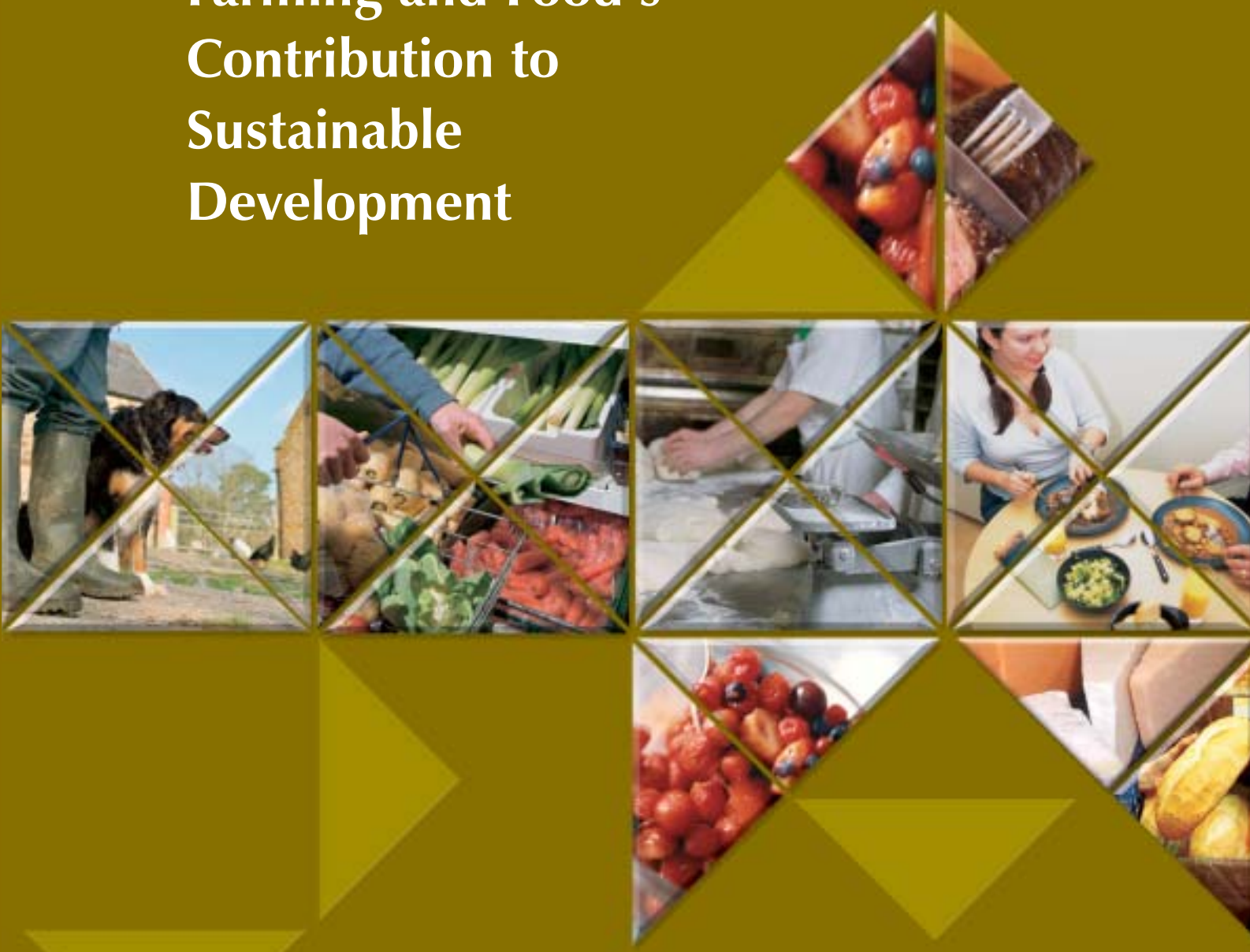
Farming and Food's Contribution to Sustainable Development



Economic and Statistical Analysis

SUSTAINABLE DEVELOPMENT

Farming and Food's Contribution to Sustainable Development

Economic and Statistical Analysis

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These papers have been prepared by economists and statisticians in Defra. The second paper – Using Economic Instruments – has been prepared jointly with economists from H.M. Treasury and it provides the report of the first stage of work on this subject which was announced in Budget 2002.

The three papers have benefited from many helpful comments on earlier drafts; the usual disclaimer applies.

Farming and Food's Contribution to Sustainable Development: The Current Situation and Future Prospects

A Introduction and summary

1. Over the last 50 years a wide range of underlying economic and social trends have profoundly shifted the contribution which food and farming makes to the three pillars of sustainable development – economic, environmental and social. These shifts in contribution have in turn shifted the nature and focus of the public policy concerns which arise in these sectors.

2. In relation to economic sustainability, 50 years ago these issues were shaped by:

    - the importance of food in households' budgets in a potentially unstable political framework for international trade;
    - the importance of agriculture as a sector of the economy, particularly in depressed rural areas; and
    - by agriculture's contribution to a trade balance constrained by fixed exchange rates.

3. The underlying economic and social changes of the last fifty years have reduced the role of agriculture in the economy and diminished the significance of these issues. Today, the key issues of economic sustainability relate to:

    - concerns with competitiveness and farm incomes;
    - concerns relating to the significant costs which present policies – particularly the CAP – impose on the rest of the economy; and
    - concerns with the costs which animal diseases impose on the economy.

4. At the same time that long term social and economic trends have shifted food and farming's contribution to economic sustainability, so there has also been a similar shift in its environmental contribution. Rising incomes, with collateral shifts in tastes and preferences, mean that the countryside environment – and countryside leisure activities – have become significantly more important to consumers. At the same time, developments in production methods, reinforced in some cases by policy incentives, mean that farming has been less likely to sustain the features of the countryside which are valued. And, similarly, it has also been more likely to cause damage to the countryside environment through pollution or over-use of natural resources.

5. Issues of environmental sustainability also concern the food chain beyond agriculture, through processing to retailing and food service. Underlying economic trends have shifted consumption patterns toward foodstuffs which require more processing and packaging whilst supply structures have become more geographically dispersed. At the same time there are rising concerns about the packaging and waste and the use of natural resources which have all been increased by these underlying changes in economic organisation.

6. Historically, the main contribution which food and farming made to social sustainability was through its central contribution to rural economies, at a time when many of these

were depressed by the long term decline in agriculture and other traditional industries. Today, this direct contribution to rural economies is less important than food and farming's indirect contribution, through sustaining the countryside environment upon which the growing countryside leisure sector, and rural businesses more generally, depend. At the same time as agriculture's role in the rural economy has declined, a combination of underlying economic and social trends has resulted in different sources of economic growth in many rural areas. The result has been sustained growth in population and employment in most of rural England over the last several decades, underpinned by the distinctive advantages of the countryside. As a consequence, most rural economies have been able to adapt reasonably successfully to the long term decline in agriculture; but not all rural areas have shared in this growth, and even in otherwise prosperous rural areas there are pockets of deprivation which remain.

7. Food and farming also makes a broader social contribution in relation to public health, in particular through people's diet and through workplace safety, and in relation to animal welfare.

8. One common theme underlying this analysis is the importance of competitiveness – particularly in farming – not just as a key to economic sustainability but also as an essential foundation for the environmental and social contributions which food and farming make. In agriculture, the UK's productivity has fallen back from a position where it was above the EU average thirty years ago, but where it lags behind the high growth EU countries today. The UK's slow productivity growth reflects slower re-structuring in UK agriculture, as compared with most other EU countries, and it is associated with lower levels of skills, slower innovation and transfer of new technologies and weaknesses in business structures and organisation. Nevertheless, there is a lot of variability in the productivity performance of UK farming. And the many first rate businesses which exist show what might be achieved across the sector as a whole.

9. In the food and drink sector, the UK's productivity similarly lags behind many of our competitors, reflecting low investment, lower levels of skills, and weaknesses in innovation and technology transfer.

10. Improved competitiveness in agriculture is important to increasing the present low level of farm incomes in the UK, which have been depressed by the decline in the value of the euro against the pound, weak world commodity markets and animal disease outbreaks. Most current forecasts of the underlying macroeconomic drivers of farming profitability – in particular, developments in commodity markets and exchange rates – suggest that only a modest recovery is likely from the present low levels of farm incomes unless it is possible to improve competitiveness.

11. The structure of the paper is as follows. The next three sections look in turn at each of the three pillars of sustainable development and draw upon economic and statistical evidence to track the key changes in farming and food's contribution – including evidence upon a broad range of costs and benefits which result from current policies and practices. Of course, there is a significant interdependence between economic, environmental and social aspects. The final two sections of the paper look at competitiveness and the implications for farming's business prospects.

B Economic sustainability

12. This section looks in turn at

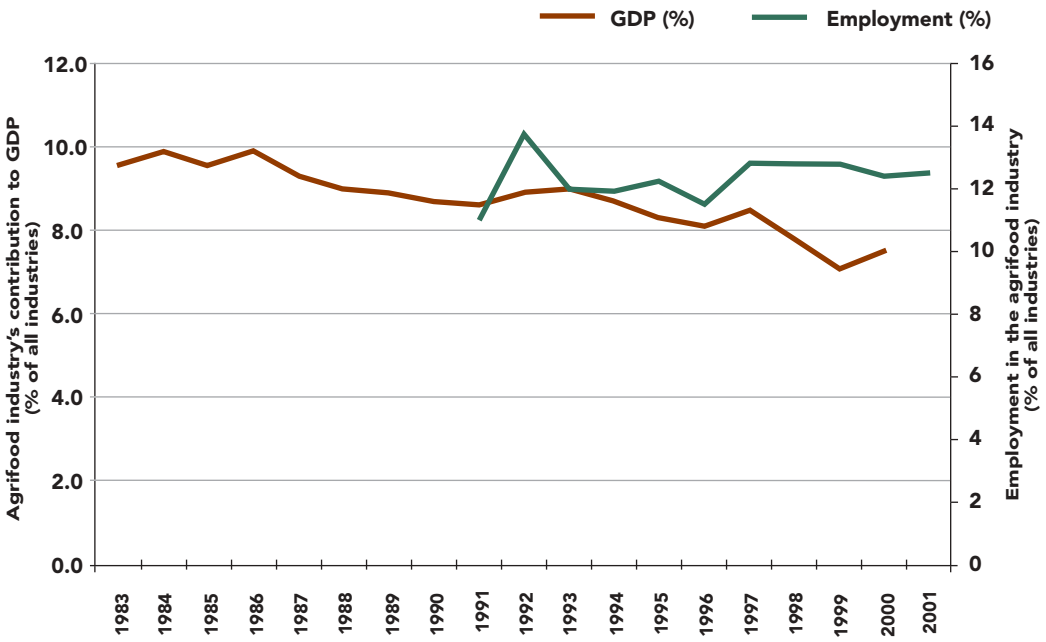
- farming and food in the economy
- shares of value along the food chain
- trade flows
- the economic costs of the CAP
- the economic costs of animal diseases.

Farming and food in the economy

13. The agri-food sector – comprising the agriculture, fisheries, food and drink, and catering industries – accounts for broadly 8% of Gross Domestic Product (GDP) in the UK and 12.5% of total employment (see Chart 1). The share of GDP and employment has declined slightly over the last 20 years (see Chart 2) principally because agriculture has declined in significance.

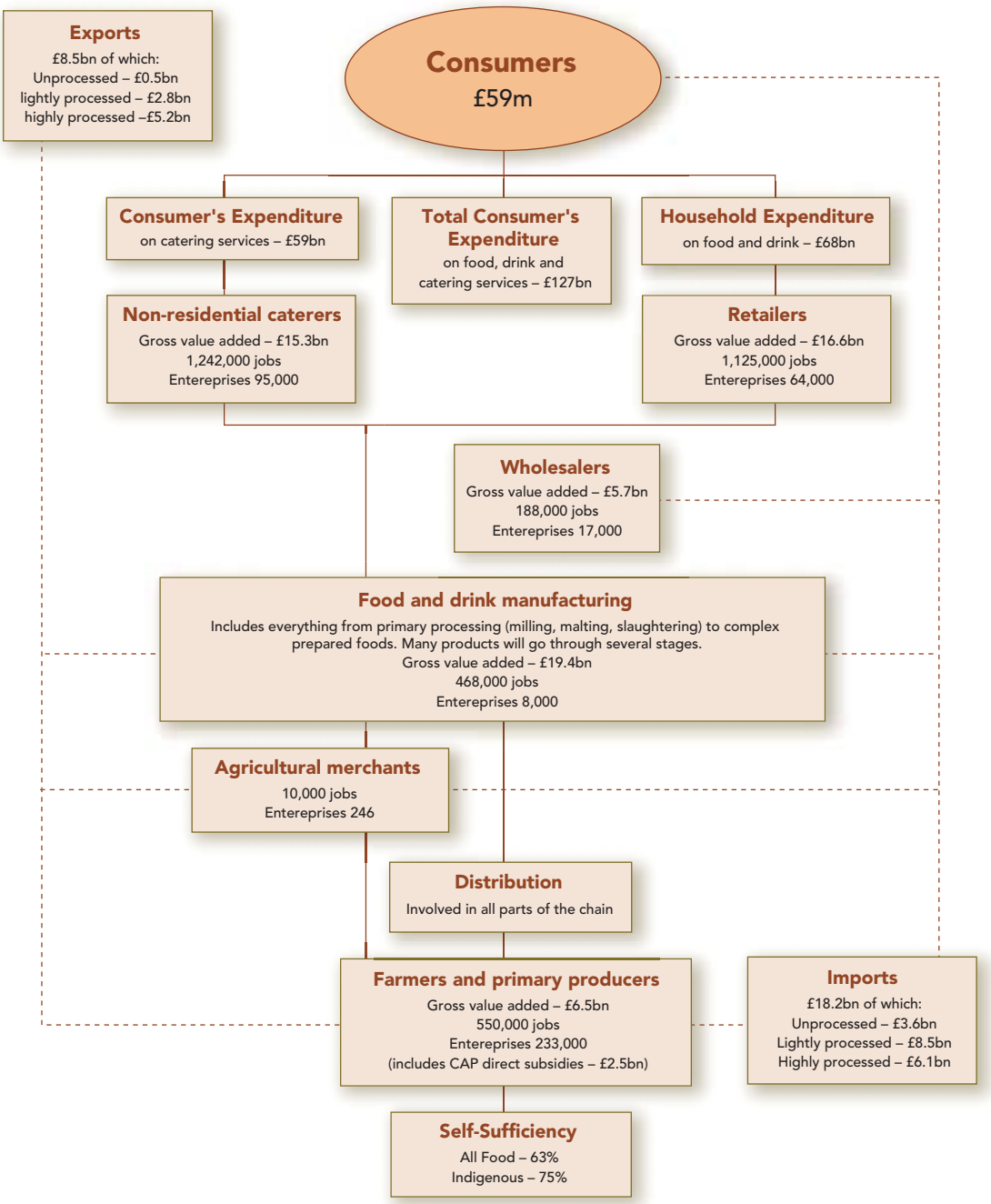
Chart 2

Employment and contribution to gross domestic product in the agrifood industry (% of all industries)



Source: Annual Business Inquiry, ONS; Annual Census of Production, ONS; UK National Accounts Blue Book, ONS; UK Sea Fisheries Statistics, Defra; Agriculture in the United Kingdom, Defra

Chart 1
The UK food chain



Sources: Economics and Statistics Directorate, Defra

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14. The last 50 years have seen a significant reduction in agriculture's share of the UK economy (see Charts 3 and 4). At the beginning of the 1950s agriculture accounted for 5% of GDP and broadly 6% of employment: today the figures stand at broadly 0.7% and 2%, although the share of employment is clearly higher in rural areas, at 4% for England. These trends are common to most developed economies and are indeed more pronounced in most other EU countries.

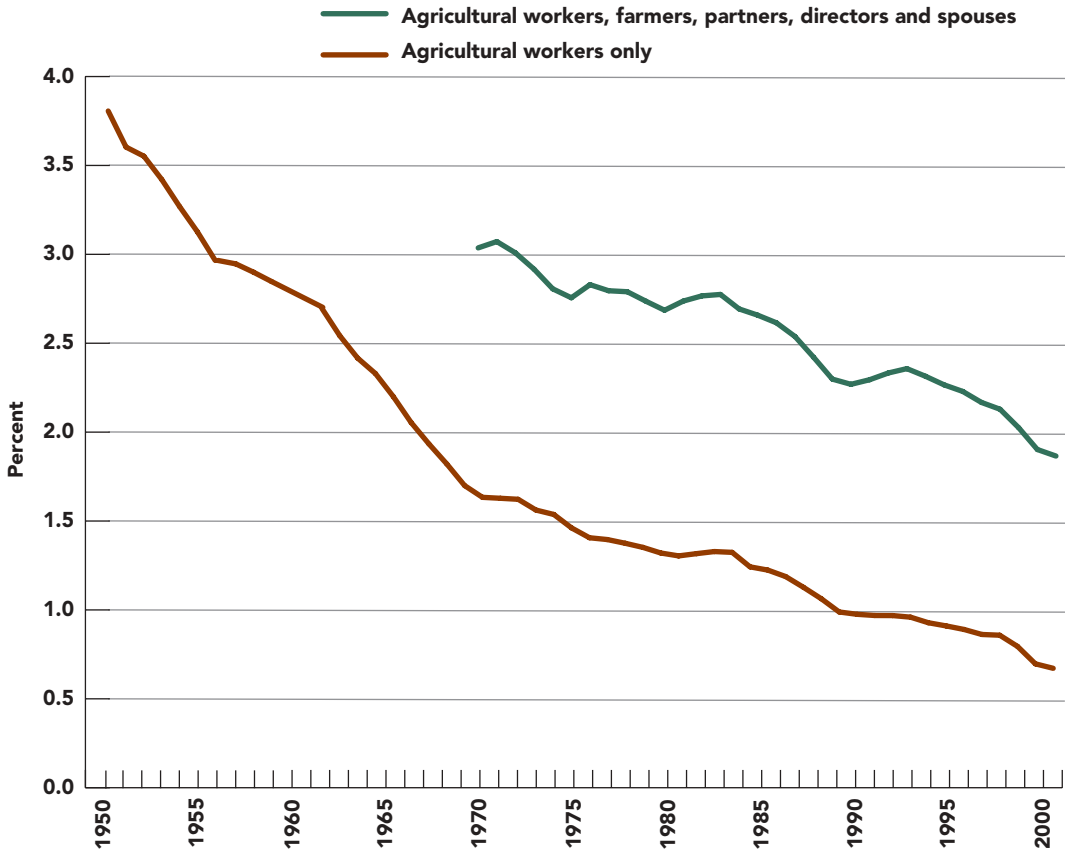
Chart 3

Agriculture's contribution to gross value added, and household expenditure on food and non-alchoholic beverages

Source: Office for National Statistics; A Hundred Years of British Food and Farming (a statistical survey); Agriculture in the United Kingdom 2001, Defra

Chart 4

Agricultural workforce as a percentage of the UK total workforce



Sources: Office for National Statistics; A Hundred Years of British Food and Farming (a statistical survey); Agriculture in the United Kingdom 2001, Defra

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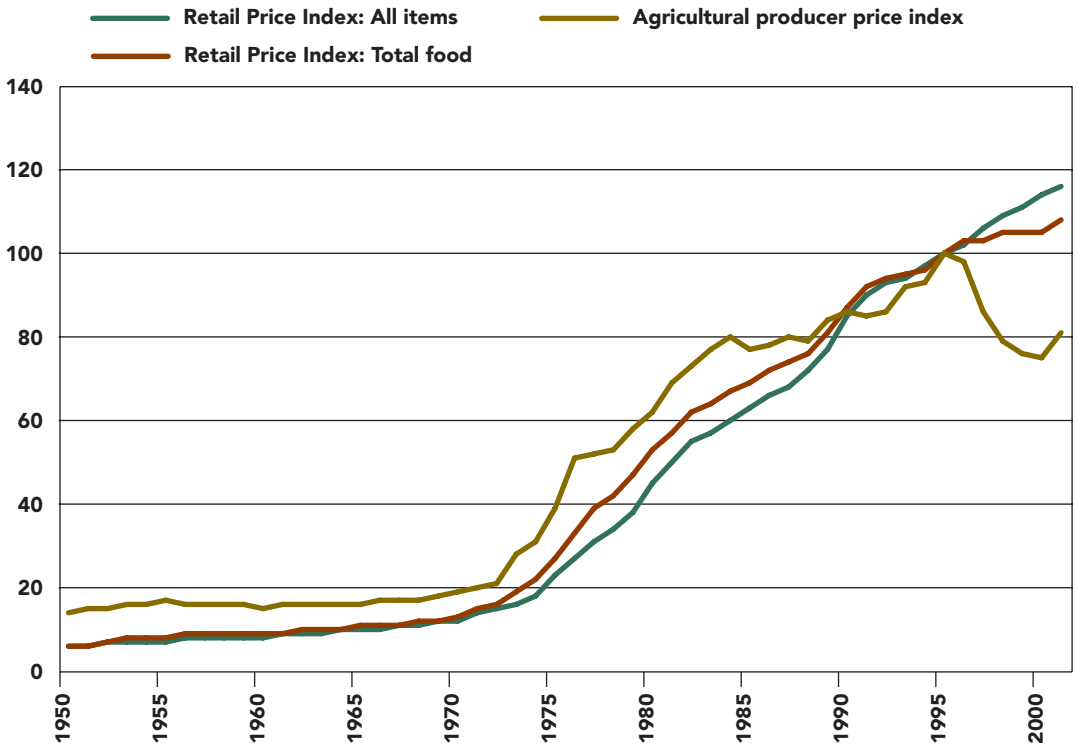
15. These trends are driven by underlying changes in consumption patterns and in technology. As consumers' incomes rise they tend to spend a smaller proportion of their family budget on food and drink (down from 30% to 10% over the last 50 years) whilst expenditure is more focussed on products where value has been added in processing and packaging. At the same time technological developments (in both the farming and transport) have reduced the prices of agricultural commodities relative to the prices for other goods and services (by around a third over the last 30 years – see Chart 5) and this means that retail food prices have also risen less quickly than the general price level (although clearly to a lesser degree, because of the range of input costs other than agricultural commodities). Trends in the prices of agricultural commodities are also shaped by policy developments; in particular, joining the Common Agricultural Policy (CAP) and subsequent reforms.

Chart 5

Prices indices (1995=100)



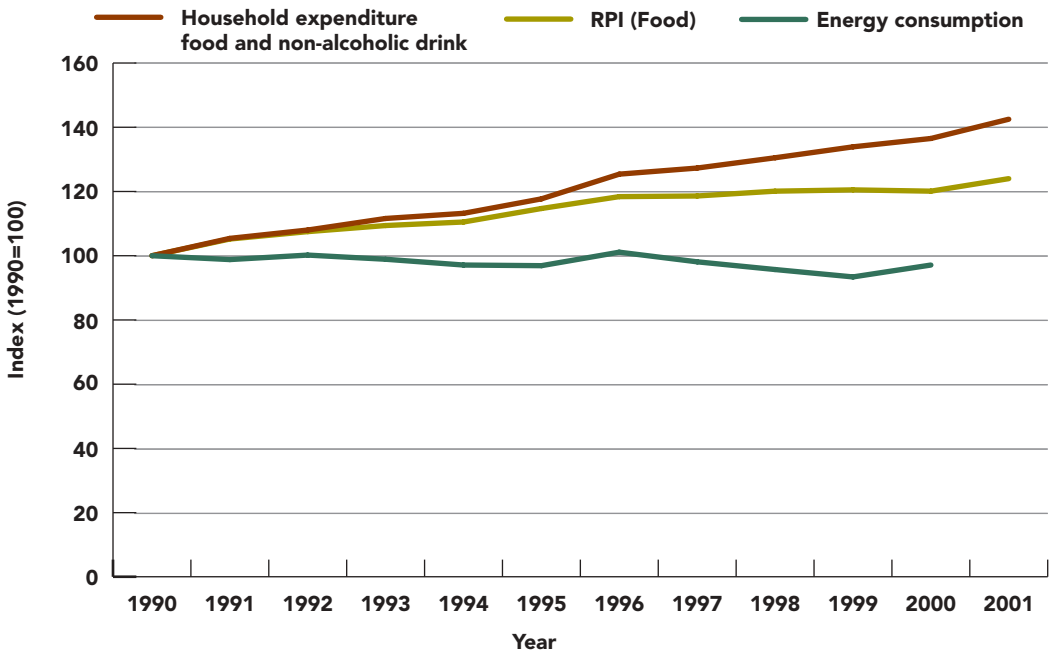
Sources: Eurostat
Statistics (C&S), Defra

Shares of value along the chain

16. These long term trends have had the effect of reducing over time the share that farmers receive of total retail spending on food. In particular, there has generally been increasing consumption of processed foods, and consequently an increase in value added beyond the farm gate. These trends are illustrated in Chart 6 which shows that consumers' expenditure on food has been rising faster than either retail food prices or physical consumption, indicating a switch toward higher value products. The implications of these trends for the farmers' share of retail spending is illustrated in Chart 7.

Chart 6

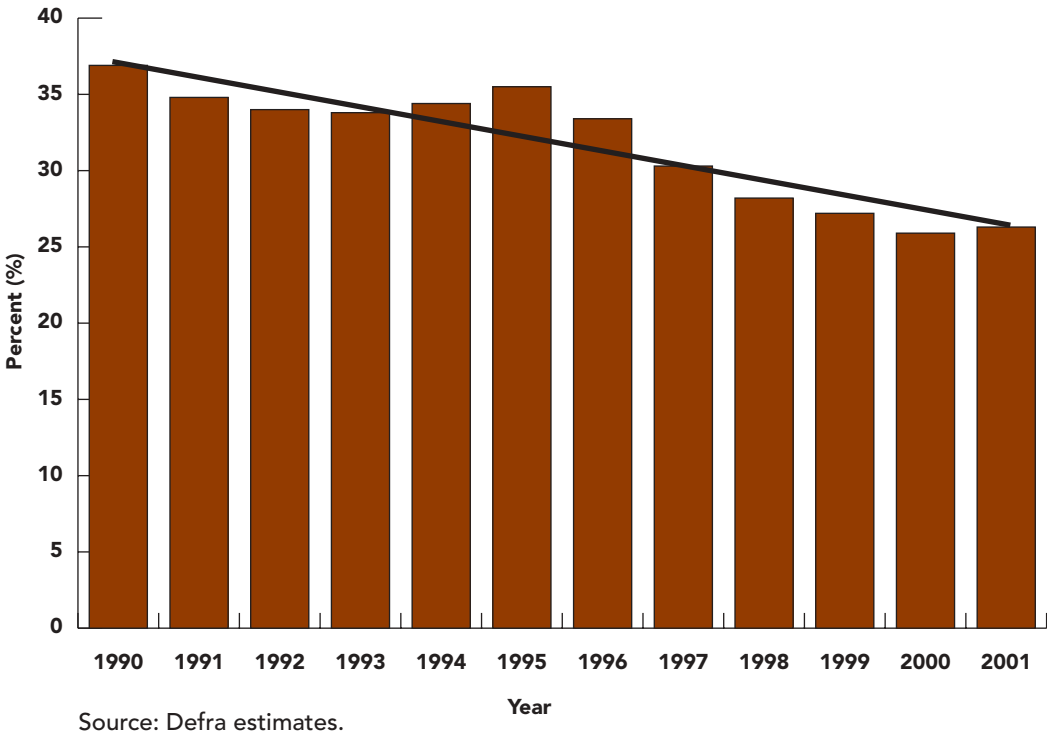
Growth in consumption and household expenditure on food and non-alcoholic drinks (1990–2001)



Source: National Food Survey (2000), Defra; Consumer Trends, ONS

Chart 7

Consumption of agricultural raw materials as a percentage of UK retail food and non-alcoholic drinks expenditure (1990-2001)



Source: Defra estimates.
Note: Black line denotes the trend line.

17. Factors that should be considered in assessing the trends in chart 7 include:

    Relative price flexibility in the food chain: changes in farm-gate prices are unlikely to produce an equal change in retail food prices because retail prices are dominated by other factor input costs.

    The exchange rate: the ups and downs of sterling during the 1990s have had a disproportionately important impact on farm-gate prices compared with the effect on other factor input prices; this means that farmers' share of retail spending has declined less rapidly than trend in the first half of the 1990s and more rapidly than trend thereafter.

    Downstream buying power: the supermarkets in particular continued to increase their share of the retail groceries market over the 1990s. A Competition Commission investigation of the supermarkets concluded that they were satisfied that the industry was broadly competitive and that, overall, excessive prices were not being charged nor excessive profits earned. Following the investigation, the Office of Fair Trading drew up a Code of Practice in order to achieve a fair and balanced trading relationship between the largest supermarkets and their suppliers.

    Imperfect transmission of changes in farm-gate prices: market imperfections may prevent changes in raw material prices entirely feeding though into retail prices but analysis of price transmission down the supply chain in UK red meat markets suggests that during the 1990s the greater part of farm-gate price changes for beef, pork and lamb (70% to 90%) were eventually passed through to retail prices (see Lloyd, T., McCorriston, S., Morgan, W, and Rayner, A (2002)). However the process was not instantaneous, averaging about four months before farm-gate price changes were fully reflected in retail prices. For the 1990s as a whole; retailers were found to be slower to cut retail prices in response to a fall in farm-gate prices than to put up prices when commodities became more expensive. However, from 1998 onwards retail prices became more responsive to changes in farm-gate prices.

    Tighter regulatory standards may impose additional costs within the food supply chain. For example, more stringent hygiene standards that abattoirs are obliged to meet are likely to have led to transportation of livestock over greater distances.

18. The evidence suggests that the key determinants of the declining share of returns to farmers in retail spending are the long term developments in the food supply chain, notably the switch of consumers to more sophisticated patterns of consumption. However underlying trends in the food supply chain over decades can be temporarily disguised or exacerbated by movements in the commodity price cycle, and the effects upon this of exchange rate movements. It seems likely though that farmers will need to move toward greater involvement in downstream value adding activities if a permanent reversal of these powerful underlying trends is to be achieved.

Trade flows

19. The reduced importance of agriculture in the economy and in household's consumption has also been reflected in trade flows: at the beginning of the 1950s food and drink still accounted for 40% of the UK's imports (see Chart 8). Today this figure has fallen below 10%, although the overall value of food and drink imports has fallen only slightly in real terms whilst imports of other goods and services have increased. Imports of a few items of food and drink, such as wine and fish, have increased (see Chart 9). In contrast, the value of food and drink exports has increased very significantly (see Chart 10). There have been increases in the exports of most commodities, reflecting both agricultural commodities and value added activities further along the chain.

Chart 8

Value of trade in food, feed and drink as a proportion of total UK trade

Sources: HM Customs and Excise
Data prepared by Statistics (Commodities & Food) Accounts and Trade, ESD, Defra

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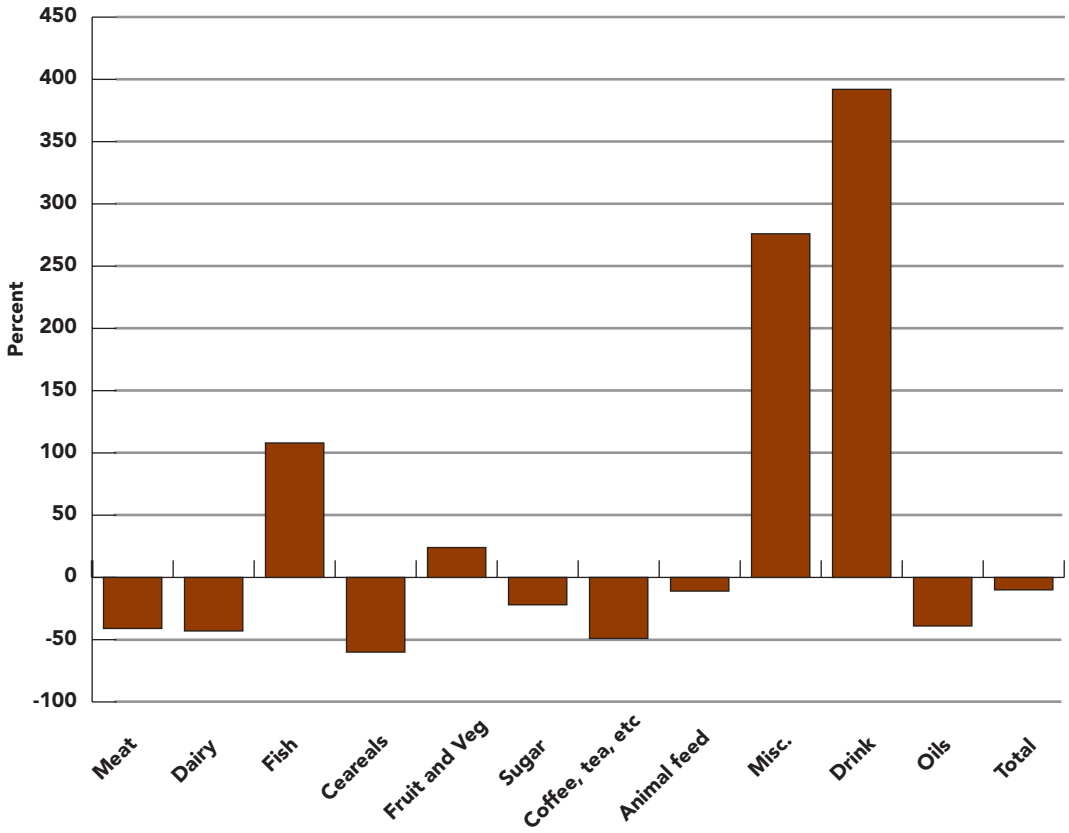
Chart 9

Percentage change in imports 1960–63 to 1999–2001: real terms



Source: H M Customs and Excise

Data prepared by Statistics (Commodities & Food) Accounts and Trade, ESD, Defra

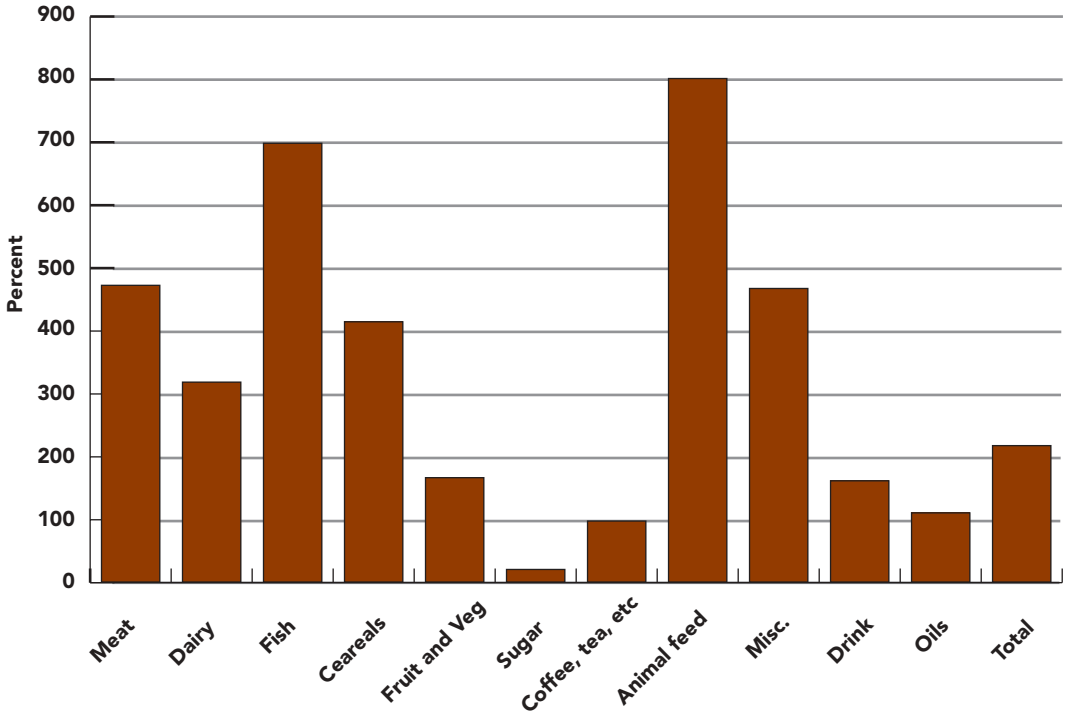
20. This strong growth in exports, coupled with a small decline in imports, means that the UK's self-sufficiency in food is considerably higher than in the 1950s (see Chart 11). In recent years, however, there has been a decline in self-sufficiency shaped by the high level of the pound/euro exchange rate and the impact of foot and mouth disease.

Economic costs of the Common Agricultural Policy

21. The CAP imposes significant costs on the European economy through the support which it provides to agricultural production. Consumers are worse off because prices are regulated above world market levels, and also because this support may weaken incentives to differentiate quality produce. And tax-payers need to finance the expenditures which are required to sustain these high prices (through buying up surplus produce or subsidising exports) as well as financing the direct subsides which are provided to agricultural production. Taken together these costs are worth nearly €90bn a year at present across the EU 15 as a whole; the corresponding figure for the UK is broadly €10bn. Reforms of the CAP, together with developments on world markets, have resulted in a significant reduction in the real value of these costs over the last ten years (see Chart 12) and a further reduction can be expected as the Agenda 2000 CAP reforms are fully implemented.

Chart 10

Percentage change in exports 1960–63 to 1999–2001: real terms

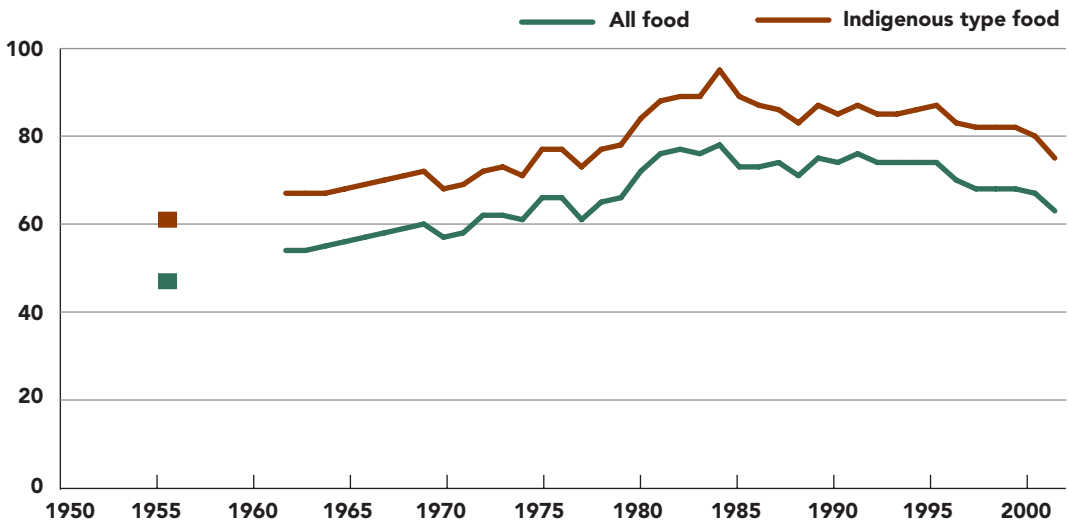


Source: H M Customs and Excise

Data prepared by Statistics (Commodities & Food) Accounts and Trade, ESD, Defra

Chart 11

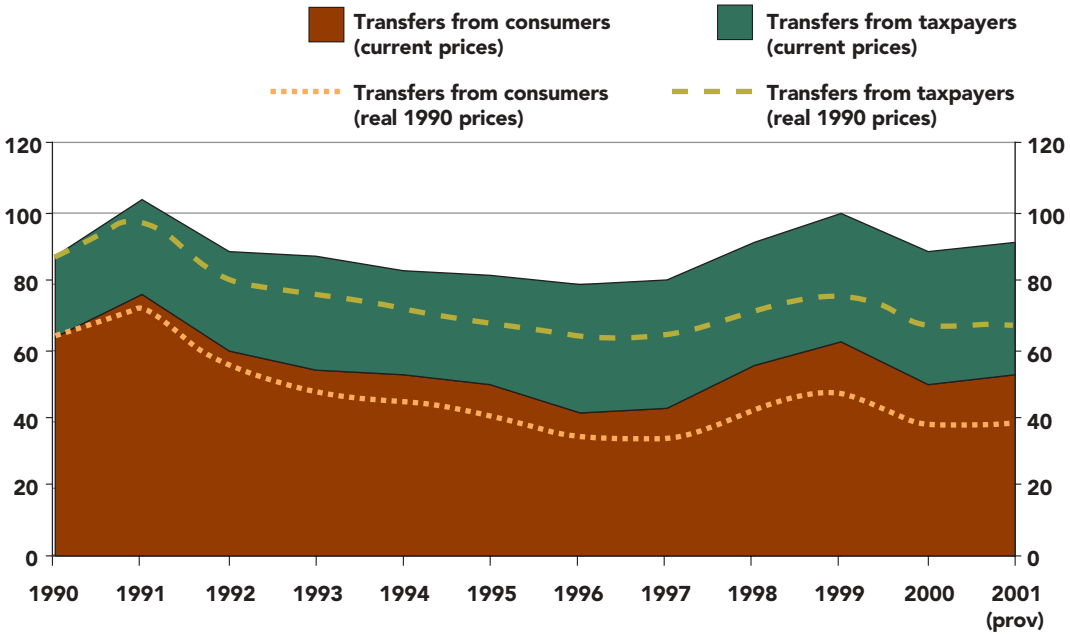
UK self-sufficiency in food as a percentage of all food and indigenous type food



Sources: Statistics (Commodies & Food) Accounts and Trade, ESD, Defra

Chart 12

Total transfers from EU consumer and taxpayers under the CAP (billion Euro)



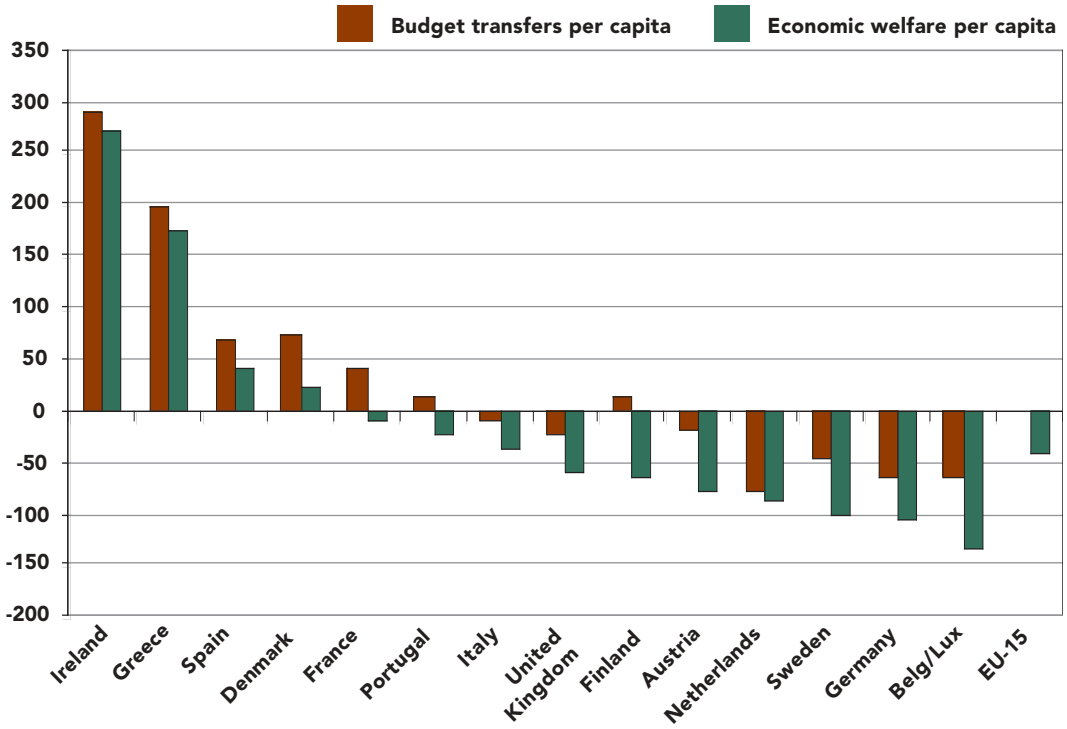
Source: Court of Auditors Report; OECD Monitoring and Evaluation Report

22. Much of these costs to taxpayers and consumers also represent additional income to farmers. However, even when this is allowed for there still remains a substantial cost to the European economy as a whole, as is illustrated in Chart 13. These costs result from holding intervention stocks, from administration costs and from substituting high cost European production in place of produce supplied from competitive world markets. In addition, there are a broader range of economic costs, which it is not possible to quantify in the chart, and which arise because the CAP has slowed productivity growth in farming, blunted market development and squeezed the market share of European food processors in world markets for value-added products. There are also costs to the environment which result from a bias towards intensive methods of production (and which are discussed further in section C).

23. The present CAP also imposes economic costs beyond Europe by distorting the commodity markets which face farmers in developing countries. For example, the Tinbergen Report (see Francois, J. (2000)) suggested that the benefits of a new World Trade Organisation (WTO) trade round in all products (that is, not just agriculture) would be worth three times as much to developing countries as what they currently receive in development aid.

Chart 13

FEOGA budget transfer and net overall economic welfare by member state 1998 (Euro per head)



Source: Defra

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24. Whilst the CAP imposes economic costs through the support of agricultural production, research studies also show that the CAP's "second pillar" support of more environmentally friendly farming – through agri-environment schemes – generally provides worthwhile value for money. The studies suggest that the public typically value the landscapes which are sustained by these schemes sufficiently highly to make the expenditure worthwhile (see Maff (2000) for a discussion of this evidence).

Economic costs of animal diseases

25. The potential costs to the economy of animal diseases are illustrated by last year's FMD outbreak. The overall costs of FMD to the food and farming sectors in the UK is estimated at broadly £3bn, with much of this cost borne by taxpayers, although there have also been loses to farmers and to other businesses along the food chain. There have also been very significant costs (of a broadly similar order of magnitude) to a range of other rural businesses as a consequence of fewer people visiting the countryside. However, much (but not all) of these latter costs have been offset by gains in other sectors of the economy as consumer spending was displaced. Nevertheless, the impact has varied widely between different parts of the country and different businesses, and consumers have been disadvantaged because they have been forced away from preferred leisure activities (for more details see Thompson et al (2002)).

C Environmental sustainability

26. This section looks in turn at:

    - farming's environmental performance;
    - costs and benefits of farming's environmental impact; and
    - environmental impacts of the broader food chain.

Farming's environmental performance

27. At the same time that long term social and economic trends have shifted farming and food's contribution to economic sustainability, so there has also been a similar shift in farming and food's environmental contribution. Rising incomes, with collateral shifts in tastes and preferences, mean that the countryside environment – and countryside leisure activities – have become significantly more important to consumers. At the same time, developments in farming technology and business practices, reinforced by incentives from the CAP and other policies, mean that farming has been less likely to sustain the features of the countryside which are valued. And it has also been more likely to cause damage to the countryside environment through pollution or over-use of natural resources.

28. Perhaps the most straightforward measure of the increasing value which consumers place on the countryside is provided by the number of visits which people make. In 2000 the number of tourist visits by UK residents was over 30m (with over a billion day visits) providing the underpinning for leisure and tourist businesses in rural areas. In a similar way, membership of organisations associated with countryside conservation provides another indicator of the significance of the countryside to the wider population.

29. The increasing importance of countryside leisure activities parallels awareness and concern about the environment and pollution as Chart 14 illustrates. Issues to do with farming and wildlife are a material part of this concern.

Chart 14

Important issues the government should be dealing with: 1986, 1989, 1993, 1996/7 and 2001

England[1] Percentages

What do you think are the most important issues the government should be dealing with?

	1986	1989	1993	1996	2001
Health/ Social Services	22	32	29	42	58
Education	14	13	17	39	43
Crime	17	17	21	19	30
Environment/ Pollution	8	30	22	15	25
Unemployment	75	26	46	28	17

Source: Department for Environment, Food and Rural Affairs

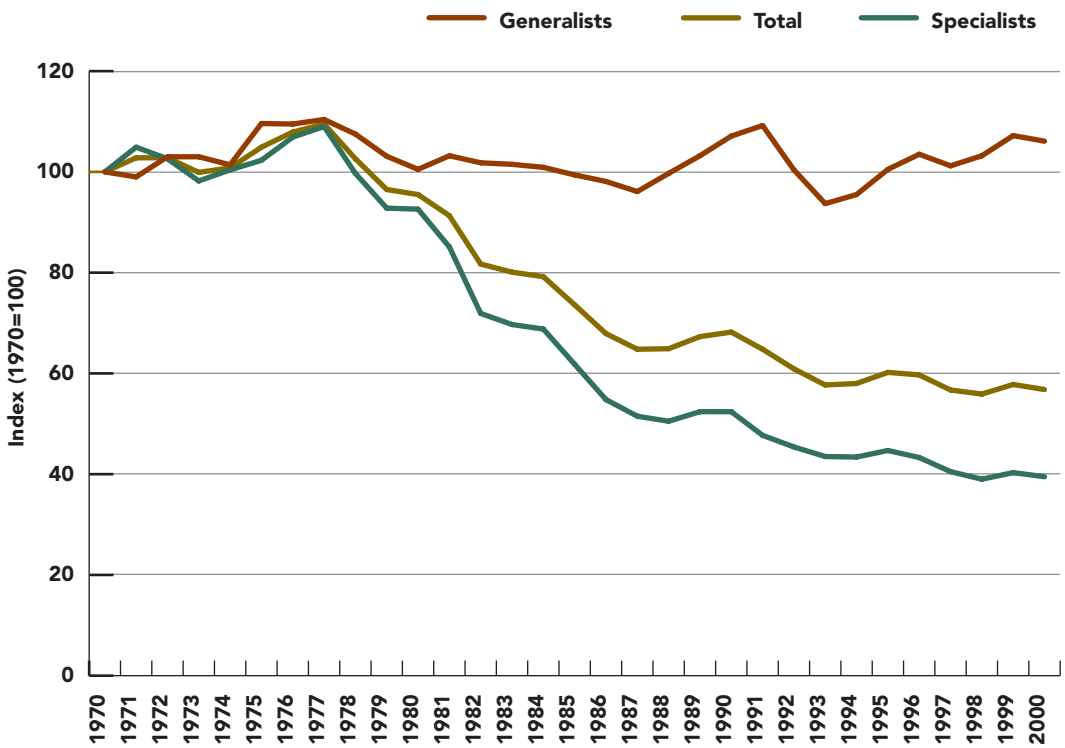
[1] England and Wales for 1986, 1989, 1993 and 1996/7

30. Whilst the public's interest and concern with the countryside environment has been increasing, technical developments in farming – reinforced by commercial incentives embedded in the Common Agricultural Policy – have tended to result in adverse trends in the state of the countryside environment.

31. A good illustration is provided by the trends in the population of farmland birds (see Chart 15): this can be regarded as a good overarching indicator of the broad state of wildlife and the countryside. The combined populations of the 20 species included in the farmland bird index have declined by nearly a half between 1977 and 1993, though they have been relatively stable since then. A number of factors have contributed to the decline, including a loss of habitat diversity and quality caused by increased specialisation in farming, the change from spring to autumn sowing for cereals (with fewer stubble fields in winter), the loss of hedgerows and other un-cropped habitats, and the use of pesticides.

Chart 15

UK Index of populations of farmland birds

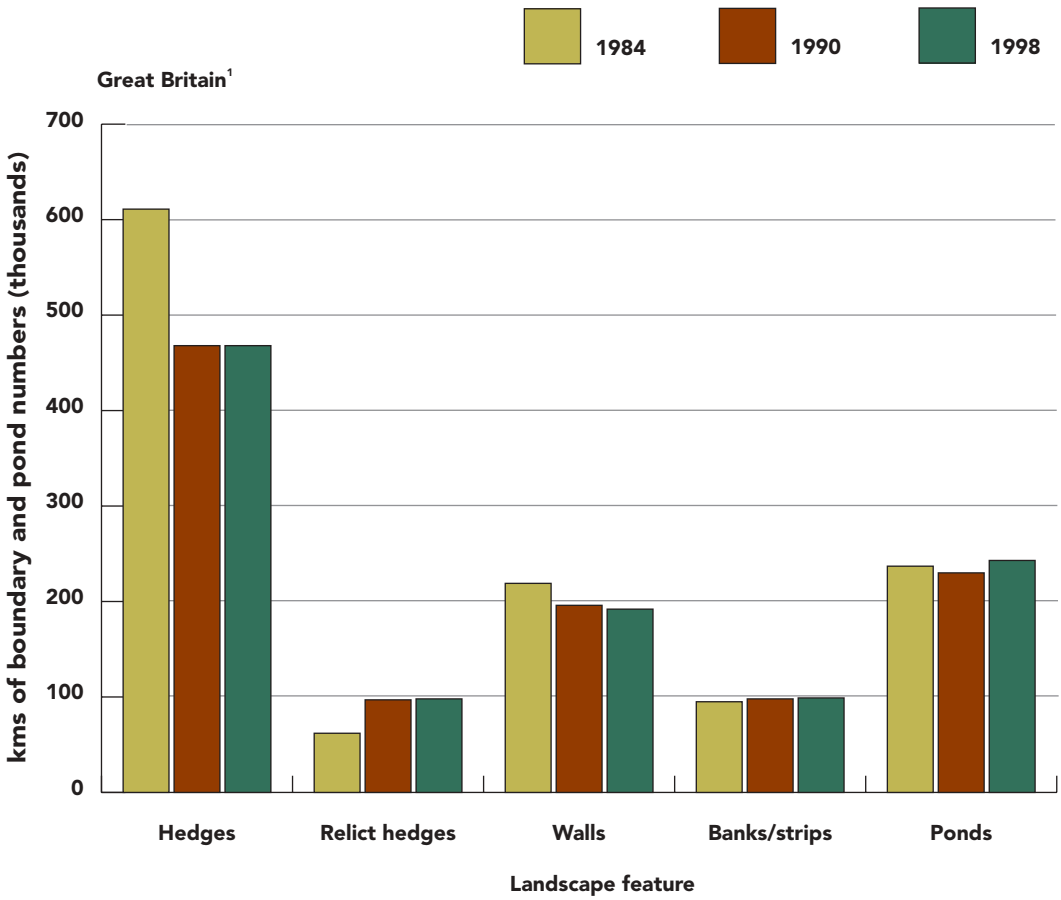


Source: Defra, BTO and RSPB

32. Countryside features – such as hedges, walls and ponds – are a valued part of the landscape, as well as providing valuable habitats. These landscape features have been on a downward trend because of their reduced cost-effectiveness in modern agriculture. Over the last ten years, however, this decline has been halted (see Chart 16). Nevertheless, the Countryside Survey 2000 showed that the condition of habitats in the wider countryside continues to decline.

Chart 16

Changes in characteristic countryside features: 1984-1998



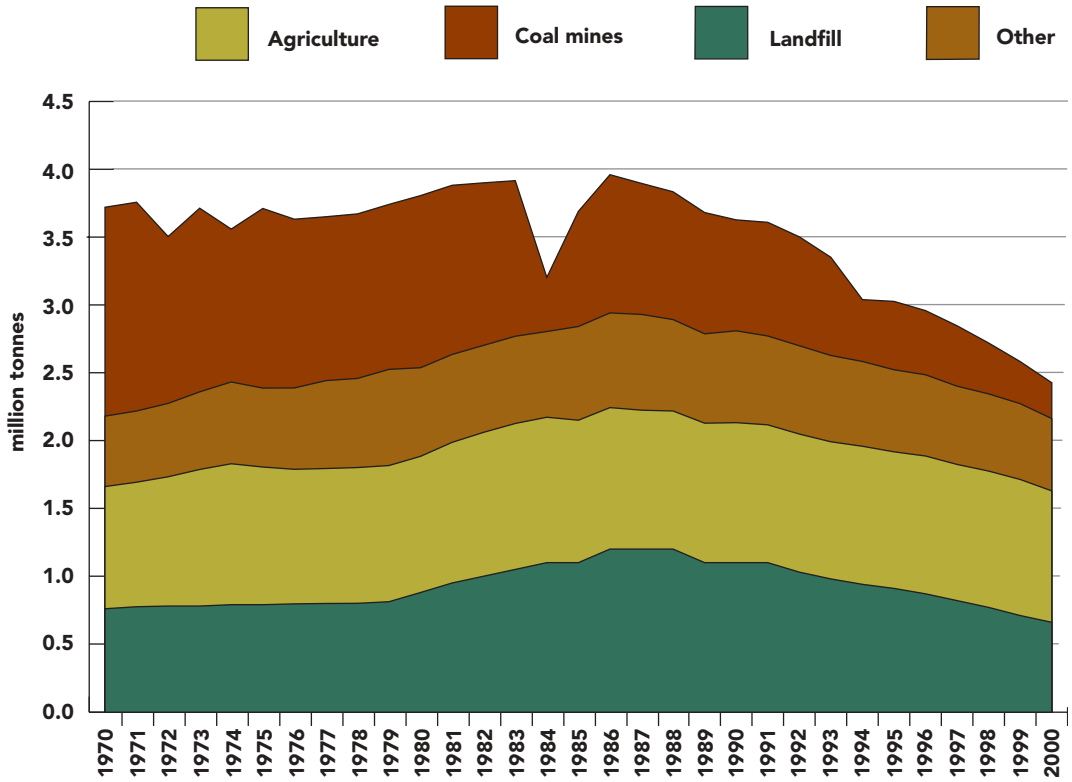
[1]except hedges, which is England and Wales

Source Defra, lowland pond survey (1996), Countryside Survey (1990), Hedgerow survey (1993), Countryside Survey (2000)

33. Agriculture is a major source of methane emissions; chart 17 shows that it contributes 40% of the total. And it also contributes 83% of the UK's ammonia emissions. Agriculture is also a material source of water pollution. Phosphate from manure and fertiliser leaks into rivers and lakes and this, together with phosphate in sediment from soil erosion, causes excessive algal growth in up to 200 freshwaters each year. Phosphate concentrations in rivers have been improving over the last ten years but nitrate concentrations (where agriculture is a major contributory source) have remained more stable (see Charts 18 and 19). In 2001, agriculture accounted for 18% of the most serious (category 1 and 2) of water pollution incidents.

Chart 17

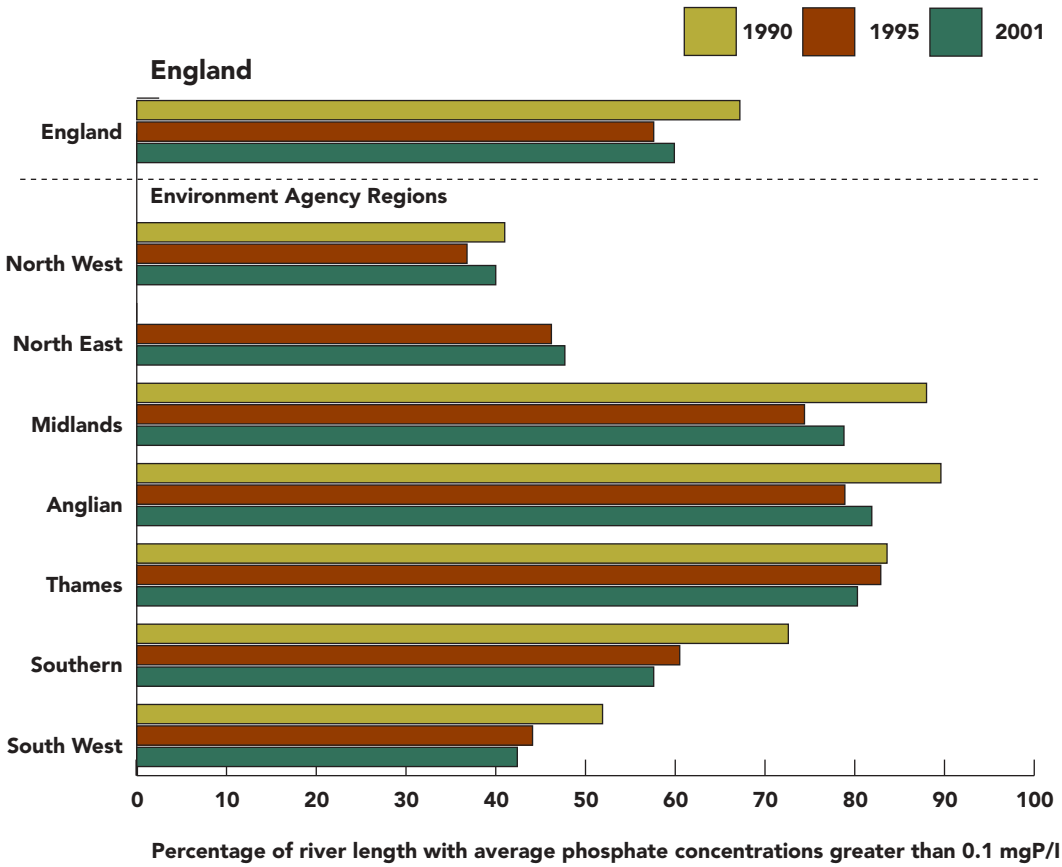
Methane emmissions by source: 1970-2000 – United Kingdom



Source: Digest of Environmental Statisics, EPSIM, Defra

Chart 18

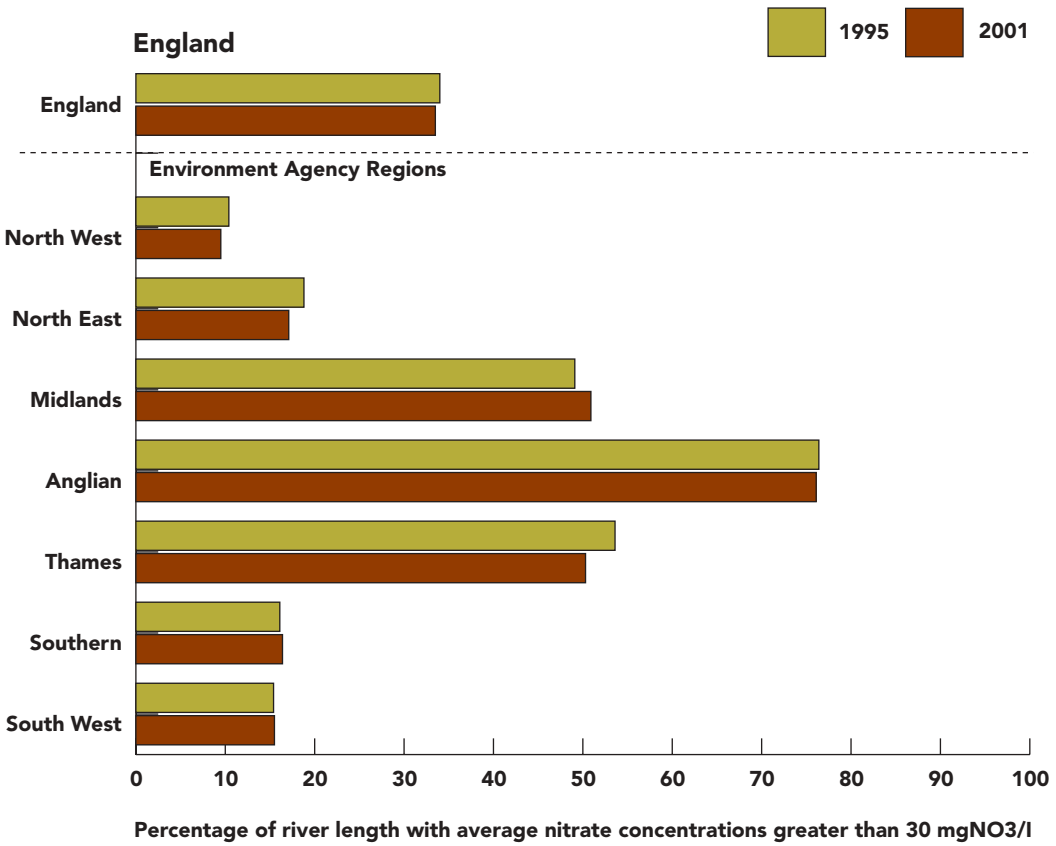
Phosphate concentrations in rivers: 1990–2001



Source: Environment Agency

Chart 19

Nitrate concentrations in rivers: 1995–2001



Source: Environment Agency

Costs and benefits of farming's environmental impact

34. Putting a value on the various contributions of agriculture to environmental sustainability – in the same way that the previous section looked at contributions to economic sustainability – is more difficult, because the impacts are not directly valued in the market place. This means that estimates of costs and benefits have very broad margins of uncertainty.

35. Even with this caveat, it is clear from the research evidence that both the costs and the benefits are substantial. Chart 20 draws together results from three studies which have estimated the costs of agriculture's negative impacts upon the environment through pollution or the over-use of natural resources. The studies show estimated costs in the range £1bn–£1.5bn (although other types of land use will also generate environmental impacts, both positive and negative). To put this in context, the value of the gross output of UK agriculture was £15.1bn in 2001 and its contribution to GDP was £4.4bn.

Chart 20

External environmental costs of UK agriculture

	Hartridge and Pearce	Pretty et al	Environment Agency
Cost Category	(£ Million)	(£ Million)	(£million)
• Damage to Natural Capital: Water	430	230	203
• Damage to Natural Capital: Air	585	1115	760
• Damage to Natural Capital: Soil	20	95	264
• Damage to Natural Capital: Biodiversity and Landscape	40	125	NA
Total	£1075	£1566	1266

Source: Hartridge and Pearce (2001)

Pretty *et al* (2000)

Environment Agency (2002)

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36. The positive environmental benefits provided by agriculture – as a bi-product of food production – include the range of environmental and cultural goods which make up the countryside landscape, the habitats embedded in the farmed countryside and carbon dioxide sinks. In relation to these environmental benefits, valuation studies which have been carried out of agri-environment schemes show that the public place a considerable value on countryside features – hedgerows, traditional field patterns and farm buildings, ponds, tracks and bridleways (see Maff (2000) for a discussion of this evidence). Chart 21 shows the results of a study which estimated the overall value of the environmental services provided by agriculture in the UK at £600m a year. A study by the Environment Agency estimated the value of the positive carbon sinks provided by agriculture at £300m a year (although these latter benefits are not included in Chart 21 because they have been netted off from the environmental costs estimated by Hartridge and Pearce).

Chart 21

Estimated external benefits of agriculture

Environmental Services	Value (£m)
• Total	595
• Agricultural Landscape	140
• Forest and Woodland	84
• Environmentally Sensitive Areas	190
• Sites of Special Scientific Interest	180

Source: Hartridge and Pearce (2001)

37. In summary, although there are considerable technical challenges – and correspondingly broad margins of uncertainty – on these findings, nevertheless the research studies provide convincing evidence that agriculture imposes significant environmental costs but also provides significant environmental benefits. The evidence shows that the balance of these positive and negative impacts has been materially worsening over the last several decades – as a result of changes in farming technology – at the same time as the public's interest and concern with the countryside environment has been steadily increasing. However, many of these adverse trends have been slowed or reversed in recent years.

Environmental impacts of the broader food chain

38. Issues of environmental sustainability concern the whole of the supply chain beyond agriculture through processing to retailing and food service. Along the whole chain each step involves the use of resources and the generation of waste and emissions (see Roberts, S. (2002) for a more detailed discussion).

39. The environmental awareness of companies operating within the food supply chain appears to be high. In October 2002 Defra surveyed the web-sites of 30 food and drink companies, 29 of which were in the FTSE 350 plus one large private company. This exercise revealed that 23 had an environmental policy or strategy, 16 published environmental reports (either separately or as part of their main annual report) and 12 monitored environmental performance. These results corroborate an Environment Survey by the Food & Drink Federation (FDF) which found that 31% of its responding members produced an environmental report.

40. *Waste:* The processing of food products can lead to high levels of loss. One estimate states that it takes ten tonnes of raw materials to deliver one tonne of product to the consumer; the remaining 90 per cent being discarded as waste (BRC Retail Link 2000). Since food waste is organic this has traditionally been seen as benign. However, if not managed carefully this can still lead to significant economic and environmental impacts. The FDF's recent report, World Summit on Sustainable Development 2002, highlighted, amongst other things, that its Environmental Survey had found that its members were taking a number of actions aimed at waste reduction, reuse, recovery and recycling. Such action is also highlighted in the British Retail Consortium's Sustainability Strategy, "Towards Retail Sustainability", which was launched last year.

41. *Packaging:* Packaging is essential for processed food and drink as it preserves and protects it during handling and helps prevent spoilage and contamination during production, distribution and sales. It is also a communication tool displaying information on ingredients, nutrition and serving and storage instructions.

42. An estimated 3.2 million tonnes of household packaging waste are generated each year (see: SUSTAIN). This can be illustrated by the 12 billion plastic carrier bags and 29 billion food and drinks cans disposed of each year. The UK's current target is to recover 50 per cent of all packaging waste. The main burden lies with the retailers, including food retailers; any company with a turnover of more than £2 million is obliged to recover 48 out of this 50 per cent. In order to achieve this, a trading system has been introduced to allow obligated companies to do the job. Reprocessing companies issue special vouchers, packaging recycling notes (PRNs), to represent the amount of waste that has been recycled. Many food retailers also provide recycling bins in their car parks to encourage consumers to contribute to recycling effort.

43. *Water:* Water is required for most food and drink manufacturing processes. Both the FDF and the CIAA (Confederation of Food & Drink Industries of the EU) note that the food and drink industry has taken a number of proactive measures to reduce, reuse and recycle water resources.

44. *Global Warming:* The cause of global warming is identified as emissions of greenhouse gases (GHGs). Energy use and the resulting carbon dioxide (a GHG) emissions are the key factors in tackling climate change in the food chain. Energy is used at all stages in the downstream agri-food sectors: in processing and packaging food products, in retailing the food products, by consumers in cooling and freezing food as well as cooking it, and throughout the chain for transport. From the perspective of greenhouse gas emissions the mix of fuels (natural gas, coal, oil, renewable energy sources etc) needs to be considered in addition to the overall quantity of energy consumed. Comprehensive measurement of energy use at all

stages in the food supply chain has proved difficult but partial data provides insights into its relative significance. An important source of carbon emissions is road transport; agricultural commodities, livestock and food products account for almost 30% of total UK HGV tonne miles and increased by 3% per year over the last decade (see Department of the Environment, Transport and the Regions (2000)).

45. The FDF and many supermarkets have entered into climate change agreements with the Government whereby participants receive an 80% discount from the climate change levy in return for meeting challenging energy reduction targets as a contribution to the reduction of greenhouse gas emissions. In addition to contributing to global warming, energy use in the downstream food industries will have implications for a wide range of environmental impacts, notably air quality.

46. *Key Performance Indicators:* The FDF has developed for its member companies a series of quantitative Key Performance Indicators (KPIs) for sustainable development that are relevant for the manufacture of food and drink. Two types of indicators can be distinguished: **core** indicators which all companies should aim to implement and **additional** indicators which companies can choose to adopt if they are relevant to their business. A summary of the proposed core indicators relating to the environment is in Chart 22.

Chart 22

Food and Drink Federation: Key performance indicators for sustainable food and drink manufacturing

Effective protection of the environment

- Volume and Composition of trade effluent (annual mass/permitted maxima under consents) discharged per tonne of product per year (kg)
- Total CO_2 equivalent emissions (kg) per tonne of product per year from i) manufacturing and ii) distribution to direct customers from sources owned or controlled by the company including own and contract transport (kg)
- Total waste ex factory (tonnes) per tonne of product per year including packaging waste arisings on the premises (kg)
- Percentage total waste ex factory recovered per year including packaging waste arisings on the premises (%)

Prudent use of natural resources

- Total raw materials in (tonnes) per tonne of product per year (all raw materials including packaging but excluding fuel and water unless water[1] is also a main ingredient/raw material). (tonnes)
- Total water consumption (m^3) per tonne of product per year (except cooling water extracted and returned to source) (m^3)
- Total packaging placed on the market per tonne of product per year (kg)
- Total energy use (KWh) in manufacturing per tonne of product per year (KWh)

Source: Food and Drink Federation (2002)

D Social sustainability

47. This section looks in turn at:

    - Agriculture in the rural economy;
    - Public health – nutrition and work place safety; and
    - Animal Welfare

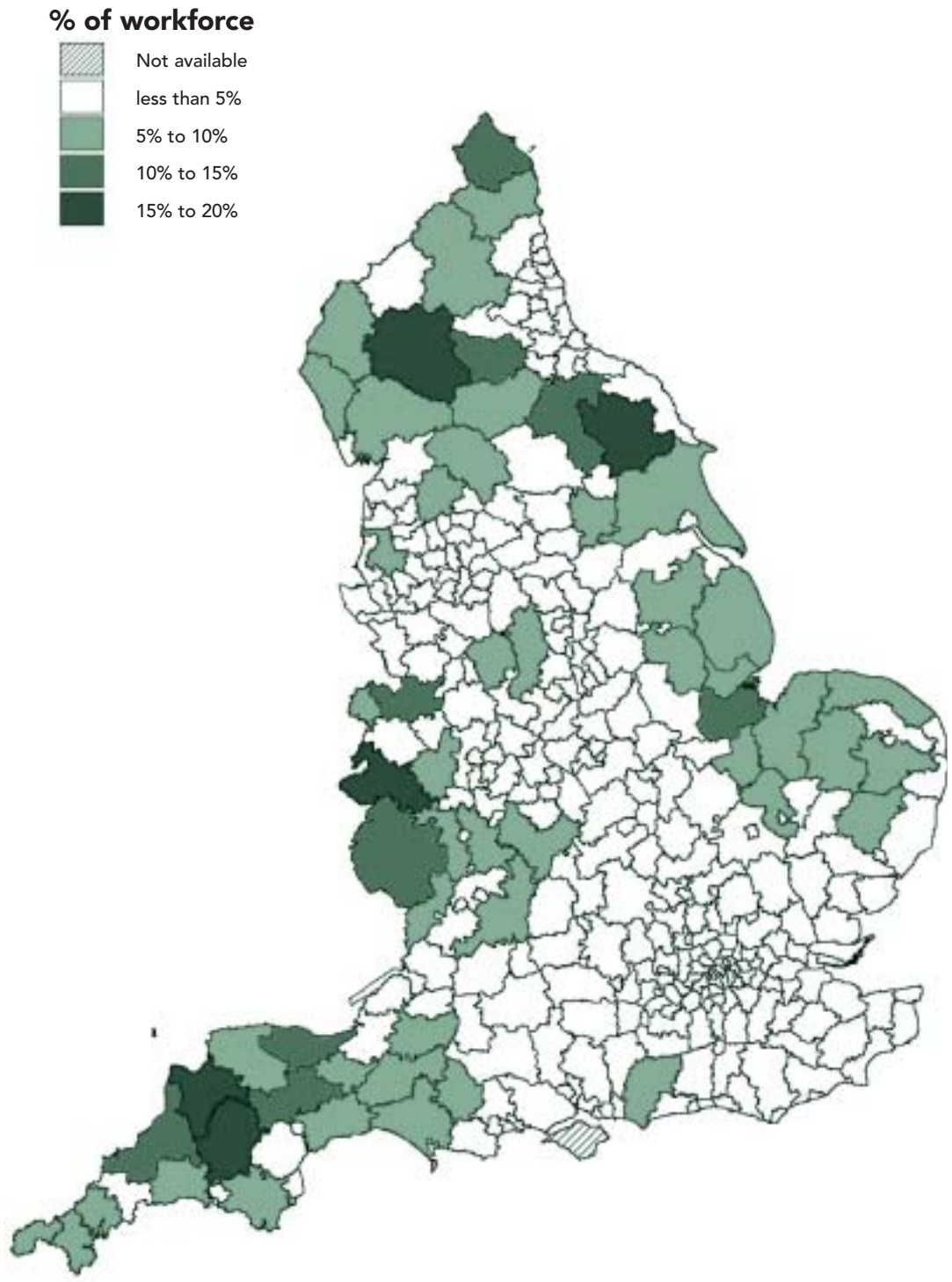
Agriculture in the rural economy

48. Fifty years ago the main contribution which food and farming made to social sustainability was through its central contribution to rural economies, at a time when many of these were depressed by the long term decline in agriculture and other traditional industries.

49. Today food and farming provides an increasingly important indirect contribution – through sustaining the countryside environment upon which the countryside leisure and tourism sectors depend, and which is also important to many other rural businesses. As the discussion of economic sustainability illustrated, agriculture's role in the rural economy has declined, and across rural areas in England agriculture now accounts for broadly 4% of employment. Nevertheless this average disguises the much greater significance of agriculture in some parts of the country, particularly the more remote and less accessible areas (see Chart 23); once upstream and downstream linkages are taken into account this significance is greater still.

Chart 23

Percentage of workforce living in rural areas in England who are employed in agriculture, by Local Authority District (2000)



Sources:

1. June 2000 Agricultural and Horticultural Census, Defra
2. Annual Local Area Labour Force Survey 2000, Office for National Statistics

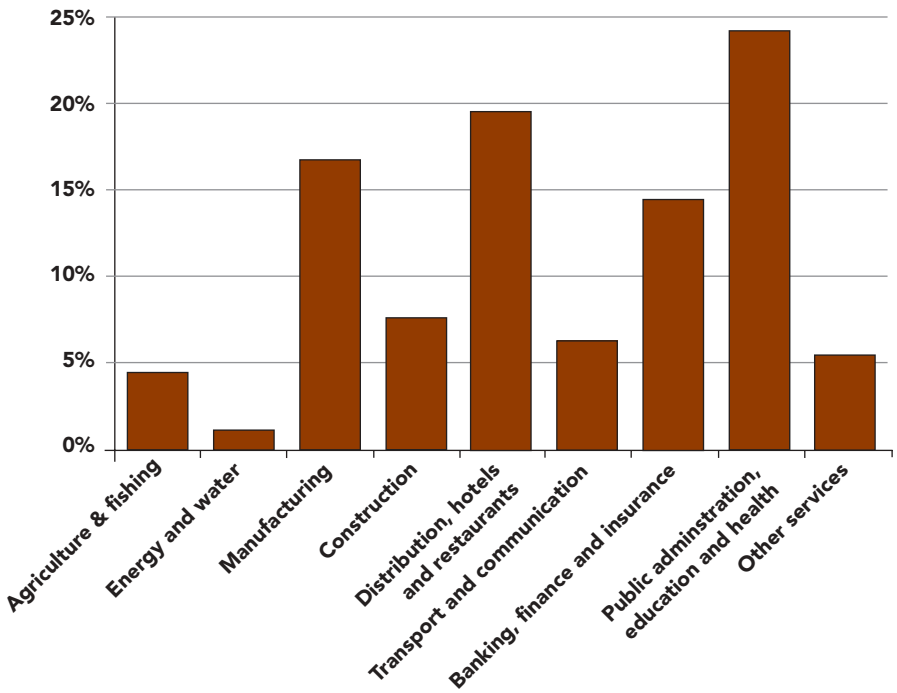
50. At the same time that agriculture's role in the rural economy has been declining, a combination of underlying economic and social trends has resulted in different sources of economic growth in many rural areas (see Ilbery (1998) for a discussion). Key drivers include:

- falling communications costs;
- structural shifts in the economy between manufacturing and services;
- together with shifts towards differentiated and customised products;
- rising demand for countryside leisure and recreation; and
- shifts in preferences toward countryside living.

51. The result has been sustained growth in population and employment in rural areas in England, with particularly strong growth in services. These are now the most important sectors of the rural economy in England (see Chart 24). As a result of these underlying trends, most rural economies have been able to adapt reasonably successfully to the long term decline in agriculture; and unemployment rates in rural England have continued to decline over most of the last ten years, although at a slightly slower rate than for urban areas (see Chart 25). But not all rural areas have shared in this growth, and even in otherwise prosperous rural areas there are pockets of deprivation which remain.

Chart 24

Employment by sector for rural areas in England, 2000



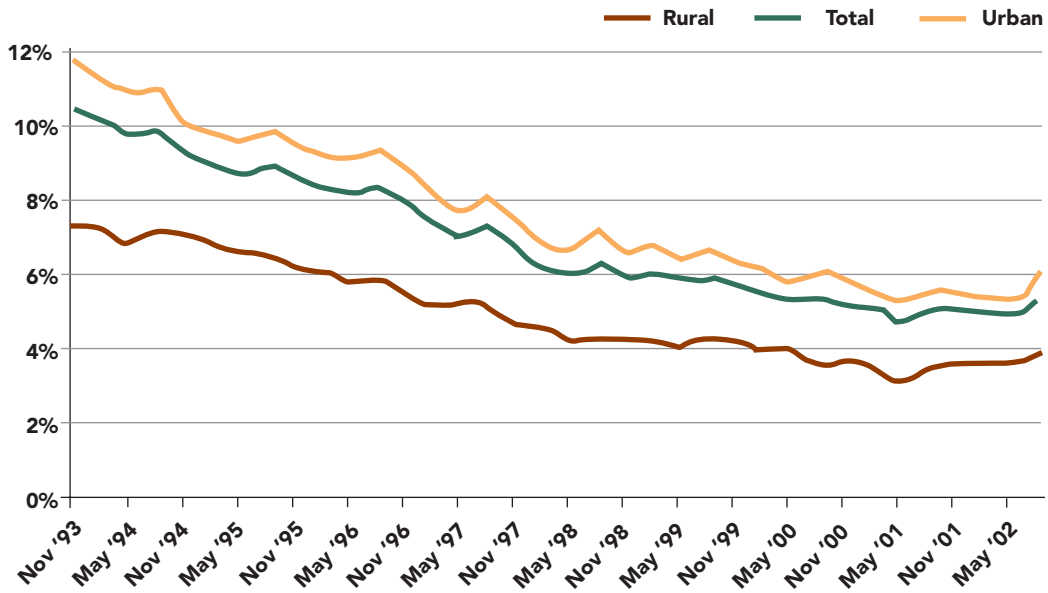
Source: Annual Local Area Labour Force Survey 2000, Office for National Statistics
June 2000 Agricultural and Horticultural Census, Defra

Notes: 1. Totals for those districts classified as such under the definition developed by the Countryside Agency.

Figures relate to people of working age

Chart 25

Unemployment rate



Source: Quarterly Labour Force Survey, England

Notes: 1. Unemployment is defined using the International Labour Organisation (ILO) definition which measures the number of people not in paid employment who are available for work and actively seeking work, rather than those claiming benefits.

2. The rural figures are the totals for those districts classified as such under the definition developed by the Countryside Agency. The urban figures are the totals for the remaining districts in England.

Figures relate to people of working age.

52. This means that food and farming's contribution to social sustainability through the underpinning of rural economies in England is now increasingly focussed on areas where economic performance is less buoyant and which remain significantly dependent on agriculture.

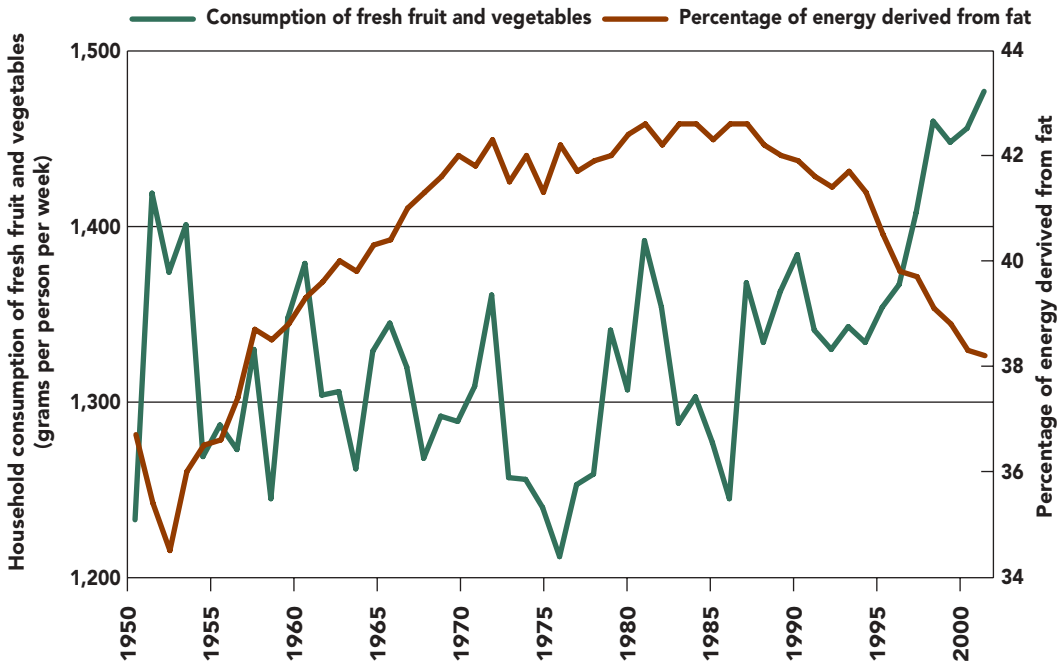
Public health – Nutrition and workplace safety

53. Food consumption patterns are being shaped by increasingly affluent and informed consumers but current eating patterns, if continued, may also lead to a segmentation of society between the "disciplined" (who take into account health) and the "undisciplined", leading to subsequent health and nutrition problems. For example, the British Heart Foundation has estimated that treating ill health caused by poor diet costs the National Health Service at least £2bn each year. Obesity has almost trebled in England since the early 1980s; 21% of women and 19% of men are now classified as obese with a further 33% of women and 44% of men classified as overweight. The NAO has estimated that the costs of obesity across the economy as a whole run to £2½bn a year.

54. Food choices are informed by knowledge of dietary recommendations, but also by factors such as taste, availability, price and social and cultural norms and are therefore shaped at every stage of the food chain. In more recent years food consumption patterns have become more favourable (see Chart 26). The consumption of fruit and vegetables has increased by 10% over the last ten years whilst the percentage of energy derived from fat has declined and now stands at 38.2% (by comparison with the targets recommended in Dietary Reference Values of 35%).

Chart 26

Trends in household consumption of fresh fruit and vegetables (a), and percentage of energy derived from fat



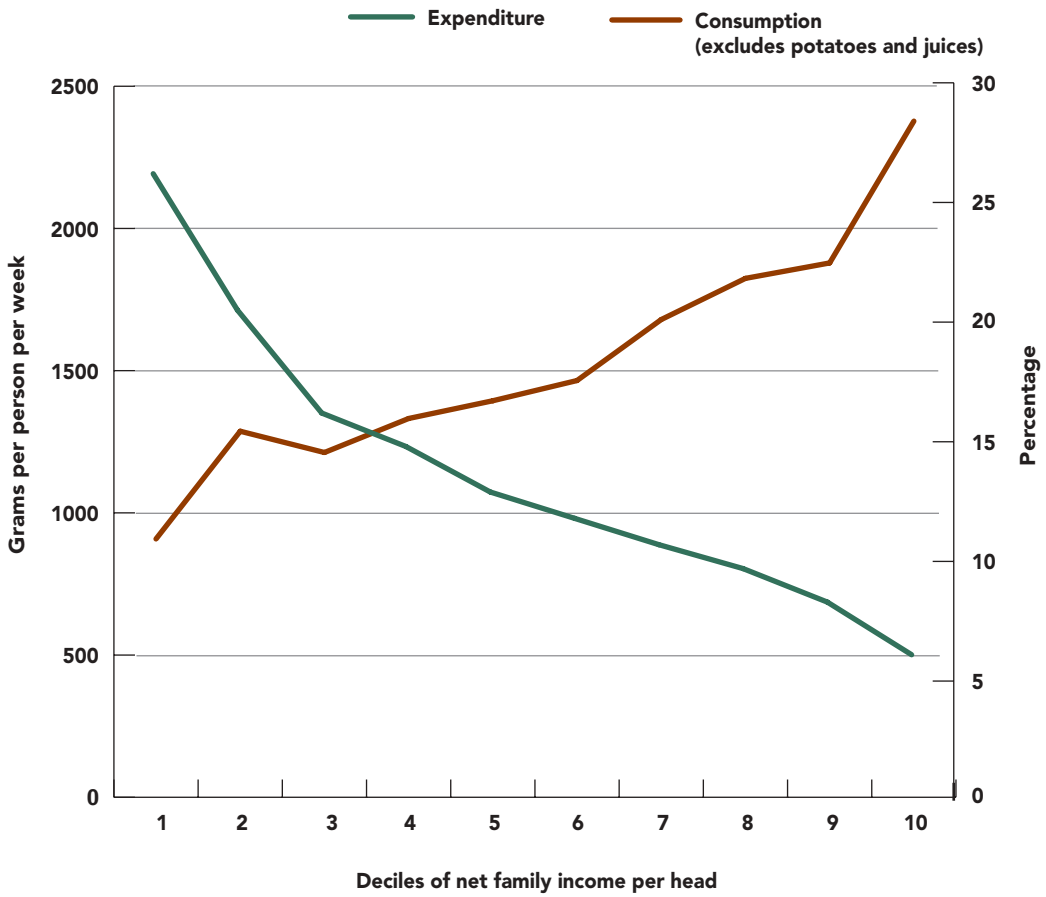
(a) includes only fresh fruit and fresh vegetables (excluding potatoes). Juices, canned, frozen and other fruit and vegetable products are excluded.

Source: National Food Survey, Defra

55. However, there are marked socio-economic differences in diet and health. For example, the death rate from coronary heart disease is three times higher amongst the unskilled than amongst professionals, and this gap has widened over the latest 20 years for which figures are available. These differences are mirrored in the patterns of food consumption. Expenditure on food and drink is very much more significant in the budgets of lower income families (26% of net family income for the lowest decile) which makes it more difficult to pay any premium for healthy eating (see Chart 27). Food prices kept artificially high by the CAP exacerbate this problem. At the same time higher income households consume far more fruit and vegetables (with the highest decile 2½ times the lowest decile) reflecting both higher spending power but also other household characteristics (e.g. more ready access to a source of supply) .

Chart 27

Expenditure on food and drink as percentage of net family income per head and consumption of fresh fruit and vegetables by income decline: GB 2000

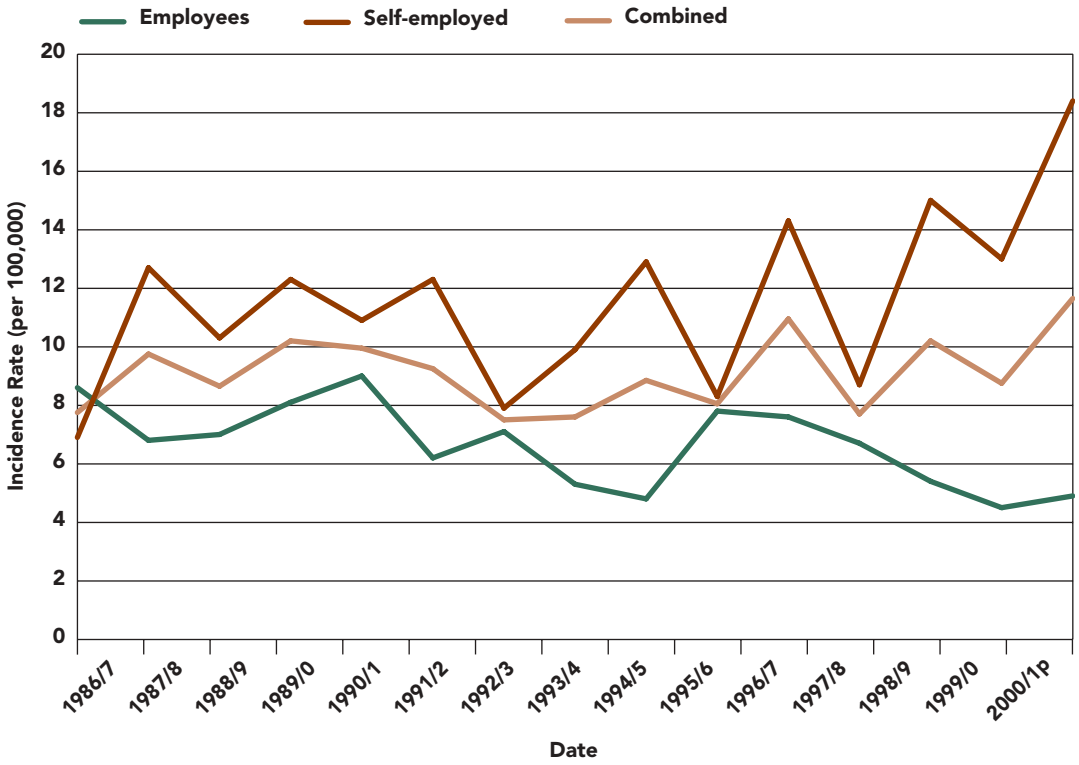


Source: National Food Survey, Defra

56. In relation to occupational health and safety, agriculture has the worst fatal injury rate of any broad employment sector – on average, one fatal accident a week. Over 100,000 working days are lost a year as a result of accidents in the agricultural sector, and these accidents cost the British economy around £130 million. Chart 28 illustrates the sustained trend in fatal injury incident rates.

Chart 28

Fatal injuries – incidence rates



Source: Health and Safety Statistics 1994/95, 1995/96,1997/98, 2000/01

NB: Injury figures from 1996/7 cannot be directly compared to previous figures due to the introduction of RIDDOR 95

NB: Injury figures from 1991/2 cannot be directly compared to previous figures due to the industry category changing from "agriculture, forestry and fishing", to "agriculture, hunting, forestry and fishing".

Animal welfare

57. Whilst there is a lack of direct evidence on the economic value which people place on animal welfare, there is a range of indicative evidence. This includes the growth in demand for food produced to higher standards of animal welfare and surveys of consumers' willingness to pay for welfare.

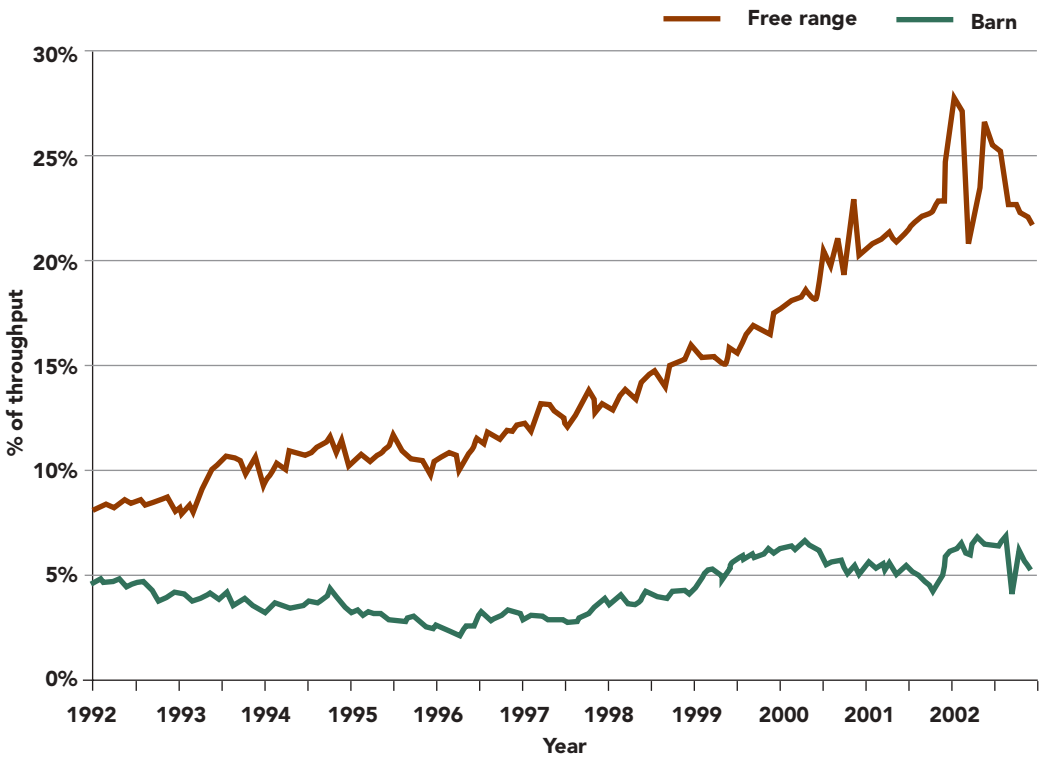
58. There are increasing instances of food being marketed on the strength of it being produced in a welfare friendly way. Recently, assured products have increasingly been branded as such, for example through the red tractor logo which specifies legal minimum requirements for animal welfare. There is also evidence that some consumers are willing to pay a premium for food produced to standards or in systems that are perceived to be more welfare friendly. The Freedom Foods scheme set up by the RSPCA in 1994 is a good example. Farms that are affiliated to this scheme are inspected regularly to see that they meet 5 basic freedoms: the freedom from Fear & Distress, from Hunger & Thirst, from Discomfort, from Pain Injury & Disease and to express Normal Behaviour. Just under 2500 farms are currently members. The willingness of consumers to pay a premium for organically produced meat may also be in part due to their perception that organic systems are more welfare friendly.

59. This trend is reflected in retail practice. A number of supermarkets say that they are committed to upholding and improving the standards of animal welfare across all the products they sell and some now sell only free range eggs.

60. Consumers will buy particular foods for a variety of reasons including some perceived aspects of quality, such as "corn fed" or "organic", the expected taste, or the welfare conditions under which the food is produced. Free range eggs are an example of this. Chart 29 shows how the consumption of free range eggs has increased over time, with the share of packing station throughput increasing from 8% in 1992 to around 22% currently. The premium that consumers pay for free range eggs over what they pay for battery eggs provides an indication of the value they assign to the free range system, with free range eggs retailing at nearly twice the price of battery eggs. However, as already noted, not all of this extra value necessarily relates to perceptions of animal welfare: some may relate to other perceived benefits.

Chart 29

UK egg packing station throughput by system



Source: Economics and Statistics Directorate, Defra

61. Some evidence on consumers' willingness to pay for higher welfare standards is available from recent academic studies. One (Glass, Hutchinson and Beattie (2001)) suggested that consumers are prepared to pay more for pork from proposed welfare schemes while another (Burgess, Hutchinson and McCallion (2001)) concluded that the public makes well defined and consistent choices between different welfare schemes, such as Freedom Foods. A public survey commissioned by the Food Standards Agency in September 2001 found that, when prompted, 88% of people rated the conditions in which animals are raised as being very/quite important to them. However, having previously been asked to state the most important factors that influence their choice of food bought, only 10% mentioned production method, 1% explicitly mentioning conditions in which animals are raised, with nearly half (46%) citing price.

62. However the production of food under higher standards can also come at a higher cost of production. For example the EU directive on The Welfare of Laying Hens aims to provide higher minimum standards for birds kept in cages. The costs to UK production of this directive are estimated as being in the region of £46m per year or around 5p per dozen eggs. However this is an average and will vary between the different production systems and between different producers. The banning of veal crates is another example of animal welfare legislation. The Regulation banning the use of Sow Stalls and Tethers also imposed a one off cost on the industry, and raised running costs by between 3% and 11% of annual turnover (CCA Welfare of Livestock Regulations (1994)). These regulations can also lead to an increase in imports from countries with lower standards of animal welfare.

E Competitiveness in farming and food

63. This section looks in turn at:

    - competitiveness in farming and
    - competitiveness in food and drink manufacturing

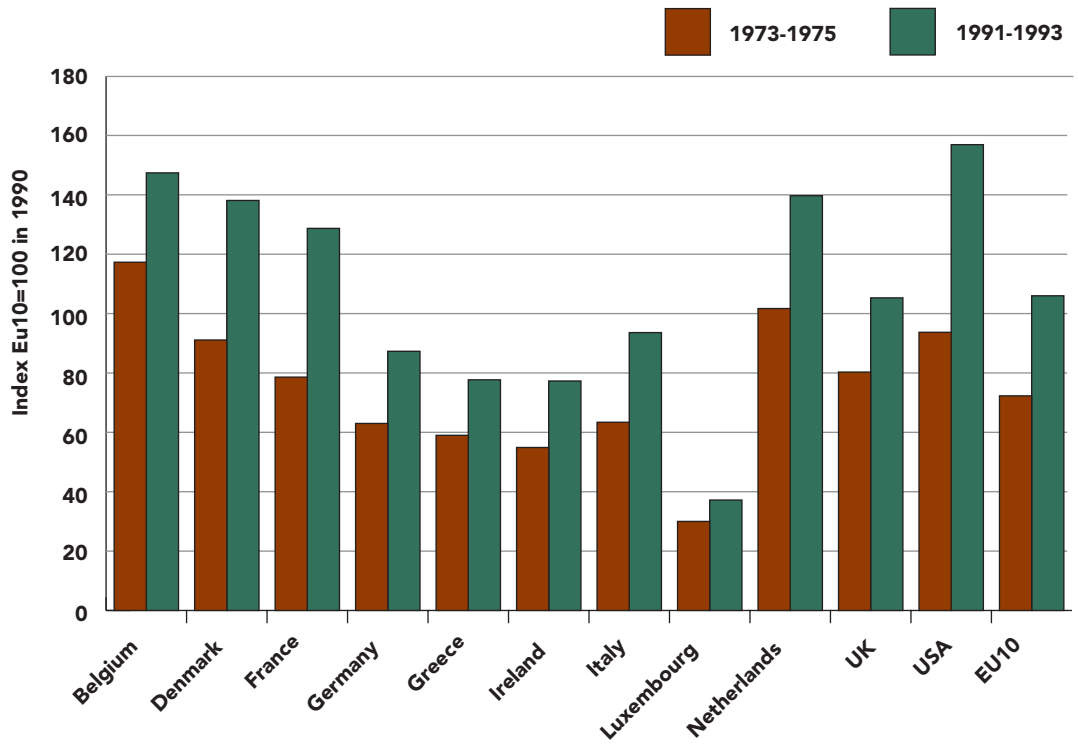
64. A key measure of the UK's economic performance is its productivity; that is, how well the economy uses the resources which are available to turn inputs into outputs. Productivity is the main determinant of national living standards. In a similar way, productivity is a key measure of the economic sustainability of UK farming and food. It is an important driver of farm incomes and it is an essential foundation for the environmental and social contributions which farming and food make. However, measuring productivity is not straightforward and comparisons need to be interpreted carefully both because of practical problems in obtaining robust data and also because productivity performance, particularly in agriculture, is often shaped by exogenous factors – to do with climate, topography and location for example – which are not easily susceptible to change.

Competitiveness in farming

65. So how does the productivity of UK farming compare with our competitors? Preliminary research evidence shows that in the mid 1970s the UK's productivity was above the EU average (for the then EU10), although still behind the leading EU countries and the US (see Chart 30 from Schimmelpfennig, D. and Thirtle, C. (1999)). Since then the position has deteriorated. By the early 1990s the UK had fallen back to around the EU average level of performance. And since then the UK appears to have fallen back further (as Chart 31 illustrates), despite accelerated productivity growth in response to the severe financial pressures of the late 1990s. A study by the National Farmers Union concluded that productivity in the UK is now below the top performing EU countries in all the main farming sectors: dairy, cereal, horticulture and livestock (see NFU (1998)).

Chart 30

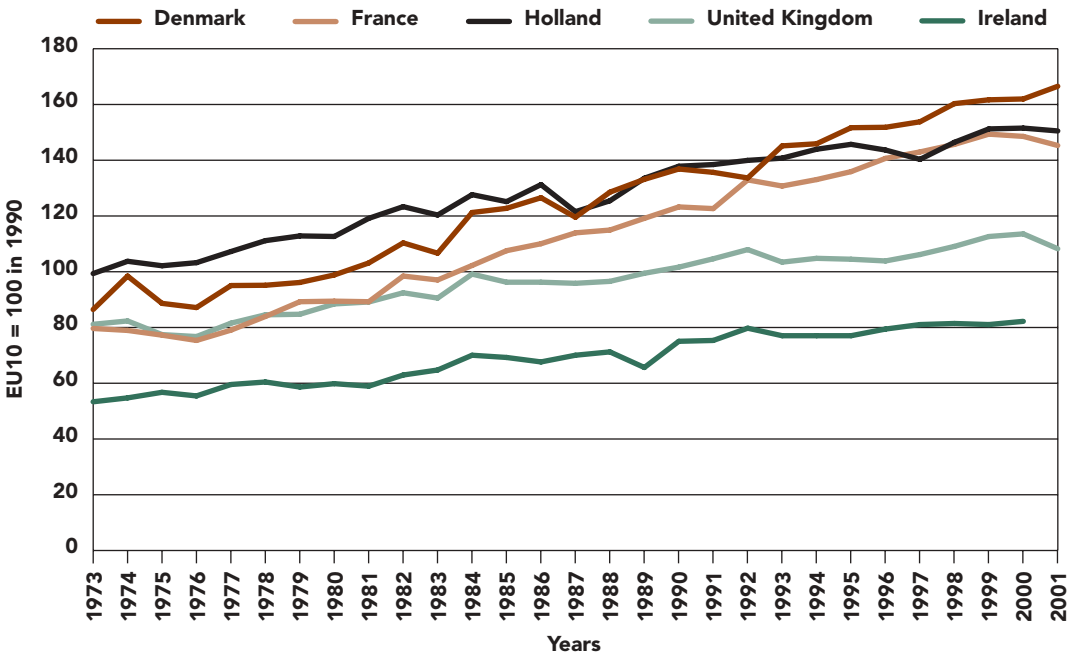
Total factor productivity in agriculture



Source: Schimmelpfennig, D. and Thirtle, C. (1999)

Chart 31

Trends in total factor productivity in agriculture

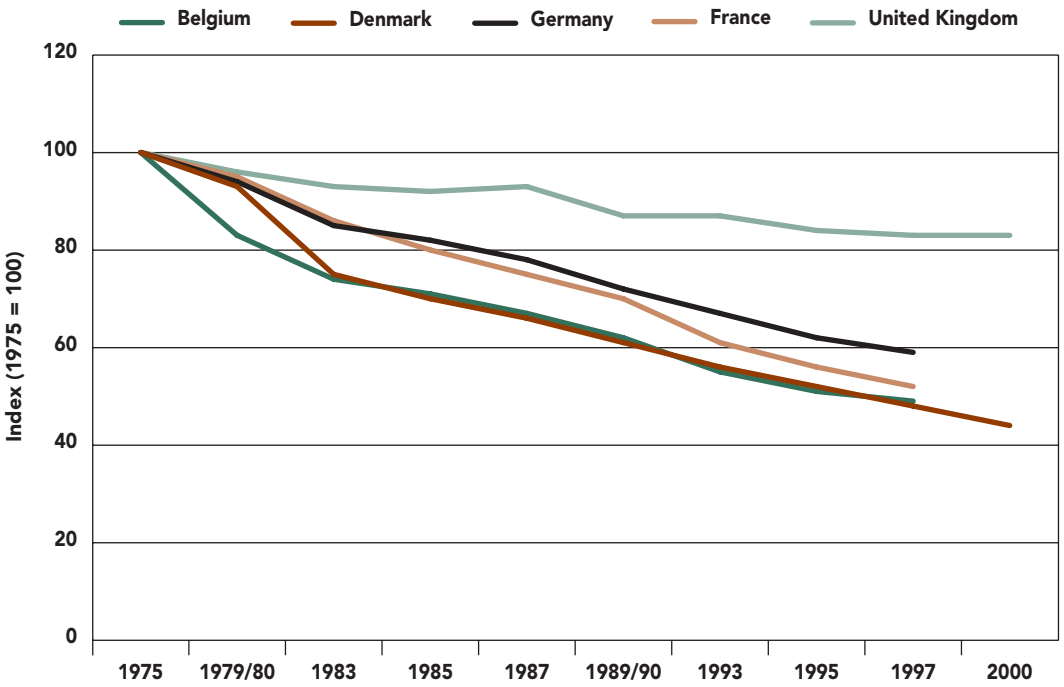


Source: Working paper for Defra by researchers cited in Chart 30 above

66. The UK's slow productivity growth partly reflects a slower pace of restructuring in UK farming. Reductions in the numbers of farms (see Chart 32) and in the numbers of people working in farming (see Chart 33) have generally been at a slower pace in the UK than in the rest of the EU. There is a more detailed discussion of re-structuring in UK agriculture in Maff (1999) and Errington et al (2002).

Chart 32

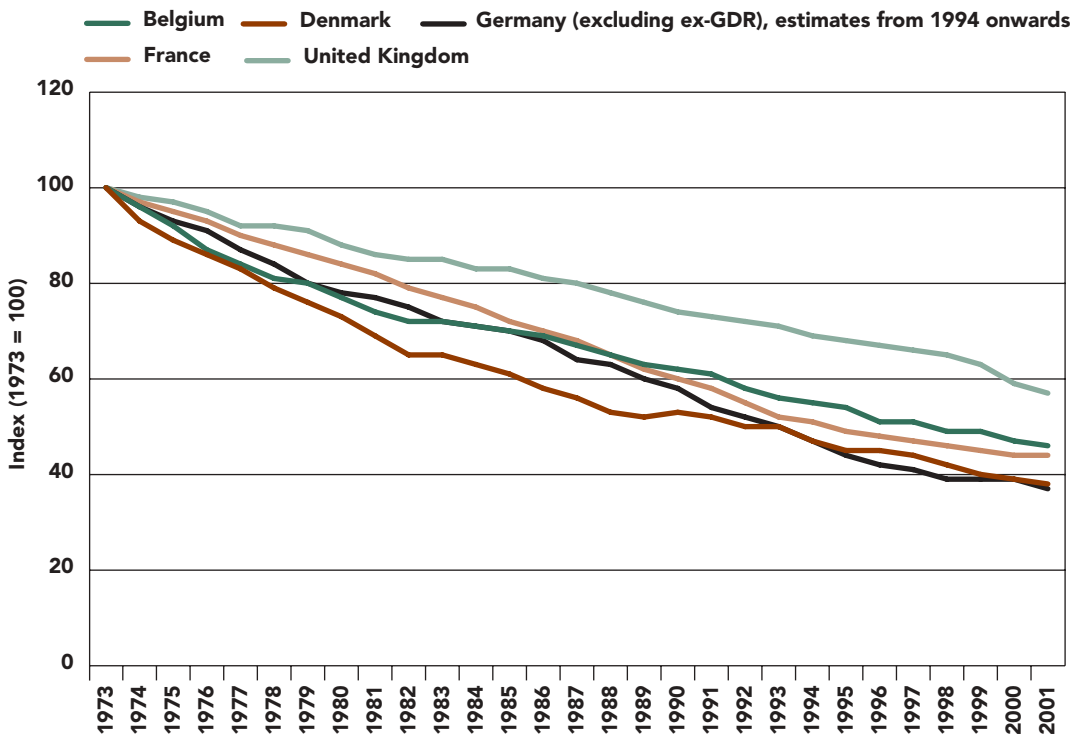
Change in number of agricultural holdings by country



Source: Eurostat

Chart 33

Change in agricultural labour force by country

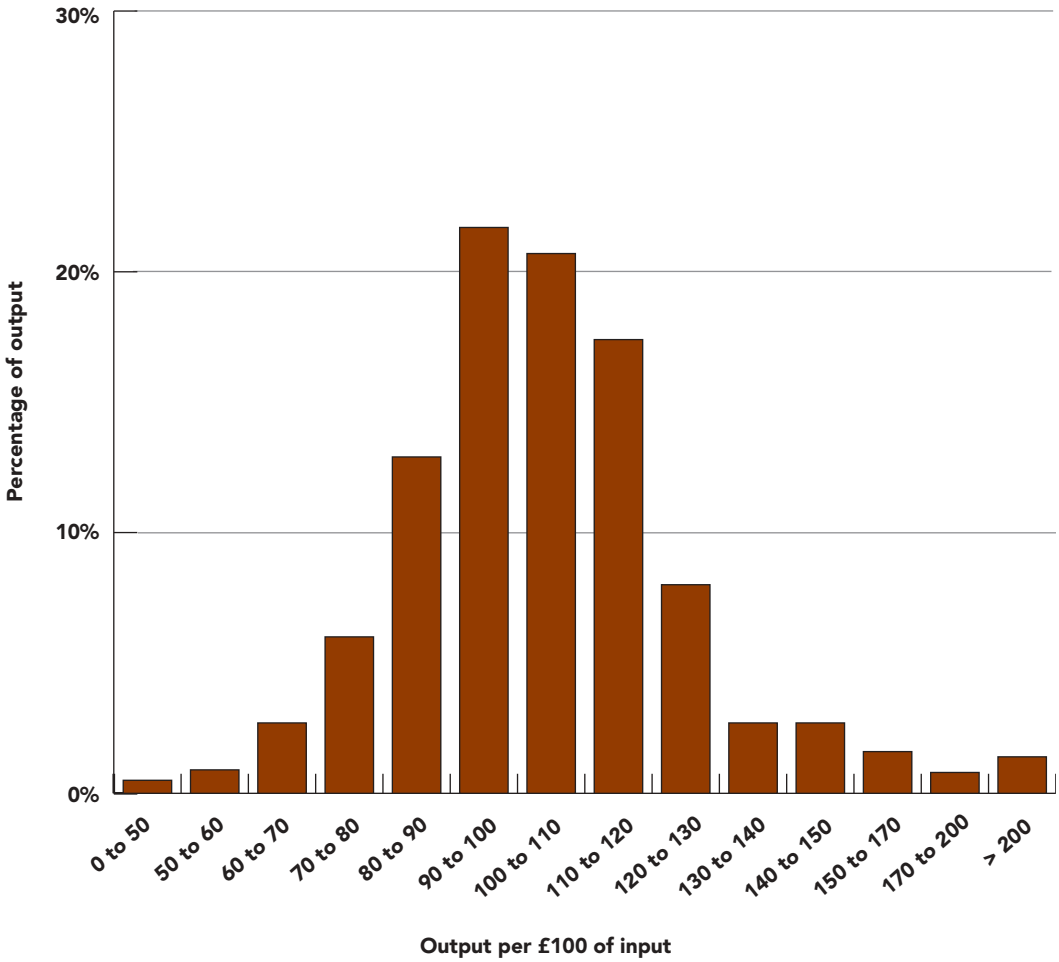


Source: Eurostat

67. Nevertheless comparisons of the productivity performance of different farm businesses in the UK show that there is significant scope to improve performance. Chart 34 shows that there are significant differences across UK agriculture between the better performing farms – in terms of productivity and profitability – and the less successful farms.

Chart 34

All farm types, distribution of performance measures across farms England 2001/02



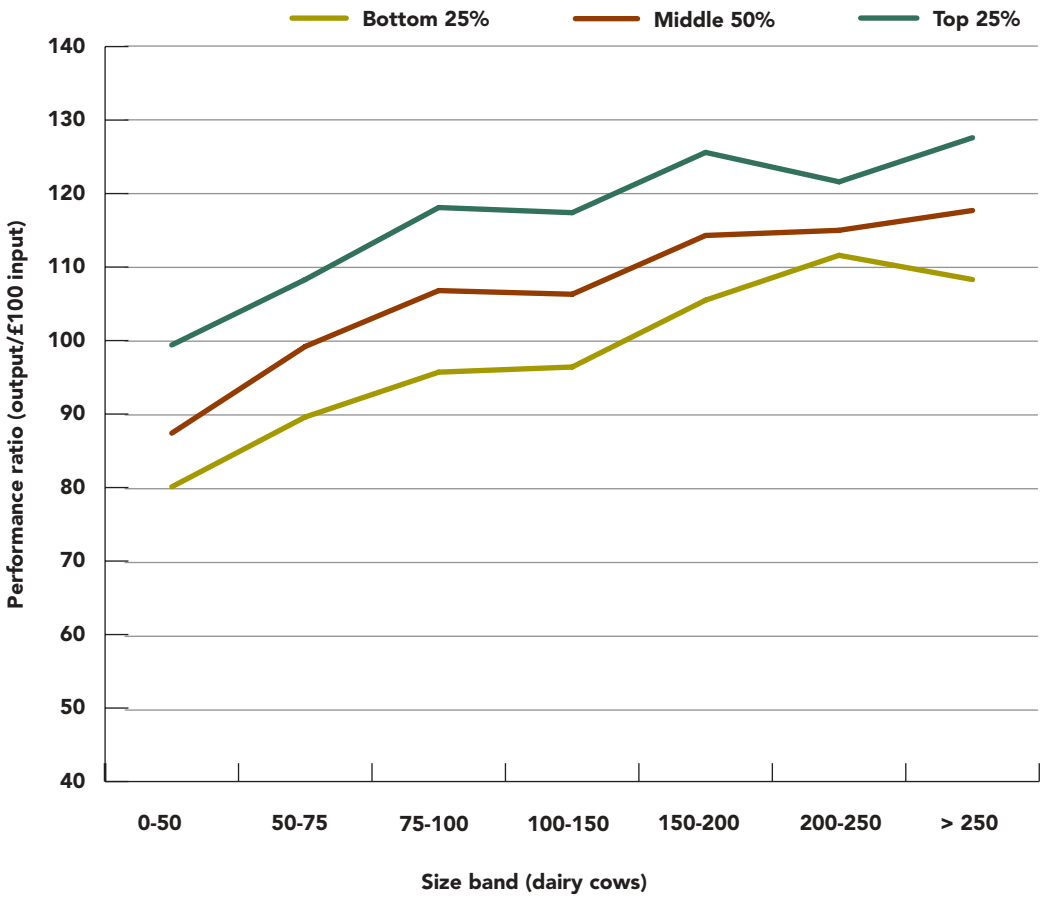
Note: Inputs include an allowance for farmer and spouse labour costs and for capital costs.

Source: Farm Business Survey

68. Research evidence shows that these differences in performance are driven by a combination of differences in costs and differences in the value added achieved from differentiating higher product quality (see Maff (2001) for a discussion of this evidence). Economies of scale are important but equally so too are other factors, relating to skills and business organisation as well as externally determined factors to do with climate and geography (see Chart 35).

Chart 35

Relationship between performance and size (dairy cows) for full time dairy farms, England 2001/02



Source: Farm Business Survey

69. What are the key drivers which explain why productivity in UK farming is increasingly lagging behind many other EU countries? In part, there has been a process of "catching-up" by lower productivity countries, but the preliminary research evidence suggests that some countries, but not the UK, have been able to sustain higher levels of productivity growth (see Schimmelpfennig, D. and Thirtle, C. (1999)). The evidence on this is incomplete – and sometimes difficult to interpret – but research studies suggest three groups of factors are important:

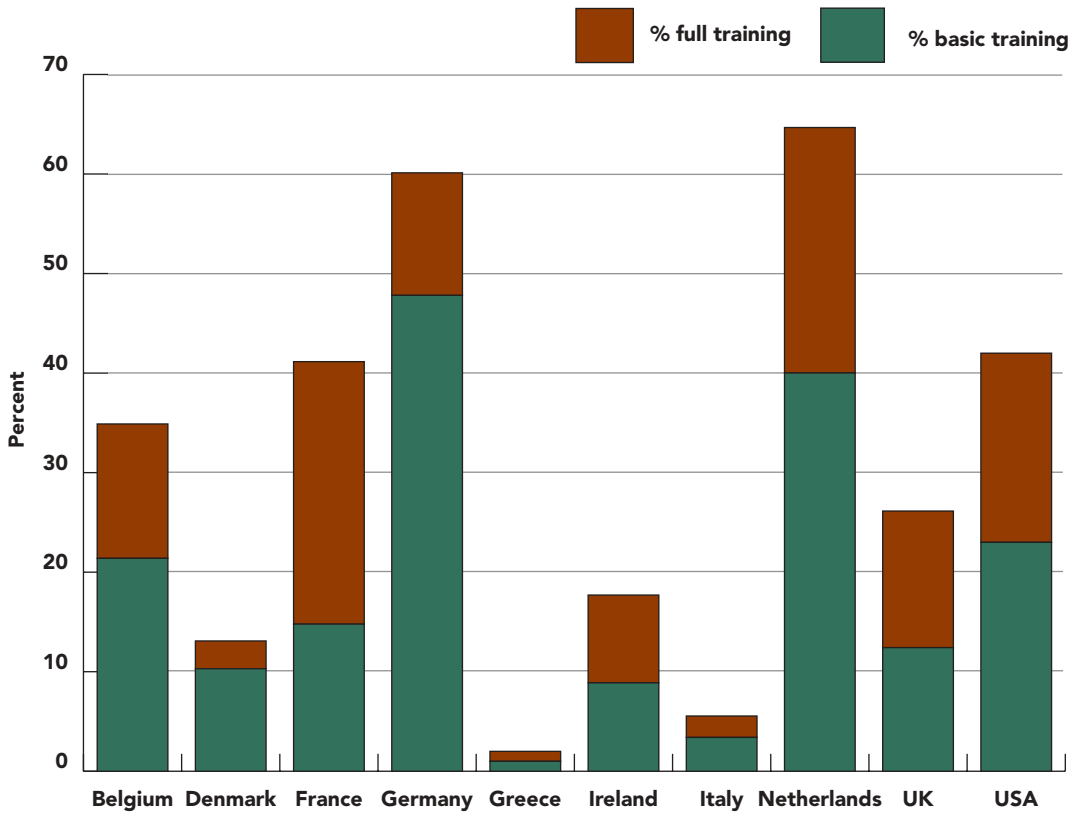
- Education and skills;
- Innovation and technology transfer; and
- Business Structures and Organisation.

70. As in many sectors of the UK economy, the level of education and skills in the agricultural work-force is lower than in many other EU countries (see Chart 36). Initial research findings show that countries with higher skill levels across their economy are also found to have higher productivity in farming, whilst evidence from the UK shows that in some sectors, the better performing farms have a more skilled workforce (see

Maff (2001)). Studies also show that farmers with higher levels of skills are more likely to re-structure their business to improve its performance and that higher levels of skills are associated with greater on-farm innovation and technology transfer (see Errington, A. et al. (2002)).

Chart 36

Percentage of the agricultural workforce with basic and full training in agriculture in the mid-to-late 1990s



Source: Featured in OECD paper on agri-environmental indicators

71. Initial research evidence also shows that Research and Development expenditure (both public and private) and technological spillovers (where businesses in one country benefit by adapting technologies developed in another) are both factors which have helped drive higher productivity performance in the more successful countries (see Schimmelpfennig, D. and Thirtle, C. (1999)). These factors seem to work together. Countries with higher levels of research and higher levels of education are better able to realise the benefits from the transfer of new technologies. In the UK, a Defra Task Force on Inputs concluded that the speed and efficiency with which new technology is applied within farming was an important component in explaining the UK's slow productivity growth.

72. There are also differences in business structures and organisation between the UK and many other EU countries. The development of farmer controlled businesses (or co-operatives) – with their potential for economies of scale, purchasing power regarding input supplies and more effective marketing – has been more pronounced in other EU countries (see Chart 37).

Chart 37

Market shares of co-operatives in the EU in 1997

Percentage	Dairy	Fruit & vegetables	Meat	Grains	Farm inputs
Member State					
Belgium	50	79-90	20-30		
Denmark	93	20-25	66-69	87	59-64
Germany	55-60	60	30		50-60
Greece	20	12-51	5-30	49	
Spain	35	15-40	20	30	
Ireland	100		30-70	69	70
Netherlands	82	70-96	35		40-50
Finland	94		68		40-60
Sweden	99	60	79-81	75	75
United Kingdom	98	35-45	20	20	20-25

Source: Scottish Agricultural College (1998) (based on information from the Plunkett Foundation)

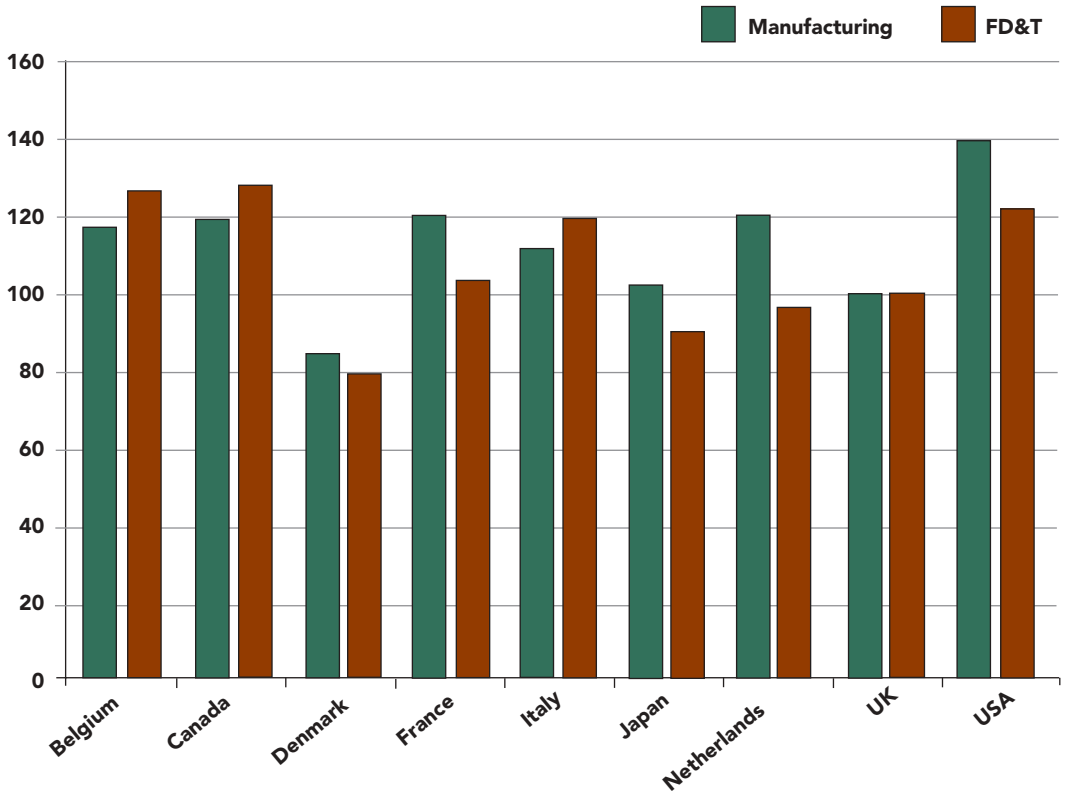
73. Whilst there is only limited evidence on the impact of these differences in business organisation upon productivity, nevertheless evaluation evidence for the UK supports the view that there is scope to improve efficiency in adding value through better linkages in the food chain, and that this would also be to the benefit of farming (see Scottish Agricultural College (1998)). At present the distorted production incentives which flow from the CAP and poor information flows within the food chain have contributed to inefficiency. Evidence from the evaluation studies of processing and marketing development grants show that these schemes have succeeded in promoting the more widespread development of marketing skills and in promoting improvements in product quality.

Competitiveness in food and drink manufacturing

74. Productivity performance in the UK's food processing sector lags behind many of our competitors. Comparisons across a selection of OECD countries in 1994, (see Chart 38) showed that the UK was over 20% behind the productivity leaders – Belgium, Canada, the USA and Italy – with only Japan, the Netherlands and Denmark (out of the countries covered) showing lower productivity. More recent research, which compares a smaller range of countries in 1999, shows that the UK's productivity continues to lag over 20% behind the US, although comparing favourably with France and Germany (see Chart 39).

Chart 38

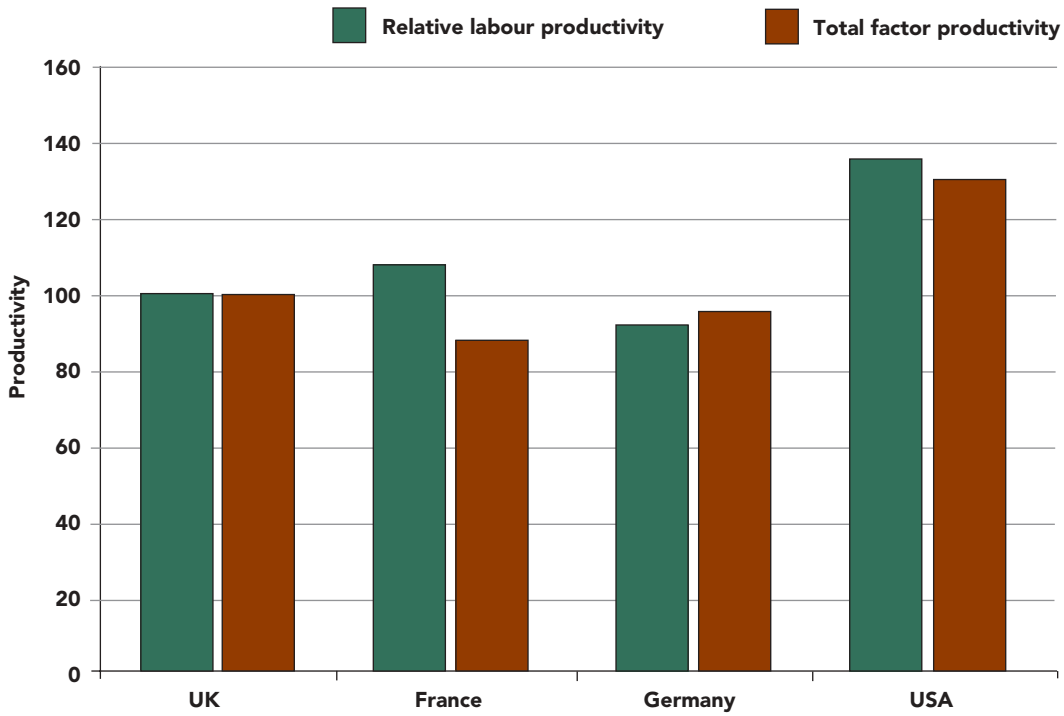
Total factor productivity in the food industry and all manufacturing, 1994* (UK = 100)



Source: Data taken from the Industrial Sectoral Database (ISD) and Structural Analysis Database (STAN), OECD.

Chart 39

Relative labour and total factor productivity in the food, drink and tobacco manufacturing industries (UK = 100)



Source: O'Mahony, M. and de Boer (2002)

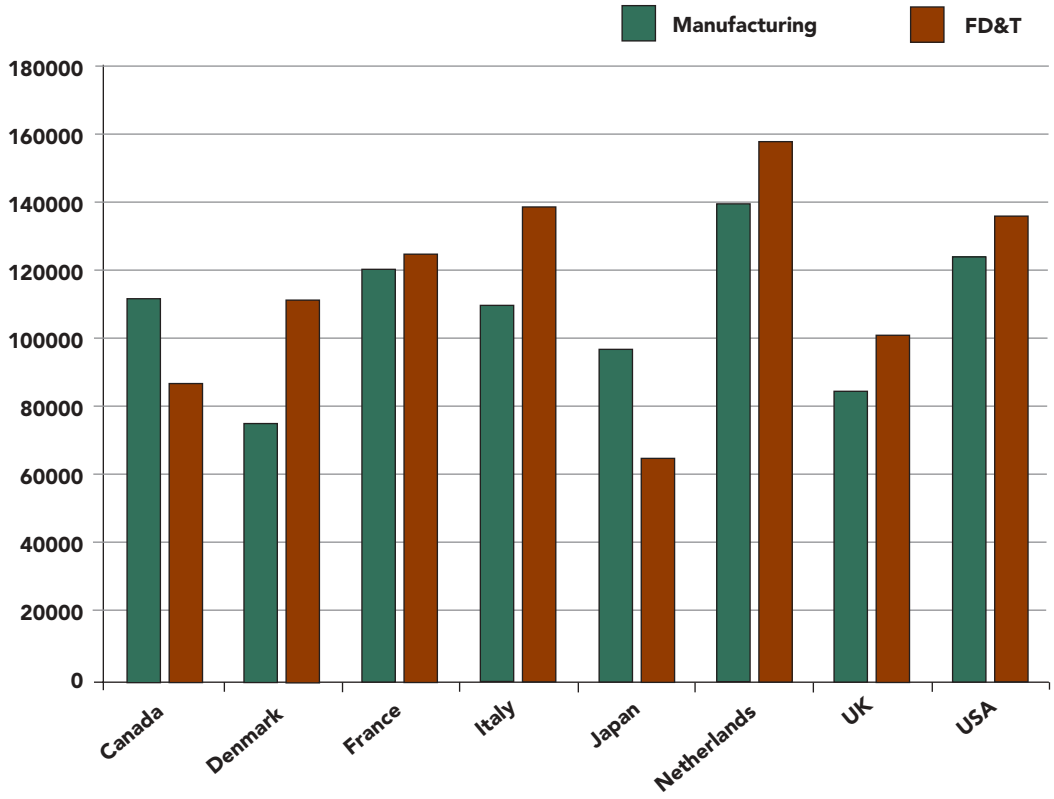
75. As with farming, the research evidence doesn't give a complete picture on the reasons for the UK's relatively weak productivity performance; but three groups of factors seem important:

    - Capital Investment;
    - Education and Skills; and
    - Innovation and technology transfer.

76. As in many other sectors of manufacturing the UK's food and drink sector has a relatively low stock of capital per worker (see Chart 40). This is a major explanation for relatively poor labour productivity in the UK.

Chart 40

Capital stock per worker in food and drink processing and in manufacturing, 1994



Source: OECD data, Defra estimate

Notes: in 1990 prices converted into $ at purchasing power parity; US estimate is for 1993

77. The UK food and drink sector also has a work-force with a lower level of skills. A study in 1998 found that the number of employees in the UK food and drink industry with educational qualifications was 30% lower than the EU average and 40% less than Japan, and that the number of employees with vocational qualifications was 20-30% lower than the EU and Japan (see Mason, G., van Ark, B. And Wagner, K. (1994)). Research has shown that this deficit in skills has hampered productivity in some sectors of the UK food and drink industry, particularly for small and medium sized plants.

78. A detailed study by McKinsey (see McKinsey Global Institute Report (1998)) comparing the UK with the US and (West) Germany – also showed weaknesses in innovation and technology transfer. In particular, McKinsey's found that UK companies:

    i. tended to be more likely to manufacture low value added products;

    ii. had higher levels of product proliferation which resulted in lower levels of automation; and

    iii. lacked marketing skills.

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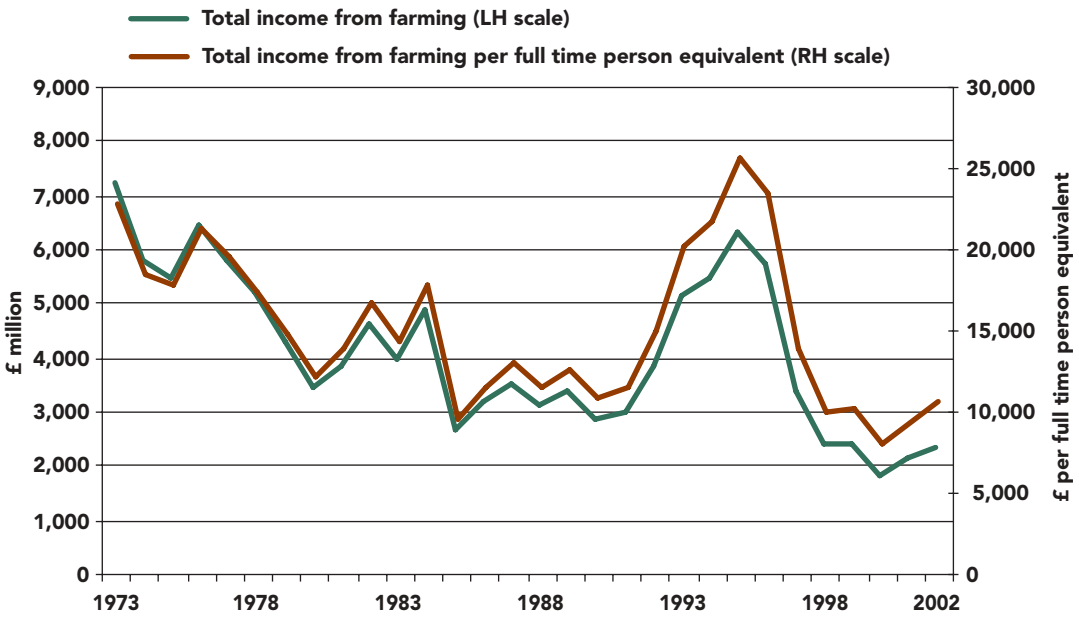
Current and future business prospects in farming

79. The farming sector faces severe financial pressures which, without a significant shift in competitiveness, are likely to continue. Some prospective policy and regulatory developments – for example, modulation– are likely to increase these pressures.

80. In 2000, the "Total Income from Farming" in the UK (the returns to the labour and entrepreneurial input of farmers, spouses and other directors) was at its lowest level, in real terms, since the depression of the late 1930s. Since then, there has been a small recovery (see Chart 41). For some farm households the downturn will be partly cushioned by other sources of income. More than a half of full time farms in England have diversified sources of income (either through off-farm employment or other types of business on the farm) and for a significant number of these households diversified income is at present more important than the income earned from farming.

Chart 41

Agricultural industry income trends in the UK (real terms at 2002 prices)



Source: Economics and Statistics Directorate (York), Defra

81. The trends in the chart are shaped by a mix of long-term and short-term drivers. Over the longer-term, the decline in agriculture's share in the economy will put downward pressure on the aggregate of total farming income as the size of the sector shrinks. The level of income per farmer would be expected to be more stable, as the chart shows, but the decline in the UK's competitiveness will have exerted downward pressure on this indicator as well.

82. The steep decline in incomes since the mid 1990s has been shaped by a combination of more immediate drivers. The exchange rate is of greatest significance. A Defra Task Force on Inputs showed that farming is particularly exposed to exchange rate movements because the value of much of its outputs is highly sensitive to shifts in the pound/euro rate whilst the prices of most inputs are largely insensitive to the exchange rate (see Maff (2001)). The result is that the decline in the pound/euro rate after the UK left the ERM, in the early 1990s, lead to a boom in farming's profitability which was reversed as the pound/euro rate increased in the latter half of the decade.

83. Whilst the exchange rate has been the key driver of the rapid reduction in farm incomes since the mid 1990s, other relevant factors are:

    - weak world commodity prices, as growth in the world economy slowed following financial turbulence in the Far East and Eastern Europe in 1997 and 1998; and
    - the impact of BSE and, more recently, foot and mouth disease.

84. Analysis of individual sectors of farming (see Chart 42) show that profitability levels have been low in most sectors, reflecting the over-arching impact of the pound/euro exchange rate.

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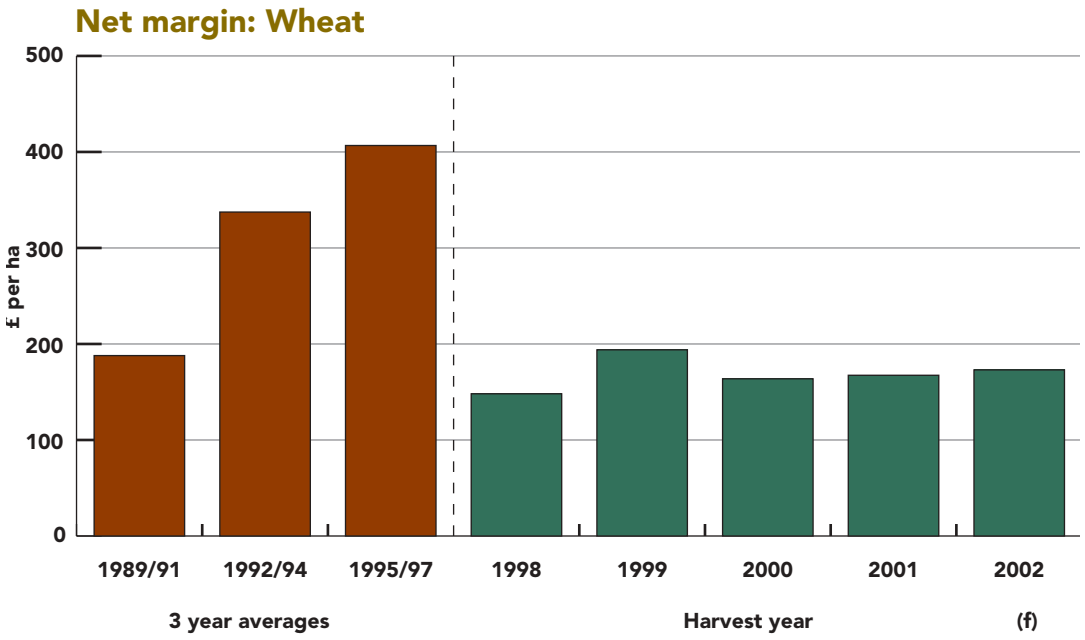
Chart 42

Farm incomes in individual sectors

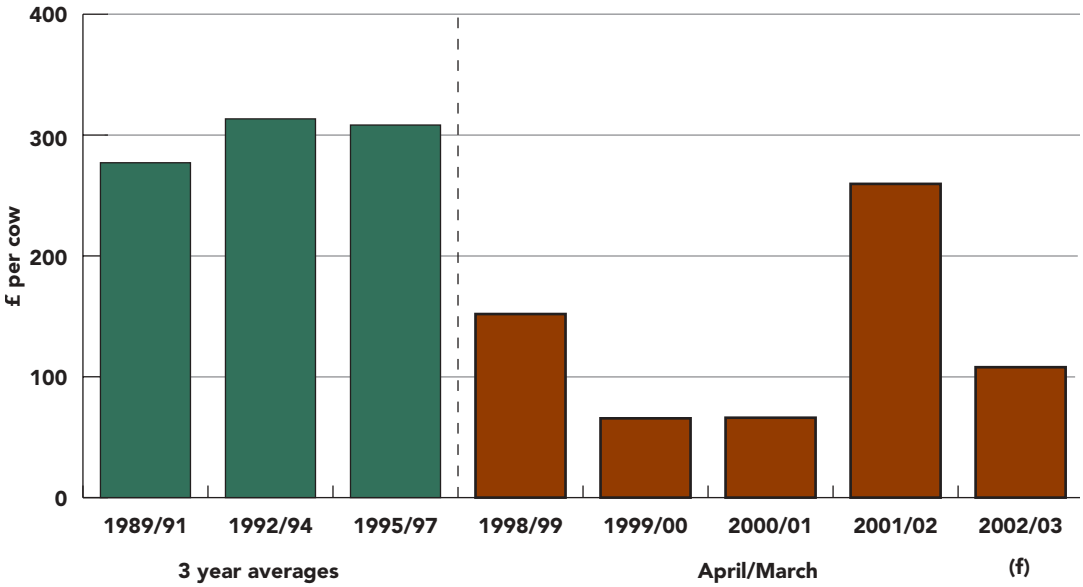


Source: Defra

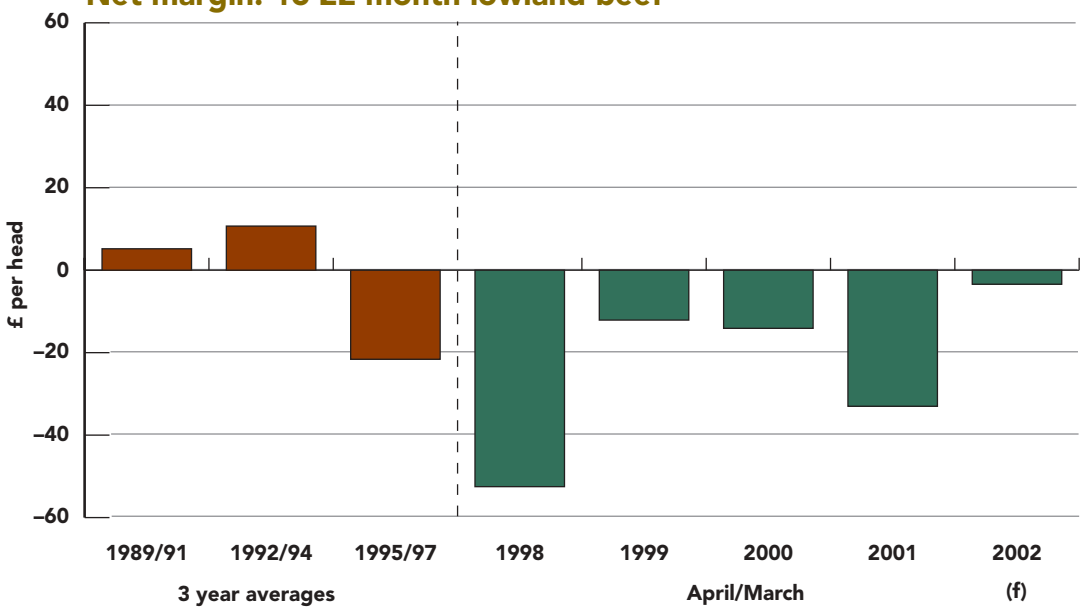
Chart 42 (continued)

Farm incomes in individual sectors

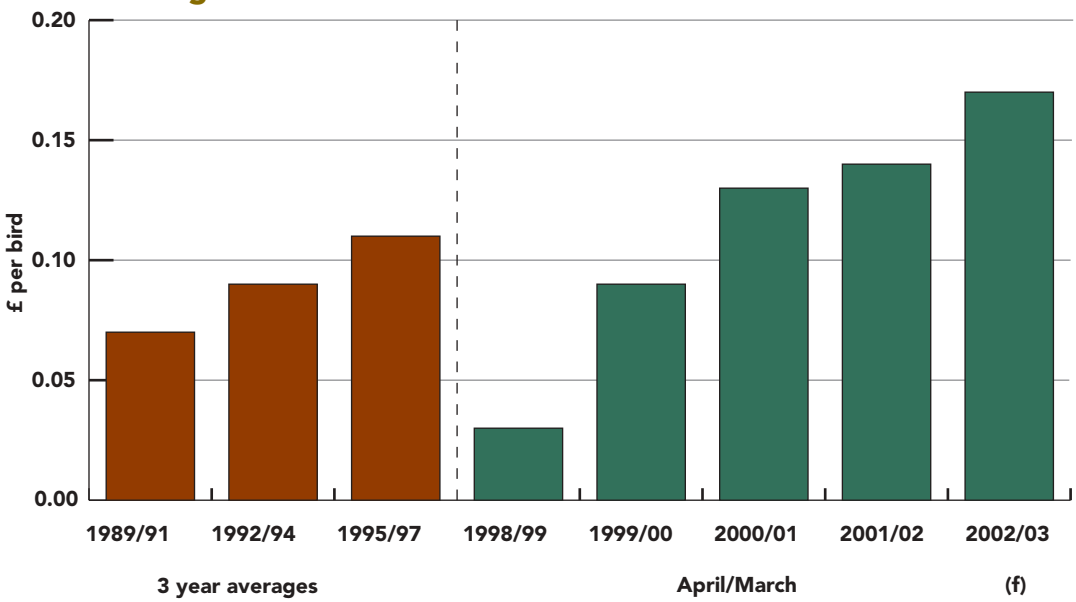
Net margin: Milk



Net margin: 16-22 month lowland beef



Net margin: Table chickens



Net margin: Eggs

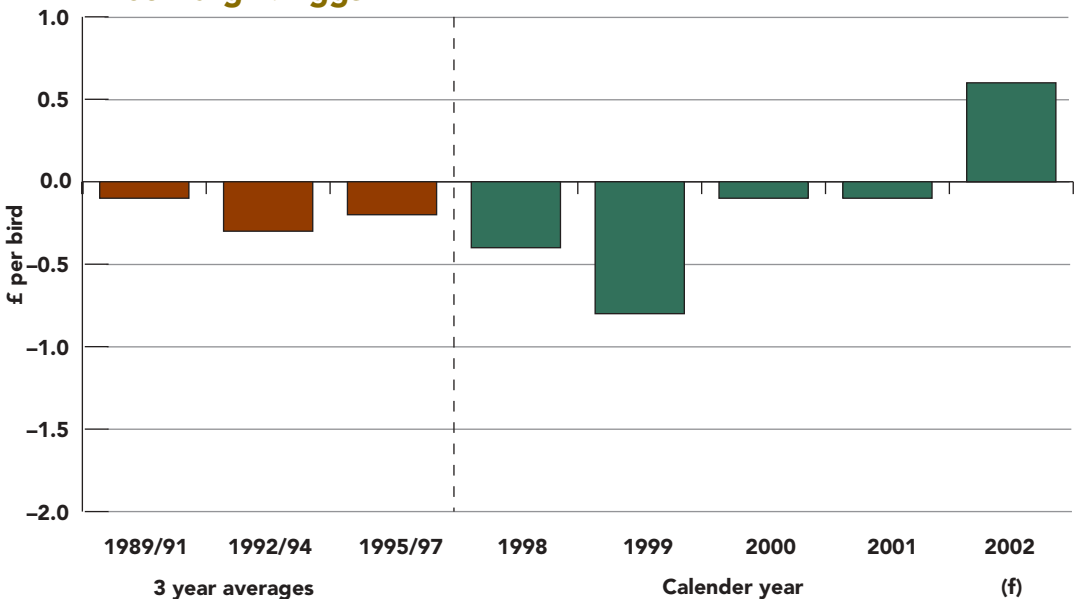


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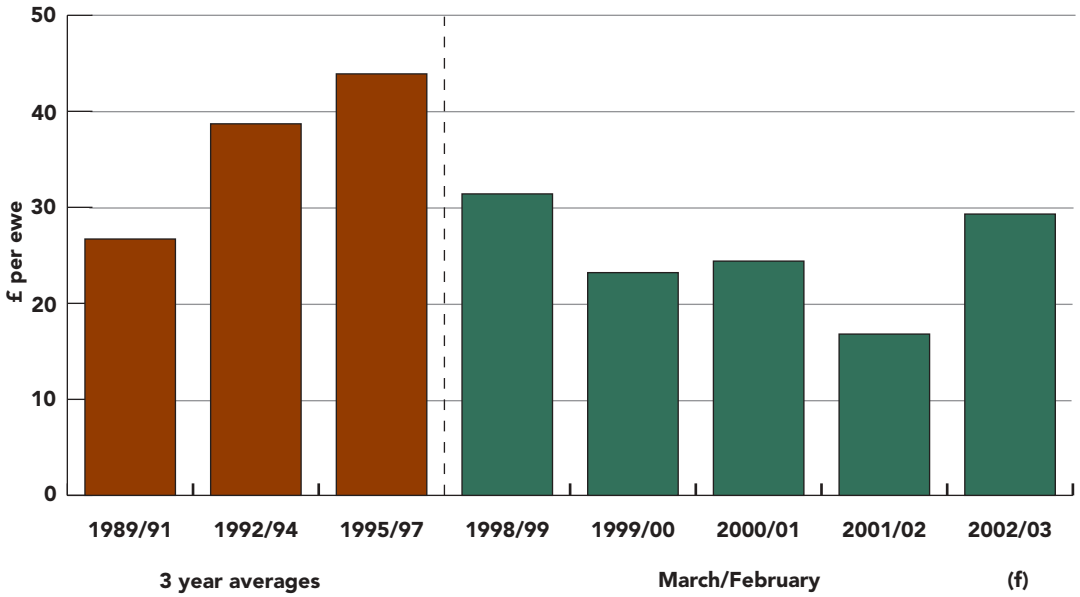
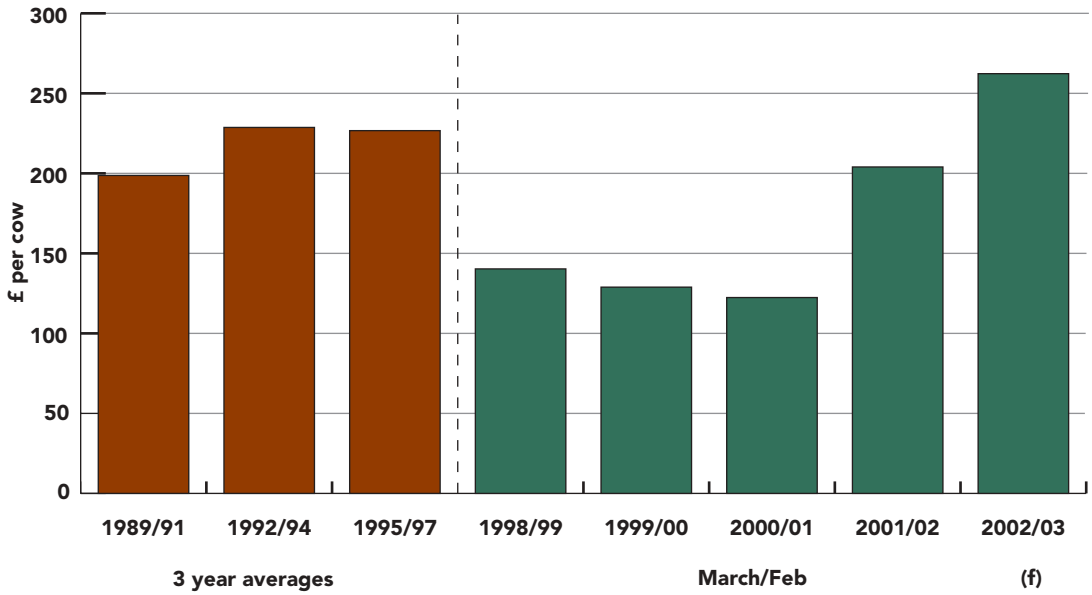
Chart 42 (continued)

Farm incomes in individual sectors

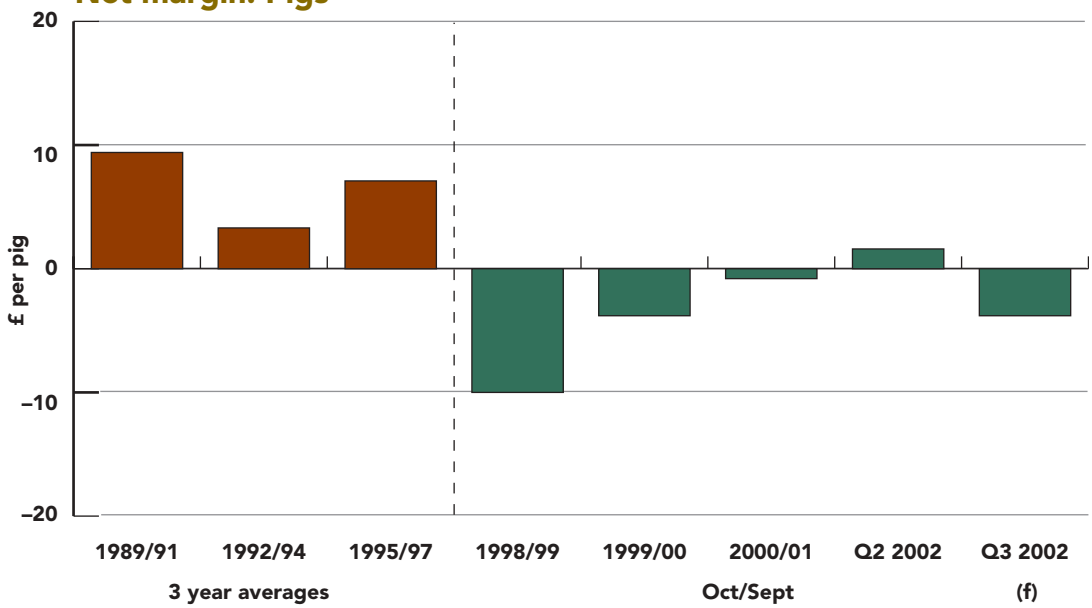
Gross margin: Hill breeding ewes



Gross margin: Hill suckler cows



Net margin: Pigs



Net margin: Potatoes – Main crop

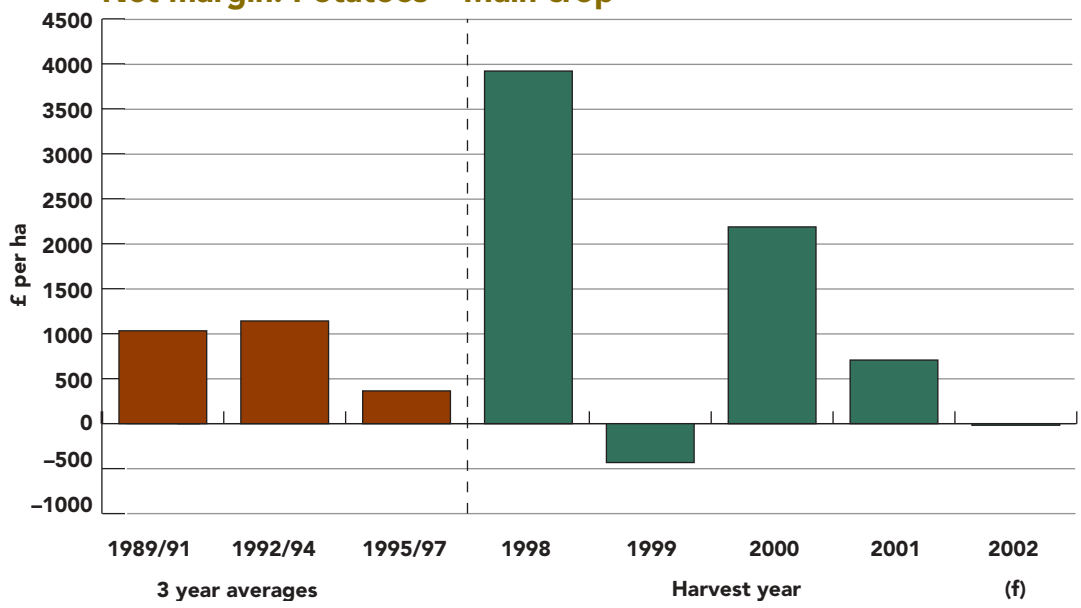


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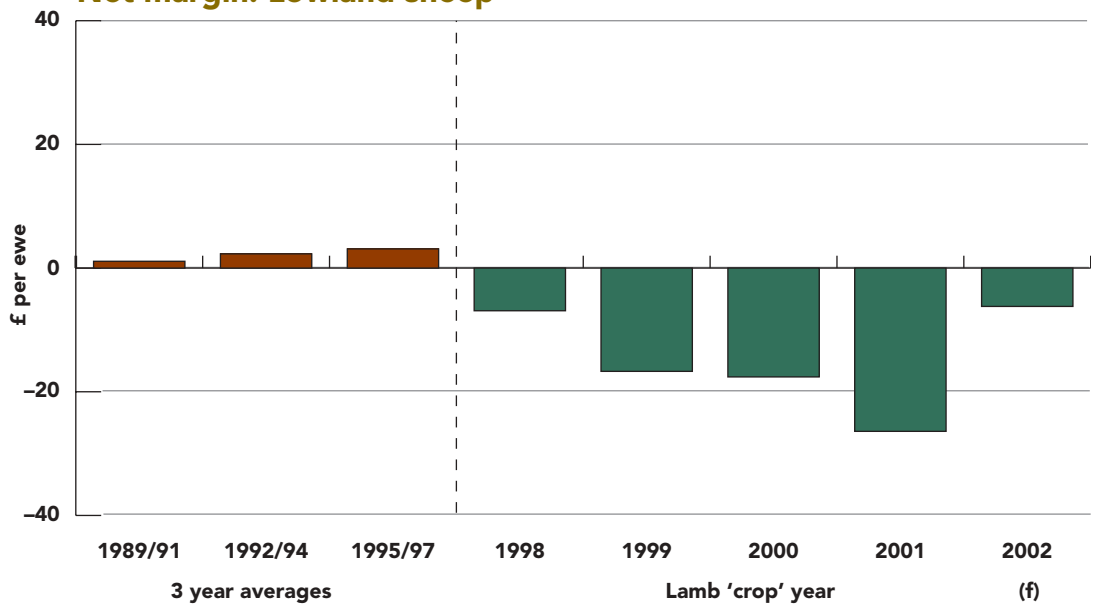
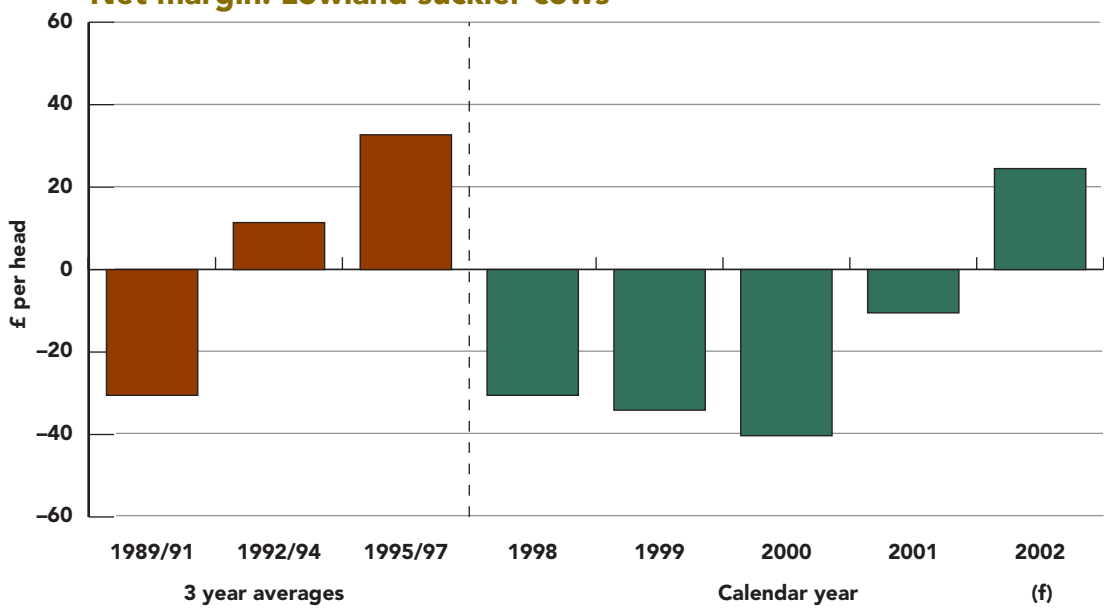
Chart 42 (continued)
Farm incomes in individual sectors

Net margin: Lowland sheep



Net margin: Lowland suckler cows

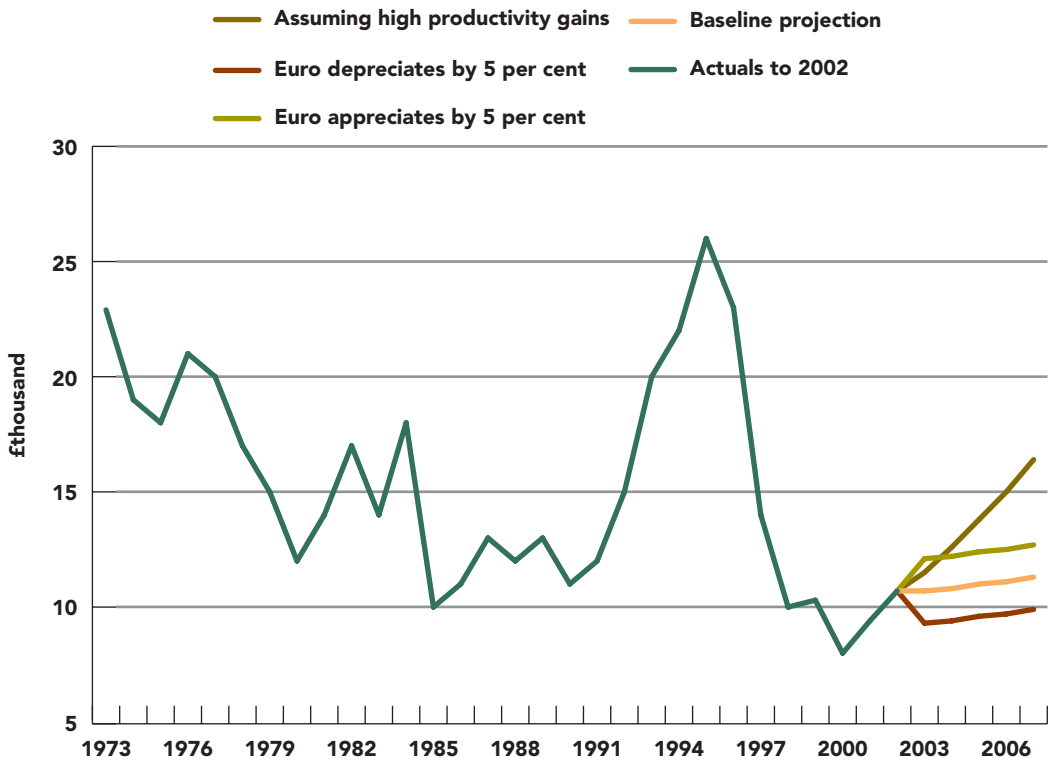


Source: Defra

85. The future business prospects for farming will reflect the inter-action of the key drivers (both long-term and short-term) which have shaped the present position. Chart 43 shows some stylised projections of underlying trends; it should be emphasised that these types of projection have very broad margins of uncertainty and also that agriculture is an industry where specific events – a disease outbreak or poor weather – can shift incomes from the underlying trend in individual years. The methodology used to develop the projections in Chart 43 (and Chart 42) is described in more detail in Maff (2000).

Chart 43

Projections of total income from farming up to 2007: in real terms at 2002 prices per full time person equivalent



Source: Defra

86. The projections indicate that the modest extent of expected recovery in world commodity markets over the next five years is likely to provide for only a marginal increase in the average level of income per farmer; future forecasts of world commodity prices are, however, quite uncertain.

87. A second key driver is the pound/euro exchange rate, and the projections show the potential importance of this. Most private sector macroeconomic forecasters expect the euro to rise against the pound but there is considerable uncertainty on how much of a shift is likely and on what timescale. Many of the forecasters expect a shift of up to 5%, and the chart shows that this would leave incomes at a relatively depressed level.

88. The other key driver is productivity. The previous discussion of competitiveness outlined the slower trend in productivity growth in the UK, as compared with many other EU countries. Chart 43 illustrates what might happen to incomes if this trend could be reversed by sustaining the exceptionally high rates of productivity growth which were achieved (under severe financial pressure) in the late 1990s.

References

British Retailing Consortium Retail Link (2000) "Waste Not." Retail Link, Summer 2000.

Burgess, D. E., Hutchinson, W. G. and McCallion, T. (2001) "Does Choosing and Pricing Methods Reveal Similar Public Preferences for Implementing Welfare Improvements for Several Major Farm Animal Species." Paper presented at the Agricultural Economics Society Annual Conference, Harper Adams University College, 10-13 September 2001.

CCA Welfare of Livestock Regulations 1994.

Defra, Agricultural and Horticultural Census (June 2000).

Defra, Agriculture in the United Kingdom.

Defra, National Food Survey.

DETR (2000), Transport of Goods by Road in Great Britain, 1999. Department of the Environment, Transport and the Regions

Errington, A. *et al.* (2002) "Implications of Changes in the Structure of Agricultural Businesses." Research Paper Prepared for the Department for Environment, Food and Rural Affairs, University of Plymouth.

Environment Agency (2002) "Agriculture and Natural Resources: Benefits, Costs and Potential Solutions."

European Commission, Court of Auditors Report (various years).

European Commission, EUROSTAT.

Food and Drink Federation (2002) "World Summit on Sustainable Development – Contribution by the UK Food and Drink Manufacturing Industry." FDF, London.

Francois, J. (2000) "The Economic Impact of New Multilateral Trade Negotiations: Final Report." Tinbergen Institute and the Centre for Economic Policy Research. Report Prepared for DG-II of the European Commission.

Glass, C. A., Hutchinson, W. G. and Beattie, V. E. (2001) "Investigating Issues of Overstatement in a CVM Study of Willingness to Pay for Pig Welfare Improvements." Paper presented at the Agricultural Economics Society Annual Conference, Harper Adams University College, 10-13 September 2001.

Hartridge, O. and Pearce, D. (2001) "Is UK Agriculture Sustainable? Environmentally Adjusted Economic Accounts for UK Agriculture." *CSERGE-Economics Paper*.

HSE, Health and Safety Statistics.

Ilbery, B. (1998) "The Geography of Rural Change." Longman.

Lloyd, T., McCorriston, S., Morgan, W. and Rayner, A. (2002) "A Further Investigation into the Relationship Between Producer, Wholesaler and Retailer Prices of Beef, Pork and Lamb." A Report Prepared for Defra. Unpublished.

Marks, H. F. (1989) "A Hundred Years of British Food and Farming: A Statistical Survey." Edited by D. K. Britton. Taylor and Francis.

Mason, G., van Ark, B. and Wagner, K. (1994) "Productivity, Product Quality and Workforce Skills: Food Processing in Four European Countries." National Institute Economic Review, 147: pp62-83. Paper originally prepared under the auspices of the National Institute of Economic and Social Research.

McKinsey Global Institute Report (1998) "Driving Productivity and Growth in the UK Economy." Report published by the McKinsey Global Institute. Website address: www.mckinsey.com/knowledge/mgi/UKProd/

Maff (1999) "Re-Structuring of Agricultural Industry". Working Paper prepared by the Economics and Statistics Group of the Ministry of Agriculture, Fisheries and Food.

Maff (2000) "Economic Appraisal of Rural Development Options". Working Paper prepared by the Economics and Statistics Group of the Ministry of Agriculture, Fisheries and Food.

Maff (2001) "The Structure of Agricultural Input Costs: The Impact of Input Prices and Input Utilisation." Working Paper prepared by the Economics and Statistics Group of the Ministry of Agriculture, Fisheries and Food.

NFU (1998) "Is UK Agriculture Competitive?: A European Perspective." National Farmers Union (NFU) Economics, NFU.

O'Mahony, M. & de Boer, W. (2002) "Britain's Relative Productivity Performance: Updates to 1999." Final Report to Department of Trade and Industry/HM Treasury and Office for National Statistics, National Institute of Economic and Social Research (NIESR).

OECD, Monitoring and Evaluation Report (various years).

ONS, Annual Local Area Labour Force Survey (2000).

ONS, Annual Business Inquiry.
Website address: http://www.statistics.gov.uk

ONS, Consumer Trends.
Website address: http://www.statistics.gov.uk

ONS, Quarterly Labour Force Survey.

Pretty, J. *et al.* (2000) "An Assessment of the Total External Costs of UK Agriculture." *Agricultural Systems*, Vol 65: pp113-136.

Roberts, S. (2002) "Sustainable Development Beyond the Farm Gate". A scoping study prepared for Defra.

Schimmelpfennig, D. and Thirtle, C. (1999) "The Internationalisation of Agricultural Technology: Patents, R & D Spillovers and Their Effects on Productivity in the European Union and the United States." *Contemporary Economic Policy*, Vol 17(4): pp457-468.

Scottish Agricultural College (1998) Evaluation of Marketing Development Scheme and Group Marketing Grants.

Thompson, D., Muriel, P., Russell, D., Osborne, P., Bromley, A., Rowland, M., Creigh-Tyte, S., and Brown. C. (2002) "Economic Costs of the Foot and Mouth Disease Outbreak in the United Kingdom in 2001." *Rev. Sci. Tech. Off. Int. Epiz.* 21(3): pp675-687.

United Kingdom Agricultural Supply Trade Association (UKASTA).

United Kingdom National Accounts: The Blue Book, ONS.
Website address: http://www.statistics.gov.uk

Using Economic Instruments to Address the Environmental Impacts on Agriculture

A Executive summary

1. The publication of the Strategy for Sustainable Food and Farming provides an opportunity to take stock and discuss the best way to approach addressing the environmental impacts of agriculture.

2. Many environmental issues arise because their costs or benefits are incurred by society as a whole rather than by the person creating them. For example, when pollution costs are not taken into account by those causing the pollution, because the costs are borne by others, then the market does not function efficiently. And the same is true when private business activity creates public benefits (e.g. through stewardship of the countryside) which are not fully rewarded in the market place. There may then be a case for Government intervention to improve the working of the market, and raise the efficiency of the economy and to deliver better environmental outcomes. There may also be a need to intervene to improve environmental outcomes in order to meet international obligations, for example under EC Directives and international agreements.

3. The effects of agriculture on the environment are significant and complex, with both positive and negative impacts operating at local, regional, national and global levels. Positive environmental impacts include: providing a 'carbon sink'; supporting and maintaining diverse and attractive landscapes with historic features; and providing a complex range of habitats and food sources for farmland wildlife. Major negative impacts include: greenhouse gas emissions (carbon dioxide, methane and nitrous oxide); soil erosion; water pollution; and adverse impacts on biodiversity. Estimates of the economic value of these impacts are necessarily broad brush and imprecise and studies to assess these impacts have used different methodologies. Three recent studies conclude that there are very large negative impacts (estimated in the range £1 billion to £1½ billion for the UK). Research studies also show very large environmental and landscape benefits (estimated in the range £0.6 billion to £0.9 billion for the UK). Of course, other types of land use will also generate environmental impacts (both positive and negative).

4. In the case of agriculture, production subsidies have had a strong influence on agricultural practices and hence on environmental outcomes. Removal of these subsidies will help considerably, overall, to reduce pollution (although with some risks of reducing stewardship benefits in some locations). This document does not deal in any detail with reform of production subsidies, but focuses on policy instruments that can be used for specific environmental purposes.

5. The best mechanism for informing a decision on whether or not to take action – and the type and extent of any action – should be to assess costs and benefits wherever it is practicable. The 'best' instrument or package of instruments will have the highest environmental benefits for the lowest cost of implementation and compliance, although it will also be necessary to take into account possible wider economic impacts (e.g. on competitiveness) and social impacts, including the distributional effects upon farm incomes and other stakeholders.

6. The forms of intervention available include: facilitating change by providing information (e.g. offering free advice, running awareness-raising campaigns); encouraging voluntary action (e.g. supporting industry-led environmental initiatives); incentivising change using economic instruments (e.g. taxes, subsidies, tradable permits, tendering systems); and requiring change using regulatory instruments (e.g. limits on emissions, technology standards).

7. The most appropriate form of intervention depends upon a number of factors, but will be determined in part by the type of market failure. Where an adverse environmental impact results from the effects of production subsidies, then policy reform which removes (or "de-couples") these subsidies represents the most obvious means of addressing the problem. Where there is an information failure, then providing advice, education or training services or running awareness-raising campaigns can help to reduce negative environmental impacts and increase provision of positive environmental impacts. Where there are negative environmental impacts, voluntary instruments (such as farm assurance schemes), regulation, taxes, charges, tradable permit schemes, or some combination of these, might be appropriate, according to the particular situation.

8. Subsidies (including agri-environment payments, grants for capital investment, tax breaks) can be used to address negative environmental impacts. The Polluter Pays Principle creates a presumption against using subsidies in this way, but there may be cases in which they offer the best solution to a problem particularly when the distributional effects upon farm incomes, and other stakeholders are taken into consideration. Subsidy is more appropriate where positive environmental impacts are being provided (the "Provider Gets" principle). They may be paid direct to farmers or via someone else (e.g. a conservation organisation). However, there are limits to what is affordable; and on what is permissible under EC State Aid rules. There may be other ways in which the market could be encouraged to deliver, such as through labelling, farm assurance or other voluntary schemes.

9. Economic instruments will generally be more advantageous for farmers than regulations. Regulations generally impose the same standards on all producers, regardless of how expensive it is for individual producers to change their environmental performance. Economic instruments allow those with high clean up costs to make smaller changes in their behaviour and incentivise those with low clean up costs to make relatively major changes. This means that economic instruments can sometimes achieve the same environmental benefits as regulation but at a lower cost to the economy and to the industry concerned.

10. No instrument is likely to perform better than alternative options in all respects and there will be trade-offs between the use of different instruments, reflecting their relative strengths and weaknesses. Frequently a single instrument does not operate in isolation. Combinations of different types of instrument work alongside each other to achieve a desired environmental outcome. This may be because, for example, there is more than one type of market failure; there is a need to take distributional consequences into account; or because it is necessary to encourage a transition from the current position to the optimum outcome, recognising that this will involve transition costs for those involved. A combination of regulatory and economic

incentives, comprising both payments and taxes, may therefore provide an effective means of addressing the mix of positive and negative environmental impacts which arise from agriculture.

11. A review of policies in other OECD countries shows that only environmental subsidies or payments have been widely adopted. While all OECD countries have introduced some form of environmental payments, only a handful have introduced charges and none has chosen to apply tradable permits on any significant scale.

12. There is a need to look across a broader range of policy instruments – information, voluntary, economic and regulatory – and seek cost-effective options or packages of measures. In particular, it would be useful to assess the scope for using economic instruments to address the environmental impacts of agriculture, as these can allow more flexibility for farmers, resulting in lower compliance costs. The Government therefore intends to take forward work on this and to publish a consultation paper on this topic in 2003.

B Introduction: The basis for Government intervention

Introduction

13. The publication of the Strategy for Sustainable Food and Farming provides an opportunity to take stock and discuss the best ways of addressing the environmental impacts of agriculture. There is a need to look across a broad range of instruments – information, voluntary economic and regulatory – and seek cost-effective options or packages of measures. The particular focus of the paper is to highlight the scope for using economic instruments (taxes and tradable permits) to address the negative environmental impacts of agriculture.

14. A particular point to note is that until recently, UK agriculture has been spared from taking on some of the environmental responsibilities introduced to other sectors through regulation. However, a number of recent or expected regulatory measures will have an impact on agriculture (designation of new Nitrate Vulnerable Zones; extension of the controlled waste regime to include agricultural wastes). In the future there may be a need to address the environmental impacts of agriculture because:

    - in many cases, point-source pollution (that from an identifiable, source, often with an 'end of pipe' solution) has been tackled and diffuse pollution (much of which is caused by agriculture) will become the focus of policy; and
    - a number of EC Directives may require action to tackle the environmental impacts of agriculture (e.g. Bathing Waters Directive; Water Framework Directive; Habitats Directive).

15. This section of the paper therefore sets out some of the concepts used to determine whether there is a case for government intervention. Section C summarises the (positive and negative) environmental impacts of agriculture, as a first step in assessing the case for Government intervention to improve environmental outcomes. Economic valuations of both positive and negative impacts from recent studies are referred to as a guide to the overall significance of those impacts. Section D describes the types of policy instrument that government can use to change behaviour. It provides some views on the suitability of different instruments in different circumstances. It sets out how the best instrument or package of instruments should be selected, and highlights the possible role of economic instruments to address the negative environmental impacts of agriculture. Section E looks at the extent to which different types of policy instrument are used in the UK and overseas. Section F draws conclusions, and proposes next steps. Annex I contains brief summaries of economic instruments currently used to address environmental problems in the UK (or instruments under development). Annex II provides examples agri-environmental policy instruments in OECD countries. Annex III explains the agri-environment payment schemes in England.

The case for Government intervention

16. The objective of Government intervention should be to improve overall quality of life, taking account of economic, social and environmental considerations. To decide whether and how best to intervene to achieve more efficient outcomes, the Government needs to be as well-informed as possible about the nature of imperfections in the market, and the costs and benefits of action and inaction.

Market failures

17. Government has a role to play to improve the function of the market. The Government may therefore want to address market failures which result in less than optimal outcomes. Market failures occur when the market fails to bring about the most efficient outcome, and can occur for the reasons set out below:

18. *The full costs or benefits of an economic activity are not reflected in the price of that good*. This problem is described as an externality, as some costs or benefits are not felt by the producer and/or consumer. Positive externalities increase welfare or reduce production costs; negative externalities decrease welfare or increase production costs. For example, industries that pollute may not face the costs that their pollution imposes on other firms or individuals. The level of pollution is likely to be too high – higher than a level that would be economically efficient (where the marginal cost of further reducing pollution is just equal to the marginal benefit of avoiding environmental damage from pollution).

19. There are *public goods*, which are underprovided in a free market. This is because public goods are indivisible (or non-rival), in that one person's consumption does not diminish the amount available for others to consume, and non-excludable, such that if they are made available to anybody they become available to everybody, e.g. public amenities, clean bathing water, etc. Because it is impossible to exclude non-paying individuals from enjoying the benefits of such goods, there is little incentive in a free market for public goods to be provided by economic agents, or for individuals to reveal and pay the true value they place on a public good.

20. Public goods give rise to externalities. For example air is a public good – it is indivisible and its consumption is non-excludable. Industries discharging exhaust gases from combustion processes into the air are using the air as a means of waste disposal. Without government intervention, industries could 'over use' the air in this way, leading to pollution that could have negative impacts on environmental quality and human health, which in turn would have negative welfare impacts. Another way of looking at it is that environmental goods cannot generally be bought and sold in markets. The *absence of markets* for environmental goods means that individuals cannot secure a level of environmental quality that they would find acceptable – they need government intervention to secure it for them.

21. *Information failures* create inefficient outcomes if economic agents are not fully informed about relative costs, available technologies, etc. There are indications that farmers do not have full information about the most efficient use of some inputs, e.g. fertilisers.

22. There may also be problems of *inertia* or 'path dependence' in relation to production technologies, and the need for structural change inhibiting adoption of more efficient behaviour. It is possible that many economic agents exhibit *'non-optimising behaviour'* – for example they fail to make investments that would yield high positive rates of return. This may be because of information failures or because their objective is not profit- or welfare-maximisation (as is usually assumed).

Impact of other policy interventions

23. These reasons for Government intervention do not just apply to agriculture, but across the economy. However, when looking at how economic incentives affect the environmental impacts of agriculture, there are considerations particular to this industry. Over many years governments in virtually all developed economies have made significant interventions in agriculture, most notably in the EU and the UK through the mechanisms of the Common Agricultural Policy (CAP). Such policies can have both negative and positive environmental effects, for example by encouraging over production and therefore inefficiently high levels of input application, or by providing payments for provision of environmental goods.

24. It is therefore important to look at the impact of existing Government policy; the likely environmental effects of future policies; and how any proposed measures to address environmental problems interact with these. However, this document does not deal in any detail with reform of production subsidies, but focuses on policy instruments that can be used for specific environmental purposes.

Determining correct extent of intervention

25. Where a possible market failure has been identified, decisions need to be taken on whether and how best to tackle it. The first step should be to gather information about the issue and decide whether action is justified.

26. The mechanism for understanding whether to take action – and the degree of action – should be to assess costs and benefits wherever it is practicable. Comparing costs and benefits can clarify how policy impacts should be assessed and how to discount the value of future benefits compared to current costs. The Treasury 'Green Book'[1], a revised version of which is currently being consulted on, gives a standard appraisal methodology.

27. Decisions should be made on the basis of good scientific evidence and information about the potential costs and benefits. However, there may be limitations or uncertainties in the science, for example on the precise impacts of climate change. As a result, the benefits of acting to protect the environment are therefore not always clear, nor are the potential risks involved. The costs of taking action are also difficult to substantiate in some cases, especially where a significant change is required. Decisions often have to be made in the absence of robust evidence on environmental benefits and financial costs. In these cases, judgments have to be made on the scale of the problem and the appropriate level of response.

1 HM Treasury Appraisal and Evaluation in Central Government, July 2002, http://www.hm-treasury.gov.uk/Economic_Data_and_Tools/greenbook/data_greenbook_index.cfm

28. In some cases, externally-imposed targets such as those from EU Directives may dictate requirements. The UK's approach is to ensure that costs and benefits are taken into account during negotiations on those targets, and to argue for flexibility in the means of implementation in different member states (where this will produce better outcomes). Implementation then allows member states to use the most cost-effective package of instruments to achieve targets, whilst aiming to ensure that the benefits of intervention exceed the costs.

Precautionary principle

29. Where there are significant uncertainties surrounding the scientific case, policy decisions should take account of the precautionary principle. The Rio declaration defines the precautionary principle as: *'where there are threats of serious or irreversible damage, lack of scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation'*.[2] In other words, if risks are sufficiently great, action is justified. But the risks need to be quantified as far as possible and the action must be proportionate to the risk. Economic analysis still has an important role, even where the precautionary principle is being employed. Risks and option values, even if they are uncertain, can still be at least partially quantified and the cost-effectiveness of the different policy options to address those risks should still be determined.

2 The Precautionary Principle is a foundation of UK policy towards sustainable development, see the 'A better quality if life: a strategy for sustainable development in the United Kingdom' DETR 1999

C Environmental impacts of agriculture

Introduction

30. The agricultural sector in the UK is made up of around 230 thousand holdings. These are of widely differing sizes and types and adopt a range of different farming practices. Varying approaches to: the way in which livestock are kept; the use of inputs; soil, water, waste, nutrient and land management (as well as local environmental characteristics) affect the extent to which farming activities impact on the environment. The effects of agriculture on the environment are therefore significant and complex – farming activities can give rise to both positive and negative impacts operating at local, regional, national and global levels. Where farming activities are carried out in an environmentally responsible manner, positive impacts include supporting and maintaining a range of diverse and attractive landscapes and providing a range of habitats and food sources for farmland wildlife. Examples of the negative impacts include the polluting effects of pesticides and fertilisers and emissions of CO_2 and other greenhouse gases. Some environmental impacts are interrelated; for example poor land management leads to soil erosion, which in turn causes water pollution.

31. Over time, technical developments in farming – and incentives that are embedded within the mechanisms of the Common Agriculture Policy (CAP) – have often tended to result in adverse environmental trends. Environmental services that were once integral to 'traditional' farming systems (and hence were delivered by agriculture without government intervention) have been reduced by developments in modern farming practice (e.g. the need for larger field sizes to operate modern machinery and the switch from spring- to autumn-sown cereals) or by perverse policy incentives (e.g. livestock headage payments tending to encourage overgrazing particularly in fragile upland ecosystems).

32. The purpose of this section is to summarise the main environmental impacts of agriculture, as a first step in assessing the case for Government intervention to improve environmental outcomes. Economic valuations of both positive and negative impacts from recent studies are referred to as a guide to the overall significance of those impacts.

Positive environmental impacts

33. Agriculture accounts for around three quarters of land cover in the UK. It therefore has a large environmental impact through its effect upon the rural landscape, wildlife habitats and its use of natural resources. Where agriculture is carried out in an environmentally responsible way, it can have a range of positive environmental impacts, which are summarised below.

34. *Maintaining the basic environmental resources of soil and water*. Farming is particularly important as the primary mechanism for managing soil and its functions. The benefits of water accumulation and supply, nutrient recycling and fixation, soil formation as well as flood control have been recognised in the literature (e.g. Pretty et al, 2000; Environment Agency, 2002).

35. *Providing a 'carbon sink.'* The agriculture and forestry sector also acts as a sink for CO_2 in three main ways. Firstly, carbon accumulates in biomass in plantation forests and leaf litter, and on non-forest land which includes crops on arable land, land set-aside and woodland grown on farmland (e.g. in response to the UK Farm Woodland Premium Scheme). Secondly, carbon accumulates in soil in afforested land, in set-aside land, and in undrained peatland. Thirdly, increasing atmospheric concentrations of nitrogen compounds (NOx and NHx) and CO_2 act as fertilisers, increasing the carbon stored in vegetation and soils. Agricultural activities also give rise to greenhouse gas emissions; see paragraph 40 below.

36. *Supporting and maintaining diverse and attractive landscapes*. The value of regionally distinctive landscapes associated with each region's traditional farming system is well recognised in the literature (*e.g. Pretty et al, 2000; Hartridge and Pearce, 2001; Environment Agency, 2002; Willis and Garrod, 1993; Hanley, 2001; McInerney et al*). This value is also reflected in the large numbers who join environmental organisations and the even larger numbers who visit the countryside for recreation. The extent to which the public can benefit from such traditional rural landscapes depends on their having access to agricultural land.

37. *Providing a complex range of habitats and food sources for farmland wildlife*. Much of England's biodiversity has evolved or adapted within farmed systems.

38. Although not central to the current analysis, it should also be noted that agriculture contributes significantly to the rural, social and economic infrastructure, in particular indirectly through the environment it creates for tourism[3], recreation, marketing industries and, arguably, rural industry more widely.

Negative environmental impacts

39. Whilst some negative environmental impacts are clearly the result of poor farming practices; others may be difficult to avoid even where farmers are behaving responsibly; and could not be reduced without significant changes to the make-up of a farm's productive activities (e.g. switching to organic production; taking land out of intensive livestock production). The main negative environmental impacts of agriculture are summarised below. Many of these impacts are already controlled through existing regulation, voluntary initiatives or other measures. However, there are residual impacts that may warrant further government intervention.

3 State of the Countryside, Countryside Agency, 2001

40. *Greenhouse gas emissions:* Agricultural and forestry activity contributes to global emissions of three of the six greenhouse gases identified in the Kyoto Protocol, namely carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O). CO_2 is emitted during cultivation of arable land or semi-natural vegetation, when the soil is rotated to the surface and exposed to the air; when peat or fenland is drained in readiness for the planting of commercial forests or arable crops; and during the combustion of fossil fuels to power tractors and other vehicles (Hartridge and Pearce, *2001*). Methane is formed from decomposition of animal wastes and enteric fermentation in livestock. Agriculture is estimated to be the second largest source of methane gas in the UK, after landfill sites. Nitrous oxide is formed from nitrogen fertilisers and from the treatment and disposal of animal wastes. Hartridge and Pearce (2001) cite agriculture as the largest source of N_2O in the UK.

41. *Soil erosion:* Reflecting its dominance in land use in the UK, agriculture is a major contributor to soil erosion. Rates of soil erosion from agricultural land are generally significant and are high where sensitive soil systems are managed inappropriately. Factors contributing to this include: a decline in the use of organic and an increase in the use of inorganic fertilisers; poor soil management practices; fewer fallow periods; compaction of soils by livestock. In addition, agriculture's increased use of heavy machinery and overstocking of livestock causes soil compaction, which may lead to changed hydrology and possibly erosion. The Environment Agency (2002) suggest that agriculture contributes to 95% of soil erosion overall. Soil erosion may lead to: falling soil productivity (through soil fine losses and plant damage); increased fertiliser and sowing costs; and increased local authority costs (such as removing soils from roads) (Environment Agency, 2002).

42. Soil erosion is also a cause of water pollution. Runoff of soil particles from the land increases water turbidity (making it cloudy), smothering the bed of rivers and lakes. Fine particles clog coarse river gravels, reducing water flow and aeration. This has adverse impacts on aquatic ecosystems, in particular reducing habitats suitable for fish spawning. Particles also carry phosphates, pesticides, faecal pathogens, and other pollutants into surface waters. Soil erosion leads to increased drinking water treatment costs.

43. *Pesticides:* Agriculture is the largest user of pesticides (89%, Environment Agency, 2002) which include herbicides, fungicides and insecticides used to protect crops and plantations from competing species, pests and diseases. Pesticides dispersed in the air or received in soils may have adverse impacts on ecosystems[4], reducing species diversity. Impacts may be increased through bioaccumulation and pesticide resistance. There may also be human health impacts (from food residues, exposure to spray drift, operator use, etc.). The on-farm costs associated with pesticide use are also significant.[5]

4 There are considerable difficulties in linking pesticide use with negative impacts on biodiversity. Campbell and Cooke (1997) suggest that insecticides and herbicides affect the availability of food sources through eliminating invertebrates and through destroying the habitat of species upon which birds prey. They highlighted the problems involved with seeking to prove a link between population decline and pesticide use. The link has been proven for the decline of the grey partridge, with the decline of 19 other species possibly affected by pesticide use.

5 On-farm costs include human health issues, domestic animals death and sickness, pesticide resistance and crop losses.

44. Pesticides can cause water pollution, entering surface waters by spillage, spray drift and runoff, and leaching into ground waters. At concentrations above the environmental quality standard (EQS) they are likely to have toxic effects on aquatic plants or animals, and they may also exceed the allowable limit for pesticides in drinking water, increasing drinking water treatment costs.

45. *Veterinary medicines* (including pesticides such as sheep dip, antibiotics, hormones, growth regulators) and disinfectants are also a possible source of water pollution although less in known about their risks to wildlife. The use and disposal of sheep dip has been a particular risk to ground and surface waters. Water is contaminated by dips located by watercourses and by inappropriate disposal of spent dip. Sheep dip can have disastrous effects on aquatic food chains, with knock-on effects on secondary and tertiary consumers such as fish, birds and otters.

46. *Inorganic fertilisers, manure & slurry* are used to increase the nutrient content of soil and promote crop growth. The nutrients (nitrates and phosphates) contained in fertilisers can lead to water pollution through runoff and leaching. Excessive nutrient levels can cause a process known as eutrophication in fresh, coastal and marine waters. Elevated levels of nutrients tend to favour a few fast-growing aquatic plant species and promote excessive algal growth. Decomposition of dead algae causes deoxygenation of water. In freshwaters where phosphate levels are usually a limiting factor for plant growth, submerged plants are lost with consequential impacts on invertebrate and fish species. In coastal and some fresh waters where nitrate levels are usually a limiting factor for plant growth, blooms of micro-algae (e.g. blue-green algae) can form, which give off toxic substances. Increased nitrate concentrations in freshwater may exceed the standard for drinking water. Excess phosphate levels and algal growth increase the costs of drinking water storage and treatment. The use of organic fertilisers has a greater tendency to cause phosphate pollution problems than the use of inorganic fertilisers. This is because manure and slurry have a lower N:P (nitrogen: phosphorus) ratio than inorganic fertilisers. Applying enough manure or slurry to meet a crop's requirement for nitrates can lead to an over-application of phosphates. The addition of phosphorus to animal feeds (as a dietary supplement) may increase the P-content of slurry and manure.

47. The Environment Agency recently estimated that agriculture is responsible for 43% of phosphate in surface water, 29% coming from livestock and 14% from fertiliser. Many lakes and rivers in the UK are heavily enriched with both nitrogen and phosphorous. This places wetlands fed by these waters at risk, as well as aquatic Sites of Special Scientific Interest (SSSIs). A report by Carvalho and Moss in 1998 concluded that 80 of 95 lakes and other standing water SSSIs surveyed in England were suffering from eutrophication (English Nature 2002).

48. Intensification of farming practices in the last twenty years has resulted in a vast increase in the quantity of manure and slurry produced. Runoff from land spread with manure or slurry or from land used for keeping livestock contains pathogens (bacteria, protozoa, viruses) present in animal faeces, heavy metals and ammonium compounds produced by the decomposition of organic material. Faecal pathogens, such as *Cryptosporidium* and *E. Coli*, and heavy metals may pose risks to human health through contamination of bathing waters and can have adverse impacts on

shellfisheries. They lead to increased costs of drinking water treatment, increased monitoring expenditure, reduced access to recreational waters and increased shellfishery restrictions (Environment Agency 2002). Ammonium compounds reduce the ability of freshwaters to support fish life.

49. The organic content of runoff can lead to high organic loads in streams, ponds, lakes and ditches. The organic material is broken down causing deoxygenation of water which can lead to loss of invertebrate and fish life. Slurry and silage effluent are up to 100 and 200 times respectively more polluting than untreated human sewage in terms of biochemical oxygen demand (BOD). Therefore, if and when it reaches watercourses, the environmental damage can be significant. The main source of organic waste is agriculture; it contributes at least 90% of all wastes (Chartered Institution of Water and Environment Management 2000).

50. Many of the water pollution problems described above arise from diffuse sources – from fertilisers spread on land; pesticides sprayed on crops. Tackling such pollution can be more problematic that controlling pollution from point sources. Diffuse water pollution from agriculture (DWPA) is currently the subject of a government review. A set of discussion papers was published in June 2002, and are available on the Defra website, http://www.defra.gov.uk/ (search for 'DWPA').

51. There are also a range of small point sources on farms, for example failure of manure, silage and slurry stores; farmyard or farm track runoff where there are inadequate dirty water collection and drainage systems. Such sources are a frequent cause of acute water pollution problems. Yard washings and slurry accounted for more than half of the 2,063 substantiated water pollution incidents involving organic materials in 2000.

52. *Ammonia:* There are also emissions of ammonia to air, contributing to problems of acidification and eutrophication. Currently 85% of the ammonia entering the atmosphere in the UK is from fertilisers and manures used in agriculture. Ammonia is one of the main pollutants that contributes to "terrestrial eutrophication". It is a source of nutrient enrichment of sensitive habitats and can lead to changes in plant biodiversity. Ammonia may also lead to acidification of soils and waters in the uplands, especially in areas receiving heavy atmospheric pollution. Acidification leads to loss of aquatic biodiversity, such as reduced populations of freshwater fish. Livestock farming contributed 85% of the UK's ammonia emissions to air in 1999.

53. *Impacts of land management practices on biodiversity and landscapes:* In some areas, farming activities have helped to conserve semi-natural habitats and farm wildlife, enhancing the aesthetic appeal of landscapes. However, intensification of agriculture has often led to the loss of habitats and less appealing landscapes. The impact of this on biodiversity is unclear. Data detailing the damage to biodiversity specifically from agriculture and forestry are difficult to find. There are multiple explanations of species' population decline, and these explanations often interact.

54. According to Pretty et al (2000), species diversity is declining, including in the farmed habitat itself. Draining and fertilisers have replaced floristically-rich meadows with grass monocultures and contributed to the loss or degradation of characteristic hedgerow and field margin vegetation. Overgrazing of uplands and the abandonment or under-management of semi-natural 'infield' habitats – mostly in the lowlands – has

reduced species diversity (English Nature, 1998). Herbicides have reduced species diversity in arable fields. Farmland birds have particularly suffered, mainly as a result of a shift from spring sown to autumn-sown cereals. The populations of nine species fell by more than a half between 1970-1995 (Pretty et al, 2000). Cropping systems have become simplified and more specialised with a loss of crop rotations and arable-pasture mosaics, resulting in a lower diversity of habitats and a severe reduction in characteristic farmland species. This view is widely supported (see, for example, Central Science Laboratory and Joint Nature Conservation Committee, 2002; English Nature, 1998).

55. *Abstraction of water for irrigation:* Excessive water abstraction has impacted negatively on some wetland habitats.

56. *Waste:* At present approximately two-thirds of all farm wastes are burnt in the open air or buried. Uncontrolled burning can lead to potentially hazardous emissions to air and soil, including dioxins. Burning of hazardous wastes can also cause long-term pollution and soil contamination.

57. *Flooding:* Changes in agricultural land-use and cultivation practices are increasing rainwater run-off and contributing to flooding. River catchment surveys in winter 2000 revealed widespread damage to soil structure, with 50% of soils having damaged structure in one area. Modelled predictions suggested potential increase in run-off from 1.2% to 20% for an individual storm.

Economic valuations of environmental impacts

58. Because there are often no markets and therefore no prices for environmental goods (e.g. clean air, visual amenity and biodiversity), it is not usually possible to obtain economic values for environmental impacts using market prices. Values must therefore be inferred or estimated, using a range of techniques. These techniques can be grouped into two broad categories:

    - techniques that measure the impact of the environmental problem on the wellbeing of humans ('welfare impacts') by estimating a societal mean willingness to pay to secure an improvement in environmental quality or to avoid a reduction in environmental quality. These techniques either elicit values directly from people (through surveys where consumers are asked hypothetical questions about their preferences) or indirectly, by observing their actual or hypothetical behaviour in related markets (for example, house prices in areas affected by an environmental problems can be compared with similar properties in an area free of the environmental problem).

    - techniques that look for surrogate measures of welfare impacts, using goods that do have market prices ('surrogate costs'). For example, pollution control costs are used as a proximate value for the value that society places on reducing pollution. This is based on the assumption that if society has chosen to reduce pollution, it must have been willing to pay at least the pollution control costs (or more) to reduce that pollution. The pollution control costs therefore provide an estimate of

society's value for reducing pollution. Such techniques are usually used in the absence of estimates of willingness to pay – they do not represent the true value of welfare impacts, only a proximate value.

59. Where a change in environmental quality has a positive or negative impact on production costs or income, the change in costs or income can usually be measured using market prices. The 'production costs' approach is useful in demonstrating the resource implications of environmental problems, whereas the 'welfare impacts' approach demonstrates how important an environmental impact is to society as a whole. They measure different things, and one should not expect the values they produce to be similar. They can both contribute to measuring the 'Total Economic Value' of an environmental resource.

60. Valuation techniques do not usually produce a single value for an environmental impact – they usually provide a range of values, taking into account the uncertainty inherent in estimating values. Further sources of uncertainty include quantifying environmental impacts and the extent to which agricultural activities give rise to those impacts. Estimates of the value of the environmental impacts of agriculture that are provided below should be treated with a great deal of care. They are provided as a guide to the significance of different environmental effects rather than as a statement of their absolute magnitude. Uncertainty and omitted impacts (impacts that have not been valued) means that one should not draw conclusions by comparing the totals for the estimates of costs and benefits. Alternative land uses would also produce a range of positive and negative environmental impacts. These are not available for comparison and are not necessary to demonstrate the significance of the different environmental impacts of agriculture.

61. A recent study by Hartridge and Pearce (2001) estimated the value of a (not exhaustive) range of positive environmental impacts of agriculture at around £595 million per year (see Table 1 at the end of this section). The Environment Agency (2002) adjust this figure to include the benefits of carbon sinks and estimate total benefits at around £914 million per year (2000 prices). Although there are large uncertainties surrounding these valuations, there is evidence[6] that society values the diversity of agricultural landscapes (with their associated wildlife habitats and biodiversity impacts), and that these are currently under-provided.

62. The results of three recent studies, which attempt to value the cost of agriculture's negative environmental impacts, are summarised in Table 2 at the end of this section. Not all the negative environmental impacts of agriculture are included; only those that can be quantified and for which economic values have already been established. The figures are not directly comparable because the studies from which the figures are derived cover slightly different sets of impacts, and value different things (e.g. welfare impacts versus production costs).

63. The study by Hartridge and Pearce (2001) seeks to estimate the environmental costs of UK agriculture, mainly using values from a range of willingness to pay studies (the

6 Willis et al., 1993; Stewart et al., 1997; Hanley, 2001

'welfare impacts' approach) – both from the UK and abroad. The authors estimate the depreciation of the stock of natural capital associated with agriculture and the environmental services generated. They obtain the relevant values from willingness to pay estimates to arrive at cost estimates.

64. The study by Pretty et al. (2000) estimates the environmental costs of UK agriculture mainly by examining the expenditure which society incurs in dealing with it (the 'production costs' approach).

65. The study by the Environment Agency (2002) draws on these two earlier studies but includes, in particular, more extensive work on soil erosion. It should be noted that the study does not attempt to include costs associated with damage to biodiversity, landscapes or to human health.

Table 1:
Economic values of positive environmental impacts of agriculture[7]

Environmental Services	**Value** (£ million per year, 1998 prices)
Agricultural Landscape	140.7
Forest and Woodland	84.5
Environmentally Sensitive Areas	187.6
Sites of Special Scientific Interest	182.1[8]
Total	594.9[9]

Source: Hartridge O. and Pearce D. (2001) 'Is UK Agriculture Sustainable? Environmentally Adjusted Economic Accounts for UK Agriculture' CSERGE-Economics paper.

7 Care should be taken with these figures as they are very broad and uncertain and based on one study.

8 This figure includes the valuation of the Countryside Stewardship Scheme, Organic Farming Scheme, habitat scheme, and Nitrate Sensitive Areas.

9 Adjusting this value to include the benefits of carbon sinks gives a total of £955.5 million per year.

Table 2:
Economic values of negative environmental impacts of agriculture

Environmental Impacts	Value, £ million per year		
	Hartridge & Pearce (1998 prices)	**Pretty et al** (1996 prices)	**Environment Agency** (2000 prices)
Damage to Natural Capital:			
Water	428.3	231	262
Air	585.4	1113	760
Soil	20.5	95	205
Biodiversity and landscape	38	126	
Total	1,072.2[10]	1,566	1,227

Sources: Hartridge O. and Pearce D. (2001) 'Is UK Agriculture Sustainable? Environmentally Adjusted Economic Accounts for UK Agriculture' CSERGE-Economics paper;

Pretty J. et al (2000) 'An Assessment of the Total External Costs of UK Agriculture', *Agricultural Systems* Vol. 65 pp. 113-136;

Environment Agency (2002) 'Agriculture and Natural Resources: Benefits, Costs and Potential Solutions.'

10 Adjusting this value to exclude the benefits of carbon sinks gives a total of £1,432.8 million per year.

D Choice of policy instruments

Introduction

66. This section of the paper considers the policy instruments that government can use to change behaviour and improve environmental performance. It provides some views on the suitability of different instruments in different circumstances. It sets out how the best instrument or package of instruments should be selected, and highlights the possible role of economic instruments to address the negative environmental impacts of agriculture.

67. Policy instruments are the means by which the Government seeks to change behaviour. For example, the Government uses:

- information instruments, such as the provision of free advice, to raise awareness and *facilitate* changes in behaviour;
- voluntary instruments, such as industry-led environmental initiatives, to encourage people to change their behaviour;
- economic instruments, such as taxes or grants, to *incentivise* people to change their behaviour; and
- regulatory instruments, such as licenses or standards to *require* people to change their behaviour.

68. Policy instruments are often not purely 'regulatory', purely 'economic' or purely 'voluntary', etc. Information instruments can be subsidised, for example where government ensures that advice is provided at reduced cost or free of charge. Voluntary schemes are also often subsidised to ensure that participation is free of charge. Tradable permits are regulatory in that people must operate within the bounds of their permit, but economic in that they are tradable and therefore provide an incentive to further improve environmental performance. Compliance with regulations is incentivised through fines and environmental liability.

Information

69. Examples of information instruments include: written, internet or face to face advice; training; research and development; and awareness raising campaigns. They work best where a lack of information about how best to reduce environmental impacts is in itself a significant barrier to people changing their behaviour. Information instruments may not need public subsidy to be effective if there is already an incentive for farmers to get this information or for others to provide it. However, public subsidy may be required, at least partially or in the start-up phase. Information can also be provided by other farmers through demonstration farms or local farmer networks. Local initiatives that bring farmers together to exchange information and receive locally relevant face to face advice can be very effective.

Voluntary

70. Examples of voluntary instruments include: voluntary product labelling or branding; voluntary codes of practice or standards; voluntary (but externally accredited) environmental management standards or audits; and voluntary agreements. The Red Tractor logo marks products produced to the standards of British assurance schemes and provides assurance on basic production standards. Other initiatives (e.g. Freedom Foods, protected designations, "White and Wild") may seek to guarantee to consumers such factors as animal welfare friendly production, the provenance of produce or environmentally friendly production and thus offer the potential to capture some of the benefits of particular production systems through the market.

71. Voluntary instruments work best where people already have some incentive to change their behaviour – it may be that just bringing different players in the market together and helping them agree common aims, or providing a scheme for people to join is enough to encourage them to change their behaviour. For example: farmers may join premium or higher level farm assurance schemes because they provide them with a marketing advantage; companies work towards attaining environmental management standards for the same reason, as well as to reduce potential environmental liabilities or environmental liability insurance costs.

72. Voluntary instruments also tend to be chosen in preference to regulation or economic instruments where: changes in behaviour can be secured through the actions of a small number of market players; the scale or localised nature of environmental impacts would not warrant the introduction of national regulations or economic instruments; monitoring and enforcement of regulations and economic instruments would be so difficult that they would have little credibility; or where it would be difficult to design a regulation or economic instrument that would be environmentally effective.

Economic

73. There are many different types of economic instruments:

    - Charges or taxes on emissions or products (inputs to or outputs of production processes). These charges or taxes provide people with an economic incentive to reduce production or use of harmful substances;
    - Tax/refund schemes, whereby people receive refunds on environmental taxes they have paid in proportion to the improvement of their environmental performance relative to their competitors;
    - Deposit/refund schemes that provide people with a disincentive to dump empty containers or used products;
    - Tradable permits or quotas that are used to control the overall level of a particular type of pollution or the use of a particular resource but allow individuals to buy or sell permits to meet their own requirements;

- Public spending in the form of: payments for provision of public goods; production subsidies with environmental pre-conditions ('cross-compliance'); tax breaks such as capital allowances for environmental investments; tax rebates, grants or loans for environmental investments; financial support for advice services or voluntary initiatives; tax credits that reduce a person's liability to pay an environmental tax if they have funded an approved environmental project;

- Enforcement incentives such as: fines for non-compliance with regulations; legal liability for environmental damage; and environmental performance bonds (whereby operators have to place a deposit that is only returned to them once they have finished their operations and restored a site to a satisfactory condition).

74. Requirements for operators to have public liability insurance or to show their environmental liabilities in company accounts can also introduce economic incentives for operators to improve their environmental performance. Removal of production subsidies for activities that cause environmental harm could also be considered an economic instrument of environmental policy. Examples of economic instruments currently being used to address environmental impacts in the UK are given in Annex I.

75. The choice of economic instrument depends on the nature of the problem to be addressed. Tradable permits are often useful where particular emissions or resource-use reduction targets or phase-out deadlines must be met, as progressive reduction in pollution or resource use can be dictated through permits, whilst trading allows compliance to be achieved at least cost. Trading works best where the location of emissions or resource use does not affect the level of environmental damage. However, tradable instruments can be designed to take account of local factors – with adjustments to traded permits according to local environmental sensitivity. They can be used to create a market for environmental quality – private individuals can purchase permits and take them out of the market to raise environmental quality above the level that would otherwise be achieved. This can also help to address local environmental issues.

76. In general, environmental taxes work by making people face the environmental costs they impose on society. This is known as 'internalising externalities'. People are able to compare the environmental costs of their activities with the costs of reducing the harm they cause the environment. Environmental taxes create incentives for economic agents to find solutions, and to balance the benefits of economic activity against the costs of damage to the environment. The Government has already outlined the principles which inform its use of environmental taxes, in the 1997 Statement of Intent (see box below).

77. Environmental taxes are useful where they can incentivise people to switch from using one product to using another or where a low-level incentive effect will help curb general levels of pollution or resource use in the long term, but there is no immediate need to control pollution or resource use in a particular way. Environmental taxes can be used to meet targets for reductions in pollution or resource use. However, they may require long lead-in times to allow rising prices to impact on behaviour. Part of the revenue from environmental taxes can be used to facilitate the desired changes in behaviour. Environmental taxes are also useful where an environmental impact is closely linked to an economic activity, and there are no obvious 'end of pipe' solutions that can allow the economic activity to continue with a reduced environmental impact.

78. Where an environmental tax is being used to achieve a specific target or objective because it is the most cost-effective instrument available, its rate will be set according to the incentive effects it is intended to provide. It is therefore important to assess short- and long-run price elasticities of demand (as well as any possible supply-side effects) in order to set the tax at a level required to stimulate the desired change in behaviour. Even where demand is relatively inelastic (it does not reduce much in response to increasing prices), environmental taxation is justified. This is because it makes polluters face the costs of the damage they cause and because the tax introduces price-signals that may have an effect in the long term; if not to reduce a problem then to prevent a problem from becoming worse over time. Where a low price elasticity reflects a lack of knowledge amongst farmers about alternatives (or a lack of willingness to experiment with alternatives as a result of risk aversion or habitual behaviour), supporting complementary information instruments may contribute to increasing the price-responsiveness of farmers and thus raise the environmental effectiveness of the tax. The most efficient environmental tax will be one which is set equal to the marginal cost of the environmental damage caused by the activity or pollutant (known as a Pigouvian tax). It is therefore important to quantify and value the environmental impacts arising from the activity or pollutant to be taxed.

Statement of intent on environmental taxation

The Government's central economic objectives are the promotion of high and sustainable levels of growth and high levels of employment. By that we mean that growth must be both stable and environmentally sustainable. Quality of growth matters; not just quantity.

Delivering sustainable growth is a task that falls across government. It will be a core feature of economic policy under this administration. The Treasury is committed to that goal.

How and what governments tax sends clear signals about the economic activities they believe should be encouraged or discouraged, and the values they wish to entrench in society. Just as work should be encouraged through the tax system, environmental pollution should be discouraged.

To that end, the Government will explore the scope for using the tax system to deliver environmental objectives - as one instrument, in combination with others like regulation and voluntary action. Over time, the Government will aim to reform the tax system to increase incentives to reduce environmental damage. That will shift the burden of tax from "goods" to "bads"; encourage innovation in meeting higher environmental standards; and deliver a more dynamic economy and a cleaner environment, to the benefit of everyone.

But environmental taxation must meet the general tests of good taxation. It must be well designed, to meet objectives without undesirable side-effects; it must keep deadweight compliance costs to a minimum; distributional impact must be acceptable; and care must be had to implications for international competitiveness. Where environmental taxes meet these tests, the Government will use them.

Regulatory

79. Types of regulatory instrument include:

    - Controls on emissions, activities, use of resources and toxic substances, through bans, permits, quotas and licensing;
    - Controls on the choice of technology or standards for the environmental performance of technology;
    - Extended producer responsibility (where producers are made liable for the environmental effects of their products, or management of their products' packaging waste or used products);
    - Mandatory environmental management standards and environmental audits.
    - Mandatory environmental labelling or product standards;
    - Mandatory training;
    - Operator licensing (operators are required to demonstrate that they are a 'fit and proper' person to hold a licence and must comply with certain licensing conditions).

80. Regulatory instruments are often chosen over economic instruments where the pollutant has very high external costs so that a ban or very strict limits need to be set and enforced. Often, regulation is used where a high level of certainty of outcome is required, or where there is little flexibility allowable on the timing or nature of the outcome required. EU environmental legislation is often drafted in a way that explicitly or implicitly requires member states to implement it using regulatory instruments.

81. The choice of regulatory instrument depends on the nature of the problem to be addressed. A mandatory environmental management standard is useful where a general improvement in environmental performance is desired, but it is not possible to dictate exactly what changes in behaviour would be appropriate for a wide range of operators and local environmental conditions. Banning the use of a particular substance is useful where it can be demonstrated that an immediate cessation in use is essential for environmental protection and that alternatives are available at a reasonable cost.

82. Removal or relaxation of regulations should be considered where they have adverse environmental impacts.

Choice of instrument

83. The choice of policy instrument(s) is essentially based on the costs and benefits of the options. The 'best' instrument will have the highest environmental and wider benefits for the lowest cost of implementation and compliance. For a given environmental outcome, the instrument chosen should impose the lowest costs (it should provide the most cost-effective means of achieving objectives).

84. Information campaigns or the provision of advice can address market failures stemming from lack of information and inertia.

85. When addressing negative environmental impacts, economic instruments such as taxes and tradable permits will generally be more advantageous for farmers than regulations. Regulations impose the same standards on all producers, regardless of how expensive it might be for individual producers to change their environmental performance. Economic instruments allow those with low clean up costs to change their behaviour the most, while those with high costs may choose to make relatively minor changes. This means that economic instruments can achieve the same environmental benefits as regulation but with less negative impacts on farm output. Farmers or other producers have greater flexibility about how much they need to change their behaviour with taxes or trading schemes.

86. Whereas regulation gives economic agents an incentive to meet specified levels of environmental protection, economic instruments provide a continued incentive for innovation, which may mean that some economic agents take action beyond levels that would be achieved through regulation. Economic instruments can allow Government more flexibility over the extent to which an instrument 'bites' over time – with gradual changes that allow businesses time to react and make sensible investment decisions, rather than be forced into production changes in time to meet regulatory deadlines. Government can use part of the revenue raised by environmental taxes to reduce distortionary taxes or increase spending on programmes that support changes in behaviour toward the environment (e.g. landfill tax credit scheme). Environmental taxes are also useful where an environmental impact is closely linked to an economic activity, and there are no obvious 'end of pipe' solutions that can allow the economic activity to continue with a reduced environmental impact.

87. Regulation, on the other hand, generally prescribes uniform standards and how to reach them, which can involve high adjustment costs for some farmers. The costs of environmental regulations can be reduced whilst making them more environmentally effective by making them outcome-focused, with risk-based enforcement regimes, incentive-based charges and simple registration and reporting requirements. Defra is working with the Environment Agency to establish a strategy to modernise our approach to environmental regulation with the aim of improving the efficiency and effectiveness of regulation. Defra will need increasingly to collect information and manage its relationship with farmers on a whole farm basis if it is to minimise the burden of compliance.

88. Subsidies can be used to provide environmental assets (which have positive impacts on welfare) which would either not be provided or be under-provided by the market. Subsidies can be administered through Government spending programmes, e.g. Farm Waste Grant Scheme, Countryside Stewardship Scheme. Alternatively, Government can incentivise private individuals to support organisations that work with farmers to improve environmental quality or that undertake nature conservation work. For example, charities such as the National Trust can claim back income tax paid on their members' annual subscription fee.

89. The *Polluter Pays Principle*, which is a foundation of European environmental policy[11], creates a presumption against using subsidies (including lump-sum payments such as grants to support investment; tax exemptions or reduced tax rates) to reduce negative environmental impacts:

'…legislation on environmental protection must apply the "polluter pays" principle, under which… persons… who are responsible for pollution must pay the costs of such measures as are necessary to eliminate that pollution or to reduce it so as to comply with the standards or equivalent measures which enable quality objectives to be met or, where there are no such objectives, so as to comply with the standards or equivalent measures laid down by the public authorities.' (75/436/Euratom, ECSC, EEC: Council Recommendation of 3 March 1975 regarding cost allocation and action by public authorities on environmental matters).

90. The rationale for the Polluter Pays Principle is that subsidies can have a range of distorting effects on the economy and international trade, leading to less efficient use of resources[12]. Subsidies may:

- impact on the entry/exit decisions of firms, attracting inefficiently high levels of entry into (or inefficiently low levels of exit from) a polluting industry;
- pay economic agents to do things that they would have done anyway; and
- provide financial support to businesses that would give them an unfair competitive advantage where such subsidies are not offered in other countries.

91. However, there will be cases in which subsidies will offer the best solution to a problem. Community guidelines on state aids for environmental protection and in the agricultural sector set out the circumstances under which member states may employ subsidies.

92. Once introduced, it is politically difficult to withdraw subsidies. Withdrawal can lead to further social or environmental harm. When using public money, value for money becomes an important issue. The benefits of spending on environmental protection are compared with the benefits of spending on health, education and other public services. It is therefore important to have a proper 'exit strategy', to minimise adverse impacts and ensure subsidies are only used where they represent the best way to deal with a problem.

Other considerations

93. It will also be necessary to take into account a number of other factors in determining the optimum form of intervention.

11 The Polluter Pays Principle is a foundation of UK policy towards sustainable development, see the 'A better quality if life: a strategy for sustainable development in the United Kingdom' DETR 1999

12 However, it is also true that other forms of Government intervention can also have undesirable and unintended consequences – good policy design should aim to minimise such impacts.

Environmental effectiveness

94. When using tax, trading schemes or subsidies to reduce negative environmental impacts, the aim should to intervene as closely as possible to the cause of the problem. This reflects the Polluter Pays Principle and is often the most efficient way of dealing with a problem. It ensures that interventions are as effective as possible and have a clearly demonstrable environmental purpose. However, it is often necessary to use proxies for actual environmental damage, such as inputs which give rise to damage. When taxing, subsidising or trading proxies instead of the pollution directly, it is necessary to ensure that this still provides incentives to reduce the pollution concerned and does not result in disproportionate costs or responses which lead to greater damage through attempts to evade the measure.

95. The scale of an intervention should also be related to the nature of the environmental problem. For some agricultural impacts, this may be at a relatively local level. However, there will usually be a trade-off with administrative complexity and practicality.

96. Where environmental impacts operate at the global level (e.g. climate change), it will also be necessary to take into account any displacement effects of intervening to tackle an environmental problem. For instance, if the impact of the intervention is to shift production to another country, the overall impact may be perverse, as there will be no change in the environmental impacts associated with production but increased environmental impacts arising from transport to the UK.

Economic and social factors

97. In considering an intervention, it is necessary to consider who will ultimately have to act in response. Often there will be impacts on several sectors, including providers of environmental goods and services as well as those who pay for them either directly or indirectly. Compliance costs for both business/individuals and government will need to be considered.

98. Any environmental intervention needs to have regard for impacts on business, including:

    - international competitiveness of sectors which compete in international markets;
    - impacts on competition within market sectors (including impacts on SMEs); and
    - distortions to markets caused by imperfect design.

99. Distributional aspects will also be important, including both the distributional benefits and costs. A judgement will probably be needed on whether the overall balance of costs and benefits is reasonable.

Tackling constraints and using package approaches

100. It will almost certainly be the case that the constraints outlined above will mean that it is not possible to design and implement the economically perfect instrument. There may therefore be more than one means of achieving an objective.

101. It may also be desirable to use a package approach, in order to ensure that the package as a whole addresses the environmental, economic and social constraints. If there were more than one market failure this would also suggest a role for more than one type of intervention. And there may be a case for using more than one measure in order to encourage a transition from the current position to the optimum outcome, recognising that this will involve transition costs for those involved.

102. Care needs to be taken in the choice and design of the different instruments to ensure that they are mutually reinforcing and that there are no perverse incentives created.

Process

Stakeholder engagement

103. In developing environmental policies, there should be opportunities for those with an interest or who are likely to be affected to contribute to the process. This may involve formal or informal consultation. There should be dialogue about the objectives and the constraints involved. Once decisions have been made, the rationale should be explained clearly.

Monitoring and evaluation

104. An environmental intervention should have clear objectives, and progress against objectives should be monitored over time. The results of monitoring should be reported publicly and the effectiveness of the intervention kept under review.

E Environmental economic instruments in agriculture

Introduction

105. This section looks at the extent to which different types of policy instrument are used in the UK and overseas.

106. Out of the three main environmental economic instruments outlined above – subsidies, taxes and tradable permits – amongst OECD governments only environmental subsidies or payments have been widely adopted. While all of them have introduced some form of environmental payment, only a handful have introduced charges and none have chosen to apply tradable permits in any significant scale. The only examples of tradable permits used in an agricultural context are very localised, such as nutrient trading schemes in some US river catchments. Annex II provides examples agri-environmental policy instruments in OECD countries.

107. In the UK, public spending programmes support agri-environment payments (see Annex III), land management advice services, grants for environmental investments (e.g. Farm Waste Grant Scheme), and other grant schemes that may bring environmental benefits as a side effect or impose environmental conditions through cross compliance. Some regulatory measures impact on agriculture, but the only economic instruments addressed at agriculture (amongst other sectors) are water abstraction license charges and water rights trading.

Payments for environmental public goods

108. The ecological impact of such measures is difficult to assess because of the very long timescale of environmental impacts and the limits of current scientific knowledge. Only a small share of agricultural land is currently covered by such schemes. However, the evidence available indicates overall positive impacts on the environment. Valuation studies relating to ESAs have indicated that the values placed upon enhanced landscape have greatly exceeded the costs of running the schemes.

109. The voluntary character of the scheme means that those farmers that are faced with the lowest costs of delivering environmental enhancements will have the greatest incentive to participate. Conversely, it is possible that the most environmentally damaging farmers choose not to participate.

Taxes

110. In contrast to the self-selection of voluntary agri-environmental payments, input taxes ensure that all users are subject to the economic incentives of reducing their application. From the literature reviewed (see Annex II), the introduction of taxes does have an effect on volumes of inputs consumed. However, it can be difficult to distinguish how much of the behavioural change is due to the tax, to its signalling effect or to other improvements in information about efficient use of inputs. One of the effects of introducing a tax on polluting inputs is the signal to farmers that they now have to account for environmental costs inflicted on the rest of society.

111. It is difficult to draw conclusive lessons from international experience of taxes used to address the environmental impact of agriculture. This is because few of these taxes had environmental protection as a raison d'être.

112. Where there are multiple market failures it may be that combining an environmental tax with a good advisory system will be more appropriate than an input tax as a stand-alone policy. The behavioural impact of product taxes is likely to be less where the products have low price elasticities. However, taxes can sometimes play an important signalling and information role. Both from a theoretical point of view and from the international evidence available, a combination of regulatory and economic incentives comprising of both payments and taxes, seems to be an effective policy option to reduce the negative impact upon the environment from agriculture.

F Conclusions

113. The range and extent of environmental impacts of agriculture described in Section C indicate that there is a good case for government intervention to improve the environmental performance of farming. Further research may be required to quantify individual environmental impacts and the extent to which they are caused by agricultural activities, as well as the costs and benefits of different options for addressing those impacts.

114. There is a need for discussion of the approaches that Government should take to influencing behaviour with respect to agriculture and the environment. Sections D and E showed that it would be possible and desirable to broaden the range of policy instruments used – regulation could be costly and subsidy (to reduce negative environmental impacts) may not be affordable or permissible under EC State Aid rules. In particular, it would be useful to assess the scope for using a broader range of economic instruments to address the environmental impacts of agriculture, as these can allow more flexibility for farmers, resulting in lower compliance costs.
The Government therefore intends to publish a consultation paper on this topic in 2003.

References

Environment Agency (2002) 'Agriculture and Natural Resources: Benefits, Costs and Potential Solutions'

Hanley, N. (2001) (ed). Estimating the Value of Environmental Features. Report to MAFF.

Hartridge O. and Pearce D. (2001) 'Is UK Agriculture Sustainable? Environmentally Adjusted Economic Accounts for UK Agriculture' CSERGE-Economics paper.

Holling, CS, Schindler, DW, Walker, BW, Roughgarden, J (1995) Biodiversity in the functioning of ecosystems: An ecological synthesis. In C. Perrings, K-G

Maler, C. Folke, CS Holling and B-O Jansson (ed.s) *Biodiversity Loss: Economics and Ecological Issues*. Cambridge University Press.

Kramer, L. (1995) *EC Treaty and Environmental Law*. 2nd Edn. Sweet and Maxwell, London.

McInerney et al, 'What's the damage: A study of farm level costs of managing and maintaining the countryside'.

Pretty J. et al (2000) 'An Assessment of the Total External Costs of UK Agriculture', *Agricultural Systems* Vol. 65

Stewart, L. Hanley, N. and Simpson, I. (1997). Economic valuation of the agri-environment schemes in the United Kingdom. Unpublished Report by the Environmental Economics Research group, University of Stirling, to HM Treasury and MAFF.

Toman, M.A. (1994) Economics and "Sustainability": Balancing Trade-offs and Imperatives. *Land Economics* 70 (4) 399-413.

Willis, K.G., Garrod, G.D. and Saunders, C.M. (1993). Valuation of the South Downs and Somerset Levels and Moors Environmentally Sensitive Area Landscapes by the General Public. A Report to the Ministry of Agriculture, Fisheries and Food. Centre for Rural Economy, Department of Agricultural Economics and Food Marketing. University of Newcastle upon Tyne.

Annex I
Economic instruments currently in use or under development in the UK

Aggregates levy

115. The aggregates levy was introduced in 2002 at a rate of £1.60 per tonne of virgin aggregate. It aims to incorporate the environmental costs associated with quarrying into market prices and to encourage a shift in demand away from virgin aggregate towards recycled and other alternative materials. The rate of £1.60 was informed by research which estimated the costs of the environmental impacts associated with quarrying (noise, dust, visual intrusion, loss of biodiversity and amenity) by using a willingness to pay approach.

116. In the Pre-Budget Report 2002, the Government announced that it is phasing in the levy for aggregates used in processed products in Northern Ireland. The rate for aggregates used in these products has been set at zero for the first year of the levy and will rise by 20 percentage points each year for five years.

117. While it is too early to get results from an evaluation for the aggregates levy there are reports of the levy having an impact on commercial decisions to investigate or develop recycled or other alternative materials to virgin aggregate.

118. Revenues raised from the introduction of the levy are recycled back to business and communities affected by extraction through a 0.1 percentage point cut in employer National Insurance Contributions (NICs) and a new £35 million Sustainability Fund.

119. As announced in the 2001 Pre-Budget Report, the Government has examined industry proposals for delivering additional environmental benefits through the aggregates levy by encouraging the positive use of aggregates waste and will shortly consult formally in order to gather information on the issues involved.

Landfill tax

120. The landfill tax encourages waste producers and the waste management industry to switch away from landfill towards waste minimisation, re-use and recycling.

121. The landfill tax has two rates: for active and inert waste. The lower inert rate has been set at £2 per tonne since the adoption of the landfill tax in 1996. Inert waste includes rock, soil, construction stone, stone from the demolition of buildings or structures, glass and concrete. There has been a significant fall in the amount of inert waste sent to landfill since the introduction of the tax. This is at least in part due to increased recycling of construction waste.

122. The higher rate of landfill tax was originally informed by the estimated external costs of using landfill, and has been increased by £1 per tonne each year to reach a rate of £15 per tonne by 2004/5. It currently stands at £13 per tonne. In order for the incentive to switch away from landfill to be strong enough, the higher rate of landfill tax will need to be increased significantly in the medium term and will also be combined with a system of tradable permits. The Government therefore announced in the Pre-Budget Report 2002 that it will consult on a proposal to increase the landfill tax escalator to £3 per tonne in 2005-6 and to increase the rate of tax by at least £3 per tonne in future years, towards a medium to long term rate of £35 per tonne. Again these increases will be introduced in such a way so that they will be revenue neutral for business as a whole.

Landfill tradable permits

123. The 1999 Landfill Directive set targets to reduce the amount of biodegradable municipal waste (BMW) sent to landfill to 35% of its 1995 levels by 2020. BMW is a major source of methane, a potent greenhouse gas.

124. It was announced in *Waste Strategy 2000* that a system of tradable permits would be introduced in England to limit the amount of BMW that authorities could landfill. These permits will be initially allocated at no cost to waste disposal authorities and apply to BMW only. Waste disposal authorities in areas where the additional costs of diversion from landfill are high will be able to choose to continue to landfill waste by buying permits from local authorities where the additional costs of diversion are lower. The system of tradable permits will thus minimise the cost of meeting the obligations of the Landfill Directive while giving local authorities the greatest amount of freedom in how they meet their targets.

125. A Waste and Emissions Trading Bill was introduced to the House of Lords in November 2002, It is hoped that the Bill will attain Royal Assent by the end of this Parliamentary session. This Bill will allow the implementation of the trading scheme described above, setting legal requirements and providing for the infrastructure to monitor the scheme including collection of information, public access and penalties for non compliance.

Packaging Waste Recovery Notes (PRNs)

126. The 1997 Packaging Regulations set national percentage targets for recovery and recycling of packaging waste. The quantity of waste that firms must recover depends on the total amount of packaging they produce or supply to consumers and the nature of their activities.

127. PRNs are the means by which companies with an obligation to recycle or recover packaging demonstrate compliance with their obligations. Blank PRNs are issued by the Environment Agency to accredited reprocessors, who then issue PRNs based on the amount of waste recovered. PRNs signify that a given quantity of waste has been reprocessed, and can be sold to obligated firms. Thus companies do not have to meet their obligations by recycling or recovering their own packaging – they can meet their obligations by funding recycling or recovery of packaging waste that is cheapest to recycle or recover. PRNs are therefore a tradable compliance instrument.

Climate Change Levy (CCL)

128. The CCL was introduced in April 2001 as part of the package of measures designed so the UK will meet its legally binding target from Kyoto to cut greenhouse gas emissions by 12.5% below 1990 levels by 2008-2012, and to cut carbon emission by 20% below 1990 levels by 2010.

129. The levy takes the form of a tax on energy. It is revenue neutral; all money raised is recycled back via a 0.3 percentage point reduction in employers' National Insurance Contributions (NICs) and subsidisation of energy efficient measures. The rates of the levy are 0.15p/kWh of natural gas, 0.07 p/kWh for LPG and 0.43p/kWh for electricity. Budget 2002 announced that the Government intends to exempt from the levy electricity generated from combined heat and power plants sold via licensed electricity suppliers and that generated from coal mine methane, in view of the environmental benefits of these forms of generation. The expected result is that the levy will save at least 5 million tonnes of carbon a year by 2010. Because the tax package is fully revenue neutral and lowers the relative price of labour to energy, it should also have a favourable impact on employment.

UK greenhouse gas emissions trading scheme

130. Participation in the UK greenhouse gas emissions trading scheme is voluntary. 34 organisations originally volunteered for the UK emissions trading scheme. These companies took on a legally binding obligation to reduce their emissions against 1998-2000 levels.

131. Emissions reduction targets for each participant were determined at an auction in March 2002, when an incentive worth £150 million was allocated in the form of payments per tonne of emission reduction. In this first stage, the total commitment amounted to a reduction of 1.1 million tonnes of carbon a year by 2006. This was a significantly greater reduction than had been anticipated.

132. The scheme works by setting targets for participants, requiring them to reduce their emissions to certain level. Each participant then receives allowances equal to this level. Participants can meet their target by reducing their own emissions; they can reduce their emissions below their cap and sell or bank the excess allowances; or they can let their emissions remain above their cap and buy allowances from other participants. Each participant will reduce their emissions until it is cheaper for them to buy a permit from another participant than to reduce their emission by another unit. In this way, the participants who can reduce their emissions more cheaply will abate more, while a definite cap on total emissions within the scheme is maintained.

Water rights trading

133. All significant abstractions of water require a licence issued by the Environment Agency. Water rights trading is the transfer of licensable water rights from one party to another, in exchange for money, property or services. It is a means of achieving the optimal distribution of water resources within and between different sectors of use.

134. Some trading of water rights already takes place. However, there are regulatory barriers and changes proposed in the Government's draft Water Bill are intended to facilitate the trading of licences. The Environment Agency is currently developing guidance that it is hoped will raise awareness of the potential for trading, and facilitate both very short-term (i.e. within season) trades as well as allowing more permanent longer-term trading.

Water abstraction charges

135. The structure of water abstraction charges reflects to some degree the environmental impacts of abstraction, but the incentive effect of charges is minimal. This is because the charges are capped at levels sufficient to recover the Environment Agency's costs in carrying out its water resources management functions. Raising water abstraction charges above the cost recovery level could make abstractors bear more of the true environmental costs of their abstractions and reduce the overall amount of water abstracted for economically low-value uses. However, to fully achieve this, it is estimated that prices would have to rise significantly.

136. In *Tuning Water Taking*, the Environment Agency was asked by the Government to review its water abstraction charges scheme. The Agency is now giving some initial consideration to incentive charging as part of the Charges Scheme Review project.

Trading scheme for NOx and SO_2 emissions

137. The Large Combustion Plant Directive (2001) aims to reduce acidification, ground level ozone and particulates by controlling emissions of sulphur dioxide (SO_2), nitrogen oxides (NOx) and dust from large combustion plants. These include power stations, plants in petroleum refineries and steelworks.

138. One of the options being considered to implement the terms of this Directive is SO_2 and NOx trading. To apply this scheme, binding caps would be set on total emissions. Individual plants would hold allowances to cover their actual emissions but could not emit more than the maximum levels specified in their individual permits specified in the Integrated Pollution Prevention and Control (IPPC) Directive. However, trading could be carried out up to the level of these permits, and those plants with higher costs of control could be expected to purchase allowances from those with lower costs. The IPPC permits would complement the trading scheme by ensuring that people and environment in the area immediately around the plant would be protected.

139. At present trading of SO_2 permits only happens when a plant is sold and there is no trading of NOx at all.

Pesticides

140. A voluntary agreement on measures to reduce the environmental damage caused by pesticides was entered into by the industry and other stakeholders in April 2001. Implementation of the voluntary initiative has been generally satisfactory and at present the Government believes it is the most effective way of reducing the environmental impacts of pesticides. Good progress has been made in assessing the current approach of farmers to the use of pesticides and in the production of good practice guidance. However targets and measures of success have not yet been finalised between Defra and industry, and incentives for encouraging farmer participation are not sufficiently advanced. Further work is being carried out on a possible tax or other economic instrument. Should the voluntary initiative fail to deliver its objectives within a reasonable timescale, these options may be introduced.

Annex II
Economic instruments for addressing environmental externalities of agriculture – examples from OECD countries

141. In response to growing attention on the effects of agriculture on the environment, agri-environmental policy measures have assumed a more prominent role in agricultural policy in OECD countries in the past two decades. Member countries currently address environmental issues in agriculture with many measures including direct regulation, economic instruments, education, persuasion and community involvement[13].

142. European countries and the USA have increased the use of incentive payments to improve environmental outcomes since the mid-1980s. By contrast, some countries such as Australia, Canada and New Zealand have made use of community based approaches e.g. through supporting collective action to solve environmental problems. There are still only limited application of taxes and charges to directly integrate the environmental costs of agricultural activities into farmers' production decisions. Taxes and charges on farm inputs are however sometimes used. Tradable rights do not appear to play a significant role in agri-environmental policy although they are applied in the Netherlands and on a state/regional basis in the USA and Australia.

143. All OECD countries impose regulatory requirements to address the negative effects of agricultural activities on the environment, ranging from outright prohibitions, to input standards and resource-use requirements. Cross-compliance measures, that is, tying minimum environmental standards to agricultural support programmes, are well established in the USA and Switzerland and look likely to become increasingly important in the EU as part of ongoing reforms to the CAP. Many OECD countries have directed greater attention toward improving the knowledge base relating to environmental issues in agriculture in the past fifteen years through increased spending on agri-environmental research. Greater emphasis has also been placed on communicating information to farmers on environmental issues via technical assistance and extension in order to induce voluntary changes in farming practices. The table below lists a selection agri-environmental policies in OECD countries[14].

13 OECD (2002) Agri-environmental Policy Measures: Overview of Developments Joint Working Party on Agriculture and the Environment, OECD, Paris.

14 OECD (2002) Agri-environmental Policy Measures: Overview of Developments Joint Working Party on Agriculture and the Environment, OECD, Paris.

Table A2.1

A selection agri-environment policies in OECD countries[15]

Country	Instrument	Description	Date introduced
Payments based on farming practices			
The Netherlands	Organic Production Promotion Scheme	Payments to support organic production systems	2000-2006
England	Environmentally Sensitive Areas Scheme	Incentive payments per hectare to to farmers who adopt agricultural practices to safeguard and enhance areas of particularly high landscape, wildlife or historic value	1987
Switzerland	Federal Agricultural Law	A range of payments based on different standards of agricultural practices	Amended in 1996
Korea	Direct payments	Direct payments per hectare for paddy field farmers who carry out environmental conservation	2001
Japan		Government support to promote the introduction of farming practices that reduce excessive use of pesticides and fertilisers	early 1990s
USA	Environmental Quality Incentives Program	Financial and technical assistance to farmers to promote the adoption of environmentally sensitive practices in environmentally sensitive areas	1996
USA	Agriculture Management Assistance	Cost-share payments to farmers to carry out activities to address environmental issue	2000
USA	Wildlife Habitat Incentives Program	Payments to farmers covering up to 75% of the costs of developing upland, wetland, riparian and aquatic habitat areas	1996
UK	Farm Waste Grant Scheme	Payments to farmers to meet 40% of the cost of improving or constructing farm waste storage.	1996
France	Farm-source Pollution Control Programme	Up to 65% funding to assist farmers to bring building and storage facilities into line with environmental regulations	
UK	Countryside Stewardship Scheme	Grants to enhance and restore targeted landscape	1996

15 OECD (2002) Agri-environmental Policy Measures: Overview of Developments Joint Working Party on Agriculture and the Environment, OECD, Paris.

Table A2.1 (continued)

A selection agri-environment policies in OECD countries[15]

Country	Instrument	Description	Date introduced
Payments based on farming practices (continued)			
France	Rural Development Plan	Environmental payments to introduce maintain and restore specific landscape features	2000-2006
Canada	Shelterbelt Program	Distribution of trees and shrubs free of charge to landowners in the Prairie Provinces	
Australia	Commonwealth Tax Concessions	Tax concessions to offset the investment cost of adopting more environmentally friendly farming practices	
Environmental taxes/charging			
The Netherlands	Levy on phosphorous and nitrogen produced on farms	Charge on estimated loss of nutrients over certain limits	1998
Belgium, Denmark, Finland, Norway and Sweden	Input tax	Taxes on pesticides	
Tradable rights/quotas			
Australia	Tradable water extraction rights	Farmers may trade excess water on a temporary or permanent basis either within or outside region	1997
USA	Clean Water Act	Trade in permits for development of wetlands	1995
Regulatory requirements			
European Union and Australia	Pesticide bans	Ban on spraying aerial pesticides	
New Zealand	Nutrient Management	Limits on the permissible levels of nitrogen applied from manure and non-organic fertilisers	
USA	Nutrient Management	Management plans required in 23 States for some classes of animal operations	
EU	Integrated Pollution Prevention and Control Directive	Requires member states to impose emission limits in environmental permits	1999
Australia, Canada, New Zealand	Buffer strips	Mandatory buffer strips around water courses and groundwater sources to help limit nutrient leaching in many OECD countries	

Table A2.1 (continued)

A selection agri-environment policies in OECD countries[15]

Country	Instrument	Description	Date introduced
Cross-compliance mechanisms			
USA	Food Security Act	Producers who bring highly erodible land into production must apply a strict conservation plan to remain eligible for farm payments	1985
EU	CAP reform	Direct payments may be reduced or cancelled in the case of non-compliance with environmental requirements.	1999
Advisory and institutional measures			
Australia, New Zealand, Denmark, the Netherlands the UK	Creation of research institutes	Special research institutes jointly funded by industry and government with a specialised agricultural research focus	
Australia, Canada, Denmark, France, New Zealand, the Netherlands Switzerland, USA	Development of agri-environmental indicators	Monitoring the environmental performance of agriculture	
Technical assistance/extension			
USA	Conservation Technical Assistance	Provides farmers assistance with planning and implementing soil conservation and water quality practices.	
Sweden	Programmes to promote awareness of environmental issues	Individual services, field and farm courses and demonstration sites	1986
Labelling			
EU, Norway, Switzerland	Government-enforced national organic labelling standards		Over past decade
Community based measures			
Australia	National Landcare Programmes	Supports group activities that address environmental issues through research, planning, technical assistance and extension	mid-1980s
Canada	Agricultural Environmental Stewardship Initiative	Supports projects addressing regional environmental issues through education and awareness, technology transfer and stewardship tools	2000-2003

Agri-environment payments

144. Most if not all OECD members have in place agri-environmental programmes providing financial incentives for farmers to deliver environmental goods. Some countries are also implementing cross-compliance measures whereby subsidies linked to agricultural production are accompanied by environmental requirements. The variability on these requirements is vast, with countries such as France requiring little more than the respect of good farming practices while others such as Switzerland use cross-compliance as their main instrument to reduce environmentally damaging farming practices.

145. Within the EU, the European Commission's 1998 review of all EU agri-environmental payments programmes concluded that the results programmes were quite positive and represented good value for money.

146. However, the OECD remains doubtful on their cost-effectiveness. Other studies also present less positive conclusions. Kleijn et al (2001), for example, claim that *'although agri-environment schemes have been implemented in various countries for well over a decade, to date no reliable, sufficiently replicated studies have been performed to test whether such measures have the presumed positive effects on biodiversity.'* The same could be said regarding their presumed positive effects on air, soil and water quality. According to Kleijn et al. (2001), *'results show that in the Netherlands agri-environmental schemes have failed to protect the species richness of the investigated species groups and that no positive effects on plant and bird species diversity were found'*. On the other hand, Potter (1998) considers that agri-environmental schemes seem to have been efficient in maintaining current levels of environmental capital, but that they have been much less successful in adding to or enhancing environmental quality.

Taxes and charges

147. The following economic instruments could be associated with the agricultural sector: product charge/taxes on pesticides, fertilisers and manure, and charges and tradable rights for water. Despite the contribution of agriculture to greenhouse gases and air quality in general, there are no examples of charging for air emissions within the agricultural sector.

Taxes on pesticides

148. Scandinavian countries have been at the forefront of attempts to reduce pesticide usage and environmental damaging input through taxation.

149. The current Swedish tax imposed on manufacturers and importers is fixed at SEK 20 (€2.2) per kg of active ingredient. Denmark introduced sales tax imposed on retail prices (before VAT) of: insecticides and soil disinfectants (53.85%), fungicides, insect repellents, herbicides, growth regulators (33.33%), others pesticides (3%). When the tax was introduced in 1986 it was set at 3% of the wholesale price, in 1998 it represented an average of 37% of the wholesale price. Around 55% of the tax yield is used to reduce the county land tax liability, and as such channelled back to farmers; 10% is allocated to payments supporting organic farming; the remaining 35% finances

the research and monitoring pesticides in the environment and the administration of the pesticide approval system.

150. In 1999 Norway introduced a much more complex system whereby the tax rate depends on the environmental status of a given area and varies from €0 to €27.5 per area. The rate is based on an estimated standard dose (per unit per area) and a classification of active ingredients according to their environmental and health risk. This system effectively doubled the previous, more uniform tax rate. Revenues were estimated at around €7.3 million in 2000, but there is no available information on the administration costs which given the nature of the scheme are likely to be significant.

151. Although the Norwegian system is quoted by some (e.g. ECOTEC 2001) as probably being the most efficient, as it is more targeted, no information on its environmental impact is available. The Swedish tax brought reduced use (35% from 1982/85 to 1994) but there has been no evaluation of the relative effects of the tax and the increased earmarked spending on advice and research services. In Denmark, the only robust evidence shows an 11% reduction in the frequency of treatment.

152. Another example is California, where a tax on pesticide sales is not considered to have a significant direct effect in reducing usage (the price elasticity of demand for pesticide is estimated to be very low and a doubling of the rate in 1992 had no discernable effect on sales) but it is perceived as crucial in order to maintain the budget and activities of the pesticide reduction programmes in the area credited with providing substantial environmental benefits.

Taxes on fertilisers

153. Austria, Finland and Sweden first introduced fertiliser taxes in the 1980s as a revenue-raising device to finance increasing export subsidies for wheat. Thus, there was no environmental evaluation undertaken prior to their introduction. Only Sweden continued to tax fertilisers after these countries joined the EU in January 1995. Austria and Finland abolished the tax out of a concern for the competitiveness of their agricultural sector.

154. The Swedish tax was last modified in 1994, on the eve of accession to the EU when rates were tripled to reach their pre-1993 levels. It now consists of a tax on nitrogen of €0.21 per kg (if the content of nitrogen is higher than 2%) and a cadmium tax of €3.5 per gramme of cadmium when the latter exceeds 5 grammes per tonne of phosphate. The tax represents around 20% of the price of fertilisers and around 3% of farmers' income. The price elasticity of demand of fertilisers is estimated at around -0.3, a similar figure to previous studies in Austria. Revenues reached €46 million in 1999 and were to mostly finance environmental programmes. They are increasingly being absorbed by the general budget.

155. The use of nitrogen is estimated to have further declined by about 10% in 1997 (IEEP 2001), but there are no available estimates on the impact on high-content cadmium phosphate.

156. There is a trade off between the compliance cost burden on farmers and how closely an economic instrument is targeted on pollution. For example, nitrogen emissions can vary according to the conditions when nitrates are applied. However attempting to reflect this in a tax may result in undue complexity and high administration costs.

Dutch tax on manure surplus

157. Levies on manure surplus, the MINAS system was introduced in 1998 to replace the old manure production quota system from 1986. The system is based on levies for nitrogen and phosphorus surpluses above a levy free surplus per hectare.

158. Farmers have to keep records concerning the nitrogen (N) and phosphorus (P_2O_5) inputs in purchased feed, chemical fertiliser and manure; and outputs in animal and plant products to calculate a net balance. The N and P_2O_5 surplus per hectare are calculated as input per hectare minus output per hectare. N-fixing of leguminous crops and deposition from the atmosphere are not included as inputs. Certain levels of phosphate and nitrogen surplus are allowed (the levy-free surplus) and these are lowered over time.

159. In 1998 and 1999 MINAS was only compulsory for intensive dairy farmers (>2.5 LU per hectare), pigs and poultry farms, but the system is to become compulsory for all farms in 2003

160. Contrary to the Scandinavian systems introduced in the 1980s, the objective of MINAS is to reduce surface and groundwater pollution caused by nitrates from agricultural sources. Its main advantages are the incentives for farmers to minimise leakages and not just usage and their reduced flexibility to substitute taxable for non-taxable products. Its main inconvenience is the very high administrative costs incurred. ECOTEC (2001) estimates annual revenues of €7.3 million against administrative costs of €24.2 million. Moreover, compliance costs at farm level are also significant, from €220 to €580 per farm.

Table A2.2

Dutch levy-free nutrient surpluses and tax rates

Year	Levy-free N surplus (kg/ha) Grass land	Arable land	Levy-free P_2O_5 surplus (kg/ha)	Tax rate applied €/kg Nitrogen	Phosphorus
1998	300	175	40	0.7	1.1
2000	250	125	35	0.7	2.3
2002	220	110	20	0.7	2.2
2003 (Gvt plans)	180 (140 for sandy soils)	100 (60 for sandy soils)	20	2.3	9.1

Source: ECOTEC (2001)

References

Anderson Robert C. and Andrew Q. Lohof (1997) Economic Incentives for Pollution Control, US Environmental Protection Agency, Washington DC, 1997.

ECOTEC (2001): 'Study on the Economic and Environmental Implications of the Use of Environmental Taxes and Charges in the European Union and its Member States.' ECOTEC Research and Consulting, Brussels.

English Nature (2002) 'The role of economic instruments in managing diffuse nutrient pollution' No.462 English Nature Research Reports

Environment Agency (2002) 'Agriculture and Natural Resources: Benefits, Costs and Potential Solutions', Bristol.

Environment Protection Agency (IEEP (2001) 'Identification and evaluation of supplementary measures to control diffuse pollution to support implementation of the EU water framework directive'. Draft report prepared for the Environmental Agency, August 2001.

European Commission (1998)'State of Application of Regulation EEC/2078/92: Evaluation of Agri-Environmental Programmes', DGVI Commission Working Document (VI/7655/98).

Hanley N., Whitby M. and Simpson I. (1999) Assessing the success of agri-environmental policy in the UK, *Land Use Policy* Vol. 16, pp. 67-80.

Kleijn, David; Frank Berendse; Ruben Smit and Niels Gilissen (2001). 'Agri-environment schemes do not effectively protect biodiversity in Dutch agricultural landscapes', Nature (vol 413) of 18 October 2001.

MAFF (2000) Economic Appraisal of Proposed Expenditure under the Rural Development Regulation.

OECD(1999) 'Economic instruments for pollution control and natural resources management in OECD countries: a survey', OECD, Paris.

OECD (2001) 'Improving the environmental performance of agriculture: policy options and market approaches', OECD, Paris.

OECD (2002) Agri-environmental Policy Measures: Overview of Developments Joint Working Party on Agriculture and the Environment, OECD, Paris.

Potter C. (1998) *Against the Grain: Agri-Environmental Reform in the United States and the European Union*. Wallingford, Oxen, UK and New York. CAB International.

Speck, Stefan (2000) 'Eco-tax database: a database of environmental taxes and charges', prepared for the Forum for the Future, London.

Annex III
England Rural Development Programme (ERDP)

161. Under the ERDP £1.6 billion will be available to farmers over the next seven years for environmental protection and improvement and rural development. The aim is to help farmers and foresters become more competitive, diverse, flexible and environmentally responsible. The schemes also provide help to rural businesses and communities[16].

Land based Schemes

Organic Farming Scheme (OFS)

162. The aim of the OFS is to encourage the expansion of organic production. Under the scheme, farmers moving from conventional to organic farming methods receive financial help during the conversion process over a period of 5 years, with payments skewed towards the initial years of conversion before a market premium for organic produce can be earned. Any agricultural land not already in organic production is eligible to enter the OFS.

163. The OFS opened in April 1999, attracting around 1300 applicants that year.[17] It closed in 2000 and reopened in January 2001. For 2002/2003, £20 million is available for organic agriculture available via the OFS[18]. Apart from the normal aid payments, additional lump sum payments are made towards the initial costs of advice and training.

164. The area of organically managed land in the UK has risen from 60,000 hectares in 1997,[19] to nearly 623,200 in June 2001.[20] This represents 3.9% of the UK's total agricultural land area, a figure slightly above the EU average.

165. Organic farming offers environmental improvements over conventional agriculture across a wide range of environmental indicators, such as soil health, biodiversity and benefits resulting from the absence of synthetic pesticides, herbicides and fertilisers. Research indicates that farmyard birds are among the main beneficiaries of organic farming.[21]

16 http://www.defra.gov.uk/erdp/erdphome.htm
17 University of Cambridge (2002) Economic Evaluation of the Organic Farming Scheme.
18 http://www.defra.gov.uk/erdp/schemes/landbased/esas/esasindex.htm
19 http://www.defra.gov.uk/erdp/schemes/landbased/esas/esasindex.htm
20 http://www.defra.gov.uk/erdp/schemes/landbased/esas/esasindex.htm
21 University of Cambridge (2002) Economic Evaluation of the Organic Farming Scheme.

166. However, with increasing implementation of water protection measures in conventional farming, the environmental benefits of organic over conventional farming are becoming smaller. Other benefits such as improved animal health, food quality and safety are not all supported in the literature.[22] In addition, it has been found that many of those who took up the scheme had managed their farms extensively before, implying the effects attributable to conversion may be smaller than they appear at face value.[23]

Environmentally Sensitive Areas (ESAs) Scheme

167. The Environmentally Sensitive Areas (ESAs) Scheme was introduced in 1987 with the purpose of protecting the landscape, wildlife and historic interest of specific areas of England of national environmental significance, where changes in farming methods posed a threat to the environment and where conservation depended on adopting, maintaining or extending particular farming practices. ESAs protect some of England's most valuable habitats, e.g. heather moorland, woodland, wetland habitats, meadows, hedges and drystone walls, grazing marsh and calcareous grassland. 22 ESAs have been designated throughout England and introduced in four stages from 1987 to 1994. These cover an area of 1.1 million hectares (over 10% of agricultural land).

168. Under the ESA scheme, farmers and agricultural land managers with land within one of the designated ESAs are able to enter 10 year management agreements with Defra (with an option of termination after 5 years). Farmers then receive an annual payment on each hectare of land entered into the scheme. At Defra's discretion, land can be eligible for an additional payment if it is agreed to allow new public access to it. Individual tiers under each ESA have different payment rates based on income foregone, with account also taken of local economic conditions. Tiers above the base tier attract higher payments as they impose additional requirements. Farmers in environmentally sensitive areas are encouraged to join the scheme and, where possible, to place land under agreement in the higher tiers of the scheme which have higher payment rates, but also impose more conditions on farmers and achieve greater environmental benefits. It also encourages existing agreement holders to upgrade their land to enable it to be entered into a higher tier.

169 Agreement holders can opt to have a Conservation Plan which grant aids work of a capital nature for enhancing the character of the landscape, wildlife habitats or for protecting historic features. Project Officers from the Rural Development Service offer expert advice and are the main point of contact for potential and existing ESA agreement holders.

170. As of October 2001, there were 577,131 hectares under agreement, representing 60% of the eligible area[24]. The proportion of eligible land under agreement tends to be higher in the Less Favoured Areas than in arable and intensified farmed regions.

22 University of Cambridge (2002) Economic Evaluation of the Organic Farming Scheme.

23 University of Cambridge (2002) Economic Evaluation of the Organic Farming Scheme.

24 University of Cambridge (2002) Defra Agri-Environment Schemes

171. Achievements include improved numbers of wading birds, landscape improvements through better management of features like hedges and dry stone walls and protection of historic features. Environmental monitoring suggests that ESA expenditure is at least partially successful in meeting its aims.[25] Resulting environmental benefits have included:

- improved numbers of wading birds in lowland wet grassland;
- protection and improvement of species rich grassland on the chalkdowns and in hay meadows;
- landscape improvements from better management of features such as hedges and dry stone walls and from conversion of arable to grassland;
- protection of historic features, such as ancient field systems[26].

172. Total payments to farmers in 2001 amounted to nearly £46 million. Increased funding for the ESA Scheme has been secured for the seven year lifespan of the England Rural Development Programme.

Countryside Stewardship Scheme (CSS)

173. The Countryside Stewardship Scheme was launched by the Countryside Commission in 1991. It aimed to show that conservation and public enjoyment could be combined with commercial farming and land management through a national system of incentive and agreements. The scheme was taken over by MAFF in 1996, and is now run by Defra. It operates outside Environmentally Sensitive Areas.

174. The Scheme aims to sustain landscape beauty and diversity, to protect and extend wildlife habitats, to conserve archaeological sites and historic features, restore neglected land or features, create new habitats and landscapes and improve opportunities for people to enjoy the countryside. By adapting land management practices, the farmer/land owner can enrich the countryside and give enjoyment to the public. The scheme is discretionary and open to farmers and non-farming land managers. Farmers and land managers enter 10-year agreements to manage land in an environmentally beneficial way in return for annual payments. Grants are also available towards capital works such as hedge laying and planting, repairing dry stone walls, etc. Payment depends on how much and what type of work is undertaken. Each item of work attracts a set payment.

175. Each county has its own specific targets for landscape types and features. Eligible landscape types and features include chalk and limestone grassland, lowland heath, waterside land, coastal land, upland, old meadows and pasture, historic features (such as orchards, parkland, buildings), field boundaries (including stonewalls, hedgerows, ditches and dykes), field margins, community forests, countryside around towns and new permissive access.

25 University of Cambridge (2002) Defra Agri-Environment Schemes

26 http://www.defra.gov.uk/erdp/schemes/landbased/esas/esasindex.htm

176. Public access is not a requirement of Countryside Stewardship, but where provided can be an important way for people to enjoy benefits created. Priority may be given to sites with existing access (for example by public footpaths), which are near to where people live, or can be readily seen. The permissive access provided by the scheme is being reviewed this year and will feed into Defra's agri-environment review, which is now underway.

177. There are now almost 12,000 agreements covering 263,000 hectares of land, 21,900 km of arable margins and 17,700 km of linear features[27]. A substantial surplus of applicants over the number that can be funded has allowed selection of those agreements likely to give the highest return. Monitoring and evaluation has suggested that the objectives of the scheme are being met. Overall CSS appears capable of delivering significant environmental benefits, and with regard to wildlife enhancement appears to be more effective than the ESAs.[28]

Pilot Entry Level Agri-environmental Scheme

178. The Government is developing pilots for a new entry-level agri-environment scheme that pays farmers to deliver positive environmental outcomes. The scheme will be designed to make a difference over the whole of the English countryside by:

- reversing the decline in farmland birds and other wildlife and plants;
- retaining features which provide local landscape distinctiveness;
- protecting natural resources of soil, water and air from damage; and
- safeguarding archaeological sites and monuments.

179. The aim of the entry level agri-environment scheme is to provide a means of scaling up agri-environment activity to make a noticeable difference to the way that the majority of land is managed and contribute to solving a number of widespread environmental problems.[29]

180. The new scheme will therefore be open to as many farmers as possible. The intention is that it would be kept simple for farmers and easy for Government to administer, with payment on a flat rate basis per hectare to support activities going beyond good farming practice but less arduous than the targeted prescriptions for existing agri-environment schemes. Because of the large number of potential participants, it will be vital to minimise administrative costs, and the pilots will help with this.

181. Provided pilots are successful, the entry level scheme will be made available to farmers across England from 2005. The Government has committed £75 million to this scheme in 2005/6 and it is intended to secure the necessary EU co-financing to match this sum.

27 University of Cambridge (2002) Defra Agri-Environment Schemes

28 University of Cambridge (2002) Defra Agri-Environment Schemes

29 http://www.defra.gov.uk/erdp/schemes/landbased/review/entrylevel.htm#entrylevel

182. Alongside the development of a new entry-level tier, the Government is reviewing the existing schemes and examining them to see how they can best be used to retain and revitalise special habitats and features within the farmed landscape. These schemes need to be easier to operate, while still delivering real and sometimes complex results.

The Woodland Grant Scheme (WGS) and Farm Woodland Premium Scheme (FWPS)

183. The FWPS and WGS aim to enhance the environment through the planting of farm woodlands, thereby improving the landscape, providing new habitats and increasing biodiversity. Aims also include providing jobs in rural areas and providing a use for land instead of agriculture.

184. The WGS provides grants to create new woodlands and to encourage good management of existing woodlands. The FWPS supports this through annual payments to compensate for agricultural income forgone. Payments are made for 10 years (for mainly conifer woodlands) or 15 years (for mainly broadleaved woodlands). FWPS payments are additional to woodland establishment grants available under the WGS.

185. Between 1992/93 and 2000/1, the total area of new woodland created in England on which grants have been paid totals approximately 41,925 hectares. Of this 52% were created using the WGS and the FWPS and 48% using the WGS only[30]. Most of the land planted was previously in arable use (57%). A survey found the main motivations of participants in the two schemes have been environmental or social rather than economic[31]. The ERDP provides for total expenditure over 7 years of £77 million on the FWPS and £139 million on the WGS over the 7 years 2000 to 2006[32].

186. The woodlands created under both schemes are too young to generate any significant environmental benefits so far. There is some evidence that they are contributing to the landscape, that important historical sites are being protected, biodiversity is being improved, water quality protected and pollution reduced. However, there is no system of long term biological and compliance monitoring in place so it is not possible to evaluate these contributions conclusively.[33]

The Energy Crops Scheme (ECS)

187. The ECS aims to promote the cultivation of energy crops, making £29 million available for the establishment of crops such as short rotation coppice and miscanthus and for establishing producer groups.

188. The main environmental benefit of energy crops is that the energy expended in growing them (in planting, herbicides, harvesting and drying the crop) is much less than that released when they are burnt, as energy is taken in from the sun during

30 John Clegg and Co/ Firn/ Crichton Roberts Ltd, Ecoscope, (2002) CJC Consulting, Woodland Creation under WGS and FWPS.

31 John Clegg and Co/ Firn/ Crichton Roberts Ltd, Ecoscope, (2002) CJC Consulting, Woodland Creation under WGS and FWPS.

32 http://www.defra.gov.uk/erdp/schemes/landbased/esas/esasindex.htm

33 John Clegg and Co/ Firn/ Crichton Roberts Ltd, Ecoscope, (2002) CJC Consulting, Woodland Creation under WGS and FWPS.

growth. Estimates of the ratio of energy used to produce the crop to potential energy from the crop vary from about 1:10 to 1:90, with a most likely figure of 1:20.

189. Over the whole cycle these crops are virtually carbon neutral. Studies have also identified real potential benefits to biodiversity and the potential to develop integrated pest management strategies.[34]

Hill Farm Allowance (HFA) Scheme[35]

190. The HFA scheme aims to maintain agriculture's contribution to rural society and the managed environment of the English uplands. It is open to extensive sheep and suckler cow farmers in less favoured areas. The HFA, which is based on area payments, replaced the HLCA scheme, where payments were headage based.

191. Unlike headage payments HFA payments do not provide an incentive to overstock the land, and thus can compensate hill farmers for the difficulties of farming in less favoured areas of prime landscape value, without causing undue environmental damage.

Project based schemes

Vocational training

192. The new Vocational Training Scheme provides funding for occupational training for farmers and others involved in farming and forestry activities.

193. A total of £22 million has been allocated to the training scheme under the ERDP over the 7 year period to March 2007, with £1 million available in the year 2000/2001. The training should prepare farmers for qualitative reorientation of production, the application of production practices compatible with the maintenance and enhancement of the landscape, the protection of the environment, hygiene standards and animal welfare and lead to the acquisition of the skills needed to enable them to manage an economically viable farm.[36] It can also prepare forest holders and other persons involved in forestry activities for the application of forest management practices that improve the social and economic, ecological or social functions of forests[37].

194. This scheme may have benefits for other schemes with more explicit environmental aims. For example it may supply conservation skills to help the management of ESAs or CSSs.

Rural Enterprise Scheme (RES)

195. The RES provides assistance for projects that help to develop more sustainable, diversified and enterprising rural economies and communities. The primary aim is to help farmers adapt to changing markets and develop new business opportunities. The RES also has a broader role in supporting the adaptation and development of the rural economy, community, heritage and environment. The scheme covers a very broad spectrum of potentially eligible activities, ranging from those designed to

34 http://www.defra.gov.uk/erdp/schemes/projectbased/energy/energyindex.htm
35 http://www.defra.gov.uk/erdp/schemes/landbased/hfas/hfasindex.htm
36 http://www.defra.gov.uk/erdp/schemes/projectbased/training/trainindex.htm
37 http://www.defra.gov.uk/erdp/schemes/projectbased/training/trainindex.htm

produce a commercial return, to those where the primary aim is to provide social and/or environmental benefits.

196. A total of £152 million EU and Government money has been allocated to the RES for the period April 2001 to the end of 2006. The different areas covered by the scheme include: setting up of farm relief and farm management services; marketing of quality agricultural products (this could include the marketing of organic products); basic services for the rural economy and population; renovation and development of villages and conservation of the rural heritage; diversification of agricultural activities; agricultural water resources management; encouragement for tourist and craft activities and protection of the environment in connection with agriculture, forestry and landscape conservation.

Other agricultural policies

Set-aside (Arable Areas Payment Scheme)

197. Since 1992, all significant producers of cereals are required to set aside a proportion of their land in order to be eligible for arable area payments. The main aim of set-aside was to control the surplus production of cereals in the EC. Environmental improvement and the encouragement of the production of industrial crops were secondary objectives.

198. The minimum rate of set-aside for 2002 was 10% of the total area claimed. Small farmers are not required to have set-aside, although they are permitted to have it if they wish.

199. Current EC legislation allows land to be set-aside either as whole or part fields, or as strips[38]. Strips must normally have a minimum width of 20 metres and a minimum area of 0.3 hectares. An exception is that strips of a minimum 10 metres width and 0.1 hectares area are permitted where they adjoin watercourses or lakes. With a few exceptions, set-aside land cannot be put to any agricultural use, except certain crops for non-food use. Set-aside cannot be used for non-agricultural or any lucrative purposes except under restricted conditions. The main management requirement for farmers is that a green cover must be established on the land.

200. Set-aside has led to some environmental improvement. Breeding birds are among the main beneficiaries and the benefits are greater within a relatively intensive arable landscape. However expectations that set-aside would lead to significant reductions in chemical emissions seem not to have been borne out. The results of studies indicate that the buffering function of set-aside is probably more important than the direct impacts.[39]

201. One of the concerns of using set-aside was that it might result in intensification on land left in production. However there is no evidence of this in practice in the UK.[40] There is also a potential problem that long term set-aside builds up organic matter in the soil and carries a risk of leaching if this is subsequently ploughed.

38 Defra UK; Farming – Schemes for crops – Arable Area Payments Scheme and Set-aside

39 University of Cambridge (2001) Economic Evaluation of Set-Aside

40 University of Cambridge (2001) Economic Evaluation of Set-Aside

Sustainable Farming and Food Strategy: a framework for evaluation and monitoring

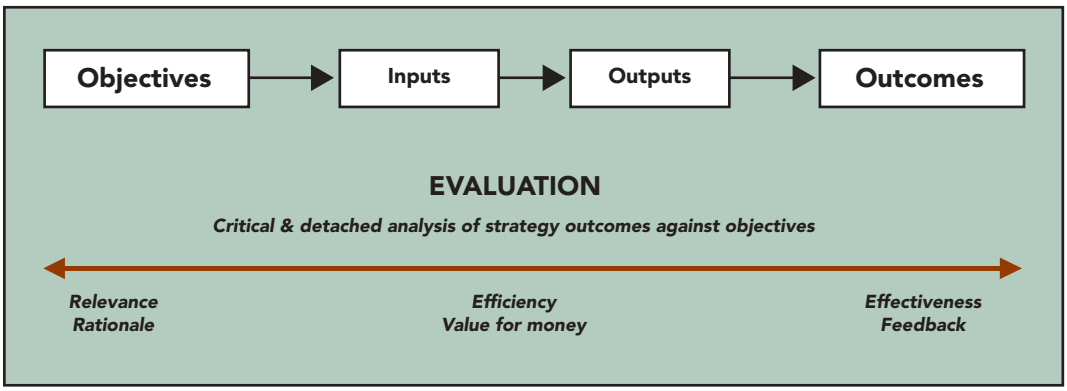
A Introduction

202. Evaluation is the process which objectively judges the actual outcomes, including any unintended side effects, of a policy or group of policies against the policy objectives, or intended outcomes, and the resources that are used in policy delivery (See **Figure 1** below). Evaluation will therefore form an essential part of the overall Strategy with the contents and the scope of the detailed evaluation plan closely reflecting the shape of the Strategy itself.

203. In designing the Strategy evaluation framework a number of key themes, common to most if not all evaluation activity, need to be addressed:

- **Relevance** – is the Strategy approach consistent with the problem?
- **Effectiveness** – how far have the Strategy objectives been achieved?
- **Additionality and side effects** – to what extent would the Strategy outcomes have been achieved anyway and are there any unforeseen side effects?
- **Efficiency** – what have been the costs (and on whom do these fall) of achieving the Strategy objectives and what have been the causes of any inefficiencies?
- **Coherence** – do the individual policy and programme measures combine to achieve the higher level Strategy objectives in a coherent fashion, are there any synergies or inconsistencies between policy instruments?
- **Durability** – will changes brought about by the Strategy be self-sustaining and continue in the long run or will there be an ongoing need for policy intervention?

Figure 1
Summary of strategy evaluation



204. A number of steps are necessary to ensure that any evaluation activity is able to generate useful results in addressing these key themes:

- A coherent set of structured and agreed Strategy objectives, specified in terms of intended Strategy outcomes, needs to be clearly defined;
- Well defined links must be established between intended Strategy outcomes and measurable indicators which provide evidence of the extent to which the outcome is actually being achieved and how specific policy measures are contributing to it;
- The results of monitoring activities and other relevant data sources (including administrative data from all the schemes) will need to be easily available for analysis in order to provide objective evidence of how effective the Strategy has been in delivering its intended outcomes, whether these could have been delivered more efficiently and if there have been any unforeseen side effects;
- Stakeholders who have a legitimate interest in the policy area, including those who designed and implemented the policy, policy managers and those affected by the policy, need to be actively engaged in the evaluation process; and
- A mechanism needs to be established which provides for the results of evaluation activity to feed back into the policy process in order to improve future policy design and delivery.

B Evaluation overview

205. It is intended that the evaluation of the Sustainable Farming and Food Strategy (SFFS) will take place at three levels.

    a) Progress in achieving the high level Strategy outcomes will be monitored by a basket of indicators reflecting different aspects of the planned change. A subset of these indicators will form 'headline' measures.

    b) As the Strategy outcomes will be achieved by the combined effects of a wide range of policies, schemes and initiatives, a set of 'output to outcome' evaluations will be undertaken to identify the early effects of strategy deliverables on stakeholders, and assess the likely contribution to outcomes.

    c) Individual Defra schemes and initiatives will be subject to evaluation in line with Defra practice.

206. Although the Strategy is Defra led, its success requires the active involvement of other Departments and Agencies, plus farmers, industry and consumers. Thus there are roles for all stakeholders in the evaluation process, which will be developed during consultations about the output to outcome studies.

207. The elements of the evaluation will match the timeframe of the pace of change. Some new initiatives will be reviewed at an early stage, for feedback on signs of success, or where changes might be necessary. Measurable trends in the Strategy outcome indicators will take longer to be observed.

208. Evaluation proposals under the Strategy will be harmonised with other work currently in progress in relation to the Rural White Paper, the Sustainable Agriculture indicators, the Sustainable Development Strategy, and the England Rural Development Programme. Opportunities will also be taken to link with similar initiatives in Scotland, Wales and Northern Ireland. In addition, it has to be remembered that the Strategy is intended to be enduring such that some policies will be developed after the Strategy launch. The evaluation process therefore needs to be sufficiently flexible to be able to deal with this.

C

Strategy objectives and outcomes

209. Although a basket of indicators, drawn largely from well-established national statistics, will be used to monitor progress in achieving the Strategy outcomes, changes in the indicator values will reflect factors that run much wider than the SFFS *per se*. Thus there will be a need for further work aimed at establishing the extent to which change can be attributed to the impact of the Strategy.

210. With any strategy a large number of mutually reinforcing policies and programmes are typically intended to contribute to the achievement of a higher level or overarching set of objectives and there is therefore a need to be clear about how the outcomes of individual policies relate to the objectives, or intended outcomes, of the strategy. For the strategy to be evaluated effectively studies need to be conducted that take this complexity into account and the evaluation plan proposes an approach known as *Output to Outcome Evaluation*.

211. A pre-requisite to the development of a coherent output-outcome evaluation framework for the Strategy is the clarification of the intended strategy outcomes and their relationship with policy and delivery programmes. Equally, it is essential that the evaluation framework supports and is closely informed by the Strategy Delivery Plan so that the two complement one another.

212. There are a number of models which could be adopted in determining how the evaluation activity relating to the Strategy should be focussed. The evaluation framework could be structured around the three pillars (economic, environmental and social) of sustainable development, the nine strategy objectives, clusters of related policies and delivery mechanisms, specific policy instruments or programmes or some combination of these possible approaches. However, given the often complex interactions and tensions between the three pillars of sustainable development (in particular economic and environmental), it is envisaged that each area of study will need to cover all three of them.

213. **Figure 2** sets out the nine agreed strategy objectives (columns), nested under the three pillars of sustainable development, and nine broad policy clusters (rows) that have been identified as a possible way of brigading the range of policies that contribute towards the delivery of the Strategy outcomes.

214. Given that the matrix contains a total of 81 cells, choices will need to be made in developing the evaluation framework in order to focus upon those areas which provide the greatest interaction between the policy clusters and the outcomes. In order to determine the strength of the linkage between cluster and outcome, it will be necessary to:

- Decide upon the policies/initiatives that are nested within each cluster;
- Describe the intended change in behaviour or performance of beneficiaries, institutions or other stakeholders that a policy or initiative is intended to achieve; and
- Determine the outcome(s) that the policy or initiative is intended have on beneficiaries, institutions or other stakeholders and how this outcome relates to the high level Strategy objectives.

In this way the major linkages between individual policies and initiatives and high level Strategy outcomes should be established. It has to be recognised, however, that the evaluation activity needs to be proportionate to the measures that are being evaluated and that, for some measures, it could involve considerable new data collection, processing or analysis, which might not always be particularly practical or cost-effective.

215. Since the aim of the Strategy is to achieve economic, environmental and social objectives within an over-arching sustainable development framework, evaluation plans will be framed around the policy clusters in the rows of the table rather than the outcomes in the columns. Two broad areas, 'Science' and 'Learning Skills and Knowledge', are likely to bear across the full range of Strategy outcomes while, for the other clusters, policies and schemes are likely to map more closely on to a narrower range of intended outcomes. All evaluations focusing on policy clusters will, however, examine impacts against all the dimensions of sustainable development. The evaluation framework will also recognise that there are tensions, potential or actual, inherent in achieving all of the Strategy outcomes together and that policy impacts will not be universally positive or negative across the full range of outcomes.

216. As noted above, individual Defra policies or schemes will be evaluated in accordance with normal Defra practice and these studies will help to inform the Strategy evaluation process.

Figure 2

Mapping of policy clusters on to intended strategy outcomes

		Our overarching aim is to promote a competitive and efficient farming and food sector which protects and enhances our countryside and wider environment, and contributes to the health and prosperity of all our communities								
		Strategy Outcomes								
		Economic			***Environmental***			***Social***		
	Policy Cluster	A farming sector focussed on the market, successfully producing food and non-food crops in a more efficient way, to help enhance the incomes of competitive farm businesses	Greater efficiency of the total food chain	Reduced burden on taxpayers and the rest of the economy	Reduced environmental cost of food chain	Better use of natural resources	Improved landscape and biodiversity	Better public health in particular through improved nutrition and workplace health and safety	Higher animal welfare	More cohesive and productive rural communities
1	Food Chain	✓✓	✓✓✓		✓	✓	✓	✓	✓	
2	Environmental Protection			✓	✓✓✓	✓✓	✓	✓		
3	Agri-Environment and Rural Development				✓✓	✓✓	✓✓✓			✓
4	Animal Health and Welfare	✓	✓	✓✓				✓	✓✓✓	
5	Food Safety			✓	✓			✓✓✓		
6	Learning, Skills and Knowledge	✓✓	✓✓	✓	✓✓	✓✓	✓	✓	✓	✓
7	Nutrition			✓				✓✓✓		
8	Science	✓✓	✓✓	✓	✓✓	✓✓	✓✓	✓✓	✓✓	✓
9	Whole Farm Approach	✓	✓	✓	✓✓	✓✓	✓	✓	✓	

✓ Indicate where policy clusters are expected to contribute to the delivery of strategy outcomes. The number of ticks provide an indication of the relative importance of the cluster in delivering the outcome.
Highlighted cells are areas where it is expected that evaluation activity will be particularly focussed.

D

Performance indicators, data collection and analysis

217. An initial set of headline and proposed core indicators for the high level strategy outcomes has been developed and is described in Annex 1. The full final set will be developed in close consultation with stakeholders but it is envisaged that the chosen indicators will be based largely on well-established statistics of food and farming from established national statistical series. It is envisaged that individual indicators will relate to individual aspects of sustainable development rather than attempting to provide a composite measure of 'sustainability'. However, when considering progress on sustainable development the indicators must be assessed collectively. When taken together, the indicators should provide robust evidence of progress in all three areas of sustainable development, economic, environmental and social, as well as highlighting any apparent tensions or trade-offs between them. The small number of headline indicators will provide a simple point of reference in relation to the three areas of sustainable development for performance of the strategy as a whole.

218. Both headline and core indicators will also be important inputs to the broader evaluations linking Strategy programmes to Strategy outcomes. However, achievement of Strategy objectives will only be possible if the individual schemes and initiatives which comprise it are successful. Individual Defra schemes and initiatives will therefore be evaluated in line with Defra practice. Before the detailed evaluation plan is finalised, however, an essential building block will be to assess how well prepared each of the schemes or policy initiatives is for evaluation. This will require answers to a number of questions:

- Does the scheme/initiative have a clearly stated goal/intended outcome?
- Is there a clearly defined target group or beneficiaries?
- Are there clearly defined outputs?
- Do the goal/outcome and outputs have objectively measurable indicators?
- Can a logical link be made between the outcome indicators and the Strategy headline or core indicators?
- Who is responsible for the scheme/initiative?
- What is its budget?
- Is there an evaluation plan in place?

219. This analysis should reveal the extent to which the scheme/initiative can be mapped directly to one or more of the Strategy outcomes/indicators, whether there are gaps in the arrangements for evaluation and, if so, how they might be filled. Each of the policy clusters identified in Figure 2 represents a concentrated area where actions under the Strategy combine to support one or, more often, a number of policy outcomes. For each cluster an intermediate outcome statement and an associated set of indicators will be developed, drawing on the suite of headline and core indicators, though not confined to it, and linking closely with the Strategy Delivery Plan. Such indicators will be based on a need to identify early evidence of change, and to determine the opinions of stakeholders about their access to, uptake of and satisfaction with the delivery of specific schemes or policy instruments. They should provide early warning information about the likelihood that the Strategy outcomes will be achieved or any potential problems.

220. A successful evaluation plan will need the active engagement of stakeholders in its development and a number of approaches to facilitate this process, such as participatory stakeholder workshops or detailed consultation, will be considered. Clearly, alternative approaches are not mutually exclusive and could be combined in part or whole. However, a number of schemes contributing to the Strategy are primarily the responsibility of other agencies or industry bodies which might also be expected to take the lead in evaluation activity. These bodies will be encouraged to develop evaluation plans, following the same principles as Defra. Guidance and support will be available to help agencies and industry bodies develop their own capacity for evaluation, with the aim of encouraging their participatory involvement in the Strategy evaluation process.

E

Evaluation capacity development and stakeholder engagement

219. Specific arrangements are being made to develop capacity to support performance measurement of the strategy, taking into account the possible resources required (both internally and externally) to support the Strategy evaluation. In addition, mechanisms, using electronic web-based media and other innovative mechanisms, will be developed to disseminate information from monitoring and evaluation activity, both to specific groups of stakeholders and to the wider public. In accordance with standard Defra practice, the results of evaluation studies will be placed in the public domain and 'policy owners' will be expected to produce timed action plans in response to the conclusions and recommendations of evaluations.

Annex
Sustainable Farming and Food Strategy (SFFS): Outcomes and indicators

220. The enclosed table provides details of a draft set of indicators for assessing the impact of the Sustainable Farming and Food Strategy. The table is arranged by the nine outcomes (three economic, three environmental, three social). Headline indicators are provided for each outcome. Some of the headline indicators will span across a number of outcomes, particularly farmland birds.

221. The table contains a set of 11 headline indicators and around 80 core indicators. Where appropriate these have been tied in with the current set of PSA targets and other available indicators, in particular the "Towards Sustainable Agriculture" pilot set of indicators, the "Foundation For Our Future" indicators of progress, the Countryside Agency State of the Countryside indicators and the wider set of "Quality of Life" indicators. In a number of instances the indicators for the Sustainable Farming and Food Strategy will need to be further refined as the indicators for various strategies that fall partly or fully under the Sustainable Farming and Food Strategy umbrella (e.g. Animal Health, Soil Strategy, England Biodiversity Strategy) are developed. It will be imperative to achieve consistency across these sets of indicators.

222. For each indicator an assessment has been made (on a scale of 1-low to 5-high) on the impact the Sustainable Farming and Food Strategy will have on the indicator; the speed with which the indicator will respond to Sustainable Farming and Food Strategy policy measures; and data availability for the indicator. These are initial subjective assessments and will need to be refined following comments from others and further investigations. In particular the impact of the Sustainable Farming and Food Strategy upon indicators will reflect both the level of policy measures designed to address a particular issue and the influence of external factors upon the indicator. Nevertheless they provide an indication as to where there may be gaps in having responsive indicators that can be readily calculated.

223. The indicators within this table attempt to link closely to the outcomes and are at a relatively high level. In many cases there will be a considerable time lag for the indicator to respond to policy developments. There is therefore the need to develop a further 3rd tier of more proximate indicators that will link to the outputs of the individual policy measures. In a limited number of cases these have been picked up as part of the core set of indicators (where there are clear links through to the outcomes and/or other indicators are not readily available). But in the majority of cases these will need to be developed. These will provide measures of progress within each policy area as well as a tangible early indication of progress for the strategy as a whole.

224. The indicators for the Sustainable Farming and Food Strategy will need to integrate with the indicators for the Sustainable Food Strategy being developed in parallel (on a slower time scale).

SUSTAINABLE FARMING AND FOOD STRATEGY (SFFS): HEADLINE INDICATORS

Outcomes	Headline indicators	Impact of SFFS 1–low, 5–high	Speed of response to SFFS 1–slow, 5–fast	Current data 1–none, 5–good	Sources/Comments
ECONOMIC OUTCOMES **1. A Farming Sector focussed on the market, successfully producing food and non food crops in a more efficient way to help enhance the incomes of competitive farm businesses**					
To enable farmers to enhance value added and to help sustain higher levels of income, resulting in enhanced self-reliance, greater international competitiveness, less dependence on subsidy and more focus on consumers' requirements.	Gross Value Added per person excluding support payments (compared with the EU15 average and adjusted to remove exchange rate effects) (PSA).	3	2	4	Aggregate Agricultural Account (UK) Gross Value Added per person. Comparison with EU15 figures compiled on the same basis by Eurostat. Methodology to adjust for exchange rate effects to be based on Inputs Task Force analysis.
2. Greater efficiency of the total Food Chain					
Greater efficiency of the food chain than would otherwise obtain particularly through improved effectiveness of the supply chain linkages between farming and the rest of the chain.	Productivity of total food chain.	2	2	3	Would need to be developed. Ideally use total factor productivity (tfp) measure. Consider ONS/DTI productivity study. May need to use indirect or partial measures of productivity.
3. Reduced Burden on Taxpayers and the rest of the economy					
Will produce a higher rate of growth of productivity of the national economy than would otherwise obtain, resulting from a lower negative impact of the CAP upon food prices and upon taxpayers, a lower risk of economic losses from animal disease outbreaks. Also links to outcomes 4 and 7 as these will lead to reduced costs of poor nutrition and lower costs to the economy from pollution from farming and the food chain.	Cost of production-linked support (PSA).	5	3	4	

Outcomes	Headline indicators	Impact of SFFS 1–low, 5–high	Speed of response to SFFS 1–slow, 5–fast	Current data 1–none, 5–good	Sources/Comments
ENVIRONMENTAL OUTCOMES **4. Reduced Environmental Cost of Food Chain**					
Reduced pollution from food and farming reflecting the true costs and benefits to society and the environment.	River water quality.	4	3	4	Data availability generally good but need to develop specific indicator. Could use water pollution incidents from agriculture (in 2001 agriculture accounted for 18 per cent of the most serious – category 1 and 2 – water pollution incidents) but this does not cover diffuse pollution. Could use main pollutant e.g. pesticides in rivers, but this does not cover other pollutants.
	Reduced Greenhouse Gas emissions from food and farming.	4	3	3	Subset of broader PSA target 2 covering total greenhouse gas emissions. Incorporates impact of 'food miles'.
5. Better Use of Natural Resources					
Sustainable use of natural resources by the food and farming industries to reflect the true value to society, both today and in the future, of the capacity of the environment to support life, biodiversity and economic activity.	Soil Nutrient Status.	4	2	4	Underlying data availability generally good but specific summary indicator needs to be developed based on soil phosphorus concentrations, nitrogen balance, organic matter content and trace elements. Will tie in with Soil Strategy. This will identify around 10 headline Indicators.
6. Improved Landscape and Biodiversity					
Improved provision of "countryside public goods" (managed landscapes, habitats with their associated wildlife, and natural and man-made historic features) which reflect the full costs and benefits to society (today and in the future) of their provision and of public access to them.	Favourable condition of nationally important wildlife sites on farmland (subset of PSA, Defra Foundations for our Future indicator).	5	3	3	Restricted to farmland SSSI's only. The condition of sites has been monitored by English Nature since 1997. Rolling process of assessment makes monitoring trends difficult. The first full assessment of all SSSIs is due to be completed in 2003.
	Farmland birds (PSA).	4	2	5	(also covers outcomes 4 and 5). Quality Of Life Counts and Defra Foundations for our Future indicator.

Outcomes	Headline indicators	Impact of SFFS 1–low, 5–high	Speed of response to SFFS 1–slow, 5–fast	Current data 1–none, 5–good	Sources/Comments
SOCIAL OUTCOMES **7. Better Public Health in particular through improved nutrition and workplace health and safety**					
Through reduced levels of heart disease and other dietary related illness through the adoption by consumers of healthier diets; reduced levels of food borne illnesses; and higher levels of safety and welfare at work in agriculture.	Fruit and vegetable consumption.	2	3	5	Expenditure and Food Survey. Would need to tie in with DoH indicators and PSA targets. Defra Foundations for our Future indicator.
8. Higher animal welfare					
Greater adoption of production systems which at least meet the statutory farm animal welfare codes, protecting animals from unnecessary suffering and promoting fitness and a sense of well-being.	Improved time taken to clear up cases of farmland and transportation animal welfare cases (PSA).	4	4	5	More a measure of administrative process rather than an outcome. Chosen as PSA target because of problem that trends in the recorded number of cases will not necessarily reflect the underlying level of incidence.
9. More cohesive and productive Rural Communities					
Improved economic performance and prosperity in rural areas, by reducing the gap in productivity between the less well performing quartile of rural areas and the English median. The government's strategy for balanced growth, following the regional economies study reported in last year's Pre-Budget report, involves improving productivity where it is lowest to contribute to higher national economic growth. This outcome also includes an enhanced contribution to socially inclusive rural communities through improved accessibility of services for rural people.	Reduce the gap in productivity between the less well performing quartile of rural areas and the English median by 2006, and improve the accessibility of services for rural people.	2	3	4	Impact of SFFS dependent on level of targetting.

ECONOMIC OUTCOME CORE INDICATORS

Core Indicators	Impact of SFFS 1–low, 5–high	Speed of response to SFFS 1–slow, 5–fast	Current data 1–none, 5–good	Sources/Comments
1. A Farming Sector focussed on the market, successfully producing food and non food crops in a more efficient way to help enhance the incomes of competitive farm businesses				
Total Factor Productivity	3	2	5	Aggregate Agricultural Account (AAA). Will be assessed against international competitors.
Total Income From Farming per full time person equivalent	2	2	5	Significant impact of external factors e.g. exchange rate
Net farm Income by farm type				Significant impact of external factors e.g. exchange rate
Gap between least well performing quartile and median	3	2	5	Farm Business Survey (FBS): ratio of value of outputs to inputs, distribution at point in time. Can measure change in spread of distribution.
Productivity measures by sector	3	2	4	Source FBS. Can use ratio of outputs to inputs (at full economic costs) in current prices, but this is affected by external factors. Ideally need to develop productivity/efficiency measure in constant prices. Productivity project is expected to provide some analysis on this. Can also link with benchmarking activity and measures that emerge from this.
Labour productivity by sector	3	2	4	International benchmarking of similar types of farm through analysis of Farm Accountancy Data Network (FADN) micro data.
Capital investment in agriculture	3	2	5	Selected items from AAA balance sheet
Average yields (milk, cereals etc.), Feed conversion ratios	3	2	5	Might be too simplistic as it does not take account of inputs and possible move to more extensive type production. But good quality data for international comparisons.
Quality of marketed produce (e.g. carcase classification)	3	2	3	Much information on quality available e.g. on carcase classification. Indicators would need to be developed in conjunction with MLC, HGCA, HMI etc. Problem of lack of data on direct sales to supermarkets?
Number (and value) of diversified activities on farm.	3	3	3	Farm Diversification baseline study for ERDP; FBS and June Agricultural Census
Farm businesses engaged in value added activities	3	3	3	Subset of diversification (see above)
Farm household income from employment off-farm and other sources	2	3	3	FBS, Survey of Personal Incomes. Will include income from diversified activities and also other employment.

Core Indicators	Impact of SFFS 1–low, 5–high	Speed of response to SFFS 1–slow, 5–fast	Current data 1–none, 5–good	Sources/Comments
Farmers share of consumers' expenditure on food.	3	2	4	AAA for market value of production and consumer's expenditure estimates. Links with 1.2. Note similar problems of volatility. Also problem of increasing level of processing in the food sector more generally. RASE benchmarking project part funded by Defra aims to increas farmers share of retail take by 1% (£500m).
Share of commodities sold through co-operatives	3	2	3	Plunkett Foundation
Visits to demonstration farms	5	5	1	Would need to be collected
Internet access	3	4	4	ADAS Farmers Voice (although problem of low response rate) or special survey/study
Skill level of farmers and farm workers	3	3	2	Some sources from studies. Could be collected via FBS, June Census or Labour Survey
Indicator of innovation, technical progress and technoglogy transfer	2	2	2	Data sources limited. Special studies. Patent information?
Farmers attitudes to farming (e.g. proportion with a positive attitude)	2	3	3	ADAS Farmers Voice (although problem of low response rate) or special survey/study
2. Greater efficiency in the total Food Chain				
Productivity of food chain beyond farm gate (reducing gap with international competitors).	2	2	3	Data limitations beyond farm gate. Consider analysis undertaken by DTI/ONS. Initially we may have to use partial productivity measures e.g. labour (but note lack of hours worked data – problem for food chain with many part-time workers) , capital stock (ONS recently refined estimates). Enhanced with special studies to measure international comparisons and counterfactual.
Real food prices	2	2	5	Real food prices provide indirect measure of productivity. Covers whole of food chain rather than beyond farm-gate. Problem of Influence from external factors. Some external factors may be the result of government policy or EU Commission regulations. Taxation, for instance, or regulations on packaging and waste could all lead to higher food prices. Changes in consumer demand could also have an impact. The index would therefore need to be interpreted in the light of such external factors. Analysis of trends could also consider impact of farm-gate prices. Defra Foundations for our Future indicator.
Gross Value Added per person (full time equivalent) for food chain beyond farm gate	2	2	3	Provides measure of income. Practical difficulties in measuring labour volume due to large number of part-time workers.
Overseas trade (e.g. exports of value added processed products)	2	2	5	Overseas Trade Statistics. Problem of impact of external factors e.g. exchange rate.
Benchmarking across food chains, including assessment of length of chains	2	2	2	Needs to be developed. Could cover proportion of commodities sold through markets, direct to retailers etc

Core Indicators	Impact of SFFS 1–low, 5–high	Speed of response to SFFS 1–slow, 5–fast	Current data 1–none, 5–good	Sources/Comments
Capital stock per worker in food and drink processing	1	2	3	Data sources limited. Special studies.
Skill level of food and drink processing workforce	1	2	2	Data sources limited. Special studies.
Indicator of innovation and technical progress e.g. level of automation	1	2	2	Data sources limited. Special studies.
3. Reduced Burden on Taxpayers and the rest of the economy				
Costs of animal and plant disease outbreaks	4	2	3	Special studies as diease outbreaks occur. Series is extremely volatile
Illegal imports of meat	4	4	2	Estimate of true incidence estimate rather than seizures. Difficult to measure.
Costs of removing pesticides and fertilisers from drinking water	4	3	2	Rough estimates available. Data would need to be collected from the water industry. Costs may fall as the water industry improves its technology.
Cost recovery of CTS, disease control levy etc.	5	5	5	Transfer of costs to producers from taxpayers brings benefits to the wider economy.
Bovine TB incidence	4	2	5	Series affected by FMD impact on testing, but consistency of series recovering.

ENVIRONMENTAL OUTCOME CORE INDICATORS

4. Reduced Environmental Cost of Food Chain				
Pesticides in rivers and groundwater (Pilot Set)	4	3	5	Separately identify pesticides in drinking water sources?
Biological river quality	2	2	4	England Biodiversity Strategy, Quality Of Life Counts, Defra Foundations for our Future indicator. Need to consider impact of food and farming sectors.
Quantities of active ingedients of pesticides used and spray area treated (Pilot Set)	4	3	5	Pestcide Usage Survey.
Fertiliser usage	3	3	5	Survey of Fertiliser Practice.
Nitrate and phosphorous losses from agriculture (Pilot Set)	4	2	2	R&D projects. Estimates derived through modelling.
Phosphorous levels of agricultural topsoils (Pilot Set)	4	1	2	National Soils Inventory. Can also be seen to cover outcome 6 and will in part be due to the undeylying geology i.e. sustainable use of the soil.
Heavy metals in agricultural topsoils (Pilot Set)	4	1	2	National Soils Inventory. Can also be seen to cover outcome 6 and will in part be due to the undeylying geology i.e. sustaibale use of the soil.
Manure management (Pilot Set)	4	4	3	Special survey run in 1997, would need to be repeated.
Ammonia emmissions (Pilot Set)	4	4	3	IGER, and R&D projects
Emmissions of methane and nitrous oxide from agriculture (Pilot Set)	3	3	3	Greenhouse Gas Emission Inventory. Data modelled. Links to wider PSA target on greenhouse gas emmissions.
Water pollution incidents caused by agriculture (category 1 and category 2)	4	4	5	Adminstrative data on incidents.
Ammonia pollution of water by agriculture	3	3	3	Likely to be an issue in implementation of Freshwater Fish Directive.
Eutrophication status of freshwaters and marine waters	2	3	4	Need to try to identify agriculture's impact upon eutrophication.
Waste produced in food processing amd retail	3	3	3	Food and Drink Federation (FDF) indicator.
5. Better Use of Natural Resources				
Energy use direct (Pilot Set)	2	2	3	R&D projects utilising various sources (See AUK table 10.1). Links to wider PSA target on use of energy saving technologies and greenhouse gas emmissions.
Energy use indirect (e.g. fertiliser, pesticide, animal feed) (Pilot Set).	1	1	3	R&D projects utilising various sources (See AUK table 10.1). Links to wider PSA target on use of energy saving technologies and greenhouse gas emmissions.
Energy derived from agricultural biomass.	4	2	4	R&D projects utilising various sources (See AUK table 10.1). Links to wider Government target of 10% of energy from renewable resources.

Core Indicators	Impact of SFFS 1–low, 5–high	Speed of response to SFFS 1–slow, 5–fast	Current data 1–none, 5–good	Sources/Comments
Organic matter content of agricultural topsoils (Pilot Set)	4	1	3	National Soil Inventory.
Selection of Soil Strategy action plan headline indicators	?	?	?	Will need to tie in with Soil Strategy. This will identify around 10 headline incicators. Choose subset of these.
Use of water for irrigation (Pilot Set)	2	4	3	Irrigation survey (last run in 95).
Area of organic farming	5	4	5	June Census; certification bodies.
Packaging per tonne of product	3	3	3	Food and Drink Federation (FDF) indicator.
6. Improved Landscape and Biodiversity				
Area of land under commitment to environmental conservation by different tiers (Pilot Set) and biodiversity objectives (England Biodiversity Strategy)	5	4	5	Headline indicator for England Biodiversity Strategy (due to be published in Oct 2002).
Area of cereal field margins under environmental management (Pilot Set)	5	4	5	Targets set with UK Biodiversity Action Plan. Not included as an indicator in England Biodiversity Strategy as simply covers quantity and not quality.
Area of semi-natural grassland (Pilot Set)	5	3	3	Targets set with UK Biodiversity Action Plan. Not included as an indicator in England Biodiversity Strategy as simply covers quantity and not quality.
Trends in plant diversity in crops and field margins	5	2	2	Core indicator for England Biodiversity Strategy (due to be published in Oct 2002). GB data published. Further analysis needed to provide England data.
Characteristic features of farmland (ponds, hedges etc.) (Pilot Set)	5	2	2	Countryside Survey and other special surveys.
Area of land farmed organically	5	4	5	Core indicator for England Biodiversity Strategy (due to be published in Oct 2002).
No. of farms with LEAF Audit; No. of farms achieving Assured Farm Standards	5	5	5	Core indicator for England Biodiversity Strategy (due to be published in Oct 2002).
Biodiversity Action Plans published and implemented	5	5	5	Defra Foundations for our Future indicator. More process than outcome measure.
Footpath condition (CA State of the Countryside)	3	3	3	CA survey every 5 years or so.
Leisure day visits (CA State of Countryside)	3	2	3	CA survey every 5 years or so.
Public access to mountain, moor, heat and down and registered common land (PSA) e.g. area under voluntary access agreements	3	4	5	
Areas under positive floodplain management	4	4	4	
Incidence of damage to historic sites from agricultural activity.	4	4	4	

Core Indicators	Impact of SFFS 1–low, 5–high	Speed of response to SFFS 1–slow, 5–fast	Current data 1–none, 5–good	Sources/Comments
Public support for the policy to pay farmers to protect the environment and regenerate landscapes and habitats	4	4	4	Defra Survey of Public Attitudes towards the Environment and to Quality of Life (every 4 years or so)
Public attitudes to farming (CA State of the Countryside)	4	3	3	CA survey every 5 years or so.

SOCIAL OUTCOME CORE INDICATORS

Core Indicators	Impact of SFFS 1–low, 5–high	Speed of response to SFFS 1–slow, 5–fast	Current data 1–none, 5–good	Sources/Comments
7. Better Public Health				
% energy from fat.	1	3	5	Expenditure and Food Survey. Would need to tie in with DoH indicators. Could also look at nutritional content of processed foods separately to identify food manufacturers contribution to healthier diets.
Proportion of processed foods with nutrition labelling	1	3	3	Link with FSA indicators for the Food Labelling Action Plan.
Proportion of expenditure on food by income group	1	3	3	Expenditure and Food Survey. Includes impact of 'food deserts'.
Pesticide residues in food (Pilot Set) and heavy metals residues	4	3	5	Samples exceeding MRLs.
Public concerns on use of pesticides and fertilisers and GM crops	3	4	4	Defra Survey of Public Attitudes towards the Environment and to Quality of Life (every 4 years or so). Links to environemntal outcomes 5 and 6.
Drinking water quality	5	3	5	
Food-borne illness (food poisoning) (FSA indicator)	2	4	3	FSA has developed a food-borne disease strategy to reduce food-borne illness (food poisoning) in the UK by 20% over a five-year period ending in 2006. Cases reported rather than true incidence.
BSE cases (PSA)	4	2	5	
Relative incidence of stress related illness	2	4	3	Sources would need to be explored.
Suicide rate of farmers and agricultural workers	2	4	4	Ties in with DoH PSA target.
Length of average period of unemployment	2	3	3	Uncertain if national data sources could provide data on agricultural workers and farmers as opposed to rural areas more generally.
Fatal and major injuries on farms compared with other sectors	3	3	4	
8. Higher Animal Welfare				
Indicator of farm animal health	4	3	1	To be developed following finalisation of Animal Health Strategy. Defra Foundations for our Future indicator.
Level of adoption of 'welfare friendly' production systems	4	3	3	Could be developed for different livestock types. Information will be required to monitor impact of new/changing regulations.

Core Indicators	Impact of SFFS 1–low, 5–high	Speed of response to SFFS 1–slow, 5–fast	Current data 1–none, 5–good	Sources/Comments
No. of cases of poor welfare in farm animals	3	3	5 (for reported cases)	Vetnet. Not chosen as headline indicator because of problem of actual versus recorded cases. Also problem of changing thresholds of poor welfare.
Public concern on livestock methods	4	4	4	Defra Survey of Public Attitudes towards the Environment and to Quality of Life (every 4 years or so)
% of food sold under assurance schemes	3	3	2	Also contributes to outcomes 1, 5, 6 and 8. Estimates available (?), but could be collected via FBS or June Census.
9. More cohesive and productive Rural Communities				
Rural Enterprise Scheme expenditure by performing quartile	5	5	3	Relevant if expenditure targetted towards less well performing areas. Currently practical problems obtaining geographic breakdown of exenditure.
ERDP expenditure on schemes which promote access to services	5	5	5	Only relevant if targetted to these type of schemes.

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