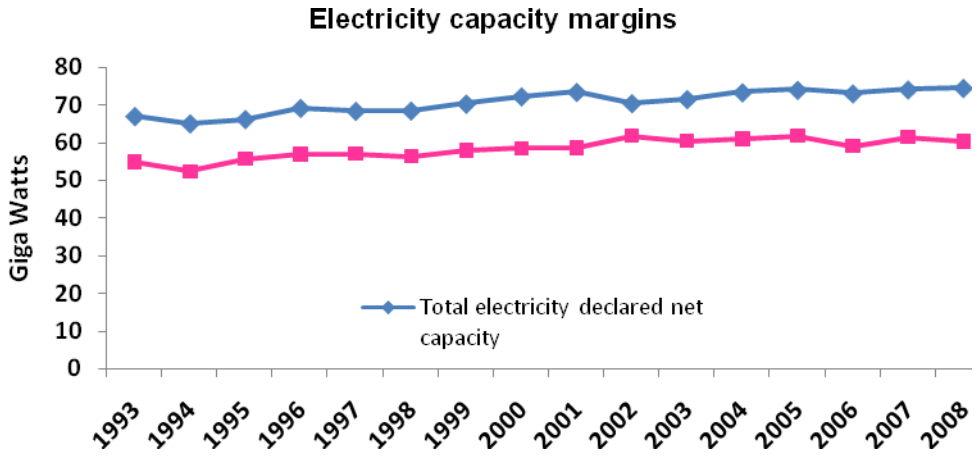
The food industry is able to access adequate power and energy even at times of high demand (i.e. cold winters) and potential supply shortages. Were this not to happen, domestic food manufacturing in certain energy dependent sectors could be held up, and shortages at retail level would appear (which could 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 2008*




[79] In its August 2009 paper, *Delivering secure low carbon electricity: a call for evidence* DECC notes the trade-off between efficiency and risk: "Maintaining a large amount of spare capacity that is never used is expensive while maintaining too little means there is a higher risk of price spikes or of electricity supplies being interrupted.", p. 4. http://www.decc.gov.uk/en/content/cms/consultations/electricsecure/electricsecure.aspx




**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." In its latest Energy Markets Outlook (December 2009), DECC notes the improvements in new import capacity and, with the measures under the Low Carbon Transition plan, a declining trend in gas demand to 2020.[80]

**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. In the near term the ability of the network to meet demand does not seem to be challenged. Additionally, DECC's current view is that expected closure of generating capacity before 2020 will be replaced by new power stations currently under construction. Given this, DECC forecasts suggest that electricity capacity margins will not fall below 8% before 2020. The level of expected unmet electricity demand associated with this forecast is, in DECC's view, low.[81]

The outlook for gas and electricity capacity is favourable, and we therefore provide a favourable rating for both the current and future positions.

| | |
|---|---|
| **Rating of current position** |  |
| **Comparison with mid-1990s** | **Similar** |
| **Likely position in 5-10 years** |  |

[80] DECC, *Energy Markets Outlook* (October 2007), p.42 http://www.berr.gov.uk/files/file41995.pdf ; Energy Markets Outlook (December 2009), pp. 13-14. www.decc.gov.uk/en/content/cms/what_we_do/uk_supply/markets/outlook/outlook.aspx. The Outlook considers all the issues in more detail. On the issue of peak gas demands, the 2009 outlook states , "The ability to meet peak demand, whether on a particular day or over a more prolonged period such as a severe winter, as well as average demand levels for gas is particularly important in a security of supply context. Each of the sources of supply – UK production, imports from Europe or LNG, and storage – will deliver a greater or lesser proportion of demand at any time depending on several factors which vary daily or seasonally and with varying levels of predictability or manageability, such as price, production conditions and contractual arrangements." p. 73.

[81] DECC, *Delivering secure low carbon electricity,* e.g. see p.6 and para. 3.8.

**Theme 4** Food chain resilience

**Supporting indicator 4.2** **Diversity of oil and gas imports**

### Rationale and associated risks

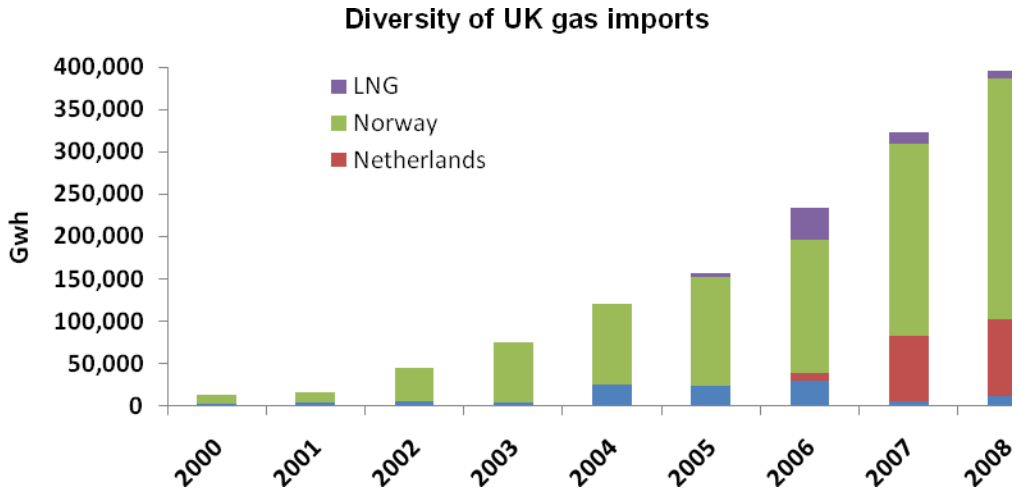
Given the reliance of the food industry upon gas and fuel, and the UK's increasing dependence upon imports of these, we also propose to include another of DECC's supporting security of supply indicators – the diversity of oil and gas imports. UK production of gas and crude oil from the North Sea is in general decline.[82] 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 11).

### Desired outcome

UK imports of oil and gas become more diverse as markets develop, so that the UK does not become dependent upon 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 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**



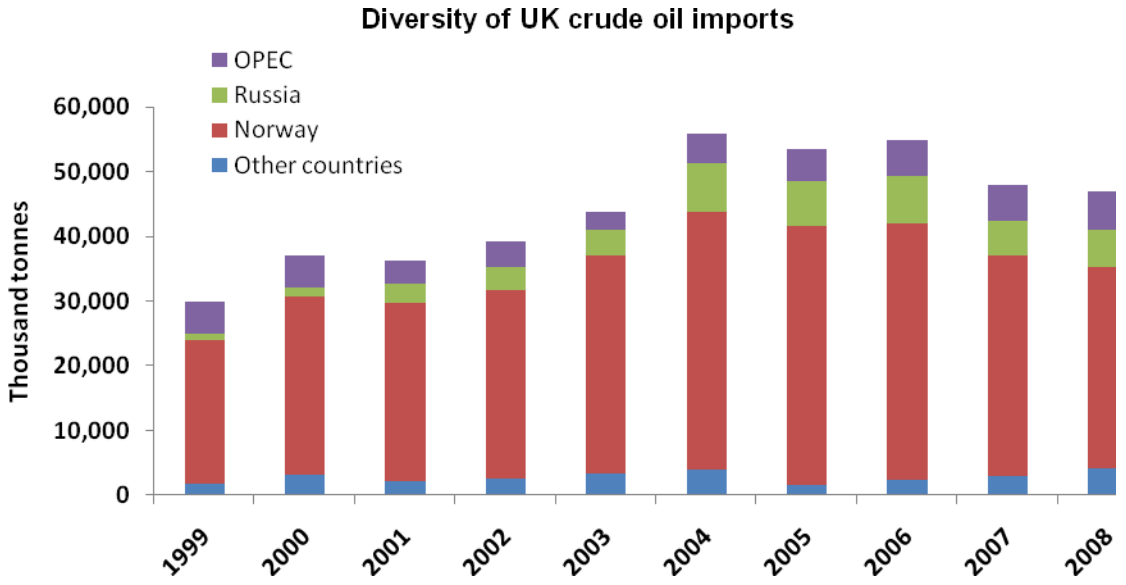

### Key points – gas imports

- Despite imports being constrained by existing pipeline infrastructure, the diversity of UK gas imports in the last decade has increased.
- In the 1990s, Norway was virtually the only source of imported gas. Now the UK also receives gas from the continent through two key pipelines, via Belgium and the Netherlands. This gas may be originally sourced

[82] 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).

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).[83]

- 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". In its December 2009 *Energy Markets Outlook*, DECC states: "While there are risks of interruption along any supply route, the UK's large and growing import capacity allows a significant amount of gas to be imported from a diversity of sources." [84]




**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.[85]
- 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.

[83] *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*.

[84] BERR, *Energy Markets Outlook* (October 2007), p.52; BERR, *LNG imports in your area* (August 2007), p. 3; www.decc.gov.uk/en/content/cms/what_we_do/uk_supply/markets/outlook/outlook.aspx

[85] 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"[86].

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** |  |

[86] *Energy Markets Outlook*, Chapter 7- Oil, p. 88 (Oct 2007)

**Box 11 How food security differs from energy security**

The issues of energy security and food security are related but distinct. At the global level, oil production for export is concentrated and oil producing countries have the ability to operate in collusion (OPEC), and several are politically influenced by governments. By contrast, food production is less concentrated and more heterogeneous: and to some extent trade patterns are the reverse of oil, with many oil and gas exporting countries also being food importers (e.g. in the Middle East)

Moreover, 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 food and energy prices may affect different groups differently. The latter, whilst affecting all groups, can have particular impacts on vulnerable groups such as 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).[87] Rising food costs are more 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.

[87] See http://www.decc.gov.uk/en/content/cms/statistics/fuelpov_stats/fuelpov_stats.aspx

Theme 4 Food chain resilience

## Supporting indicator 4.3 Business continuity planning

### 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 2005-6explored the current scope and state of existing business continuity management (BCM) in key sectors of the food and drink industry.[88] 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

[88] 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

supporting infrastructure. Companies were reluctant to invest in costly preventative measures or redundant capacity “just in case”.

- 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 was 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** | **Improved** |
| **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 risks [89]

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 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.

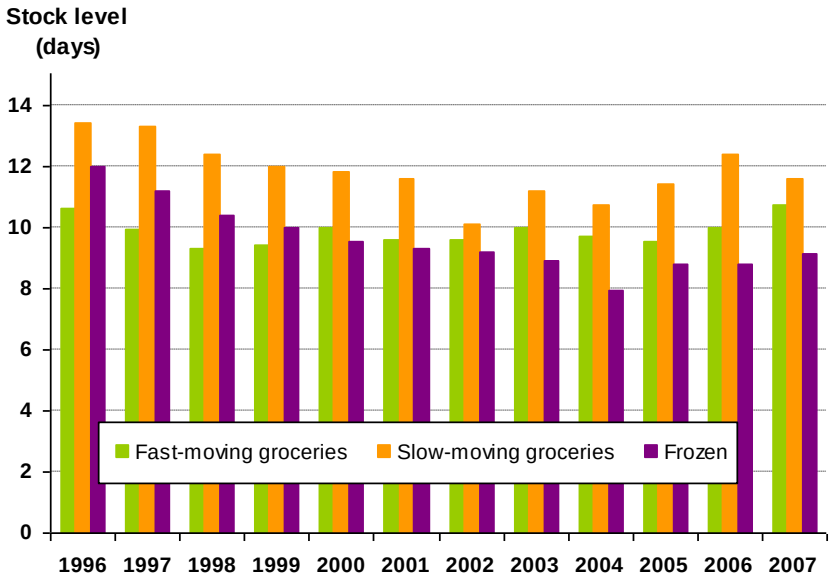
### Key points

- 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%.

[89] 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** | **Deteriorated** |
| **Likely position in 5-10 years** |  |

Theme 4 Food chain resilience

## Supporting indicator 4.5 UK cereal stocks

### Rationale and associated risks

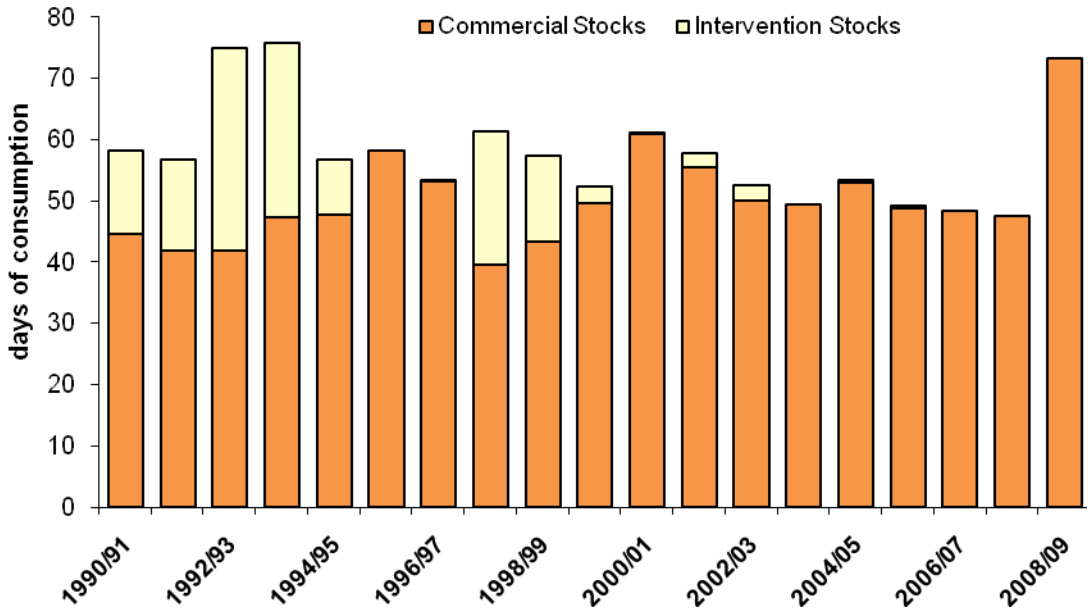
End of crop year stocks are viewed by the industry as the "buffer" stocks that are available to accommodate increases in demand or reductions in supply in the following year. Domestic end of crop year stocks can be used to assess the level of resilience of the UK food chain to disruptions in cereal supplies (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




*Note - 2008/9 is an updated estimate*

### Key points

- 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.

- Stocks included in these figures are stocks held at ports, co-ops, merchants, processors, on farm and intervention stores.
- At the end of the 2008/09 marketing year, stocks were estimated at some 4.2 mt of cereals, representing over 70 days of consumption for that year. The last increase in stocks in 2008/09 is due to the record wheat harvest in 2008 and slow exports due to a very competitive export market.
- 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 have increased following the 2008 harvest.

| | |
|---|---|
| **Rating of current position** |  |
| **Comparison with mid-1990s** | **Similar** |
| **Likely position in 5-10 years** |  |

Theme 4 Food chain resilience

## 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.

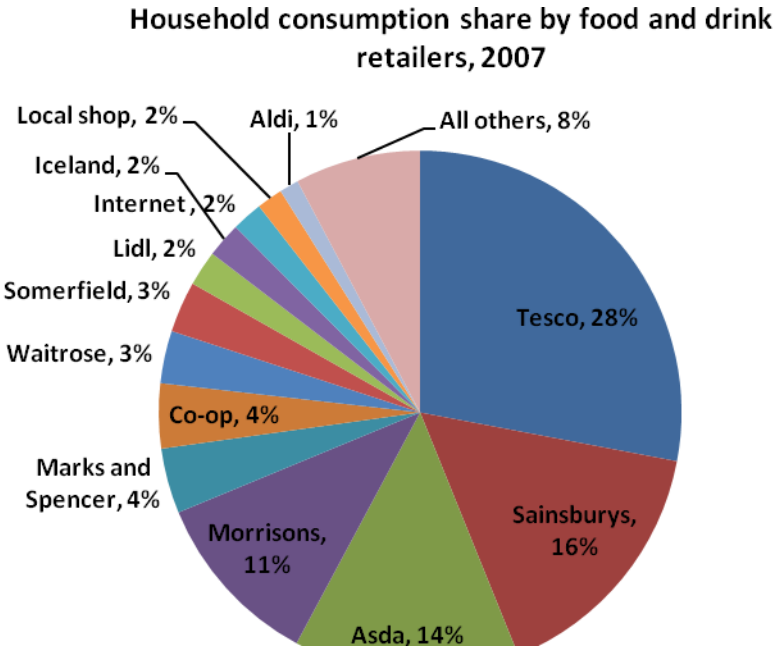
### Desired outcome

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 Expenditure and Food Survey (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 indicators on business continuity planning (indicator 4.3) and viability of large manufacturers (indicator 4.7) in this theme.

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

Theme 4 Food chain resilience

## 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

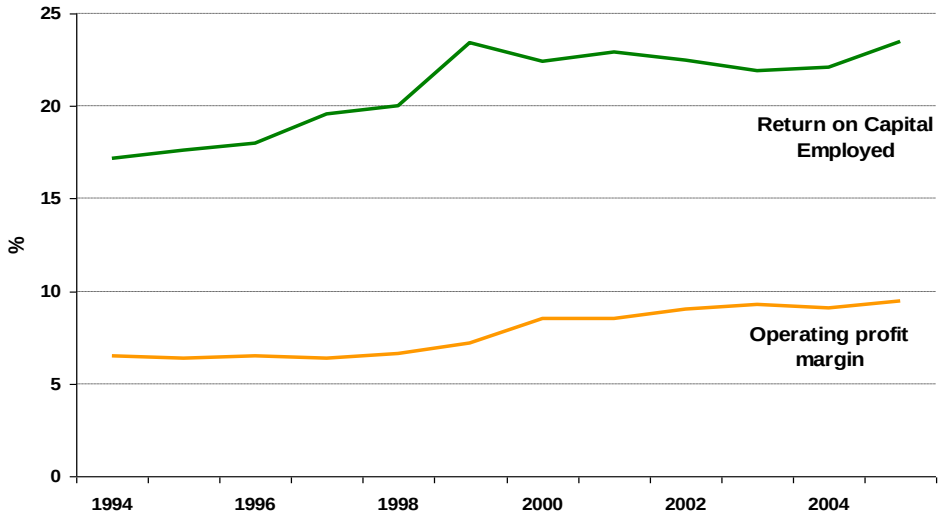
A diversity of large and resilient food and drink suppliers maintain sufficient profitability to maintain and enhance operations and so are able to provide safe and nutritious products to consumers and are resourced to absorb shocks to the system. If individual companies become weak, others have the 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.[90] 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** **Improved**

[90] 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).

**Likely position in 5-10 years**

**Potential development**

Consider aggregate measures of levels of indebtedness in the food industry as an indicator of exposure to major shortages of capital in financial markets. The experience of the credit squeeze in 2008-9 suggested that some significant manufacturing firms were heavily exposed to tighter credit conditions, but that in broad terms the industry was able to withstand and adjust to the shock without notable impact upon consumers.

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.

### 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.**

minutes per 10 vehicle miles / *per cent*

| | Weekdays | | | | Weekends | Week |
|---|---|---|---|---|---|---|
| **Period** | **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* |

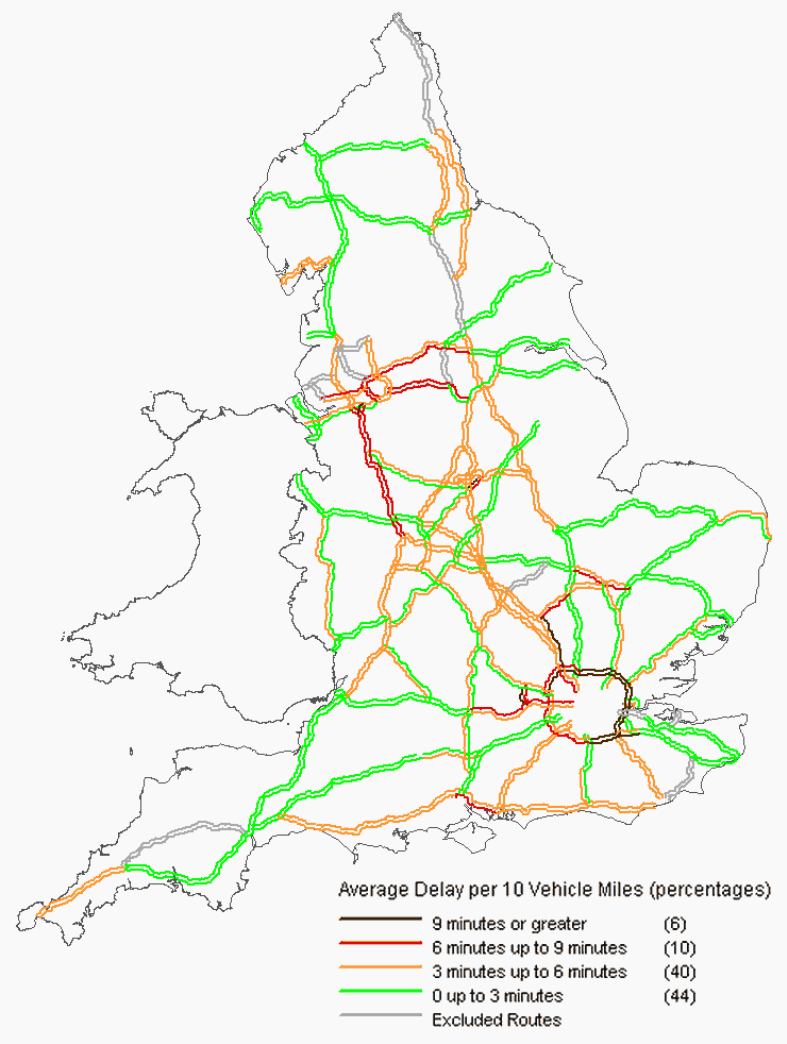
[1] The baseline period is later for 7 of the 91 routes due to data quality considerations.

*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 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.[91]

**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. But these 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 day[92], 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. Its Network Resilience Team actively leads on activities to increase the resilience of the strategic road network to major disruption, and in doing so has[93]:

- Identified the vulnerability of a set of high priority strategic road network assets;
- Developed a methodology for assessing and prioritising major risk events with potential for severe disruption to the strategic road network.
- Developed detailed mitigation and contingency plans for each of the major risk events identified.

[91] Department for Transport, *Transport Statistics 2008*, tables 7.6, 7.13, 7.16

[92] A. McKinnon, *Life Without Lorries* (2004), p. 9.

[93] Highways Agency Sector Resilience Plan report to Natural Hazards Team, Cabinet Office (2009).

- Manages an ongoing programme of crisis management training and exercises to improve the Highways Agency's response to the identified major risk events.
- Developed a set of regional crisis plans that form a National Crisis Management Plan, which sets out key roles and responsibilities in the event of major risk events.

Additionally, the Highways Agency also works with DfT TRANSEC, to ensure its contingency plans fit with Government's wider contingency and resilience planning framework. It has also worked with Defra on the coastal flooding project, and has an Memorandum of Understanding with the EA (Environment Agency) for the exchange of 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.

**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.[94]

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 public 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** |  |

[94] See Department for Transport, *Road Transport 2008 Forecasts – tables,* table 1.

## Theme 5 Household food security

### *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 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

### Text boxes in this theme

- Consumers' response to rising food prices

- Defining a healthy diet
- Tracking the affordability of a healthy diet

**Other indicators under consideration, which may require further research**

- Self-reported food insecurity, from the Low Income Diet and Nutrition Survey
- Income trends for low income households

## 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 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.[95] 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**

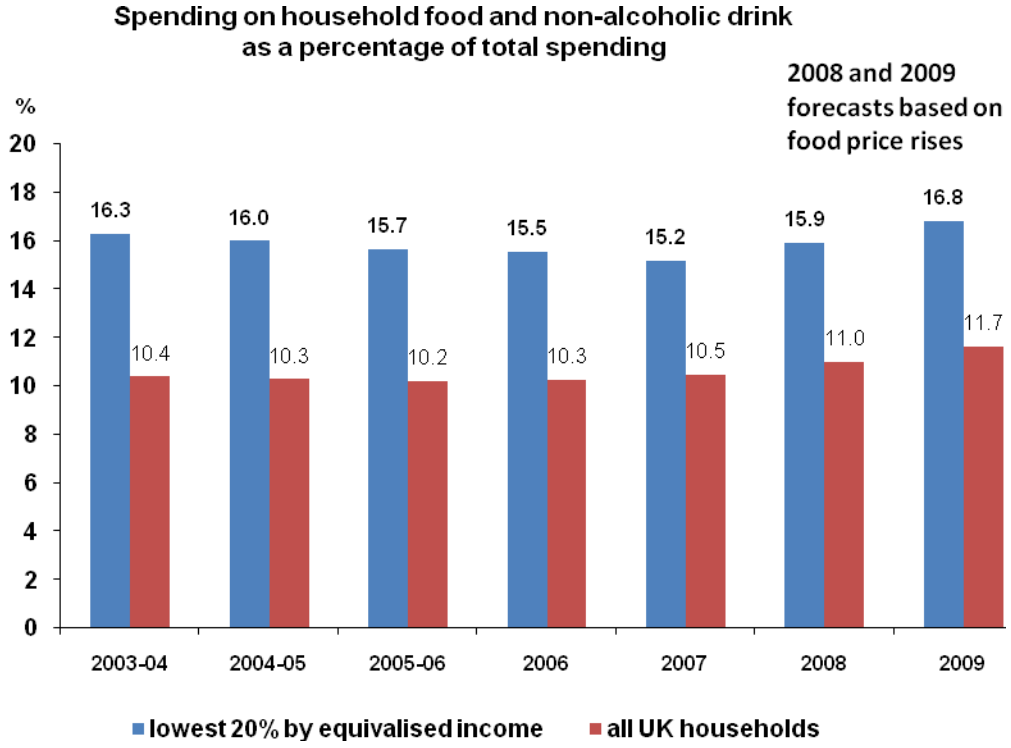
Assuming no change in the British culture towards food a fall in this indicator means food is more affordable and vice versa. As this happens people have an increasing ability to buy better quality produce and to take the healthier options which may be more expensive.

**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-

[95] Defra / ONS Family Food Survey & Retail Price Index data

20%[96] of calorific consumption and (c) eating out may be considered by some to be a luxury and not representative of affordability of food.




*Source: Defra / ONS Family Food Survey / ONS Family Spending reports. 2008-9 are projections based on food price rises.*

**Key points**

- The percentage of household expenditure going on food by low income households in 2009 (defined as the lowest 20 per cent by equivalised income) is estimated to be higher in 2009 than in the previous six years. This is entirely due to the food price rises since August 2007. Food prices rose by 16 per cent between August 2007 and October 2009 while non-food items rose by only 2.8 per cent. This indicates that the pressure food is exerting on the household budget has increased substantially in the last two years although food price inflation has reduced to more normal levels after its peak in August 2008.
- In absolute terms, food prices reached a peak in February 2009, then falling by 1.1% by October 2009.
- The percentage spend on food by 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, or possibly due to purchasing better quality food products. In 2008 and 2009 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 (See Box 12)

[96] 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.

- 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 projected rises in 2008 and 2009 to 16.8%.
- Food price rises hit lower income households hardest, because food accounts for a greater percentage of their spend, but 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.[97]
- Low income households spend a lower proportion of their food bill on meat and 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.

**Assessment**

Up to 2006, the share of spending on food in the UK declined. However, in response to the food inflation of 2007-2009 it is estimated to have risen sharply. If we assume there is no short term change to the British attitude to food we can infer that food has become less affordable, and has brought a material deterioration to lower income households – hence the amber rating for the current position.

In time, we would expect a resumption of economic growth, together with declining or stable real food prices, to result in the share of spending on food declining once more. In short term relatively high real food prices (see indicator 5.2), and uncertain prospects for growth in the economy and disposable incomes are unlikely to see the share of spend fall quickly, but over the decade we would expect incomes growth to bear down once more on food's share of spend on low income households.

| | |
|---|---|
| **Rating of current position** |  |
| **Comparison with mid-1990s** | **Improved.** 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.

[97] Defra / ONS Family Food Survey & Retail Price Index data

**Box 12 Consumers' response to rising food prices**

Rises in food prices will affect consumer demand and change the pattern of food purchases. If the price of a particular type of food rises then, other things being equal, its demand will fall, and rises in demand may occur elsewhere where prices haven't changed. Where many food prices rise at the same time then the situation is more complex because there will be income as well as substitution effects. Demand for foods considered to be luxuries will tend to fall. Foods considered to be necessities will be less disadvantaged and may even find demand rising. A full analysis of the effects on consumer demand would involve econometric modelling to estimate own and cross price elasticities as well as income elasticities.

Elasticities were estimated for food purchases between 1988 and 2000 and reported in the National Food Survey 2000. That analysis found that income elasticities are relatively high for processed cheese, fish, fresh green vegetables, fresh fruit and fruit juices. So demand for those foods could be expected to fall when overall food prices rise.

During 2008 and 2009 prices rose for many foods. Data on food purchases for this period is not yet available for analysis but some early signs can be seen in estimates of consumers' expenditure published by the Office for National Statistics.

Food price rises peaked soon after the end of 2008. Most foods rose in price and measured over the two years from January 2007 to December 2008 food items overall rose by 18% and non-food items by 4%. In particular:

| | | | |
|---|---|---|---|
| Butter | 29% | Cheese | 23% |
| Bread | 27% | Eggs | 42% |
| Biscuits and cakes | 20% | Milk | 30% |
| Beef | 21% | Soft drinks | 5% |
| Lamb | 16% | Sweets and chocolate | 13% |
| Poultry | 23% | Vegetables | 23% |
| Fish | 15% | Fruit | 18% |

ONS Consumers' Expenditure statistics show expenditure deflated by price changes for different food groups. These estimates suggest that the main downward impacts on demand have been on fruit, vegetables, fish and processed foods. Estimates for Q2 2009 show:

- further small falls in seasonally adjusted demand for fruit and vegetables mean that **healthy eating continues to be adversely affected by overall food price rises.** Fruit is now provisionally forecast to be 9% down in volume on last year and vegetables 12% down.
- overall volume of purchases of bread, meat and more generally all food showed a small drop in demand in Q2 2009 and are provisionally forecast to be about 5% down on 2008.

Theme 5 Household food security

## Supporting indicator 5.1 Relative prices of fruit & vegetables

**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 (See Box 13). 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 and price changes can affect demand (see Box 12).

There is a focus on low income households because they tend on average to have a poorer diet. Family Food 2007[98] 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)[99] 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.

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.[100] 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 (and vice versa)
- 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)[101] 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

[98] Defra, Family Food 2007, Chapter 4 Demographic Comparisons

[99] LIDNS sampled households in the bottom 15% of the population in terms of material deprivation.

[100] 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.

[101] Former version of the Family Food Survey

'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.

**Box 13 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.

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.

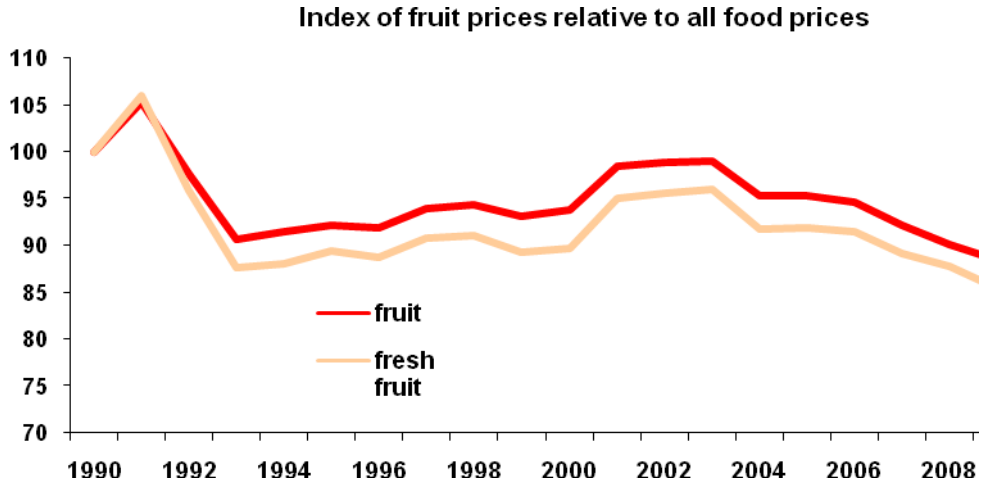
**Desired outcome**

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) |

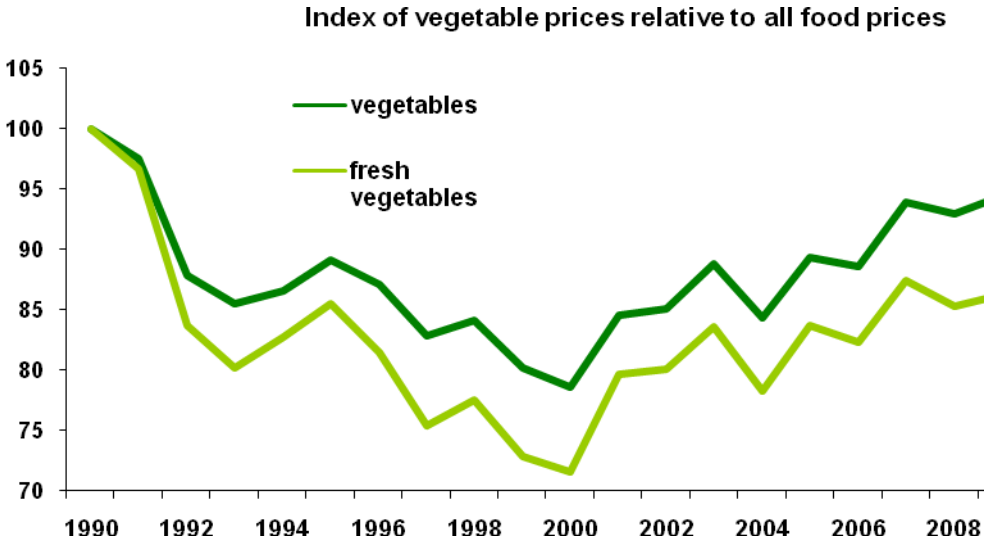
**Key points**

- **Fruit** has become about 12% 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 relatively during 2008 and 2009 when food prices rose substantially**.**
- Despite the 5 A DAY message fruit may be considered by some to be a luxury food item which will could be affected by the overall rise in food prices in 2008 and 2009. This could lead to reduced demand for fruit even though fruit has become relatively cheaper than other foods (Box 12).




*Note – 2009 is a projection based on forecast prices for November and December 2009.*

- **Vegetables** - Between 1990 and 2000 vegetables became over 20% cheaper relative to other foods and, despite the recent rises, are still relatively cheaper (particularly fresh vegetables) than in 1990.



*Note – 2009 is a projection based on forecast prices for November and December 2009.*

- However, since 2000 vegetable prices have been gradually becoming more expensive compared to other foods. The food price rises in 2008 and 2009 had little effect on the price of vegetables relative to all foods.

**Assessment**

**In the last two decades, fruit and vegetables have become cheaper relative to 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%.[102] 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 there are early signs of a dip in consumer demand due to higher prices, fruit has become relatively more affordable. A short term dip in consumer demand may be expected but it is the long term effect of price changes that is most important here. Also although vegetables prices are rising in price relative to other foods, current evidence of the long term 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 (see Box 14). Other groups, aside from low income households, may also have lower access to healthy food and may be the focus of further work.

[102] *Agriculture in the UK,* datasets https://statistics.defra.gov.uk/esg/publications/auk/2007/excel.asp Table 5.12

**Box 14 Tracking the affordability of a healthy diet**

Ideally we want to track the affordability of a healthy diet over time to ensure that it is affordable by low income households. Defining such a diet is a major challenge because we must take into account (a) nutritional recommendations that depend on age and gender, (b) the food industry must be able to produce the foods, (c) the diet must be acceptable to the consumer. Each of these aspects presents complications.

Nutritional recommendations are provided by SACN, an independent advisory body of the Food Standards Agency, but the overarching advice is for a balanced diet which is only specified in general terms. However, because all foods can be converted into their nutritional content, it is in theory possible to compare diets against these recommendations.

The food industry can change what it produces but there are limits and changes will affect prices, especially if supply struggles to keep pace with demand. The diet must also be desirable to the consumer which poses serious problems of how to allow for consumer choice. One compromise approach to both these two problems is to aim for a diet that is close to the current diet in some way.

Once a diet (or a set of diets by age and gender) has been established its cost can be monitored by using prices from the retail price index. A limitation arises here in that the RPI has only 60 food groups. A greater breakdown is available in the Family Food Survey where a unit value price can be found for 250 food groups.

The US Department of Agriculture has tackled this problem with its Thrifty Food Plan (TFP), 2006. The TFP provides a representative healthful and minimal cost meal plan that shows how a nutritious diet may be achieved with limited resources. The model minimises deviations from average consumption patterns for the 58 food categories and suggests new consumption patterns that meet required dietary standards and maintain constant cost levels. There are 15 TFP market baskets - one for each of 15 specific age-gender groups, and each basket specifies the types and quantities of foods.

Theme 5 Household food security

## Supporting indicator 5.2 Food prices in real terms

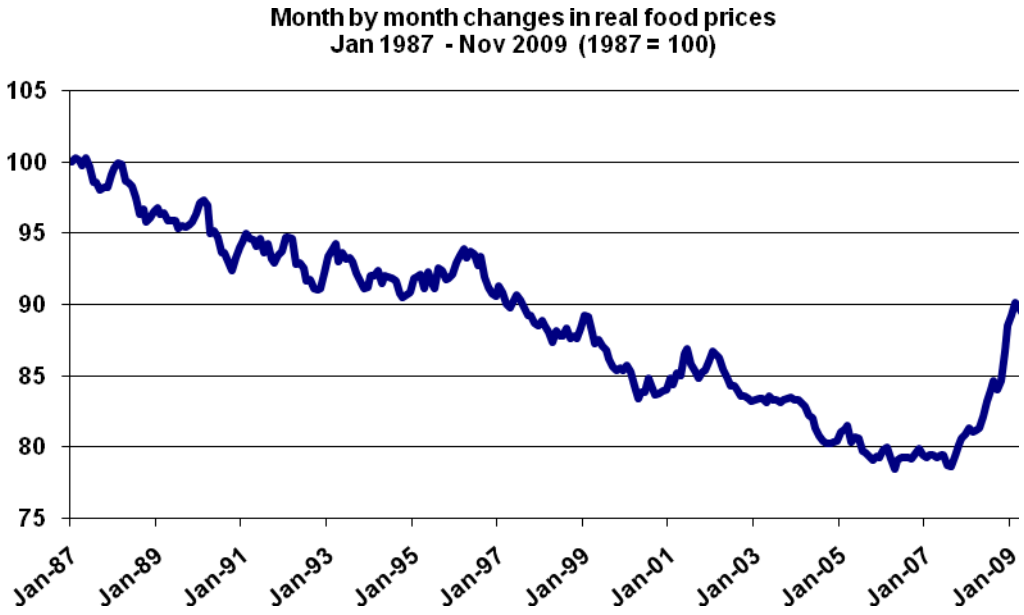
### Rationale and associated risks

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. However, falling real food prices should also be considered in the wider context of desirable outcomes set out in Defra's Sustainable Food Indicators.




### 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 late 2009 were, in real terms, back at 1999 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 a significant decline in the value of sterling.

Food inflation has fallen 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 1999 levels, though still lower than in the early 1990s. |
| **Likely position in 5-10 years** |  |

Theme 5 Household food security

## Supporting indicator 5.3 Household access to food stores

**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.[103] 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 cycling"**

**Source** Department for Transport, *Core National Accessibility Indicators 2007* [104]; 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**

[103] 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

[104] http://www.dft.gov.uk/162259/162469/221412/221692/368506/accessibilityreport2007.pdf ; http://www.dft.gov.uk/pgr/statistics/datatablespublications/ltp/coreaccessindicators2007

- 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.
- 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."[105]

**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 may also reflect in part the opening of new convenience stores by leading supermarkets such as Tesco Express and Sainsbury's Local (although some of those would be replacing existing stores). 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** | **Improved** |
| **Likely position in 5-10 years** |  |

[105] Food Standards Agency, *Low Income Diet and Nutrition Survey* (2007), *Summary of key findings*, pp. 42-3. Emphasis added. http://www.food.gov.uk/science/dietarysurveys/lidnsbranch 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 be slight. (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

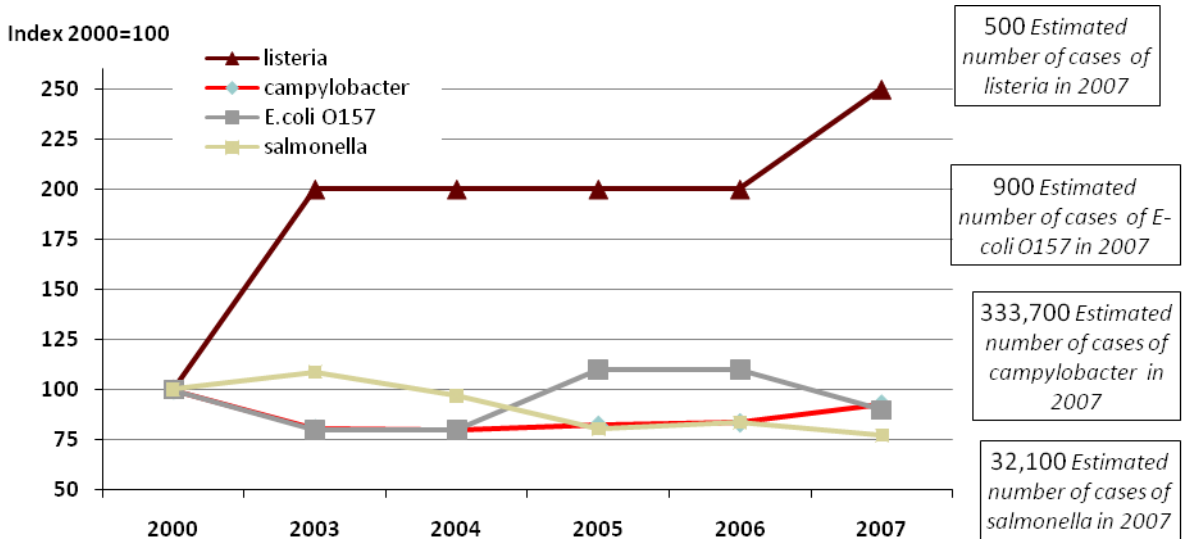
### Rationale

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. Although cases of Campylobacter are slightly lower than in 2000, reduction of this organism in our food remains a priority.
- In 2007 there were an estimated 32,100 cases of salmonella, 23% fewer than in 2000. A UK wide survey in 2007-08 showed that the reduction of Salmonella contamination in UK-produced retail chicken seen since 2000 has been maintained.
- 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

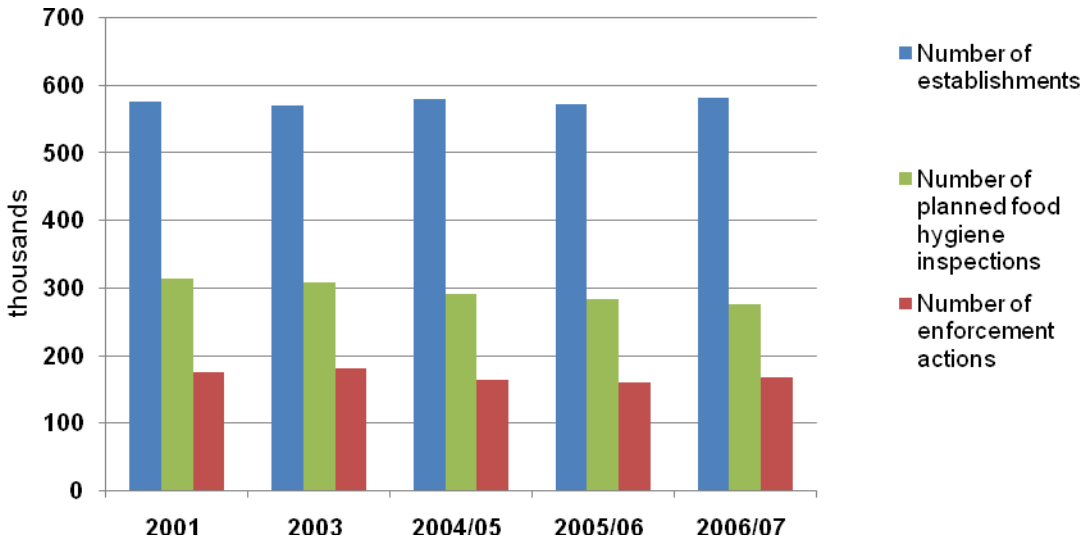
The best way to ensure and improve food safety is by setting and enforcing high standards of food hygiene for all establishments involved in food production.

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.

From the 2008/09 data returns, the FSA will be able to calculate the numbers and percentages of food establishments which are broadly compliant with food law, based on the assessment scores given by LA inspectors when they visit. This will, for the first time, allow an assessment of levels and trends in business compliance and thus food safety.

Numbers of reported contamination incidents are increasing (the total number of reported contamination incidents[106] 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** |  |

[106] Covers both environmental contamination incidents and food contamination incidents

Theme 6 Safety and confidence

## 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.

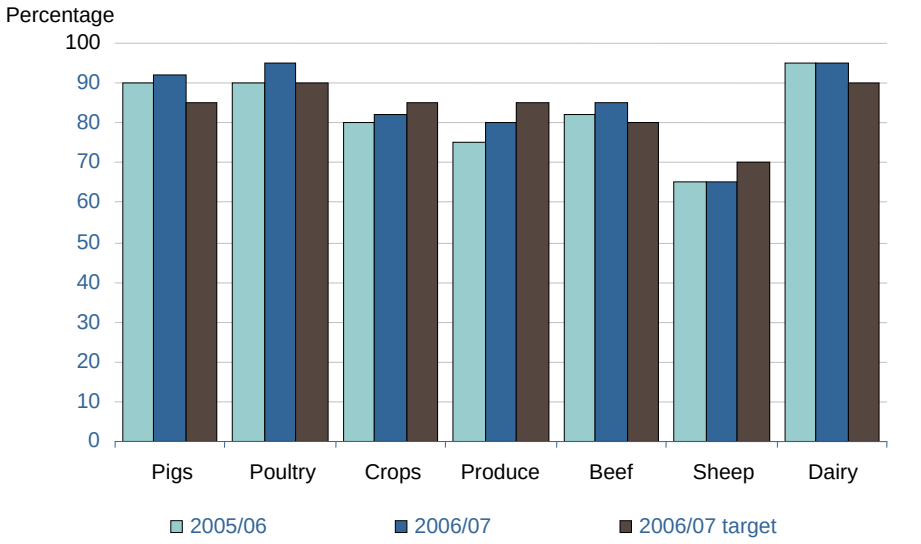
This indicator shows the proportion and retail value of domestic agricultural production which is covered by farm assurance schemes (Assured Food Standards AFS) and the value of food covered by the "Red tractor" logo. Available data typically relates to domestically produced food.

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.

**Proportion of production under Farm Assurance Schemes**



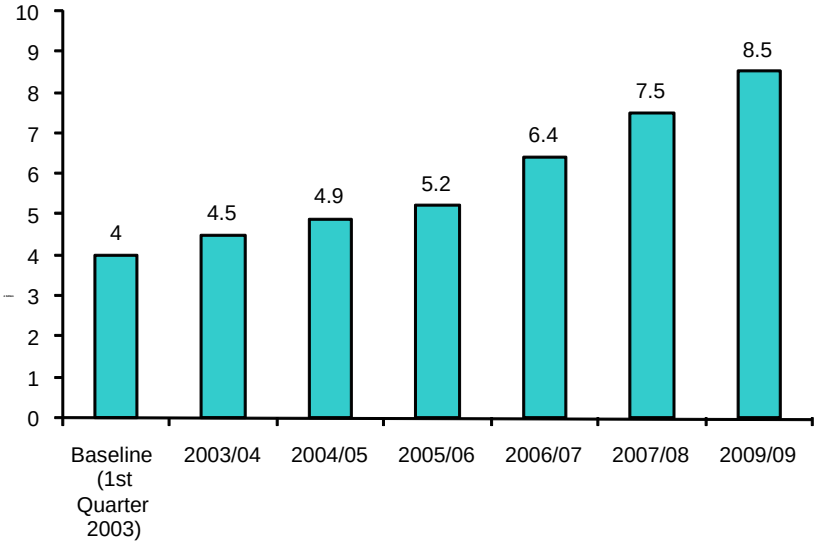

© Crown copyright 2007 Source: Defra

### Key points

- In 2006/07 most sectors showed a rise 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 (£ bn) of food packed under the Red Tractor logo (RTL).




*Source: Assured Food Standards*

- 2008/09 saw the value of food packed under the RTL reach £8.5 billion.
- In 2006/07 saw the value of food packed under the RTL was £6.4 billion, an increase of 22% from the 2006/07 target figure £5.24 billion.
- Since 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** | **Improved** although no data available. |
| **Likely position in 5-10 years** |  |

**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

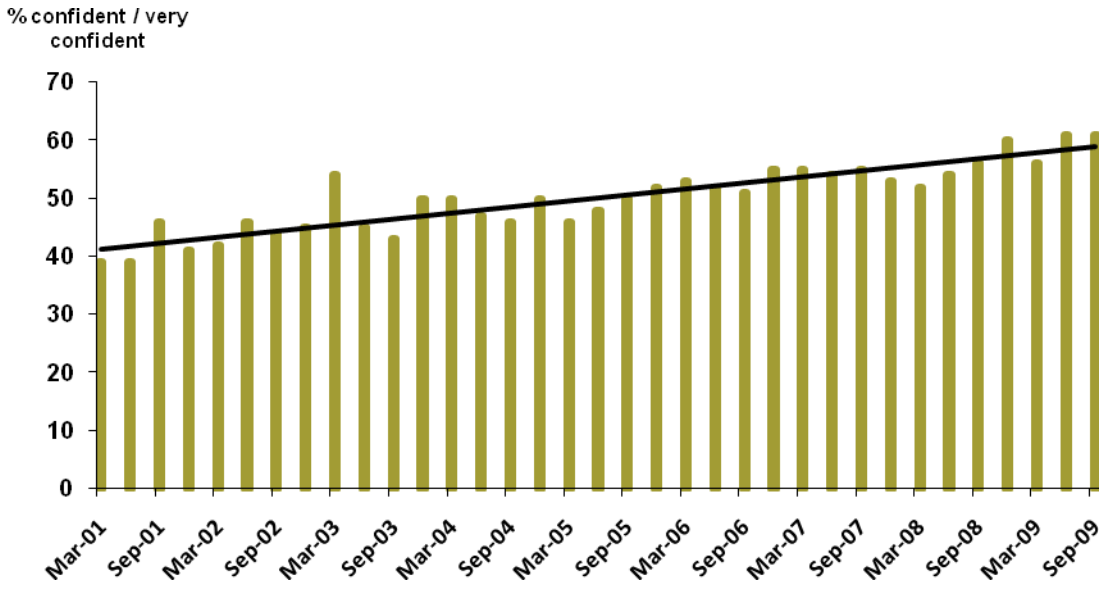
For people to eat a healthy diet the food in the shops has to be safe to eat and consumers have to have confidence that it is safe to eat. Public confidence in food safety will be affected by animal health incidents, statistics on cases of food related illnesses, research linking types of foods with 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 - September 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 all organisations involved in protecting health with regards to food safety remained constant with the previous wave (June 2009) at 61%.

- Confidence in all organisations is currently at its highest since tracking began.
- Since 2001 confidence has increased gradually from 39% in March 2001 during a major foot and mouth outbreak to 61% in September 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** | **Improved** |
| **Likely position in 5-10 years** |  |

Theme 6 Safety and confidence

## Supporting indicator 6.4 Public confidence in food availability

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**