Agriculture and Land Use:
Demand for and supply of agricultural commodities,
characteristics of the farming and food industries,
and implications for land use in the UK

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Abstract

Agriculture is the largest type of land use in the UK, accounting for about 77 per cent of the total area, compared with an average 50 per cent for the EU27. But in common with most high-income countries, agriculture’s contribution to UK GDP and employment is low, at about 0.5 and 1.8 per cent respectively, although the regional importance of the sector (and its associated food and farming industries) varies considerably.

Of the 17.5 million hectares used for agriculture, about 28 per cent is allocated to crops, and 67 per cent is grassland. The grassland includes 4.4 million ha of sole-owned rough grazing and 1.1 million ha of common land in mainly upland “disadvantaged areas,” primarily used for beef and sheep production. This has a major influence on land use, especially in the northern and western parts of the UK.

From the 1930s until the mid-1980s, UK policy promoted increases in agricultural productivity to feed the nation from its own resources. An array of income and production support measures encouraged intensive farming, including a relative switch to arable farming in eastern areas. Since the early 1990s, policies have sought simultaneously to make UK agriculture internationally competitive and environmentally benign. These policies, evident in the Agenda 2000 Reforms of the Common Agricultural Policy, point the way forward for the future. It is likely that a greater distinction will emerge between policies to protect natural resources and enhance the flow of non-market ecosystem services from rural land, and agriculture and food policies intended to encourage an appropriate proportion of national food requirements to be met from domestic sources.

It seems likely that over the next 50 years, the UK’s land area will be required to deliver an increasingly diverse range of private and public goods to meet growing human needs and aspirations. This will require a balance of policy-driven goals and market forces. It will also need a much improved understanding of the trade-offs between food production and environmental...
goals and of the institutional arrangements required to achieve a balance of economic, social and environmental outcomes.

**Keywords:** Agriculture, land use, farm incomes, food commodity prices, agri-environment.

1 **Introduction**

Agriculture is the largest single type of land use in the UK. In 2008, approximately 77 per cent of the total area of the UK (17.5 million ha) was used for agricultural purposes (Defra, 2008c). This compares with 50 per cent in the EU27, and 54, 47 and 50 per cent for France, Germany and Spain respectively (Eurostat, 2009).

This means that UK rural land use, and the UK landscape in lowland and upland areas, are largely the products of agricultural management, which has evolved over many centuries. They are particularly the result of government agricultural policies over the past 70 years. These originally focused on food production and have only more recently given prominence to environmental protection and the wide range of environmental services provided by farmed areas. Likewise, future land use in the UK will be affected by change in the food and farming sectors, and by priorities in the management of natural resources and the environment.

This paper reviews the main changes in UK agricultural land use and farming systems over the last 50 years and the underlying causes and effects. The factors shaping the demand for and supply of agricultural commodities are explored, including changes in agricultural policy and markets and the organisation of the farming and food industries. Forecasts of agricultural land use are reviewed, providing perspectives on how the main drivers of change will affect future land use in the UK. Although they are relevant to this discussion, technological change and climate change are not discussed here. The interested reader is directed to Burgess and Morris (2009) and Rounsevell (2009).

2 **UK agricultural land use and economic importance**

2.1 Current UK agricultural land use

Table 1 shows current agricultural land use in the UK. About 28 per cent of the UK agricultural area is associated with arable cropping, including fallow land, and about 67 per cent with grassland, mostly permanent pastures. Farm woodland and other land occupies about 6 per cent of the total agricultural area. In 2002, 8.7 million ha (42 per cent of the agricultural area) of UK upland, defined as land more than 240m above sea level, was classed as less favoured. These areas as regarded as disadvantaged from an agricultural and
From the 1950s through to the mid 1980s, reductions in farmed areas were more than offset in output terms by increased yields, associated with improvements in crop and livestock genetics, nutrition, and health and land improvements such as drainage (see Burgess and Morris, 2009). Wheat yields per hectare and milk yields per cow doubled during the period 1960-2000. Agricultural systems tended to intensify in areas where they were most suited. There was a net change from grassland to arable production in England and vice versa in Wales (Morris, 1992, Morris et al., 2005) (Figure 2). UK total agricultural output (weighted by value) rose by almost 180 per cent between the mid-1950s and a peak in the mid-1980s, after which it declined slightly, mainly in response to policy changes.

Table 2 shows changes in the distribution of crop and grassland areas in the UK between 1995 and 2008, reflecting the relative profitability of farming as a whole and of particular crop and livestock enterprises. The decline in farmed areas, especially in arable cropping prior to 2000, reflects falling real product prices, and declining farm incomes, which caused farmers to leave the industry. As the Policy Commission on the Future of Farming and Food...
(2002) commented at the time, land abandonment seemed a possible outcome. However in the short term, agricultural land and other agricultural assets, including farmer skills, have limited alternative uses. This results in supply-side inertia whereby farmers continue to operate unprofitable businesses because economic adjustment is painful and resource specificities prevent movement to non-agricultural uses. More recently, the strengthening of crop prices, especially for cereals and oilseeds and the curtailment of the set-aside programme that took cereal land temporarily out of production, have led to an increase in the areas of cereals and oilseeds. By comparison, sugar beet plantings have declined in response to falling sugar support prices, while relatively low livestock prices and high feed prices have reduced the profitability of grassland farming. Some of the increase in the grassland area since 2005 shown in Table 2 is attributable to increased registration of smallholders under the EU single farm payment scheme.

The underlying message here is that farmers are responsive to prices, whether market or policy driven. They are particularly responsive to upward movements in prices and changes in relative commodity prices. As we have seen, they are much less responsive to declining prices because of the inherent ‘immobility’ of agricultural assets, including land, and the lifestyle and taxation benefits associated with farming.

Thus for most of the postwar period of declining commodity prices in real terms, the farming industry has faced a continuing challenge of structural adjustment. It is these economic forces that have caused “the drift from the land” of agricultural labour which occurs in all developed economies, mainly because as general prosperity increases, people tend to spend a declining proportion of their extra income on raw food.
Figure 1: Agricultural land use in England for selected years between 1900 and 2008

Figure 2: Agricultural land use in Wales for selected years between 1900 and 2007

Table 2: UK agricultural land use (‘000 hectares) and livestock numbers (thousands) for selected periods between 1979 and 2008
### Crops

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>Wheat</td>
<td>1,435</td>
<td>2,014</td>
<td>2,086</td>
<td>2,080</td>
<td>45</td>
</tr>
<tr>
<td>Barley</td>
<td>2,335</td>
<td>1,518</td>
<td>1,128</td>
<td>1,032</td>
<td>-56</td>
</tr>
<tr>
<td>Oats</td>
<td>142</td>
<td>107</td>
<td>109</td>
<td>135</td>
<td>-5</td>
</tr>
<tr>
<td>Other cereal crops</td>
<td>20</td>
<td>21</td>
<td>26</td>
<td>27</td>
<td>35</td>
</tr>
<tr>
<td>Oilseed rape</td>
<td>97</td>
<td>390</td>
<td>332</td>
<td>598</td>
<td>516</td>
</tr>
<tr>
<td>Sugar beet not for stockfeeding</td>
<td>212</td>
<td>194</td>
<td>173</td>
<td>120</td>
<td>-43</td>
</tr>
<tr>
<td>Peas for harvesting dry and field beans</td>
<td>78</td>
<td>216</td>
<td>208</td>
<td>148</td>
<td>90</td>
</tr>
<tr>
<td>Linseed</td>
<td>-</td>
<td>-</td>
<td>71</td>
<td>16</td>
<td>-</td>
</tr>
<tr>
<td>Other crops</td>
<td>198</td>
<td>132</td>
<td>192</td>
<td>269</td>
<td>36</td>
</tr>
<tr>
<td>Potatoes</td>
<td>200</td>
<td>177</td>
<td>166</td>
<td>144</td>
<td>-28</td>
</tr>
<tr>
<td>Horticulture</td>
<td>270</td>
<td>208</td>
<td>172</td>
<td>170</td>
<td>-37</td>
</tr>
<tr>
<td><strong>Grassland</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Permanent grass</td>
<td>5,145</td>
<td>5,316</td>
<td>5,363</td>
<td>6,036</td>
<td>17</td>
</tr>
<tr>
<td>Temporary grass</td>
<td>1,933</td>
<td>1,606</td>
<td>1,226</td>
<td>1,141</td>
<td>-40</td>
</tr>
<tr>
<td>Rough grazing</td>
<td>5,093</td>
<td>4,965</td>
<td>4,445</td>
<td>4,359</td>
<td>-14</td>
</tr>
<tr>
<td>Set aside</td>
<td>0</td>
<td>72</td>
<td>567</td>
<td>0</td>
<td>-</td>
</tr>
<tr>
<td>Common rough grazing (estimate)</td>
<td>1,213</td>
<td>1,236</td>
<td>1,228</td>
<td>1,238</td>
<td>2%</td>
</tr>
<tr>
<td><strong>Total agricultural area</strong></td>
<td>18,899</td>
<td>18,884</td>
<td>18,311</td>
<td>18,702</td>
<td>-1%</td>
</tr>
</tbody>
</table>

### Livestock

| Livestock                          |                     |       |       |       |                                             |
|------------------------------------|---------------------|-------|-------|-------|                                             |
| Total cattle and calves            | 13,384              | 12,059| 11,135| 10,107| -24%                                        |
| Dairy cows                         | 3,237               | 2,848 | 2,336 | 1,909 | -41%                                        |
| Beef cows                          | 1,481               | 1,632 | 1,842 | 1,670 | 13%                                         |
| Total sheep and lambs              | 31,163              | 43,799| 42,264| 33,131| 6%                                          |
| Total pigs                         | 7,836               | 7,449 | 6,482 | 4,714 | -40%                                        |
| Total fowl                         | 125,712             | 124,615| 154,504| 166,200| 32%                                         |

In the livestock sector, the combination of improved productivity (Burgess and Morris, 2009), with the imposition of milk quotas, the abolition of the Milk Marketing Board in 1993, poor financial returns, and static or decreasing demand have caused a 41 per cent decline in dairy cows between 1979-81 and 2008 (Table 2). Similarly, there has been a reduction in the number of beef cattle following the BSE crisis in the late 1990s and the reduction and eventual removal of specific beef production incentives in 2005. The UK sheep flock peaked in 1992 at 44 million, because of a favourable EU sheep meat regime. Following the end of this regime, sheep numbers declined to 33 million in 2008. Pig numbers have decreased rapidly over the period shown in Table 2, largely as an effect of high feed prices, disease outbreaks and the cost of implementing new welfare standards for pigs. The rapid increase in poultry
is a result of changing diets, with white meat becoming more popular than beef and lamb with UK consumers.

The pattern of agricultural land use is also influenced by a combination of climate, soils and topography. In England and Wales, this results in a relative concentration of grassland and livestock farming in the north and west, and arable farming in the east and south (Figure 3). Horticulture, including the production of high-value vegetable and salad crops, is mainly concentrated in areas of peat or light mineral soils, usually involving irrigation and controlled drainage. These are mainly in East Anglia, the West Midlands, south west Lancashire, and south Yorkshire.

![Figure 3 Cereal crops and grassland as a proportion of agricultural land across England (DEFRA, 2008a)](image)

2.2 The economic performance of UK agriculture and implications for land use

In line with other EU and OECD member states, agriculture’s share of UK national economic output and employment has declined over time as overall prosperity has increased. In 1900, UK agriculture’s share of GDP was about 11 per cent (National Statistics, 2003). In 2007 the farming sector in the UK accounted for £5.5 billion gross value added, equivalent to about 0.5 per cent of total UK GDP. Employment in farming provided 531,000 full time equivalent jobs, about 1.8 per cent of the UK workforce. As a comparison,
agriculture’s share of GDP in the EU-15 and in the US were 1.7 and 1.4 per cent respectively in 2002 (Normile and Price, 2004).

Crop outputs excluding horticulture totalled £3.5 billion in 2007. They form 22 per cent of the total output of UK agriculture, which was valued at £15.7 billion, excluding single farm payments and subsidies of £2.9 billion (Defra, 2008). This output occurs on about 27 per cent of the crop and grass area excluding rough grazing. Horticulture at £2.3 billion accounts for about 15 per cent of total output on about 1.3 per cent of the crop and grass area, confirming the relatively high value per hectare of vegetable and fruit production. Meat production (e.g. cattle, sheep, pigs and poultry) contributes about £4.4 billion or 28 per cent of the total output and other livestock products (primarily milk but also eggs,) contribute a further £3.2 billion (21 per cent). Thus livestock accounts for about 50 per cent of the value of output of UK farms, occupying just over 60 per cent of the total crop and grass area excluding rough grazing. Furthermore, a large share of crop products are fed to livestock. Additionally, 5.5 million ha of rough grazing in mainly upland areas is associated with livestock production, mainly of beef and sheep, which is included in the output values given above.

Thus in many respects, the rural landscape and the UK agricultural economy are inexorably linked to grassland and livestock. Any changes in the economics of the livestock sector and policy changes directed at this sector will have important land use implications. But this sector, often associated with small family farms in relatively ‘disadvantaged’ or ‘less favoured’ farming areas, has been most vulnerable, and to a degree most resistant, to recent policy and market changes such as reductions in upland sheep and beef breeding subsidies.

2.3 Number of UK agricultural holdings

The number of full-time farm holdings declined over the past 70 years in response to changing economies of size and scale, to 233,000 agricultural holdings in the UK in 2000 (Table 3). But since 2000 the number of registered farms has started to increase (Defra, 2009a) in anticipation of the introduction of single farm payments in 2005. In 2000, the average size of farms considered to offer full time employment for one person in the UK was 125 ha. This is about four times the EU average. The largest farms in the UK are concentrated in southern and eastern England (Ward, 2000).

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<tbody>
<tr>
<td>&gt;50</td>
<td>81.0</td>
<td>79.9</td>
<td>80.1</td>
<td>78.4</td>
<td>75.5</td>
<td>75.4</td>
<td>74.5</td>
<td>74.0</td>
</tr>
<tr>
<td>20-50</td>
<td>60.7</td>
<td>58.9</td>
<td>56.5</td>
<td>55.4</td>
<td>47.8</td>
<td>45.0</td>
<td>46.7</td>
<td>46.5</td>
</tr>
<tr>
<td>5-20</td>
<td>67.9</td>
<td>67.6</td>
<td>65.6</td>
<td>63.1</td>
<td>56.1</td>
<td>56.7</td>
<td>58.7</td>
<td>60.1</td>
</tr>
</tbody>
</table>
2.4 UK agriculture: goods and services

For much of the past 70 years, agricultural policy has been geared to achieving a high level of self sufficiency, whether for the UK alone or as part of the EU. Self-sufficiency peaked at about 75 per cent of indigenous foods in the mid 1970s, when “Food from our own resources” was a policy objective (MAFF, 1975). In 2008, UK agriculture supplied about 60 per cent of all food consumed in the UK and around 70 per cent of all indigenous food (food that can be commercially produced in the UK) (Defra 2008c). Table 4 shows UK consumption of food by value and where that food originated. It also shows the proportion of UK exports.

Table 4: UK production, self-sufficiency and exports as a proportion of domestic production

<table>
<thead>
<tr>
<th>Year</th>
<th>Other</th>
<th>Africa</th>
<th>North America</th>
<th>EU</th>
<th>UK (a)</th>
<th>UK exports (b)</th>
</tr>
</thead>
<tbody>
<tr>
<td>88</td>
<td>88</td>
<td>97</td>
<td>97</td>
<td>97</td>
<td>97</td>
<td>97</td>
</tr>
</tbody>
</table>

Source: Defra 2008c;

Agriculture has an important environmental role in the UK because of the large amount of land it uses. Its role as a source of both environmental benefits and costs has received much policy attention in the past decade. (Defra 2006a; Jacobs et al., 2008). More recently, food security has been reinstated as a policy target in response to concern about the impacts of global warming and its associated environmental threats at the global scale (Sustainable Development Commission, 2009; Defra 2006b). The extent to which UK food demand will be met by domestic agricultural production and the share of domestic food consumption to be sourced through food imports have yet to be determined.
3 Drivers of agricultural land use change

3.1 Government intervention in agriculture 1947-2008

Government intervention in agricultural markets is probably the most critical driver of agricultural land use. In the recovery period that followed World War II, the UK Agriculture Act of 1947 focused on the production of more and cheaper food as part of a wider programme of economic revival, including the alleviation of food rationing, which continued until 1953. “Deficiency payments” were introduced when market prices fell below guaranteed levels, and there were subsidies for fertilisers and grants for drainage and the ploughing up of permanent pasture.

In 1973, the UK joined the European Economic Community and ever since, UK agricultural policy has primarily been determined by the European Common Agricultural Policy (CAP). While the CAP covers the key agricultural commodities, it did not apply to the poultry, pig, egg and horticultural sectors, which largely operated on the basis of prices determined in international markets.

The CAP was devised to increase agricultural productivity, stabilise markets, assure the availability of reasonably-priced food, and to ensure a fair standard of living for all those involved in farming. These objectives were largely met by the support of internal prices and incomes, through direct market intervention, and border protection through tariffs and levies on food imports. Export subsidies were paid to offload otherwise uncompetitive EU surplus production onto world markets. The policy was successful in terms of increasing domestic food production, to the extent that the EU became the second largest exporter of food in the world. EU self-sufficiency in wheat increased from 89 to 101 per cent between the late 1950s and the mid-1960s (Fennell, 1997). However, this policy resulted in higher consumer food prices within the EU and increasing tax burdens on EU citizens. Its legitimacy as a means of supporting farm and rural incomes was eventually challenged by food exporting nations and the World Trade Organisation.

By 1984, surplus milk production led to the introduction of marketable milk quotas, initially set at 1983 milk delivery levels minus 9 per cent for any individual farm. This placed a ceiling on growth in national milk production, but individual farmers could expand their production by purchasing quota from farmers who were reducing their milk output. Eight years later, in 1992, the MacSharry Reforms of the CAP led to constraints being placed on beef and sheep sector, with compensation payments which were subject to regional ceilings and maximum stocking rates. At the same time, compensation payments in the arable crop sector required the compulsory withdrawal (or setting-aside) of up to 10 per cent of arable land from arable production. By contrast at the same time the EU was still importing large quantities of vegetable oil and vegetable protein. The CAP reforms, therefore,
created additional incentives for farmers to grow oilseed and protein-rich crops, such as oilseed rape, linseed and pea and bean crops.

These successive policy changes have impacted significantly on the UK landscape. The drive for food production between 1940 and 1984 had led to substantial areas of permanent pasture being ploughed and drained, usually with grant support. The rapid increase in sheep numbers in both upland and lowland areas during the 1980s brought about by ewe subsidies was curtailed in 1992 by regional ceilings. The increased support for protein and oilseed crops has meant that oilseed rape and field beans have become important new crops in the UK landscape.

The introduction of compulsory set-aside in 1992 led to a large increase in the fallow arable land in the UK. Conversely the removal of compulsory set-aside in 2008 in response to an increase in cereal prices caused a rapid decline in the area set aside. The area of bare fallow increased rapidly in 2008 because land voluntarily left as set-aside was reclassified as bare fallow (Table 5).

Table 5: Area of uncropped land ('000 ha) in the UK for selected years between 1985 and 2008

<table>
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<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>Bare fallow</td>
<td>41</td>
<td>68</td>
<td>43</td>
<td>37</td>
<td>195</td>
</tr>
<tr>
<td>Set-aside</td>
<td>0</td>
<td>72</td>
<td>734</td>
<td>495</td>
<td>0</td>
</tr>
<tr>
<td>Total uncropped</td>
<td>41</td>
<td>140</td>
<td>777</td>
<td>532</td>
<td>195</td>
</tr>
<tr>
<td>Farm woodland</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>500</td>
<td>750</td>
</tr>
</tbody>
</table>

Source: MAFF, 1989, Defra 2008a;

3.2 From food supply to ecosystem services

During the 1970s and 1980s, numerous commentators highlighted the negative environmental effects of intensive farming (Nature Conservancy Council, 1977; Shoard, 1980; Body, 1982), including loss of habitats and wildlife, soil erosion and water pollution. In response to this and to pressure from the UK, the European Community accepted the concept of Environmentally Sensitive Areas in 1985, and a broad suite of “accompanying measures” was introduced in the CAP reform of 1992 to promote the agri-environment and farm woodlands. Through a range of schemes, participating farmers were paid for managing a proportion of their land to produce “ecosystem services” rather than food. This included support for farmers to move land from productive agriculture into management practices that supported local biodiversity, such as the Environmentally Sensitive Areas (ESA) and the Countryside Stewardship (CS) schemes. Incentives were also offered for farmers to switch to organic systems, and for the afforestation of agricultural land through initiatives such as the Farm Woodland Scheme (FWS), the Woodland Grant Scheme (WGS), and the Farm Woodland Premium Scheme (FWPS).
Since 2000, European Union support for the rural sector has been delivered through two main mechanisms. Pillar I involves support for agriculture and Pillar II provides support for rural development, including agri-environmental interventions. In 2003, the CAP reformed key agricultural subsidies under Pillar I (such as the Arable Area Payment and the Beef and Sheep Premiums in England), which were linked to production with a Single Farm Payment (SFP). This payment was not linked to a particular type of production, but did require “cross-compliance”, an adherence to EU environmental, food safety, animal welfare standards and regulations, and the need to keep farmland in “Good Agricultural and Environmental Condition”. This is defined at a national level, and includes soil protection, maintenance of soil organic matter and soil structure, and maintenance of habitats and the landscape.

Agricultural commodity prices, and the incentives for agricultural production in the UK, are now largely determined by world market conditions and farm and rural income support is ‘decoupled’ from farm production levels. This should prevent the wasteful and inefficient build-up of agricultural surpluses which brought the CAP into disrepute in the 1980s.

Pillar II of the CAP relating to rural development includes agri-environmental and afforestation measures. Separate rural development programmes exist for England, Scotland, Wales and Northern Ireland. Since 2005, the agri-environmental measures for England include “Environment Stewardship” which is steadily replacing the ESA and CS schemes. In England in 2008, 5.3 million ha were under environmental stewardship, 6 per cent of which was in the higher tier. The total land area under agri-environment schemes in the UK was about 8.7 million ha in 2008, compared with only 175,000 ha in 1992.

Over time, the proportion of total agricultural funding allocated to the Single Farm Payment is being reduced by the “modulation” of funds to rural development measures, in other words from Pillar I to Pillar II. Farmers are now paid to manage their land according to a set of rules, regardless of what or how much is produced on-farm. This marks a shift in public financial support from the production of food and fibre to the conservation of natural resources and the environment.

4 Agricultural prices, farm incomes and land values

World market agricultural prices have fallen in real terms for much of the past 70 years, with the exception of short lived spikes in the early 1970s, the early 1990s and more recently the 2007-08 period, mainly caused by supply disruption at a global scale (Piesse and Thirtle, 2009). Agricultural prices for UK farmers have mirrored these trends, especially since the early 1990s, but have been modified by the rate of farm support within the European Union.
Figure 4 shows price trends for selected major commodities for the UK from 1988 to 2008. Over this period, prices were relatively low between 1998 and 2004 before the recent price spike (Piesse and Thirtle, 2009). For many products, prices have returned to the levels experienced in early to mid 1990s, when prices increased because of a weak pound relative to the currency of other EU competitors, as well as strong food demand from Asia (Defra, 2009b; USDA 2009b). The combination of a stronger pound, falling demand in the wake of the Asian financial crisis and a liberalisation of EU agriculture combined to depress prices from the late 1990s until 2005.

![Figure 4: UK Agricultural price index for selected products 1988-2008](image)

Figure 5 shows how farm incomes have been affected by price variations, showing volatility around a generally declining trend. In 2008, Total Income from Farming (TIFF) was about 60 per cent lower in real terms than in 1973.
4.1 Recent changes in the value of land

Agricultural land prices tend to reflect the profitability of farming, including the effects of subsidies and income support. But in recent years, distortions in UK land markets have kept agricultural land prices at levels much higher than their agricultural income earning capacity would imply. Factors at work here include limited offerings of land for sale (typically less than 0.2 per cent of the total land area each year), strong demand for small parcels of “agricultural” land from urban dwellers, and tax advantages of land ownership. Figure 6 shows how the sale value of agricultural land rose in the early 1990s during a period of relatively favourable commodity prices (Figure 4) and farm incomes (Figure 5) but levelled off and remained stable between 1996 and 2004, even during this period of unprecedented low prices and incomes. Where agricultural land included a house, the value per hectare of that land increased by 60 per cent between 1995 and 2004 (Figure 6).

More recently, the value of agricultural land in England and Wales has more than doubled between 2004 and 2009 (Figure 7), partly in response to recent increases in food commodity prices and farming profits. In 2009, prices for agricultural land in England and Wales with vacant possession are about £13,000-£15,000 per hectare for arable land, reflecting the presence of keen local buyers as much as the quality of agricultural land. RICS (2009) reported an increase in 2008 in the number of purchases of land by adjacent family

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**Figure 5: Total Income from Farming (TIFF) 1973-2008**

*Source: Defra 2009*
managed farms in order to maintain economies of scale and benefit from the exemption of farm land from inheritance tax.

Figure 6: Agricultural Land Values in England (1993-2004) at 2007 prices (Defra, 2008c)

Figure 7: Value of freehold dairy, arable and hill land without buildings in England and Wales (Valuation Office Agency, 2009)
4.2 Power relations in UK food and farming

In analysing competition in particular industries, Porter (1998) identifies five sources of competition. The key areas in the agricultural supply chain relate to the buyer power of consumers and supermarkets, the power of agricultural supply companies, international competition including the role of biofuels, new entrants, and rivalry between existing agricultural businesses.

![Figure 8: Five competitive forces within the UK agricultural land use sector](image)

4.2.1 Buyer power

The final buyers of agricultural products are consumers. However, their choices are increasingly mediated through a limited number of supermarkets. The generic demand for food in the UK is relatively unresponsive to changes in prices, it is price inelastic (Lechene, 1999; Tiffin and Tiffin, 1999) (Table 6). Price changes, whether up or down, bring about proportionately small changes in the quantity of food purchased. For instance, a 1 per cent increase in the price of fresh fruit would cause an 0.29 per cent fall in the quantity demanded. Conversely, a 3.4 per cent fall in price (1/0.29) is needed to raise demand by 1 per cent. Because of this relatively constant and inelastic demand, farmers can experience considerable variation in prices and incomes, for example when year-on-year changes in weather patterns affect production. Oscillating and unstable food prices, and the importance of securing food supplies for Britain's industrial workforce, were the main reasons for the Government introducing Agricultural Marketing Boards in the 1930s.

<table>
<thead>
<tr>
<th>Cross price elasticity*</th>
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The demand for food is also income inelastic, that is, expenditure on raw food as a whole does not keep pace with increases in income. Drawing on the Household Food Survey, Lechene (1999) suggests that a 1 per cent increase in average income will increase total food demand by 0.2 per cent. But the increase in demand will not be uniform across all categories of foods and all income levels (Defra, 2008e). Low-income households tend to buy more bread and cereals, milk, cheese and eggs, sugar and confectionery but less meat, vegetables, fruit and other foods than more affluent families. Increased average income, together with increased food choices and changing tastes and lifestyles, were associated with a 30 per cent fall in milk and dairy consumption over the past 30 years (Defra, 2008b). Bread purchases have decreased by 15 per cent and fresh potatoes by 27 per cent in the past 10 years (Defra, 2008b) while purchases of fruit and vegetables have increased by 8 per cent over the same period. Quantities of fruit and vegetables purchased by all households and by low income households have both risen by 9 per cent since 2001 (Defra, 2006c).

Similarly, fresh red meat sales have fallen by 40 per cent over the past 30 years, but have remained steady over the past decade. This reflects the impact of changing food tastes and lifestyles. There have been large fluctuations in the type of meat bought because of health concerns, such as BSE, but in general meat consumption has remained relatively steady. The major change has been the increase in poultry consumption, which has surpassed consumption of other meats in the UK since 2000 (Foster and Lunn, 2007). Recent concerns about the growing incidence of obesity have prompted calls for healthier eating, with implications for the balance of livestock, fruit and vegetables products in the national diet (Foresight, 2007).
Although income elasticity is low for raw, unprocessed food (Table 6), it is much higher for total food expenditure including the convenience and recreational components provided by the food processing and catering sectors. Farmers can offset the disadvantages of the market place for raw, farm-gate food by adding value by moving up the supply chain, by undertaking processing or direct sales themselves, or by focusing on niche, quality produce rather than bulk produce.

There is also an increasing trend towards demand for food which meets high ethical standards and animal welfare considerations, which protects the environment, and which respects the rights of people involved in food production, particularly in developing nations. Defra (2007) shows an increasing demand between 2000 and 2007 for local food and for food from organic, free range and other systems orientated to animal welfare, as well as for fair trade foods. Over a third of sales of ethical foods are now organic. Sales of organic foods increased by nearly 20 per cent between 2005 and 2006 to a market value of £1.7 billion (NFU, 2008a). It is unclear as yet how these trends will affect aggregate land use, but increasing quantities of organic and food from animal welfare systems would require more land than conventional agricultural production systems because of relatively lower yields.

A number of changing demographic factors, some of them counteracting each other, could influence future demand for food (National Statistics, 2009). Increased participation in the workforce by women, decreasing household size and more individualistic eating patterns are driving demand for convenience foods and meals with smaller portions (Buckley et al., 2007). Conversely, an ageing population with more pensioners who have low incomes but plenty of time to cook, could increase the demand for raw food and for cheaper options. Renewed ‘connectedness’ between people and food has increased interest in local foods, encouraging farmers’ markets, and a resurgence in allotments and urban agriculture. Concerns about rising food prices, however, does not fit comfortably with the finding that 30 per cent of food purchased by households is thrown away, and that most this waste (19 per cent of purchases) could have been avoided (WRAP, 2008; Cabinet Office, 2008). Losses in the catering sector and the food chain as a whole would increase this estimate of total loss (Lundqvist, 2008).

Over the past two decades, market power has moved from farms to the retail sector and consumers (IAASTD, 2009). Large supermarkets have delivered increasing convenience and choice to the sector. The number of product lines in supermarkets has increased from about 5,000 in the 1970s to over 40,000 currently (Foster and Lunn, 2007). They have taken an increasing share of the UK food market (Frances and Garnsey, 1996; FAO, 2005), out-competing smaller and more specialist food retailers. Defra (2006c) reported that
approximately 75 per cent of food sales were made by supermarkets or superstores and only 7 per cent attributed to small traditional stores. The supermarket sector is also highly concentrated. Four companies account for approximately 74 per cent of all supermarket food sales.

As a consequence, large supermarkets exert significant power over their suppliers, including farmers (Dobson et al., 2003). The OECD (2006) explained the process of retail market capture and cited several practices that supermarkets use to exert market power, such as changes in contract conditions at short notice, breaches in contract, late payments and buy-back clauses for unsold products. Lloyd and Morgan (2007) concluded that these practices cause supermarket and farming profit margins to diverge. In 1988, farmers received 47 per cent of the final market value of retailed fresh foods, but by 2008 this had fallen to 37 per cent (Defra, 2008c). However, others point to an improvement in the ‘relationships’ associated with dedicated supply chains, such as supermarket-operated quality assurance and traceability schemes for livestock and vegetable produce. The share of farm-gate output in the final retail price of different forms of food is also variable, typically being 40-51 per cent for most fruits and vegetables, 47-50 per cent for beef and lamb, and 35 per cent for milk (Defra, 2008c). Crude price comparisons can also be misleading because different amounts of resources are committed to marketing different products and adding value to them.

McCullough et al. (2008), World Bank (2007) and IAASTD (2009) report that the dominance of supermarkets in the agri-food chain for high-value produce tends to favour larger producers. In some cases, farmers have responded to the dominance of supermarkets by creating co-operative groups, farmer wholesale companies or larger farm enterprises. This is likely to encourage further increases in average farm size or more collaborative ventures, as producers seek economies of scale in production, and in the case of fresh produce, economies of marketing into the supermarket-dominated supply chain.

4.2.2 Rivalry between agricultural producers

With almost 200,000 farmers producing mainly bulk, low-value, high volume, high transport cost, commodities, there is little rivalry between producers themselves. Most rivalry is associated with gaining and maintaining market outlets to supermarkets and processors for high-value produce. There is also rivalry at the national scale between domestic production and imports.

4.2.3 New entrants

Competition from new entrants in the agricultural sector is low. The returns from agricultural production do not justify the investment in purchasing or renting agricultural land. In fact the issue is not competition from new
entrants into the sector, but the loss of commercial farmers and agricultural land from it. Existing farmers can find it attractive to release the capital in their land by selling it for non-agricultural uses such as housing development, or converting it for amenity use such as paddocks for horses.

### 4.2.4 Supplier power

Agriculture is a primary industry and is less exposed to changes in input costs than many other industries. However, the profitability of some sectors, pig and poultry production in particular, is dependent on the supply of cheap animal feed. In the past century, agriculture has also become reliant on cheap energy, for running agricultural machinery and for nitrogen fertiliser production. Between 2005 and 2008, prices for fertilisers and soil improvers in the UK increased by 270 per cent (Defra, 2009c), in part a result of high energy prices but also because of a lack of competition in the domestic fertiliser supply sector.

A long-term increase in the price of fossil fuel will affect the viability of current energy-intensive farming systems that are dependent on large inputs of inorganic fertilisers and pesticides, on and the use of farm machinery. Energy efficiency considerations may encourage less intensive farming systems and lower yields, implying greater agricultural land use to maintain total agricultural output (Sustainable Development Commission, 2007).

### 4.2.5 International competition

A key consideration for UK agricultural land use is the capacity of UK agriculture to compete on the international market. Systems that are internationally competitive can secure additional income from selling in international markets; systems that are not competitive are likely to face competition from imports. Since 2002, the Common Agricultural Policy has sought to make EU, including UK, agriculture internationally competitive, while simultaneously ensuring food security though a balance of domestic and foreign sourcing.

At the global scale, demand for food is closely linked to increases in the economic prosperity of populations. Between 2004 and 2006, 22 of the world’s 34 most food-insecure countries experienced gross domestic product increases of 5-16 per cent (IFPRI, 2007), with a resulting shift from basic staples such as cereals to more varied, protein-rich diets, especially vegetables, fruits, meat, dairy and fish. Between 1964-1966 and 1997-1999, consumption of meat per capita developing countries increased by 150 per cent, and of milk and dairy products by 60 per cent (FAO 2005). Milk and dairy consumption is is expected to rise by 1 per cent per year through to 2019 (Trostle, 2008). By 2030, it is forecast that per capita consumption of livestock products could rise by a further 44 per cent from current levels (WHO, 2003). But demand for other agricultural commodities could decline. IFPRI (2007)
predicts that as incomes increase in South Asia, there will be a 4 per cent decline in rice consumption between 2000 and 2050, while the consumption of vegetables is projected to increase by 70 per cent, and consumption of meat, eggs, and fish is projected to double.

The growing global demand for meat products has implications for the grain and protein feed markets. Trostle (2008) suggests that producing 1 kg of chicken, pork and beef requires to 2.6, 6.5 and 7 kg of maize feed respectively. So the increase in demand for meat will have far-reaching consequences for the demand for cereals and coarse grains for animal feeds. Analysis suggests that other countries and regions than the UK may have comparative advantages in the production of bulk agricultural commodities such as wheat, plant oils and beef. However, these potentials may be threatened by climate change, and the UK may be able to gain advantage in markets that differentiate on food quality rather than price. Strong international prices for commodities could maintain a high demand for land use for agriculture in the UK, in substituting for expensive imports and in supplying high-value, locally sourced, quality-assured products. Participating in such markets will require high levels of knowledge, skills and technology in UK farming systems.

A key factor in the international market for food is the impact of bioenergy. The EU and the US both have targets for the minimum proportion of conventional road transport fuel to be met by renewable sources (Sugden, 2009; Somma and Lobkowicz, 2009). Several studies have estimated the amount of land required to achieve the EU renewable transport fuel target of 10 per cent. Upham et al. (2009) estimated that meeting biofuel targets with oilseed rape would need 600,000 ha of current agricultural land and an additional 840,000 ha of land which is now unused. To meet these targets from a sugar beet feedstock would require 10 per cent of UK arable land and from straw would require 45 per cent of UK arable land. There appears to be a direct link between biofuel demand and the price of crude oil, creating a trade-off between food and fuel production (Senauer, 2008). Fossil fuel prices are expected to increase in real terms in future, thus maintaining the demand for biofuels (Davis, 2009). However, it is likely that attention will switch from conventional crops to second generation biomass crops such as miscanthus and willow, much of which can be grown on poorer land, although they can be water-intensive (Cannell, 2003).

5 Forecasts for land use

The sections above have reviewed the main drivers of UK agricultural change, citing evidence of the way in which they have shaped current land use and how they may change land use in the future. The main issue is an emerging conflict over agricultural land use for food, fuel and ecosystem services. There are some complementarities in the production of these
separate outputs, but competition is more commonly the case, and it will be necessary to establish the significant trade-offs. However, it is difficult to predict the future conditions for agriculture. The prices of all main commodities have shown much volatility in recent years (Figure 9). FAO and OECD (2009) forecasts suggest that the prices for the UK’s major agricultural products will remain strong to 2017 (Figure 9). This reflects growing food and fuel demand and government policy interventions that have reduced supply but enhanced environmental protection. Overall, long term prices are predicted to remain about 25-30 per cent higher than 2003-2006 international levels. Therefore, it is reasonable to predict a future where there is strong demand for agricultural products, and where demand for ecosystem services including forestry production is also increasing.

Figure 9: World price for wheat, oilseed, and butter as recorded from 1992 to 2008 by OECD-FAO, and for 2009 to 2018 as predicted by OECD-FAO in January 2009 (OECD, 2009)

5.1 Agriculture, multifunctionality and ecosystems

It is recognised that agriculture’s role in society extends beyond the production of food and fibre and that agricultural practices produce food alongside cultural and environmental services as joint products (Hodge, 2007). Specifically, agriculture provides management (for better or for worse)
of renewable natural resources, regulates hydrological flows, enhances landscape aesthetics, conserves biodiversity, and contributes towards the socio-economic viability of rural areas (Renting et al., 2009). Many of these services are not priced and appropriately valued within market economies, and consequently such public goods must be supported by government intervention. For this reason, policies such as the agri-environment schemes discussed earlier, have been devised to pay farmers for producing these valuable services.

In this context, the multifunctional role of agriculture has become a political issue, seen by some as a useful means of ensuring the supply of important countryside goods, and by others as a dubious mechanism for covertly subsidising agriculture (Potter and Tilsey, 2007). EU payments to farmers for the provision of a range of countryside services, and the concept of multifunctionality, have found resonance among some participants within the World Trade Organization debate on agricultural market liberalisation. It is expected that EU and UK policy will continue to target financial support for agricultural practices that deliver countryside services, rather than subsidising food and fibre production.

The concept of multifunctional agriculture accords with the recognition that environmental policy needs to take an ecosystems approach (Defra, 2007). Attempts to produce environmental accounts for agriculture in the UK confirm the range of positive and negative ‘external’ impacts that agriculture has on the environment (Pretty et al, 2000; Pearce and Hartridge, 2001; Environment Agency, 2002; Eftec and IEEP, 2004). Estimates for 2007 (Jacobs et al, 2008) show that UK agriculture generates a net positive environmental value of around £650 million per year, although this probably significantly underestimates the value of managed landscapes. But agriculture is also associated with damage from greenhouse gas emissions estimated at £2.07 billion per year, or £37 per capita of the UK population. Future UK government and EU policies are likely to financially reward the provision of ecosystems by an incentives approach to public good provision, and punish the production of negative externalities such as pollution and natural resource degradation by punitive polluter-pays taxes.

5.2 Future agricultural land use: the case of England and Wales

A number of studies have explored alternative futures for agriculture in the UK, with implications for land use. An example of how farming and land use could change as a result of changes in the drivers affecting the demand for agricultural commodities and land management is contained in Morris et al. (2005). Possible future scenarios for agriculture in England and Wales were drawn up through to 2050. These were based on those used by the Foresight Programme (Berkhout et al., 2002, OST 2002), in which futures are distinguished in terms of social values and governance. Four scenarios, World Markets (WM), Global Sustainability (GS), National Enterprise (NE)
and Local Stewardship (LS) were used to define possible agricultural futures, recognising the dominant influence of the agricultural policy regime as a key driver of agricultural change (Table 7). A ‘Business as Usual’ case was included to represent a continuation of the existing regime.

Table 7: Links between Foresight and Agricultural Policy Scenarios

<table>
<thead>
<tr>
<th>‘Foresight’ Scenario</th>
<th>Agricultural Policy Scenario</th>
<th>Intervention regime</th>
</tr>
</thead>
<tbody>
<tr>
<td>Business as usual (BAU)</td>
<td>Baseline</td>
<td>Moderate: Existing price and income support, export subsidies, with selected agri-environment schemes</td>
</tr>
<tr>
<td>Global Sustainability (GS)</td>
<td>Global Sustainable Agriculture (Reformed CAP)</td>
<td>Low: Market orientation with targeted sustainability ‘compliance’ requirements and programmes</td>
</tr>
<tr>
<td>National Enterprise (NE)</td>
<td>National Agricultural Markets (Similar to pre-reform CAP)</td>
<td>Moderate to High: price support and protection to serve national and local priorities for self sufficiency, limited environmental concern.</td>
</tr>
<tr>
<td>Local Stewardship (LS)</td>
<td>Local Community Agriculture</td>
<td>High: locally defined support schemes reflecting local priorities for food production, incomes and environment</td>
</tr>
</tbody>
</table>

(Source: Morris et al, 2005)

Informed by an analysis of historical trends, and drawing on literature and expert opinion (Sylvester Bradley and Wiseman, 2005; Morris et al, 2005), estimates of crop and livestock yields were derived for the scenarios. Commodity prices, the use of production inputs including management expertise, farm size, and the adoption of gene technology were all assumed to be positively correlated with yields, whereas input prices, environmental regulation, adoption of organics and business uncertainty were perceived to have a negative association with yields. These influencing factors were then mapped out for each scenario. Scenario assumptions were also developed for the major drivers of demand such as changes in demographics and income, dietary trends, and demand for bio-energy.

The resulting estimates of demand for agricultural commodities to be met from domestic sources in 2050, inclusive of bio-energy crops, are shown in Table 8, expressed as a percentage of those for 2002. It is noted that demand for domestic produce is lower under the BAU and WM scenarios than in others, although details vary, reflecting the greater proportion of imports.

Table 8: Estimated change in demand for agricultural commodities to be met from domestic sources for a Business as Usual (BAU) and four contrasting governance and social value scenarios for 2050 (2002 =100)

<table>
<thead>
<tr>
<th>Scenario</th>
<th>BAU</th>
<th>World market</th>
<th>Global sustainability</th>
<th>National Enterprise</th>
<th>Local stewardship</th>
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</thead>
</table>

24
The analysis provides a number of useful insights. Land use modelling involving an optimisation process (Annets and Audsley, 2002) derived commodity prices that are sufficiently attractive to farmers to balance domestic demand and domestic supply, assuming likely levels of imports for each scenario. As expected, prices are higher under scenarios which have the greatest protection from imports and a high degree of self sufficiency. Commodity prices for cereals, oil seeds and sugar beet are generally higher where energy crops are included in scenarios than when they are not. Quantities and prices for protein crops fall as a consequence of competition from oil seed residues in animal feed markets. Under BAU, because of increased yields and increased imports, cereal prices fall to 60 per cent of 2002-4 prices, and sugar beet prices are more than halved. For the assumed WM scenario, there is a long-term decline in most commodity prices in the face of competition from imports.

The GS scenario shows moderate increases in demand for cereals and oil seeds relative to the current situation and BAU. As a consequence, prices are strong, increasing by 50 per cent in the case of cereals. The demand for oilseed rape cannot be met from domestic sources. Under NE, there is strong demand for a broad range of commodities to be met from domestic sources. Under LS, prices are high because of persistent supply deficits in cereals and oil seeds, mainly attributable to low yields. It is likely there would be pressure to increase yields or imports.

<table>
<thead>
<tr>
<th>Crop</th>
<th>2002</th>
<th>2003</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wheat</td>
<td>117</td>
<td>98</td>
<td>137</td>
<td>142</td>
<td>129</td>
</tr>
<tr>
<td>Barley</td>
<td>112</td>
<td>93</td>
<td>113</td>
<td>134</td>
<td>103</td>
</tr>
<tr>
<td>Oilseed rape</td>
<td>172</td>
<td>153</td>
<td>212</td>
<td>186</td>
<td>184</td>
</tr>
<tr>
<td>Sugar beet</td>
<td>80</td>
<td>67</td>
<td>70</td>
<td>134</td>
<td>120</td>
</tr>
<tr>
<td>Potatoes</td>
<td>98</td>
<td>82</td>
<td>108</td>
<td>156</td>
<td>146</td>
</tr>
<tr>
<td>Peas</td>
<td>38</td>
<td>9</td>
<td>22</td>
<td>124</td>
<td>185</td>
</tr>
<tr>
<td>Beans</td>
<td>38</td>
<td>9</td>
<td>22</td>
<td>124</td>
<td>185</td>
</tr>
<tr>
<td>Beef</td>
<td>134</td>
<td>119</td>
<td>106</td>
<td>155</td>
<td>135</td>
</tr>
<tr>
<td>Dairy (milk)</td>
<td>102</td>
<td>81</td>
<td>104</td>
<td>115</td>
<td>142</td>
</tr>
<tr>
<td>Sheep meat</td>
<td>118</td>
<td>140</td>
<td>119</td>
<td>174</td>
<td>119</td>
</tr>
<tr>
<td>Pork</td>
<td>130</td>
<td>161</td>
<td>213</td>
<td>180</td>
<td>151</td>
</tr>
<tr>
<td>Chicken meat</td>
<td>131</td>
<td>144</td>
<td>151</td>
<td>147</td>
<td>131</td>
</tr>
</tbody>
</table>

(source: Morris et al, 2005)
These possible futures have major implications for land use. Figure 10 shows the proportion of total potentially suitable land that is used for intensive farming under the future scenarios for 2050 compared with the current (2002) case (Figure 10 includes energy cropping). Land requirements vary between scenarios. Land use declines as a percentage of current land use under WM, BAU and NE. It falls to 65 per cent of current use under the WM scenario, with the greatest release of land in areas currently dominated by cereal production and grassland for dairying. However, there is insufficient land to meet the demand for agricultural commodities under GS and LS, partly because of high demand for energy crops under GS, and the relatively low yields under LS. Pressure on land in the lowlands puts pressure on the uplands, which deliver that part of domestic demand for livestock products that is not met by the lowland sector. Stocking rates in the uplands typically fall by 30 per cent to 50 per cent in some regions under scenarios such as WM, which also result in a release of lowland farmland. Under LS, however, a shortage of capacity in the lowlands increases pressure on the uplands and leads to a theoretical doubling of upland stocking rates.

The results of this horizon-scanning exercise must be treated with caution. But they show how future land use and the intensity of land management could vary with changes in national and global circumstances that affect the demand for, and supply of, agricultural products, as well as the other services provided by land. Recent policy changes suggest a move towards the Global Sustainability scenario, which promotes internationally competitive agriculture which has a commitment to the protection of the environment, as well as to vulnerable rural communities. With high international prices for...
food, and an increase in domestic biofuel production, this scenario suggests a continued high demand for the use of land for farming in the UK.

5.3 Other views on future land use

There are a limited number of studies that project the pattern of future UK agricultural land use. These studies often suggest only the broad impact of future agriculture, such as Sutherland et al. (2008), where the possibility of agricultural intensification was identified as a possible threat for long-term ecological conservation in the UK (2008).

The Centre for Rural Economic Research (2004) used literature review and expert judgement to estimate the likely changes in agricultural land use across England and Wales to 2015 under a Business as Usual Scenario but allowing for the Agenda 2000 reforms. Broadly it predicted that the area of agricultural land would decline by 3 per cent in England and Wales between 2002 and 2015. Within this, there would be a 10 and 2 per cent reduction of temporary and permanent grassland respectively. The agricultural area is projected to decrease over the period in all regions, but most quickly in the South East (5 per cent) and Eastern regions (3 per cent) and slowest in the North East (2 per cent) and Yorkshire and Humber (2.5 per cent).

The same report predicted a reduction in output from most livestock sectors. The beef herd was reduced by 15 per cent between 2002 and 2015, and dairy production declined by 20 per cent over the period. Pig and sheep numbers were down over the period by 10 and 6 per cent respectively. Only poultry numbers were projected to increase, by 8 per cent. In terms of crops, wheat and oats production were projected to increase by 11 and 2 per cent, with all other cereals remaining stable across the period. The area of protein crops was predicted to remain constant. Potato output was projected to decrease by 10 per cent while oilseed rape and maize output were projected to increase by 15 and 30 per cent. There was a projected fall in the output of most horticultural crops by 20 per cent over the period, with field vegetable output 19 per cent down and fruit down by 20 per cent. Farm woodland is projected to increase by 17 per cent.

Other projections of the long-term land use implications of agricultural change have been made at a European scale. These have mostly been scenario based studies, which have attempted to project possible land use patterns under different trajectories of socio-economic and environmental development. Several studies have used the SRES scenarios (similar to those described in Table 6), which include a set of qualitative descriptors developed by the IPCC (1994). Rounsevell et al (2005) and Ewart et al (2005) both used these scenarios in combination with a simple supply/demand model which calculates land use change given relative changes in the demand for agricultural commodities and the productivity of agriculture. This approach was based on a set of assumptions regarding climate change, economic
development and agricultural technology advancement. The model findings from Ewart et al (2005) predicted that at the EU level, increases in productivity would outstrip growth in demand. Based on these results, Rounsevell (2005) projected that large areas of land would be taken out of agricultural production, with surplus land moving into urban, forestry and recreational uses. They view this as being consistent with previous land use trends, where, even with subsidies, the area of agricultural land in Europe decreased by 13 per cent between 1960 and 2000.

Studies by Meijl et al. (2006) and Eickhout et al. (2007) use the GTAP econometric model to determine land use change across the EU under the SRES scenarios. They found that the area of arable land decreased under scenarios depicting liberalised agriculture. This area remained stable over the period where CAP offered some protection to agricultural production. Land moves from arable to livestock production in the liberalised scenarios, as demand from developing countries incentivises the production of meat. The study concluded that the loss of agricultural land would be minor, although there would be a relative shift in the profitability of some sectors. Arable land could be used for biofuel production, maintaining livelihoods in this sector, while liberalisation could cause a “collapse” in the EU sugar sector.

A modelling exercise by Verburg et al. (2006) used the SRES scenarios to predict land use change, this time for the period 2000-2030. They predicted a high level of abandonment of agricultural land in the future, ranging from 2.5 to 13 per cent of the agricultural area of the EU-15 in 2000. This abandonment was more pronounced for the scenarios where agriculture is exposed to a liberalised world market. This loss would be more pronounced near large urban conurbations, where there is pressure for urban growth.

The general findings from this range of forecasting studies are that land in the UK will continue to move out of agriculture, because of demands for other uses or because some types of farming are no longer viable. However, this outlook depends on demands from the global market and the viability of farming. Most horizon scanning studies, conducted before the global food price spikes of 2007/08, predicted some degree of agricultural land abandonment in the UK and EU under a liberalised world market regime, in response to falling real prices for raw food. But they also recognise that higher commodity prices might arise, caused by strong global demand for food and biofuels, and possible constraints on some types of intensive farming. Under such conditions, there could be strong demand for agricultural land in the UK, producing for domestic needs or for export. As we mentioned above, more recent FAO/OECD forecasts predict strengthening food and bio-energy prices over the next 15 years or so. These could provide sufficient incentives for UK farmers, especially those with comparative advantage in relatively large scale, intensive farming systems.
6 Conclusions

This review has argued that future land use in the UK is likely to be shaped by two main forces: agricultural and environmental policy and the market for agricultural and food products. There may in future be a clearer distinction between agricultural policy and rural environment policy.

It seems likely that future policy will be mainly directed to non-market issues of natural resource and environmental protection and the provision of environmental services. Future food production and its associated land use pattern will be largely determined by economic forces operating in the food market and the price signals they send. Given reform of the CAP and the decoupling of support from farm production, additional food production in the UK and elsewhere in Europe will probably be stimulated by the market rather than by policy. In this respect, EU farmers will respond to changes in product prices, input prices and profitability opportunities, and the aggregate impact of their behaviour will determine whether crop and livestock outputs increase, fall or remain constant.

Policy will primarily be directed to environmental impacts, including the need to meet demanding targets for improved water quality, atmospheric pollution containment and biodiversity. The key contemporary concerns of climate change, sustainability, maintenance of the natural resource base and future food security should be seen in this context. Food security, self-sufficiency and import penetration will be driven by forces operating in global food and agricultural markets. Environmental targets will be achieved by largely non-market, EU and UK government policy.

Policy will also affect land use via the technologies used in future agricultural production (see Burgess and Morris, 2009). Future farming will be determined in part by technology which, in turn, depends upon Research and Development (R&D). Investment in R&D will continue to be made in both the public and private sectors. The former is mainly driven by public interest in topics such as environmental protection, food quality and food safety, and the latter by business opportunities. Decisions made today in private and publicly-funded research organisations have an important influence on the technologies which will be available to farmers in the future.

It will probably continue to be a valid use of public funds to maintain and develop the knowledge and technological capacity that UK agriculture needs to cope with climate change or food security. For example, the permissible roles and regulation of GM crops and of pesticide use could have important impacts on land use (see Burgess and Morris, 2009).

A range of plausible futures each have their own implications for the role of agriculture and rural land management. Much depends on a combination of
UK national demographic and economic factors, and on global conditions as they shape the incentives to farmers in the UK. It seems likely that over the next 50 years, the UK's land area will be required to deliver an increasingly diverse range of private and public goods to meet growing human needs and aspirations. This will require a balance of policy-driven goals and market-driven forces. In particular it will require a much improved understanding of the trade-offs between food production and environmental goals, and of the institutional arrangements required to achieve a balance of economic, social and environmental outcomes.

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