FOREWORD

By the Minister of Agriculture, Fisheries and Food

On 17 May 1999 the Government reaffirmed its commitment to the principle of sustainable development by publishing the document *A Better Quality of Life: a Strategy for Sustainable Development in the United Kingdom*. Agriculture plays an important part in that strategy. It can help society in the quest for a better quality of life for everyone, now and for generations to come.

This publication, *Towards Sustainable Agriculture*, highlights the role of agriculture in helping to achieve sustainable development. It provides a pilot set of key indicators that reflect the three strands of sustainable development: economic, social and environmental.

This pilot set of indicators helps us to identify, quantify and evaluate the effects of agriculture. We will be able to see the consequences of our policies on progress towards sustainability. Our future programmes and initiatives, as well as those of others, will be more easily and better targeted.

This publication is the culmination of a long consultative process to which many people have contributed. I am grateful to all who have helped us shape the document. But this indicator set represents the beginning, not the end, of a process. It is my sincere hope that by highlighting some of the key issues facing agriculture today we can encourage a positive debate on making agriculture sustainable for today and tomorrow.

Nick Brown
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Part I – Introduction

This set of indicators provides a means of measuring the economic, social and environmental impacts of agriculture and to help assess the effectiveness of policies and the sustainability of the sector. The set complements the document *A Better Quality of Life: a Strategy for Sustainable Development in the United Kingdom* published by the Department of the Environment, Transport and the Regions (DETR) in May 1999 and its associated set of indicators *Quality of Life Counts*.

It is hoped that farmers, landowners, non-governmental organisations, Local Agenda 21 Groups and others will find these indicators a useful reference point for regional and local use. Within Government the indicators will:

- track changes in the impacts of UK agriculture over time and, where possible, show how agriculture is becoming more or less sustainable;
- provide policy makers with a tool to help assess the social, economic and environmental effects of their policies, identify the need for new policies and appraise policy options;
- raise awareness of the environmental impacts of agriculture and its contribution to sustainable development; and
- more effectively influence and contribute to the international debate about indicators and sustainability targets.

**What is sustainable agriculture?**

There is no universally accepted definition of sustainable agriculture. The MAFF definition, which lies behind the thinking in this document and in all our policies, is set out below.

**Sustainable agriculture means:**

- ensuring the continuing availability to the consumer of adequate supplies of wholesome, varied and reasonably-priced food, produced in accordance with generally accepted environmental and social standards;
- maintaining a competitive and flexible industry which contributes to an economically viable rural society;
- ensuring effective protection of the environment and prudent use of natural resources;
- conserving and enhancing the landscape, wildlife, cultural and archaeological value of agricultural land; and
- respecting a high level of animal welfare.
The agriculture sector should not be viewed in isolation from other sectors of the economy. The indicators therefore take account of the four key objectives identified by the Government’s sustainable development strategy:

1. social progress which recognises the needs of everyone;
2. effective protection of the environment;
3. prudent use of natural resources; and
4. maintenance of high and stable levels of economic growth and employment.

**Signs of progress**

In order to be able to make a balanced assessment of agriculture’s progress towards sustainability, social, environmental and economic factors must be examined. This calls for indicators that are cross-linked as well as representative of the issues most relevant to agriculture. The trends revealed by individual indicators need careful interpretation before conclusions can be drawn on the progress towards sustainability of the sector as a whole.

Indicators are able to show positive progress towards sustainability. For example, the use of environmentally friendly farming systems has been rising. And by combining indicators on agricultural productivity and energy use we can see that energy efficiency has been rising. But other indicators show adverse movement. The numbers of certain species of farmland bird, for example, are in decline. Some of the indicators included in this set are not yet fully developed as they are based on existing data. In time, however, they should provide a better reflection of the trends towards a more sustainable agriculture sector.

**Selection of the indicators**

A pilot list of 35 indicators has been selected, focusing on the key issues for sustainable agriculture and taking account of data availability. The indicators have been grouped under the following headings:

A  Agriculture within the rural economy and society
B  Farm management systems
C  Input use
D  Resource use
E  Conservation value of agricultural land

The indicators have been selected against the following objective criteria:

- **Policy relevance.** The indicators need to be closely related to the issues identified as important by Government, farmers and other land managers, non-governmental organisations and consumers.

- **Analytical soundness.** The indicators should establish clear links between agricultural activities on the one hand and environmental, economic and social impacts on the other.

- **Measurability.** It should be possible now or in the near future to measure the changes described by the indicators on the basis of readily available data or data that can be collected at reasonable cost.
Appropriate level of aggregation. Although indicators should ideally capture the spatial and temporal diversity of agriculture, the primary aim of this pilot set is to capture information on aspects of sustainable agriculture at a national level.

Ownership and consensus are crucial if the indicators are to have credibility and be widely used. Their selection has followed intense public consultation. The set seeks to recognise society’s concerns and aspirations for agriculture and the environment. The indicators also take account of international work, in particular by the Organisation for Economic Co-operation and Development’s (OECD) Joint Working Party of the Committee for Agriculture and Environmental Policy.

As an aid to analysis, the indicators were classified during their development according to the ‘driving force, state and response’ model (DSR model) developed by the OECD.

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<td>describe what is causing environmental, economic or social conditions to change</td>
<td>measure the quality of the environment in agriculture, the stock and quality of natural resources available to it and the wealth and welfare that agricultural businesses generate</td>
<td>report the actions being taken by policy makers and farmers to respond to these driving forces</td>
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<td><strong>Example:</strong> spray area treated with pesticides</td>
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This set of indicators identifies state indicators as well as driving force and response indicators which illustrate the extent and nature of agriculture’s impacts on the environment and its contribution to sustainable development. Appendix I categorises each of the individual indicators in terms of the DSR model. Appendix II consists of detailed background information on the indicators and of suggestions on how the indicators may be developed and improved in future reviews.

**Issues which have been omitted**

The indicators are concerned with primary agriculture rather than the whole range of matters for which MAFF is responsible. Issues such as trade, access to the countryside, the marine environment and fisheries are covered by the indicators that accompany the new UK sustainable development strategy or are being developed by other bodies. They have therefore been omitted from this pilot set.

In addition, it has been difficult to collect data in some areas. This has been the case particularly with social progress, animal welfare, soils and upland areas. Ensuring high standards of farm animal welfare is an important part of sustainable agriculture. The UK’s already high standards have been maintained and furthered by Government action...
and by the efforts of other groups. There is currently, however, no indicator to measure this. It is hoped that the outcome of research in this field will allow the setting of an indicator of farm animal welfare when the first review of this set takes place in 2003. A number of indicators on agricultural soils have been included although there remain some issues for which we need indicators but where there is insufficient knowledge at present to frame them effectively. Further work on these issues, such as soil erosion, is to be undertaken as part of the development of indicators for the Government’s forthcoming Soil Strategy. Another important issue not covered in this document, because of a general lack of data, is the impact of agricultural practices on the condition of heather and other sensitive upland vegetation. Alternative indicators using data on livestock numbers in less favoured areas have been considered but do not provide sufficient information about the quality of management or the condition of the upland.

**A national set**

The indicators are intended to capture information about the environmental, economic and social impacts of agriculture across the UK. However, limitations in data availability mean that for some indicators information is only available for England or for Great Britain.

Under the Government of Wales Act the National Assembly of Wales has a statutory obligation to develop its own sustainable development plan. This would reflect any specific Welsh interest. Work on indicators is being conducted by other agriculture departments (for example indicators at farm level in Scotland), by agencies (for example the new Countryside Agency indicators on the state of the countryside) and many local communities are developing their own indicators in line with the Local Agenda 21 process. It is hoped that they will draw ideas from this publication. In addition, the DETR has produced a comprehensive set of indicators of sustainable development, *Quality of Life Counts: a Baseline Assessment*. These cut across all Government departments and also include a number of indicators related to agriculture. Indeed, seven of our indicators here are mirrored in the DETR document (numbers 11, 17, 26, 29, 31, 32 and 35). Such overlaps highlight the importance given to the whole sustainable development strategy and demonstrate the ‘joined up thinking’ at the heart of government.

**Targets and guideline levels**

Targets reflect desired policy outcomes or actions and can help to give policy makers a clearer sense of direction. They provide an impetus to policy development and implementation. Targets also help to identify a level or path that can be sustained in the long term. There needs to be a direct link between the indicator and the target or guideline level if a meaningful target is to be set.

Setting targets and guideline levels for agriculture is difficult. Production systems, together with the climatic and other conditions in which they operate, are highly diverse and liable to substantial local variation. This gives rise to complex policy responses by Government and others. The achievement of targets is further complicated by the long time-lags that may occur between agricultural activities and their possible impacts.

Some targets or guideline levels already apply to UK agriculture as a result of national, EU or international measures. These apply in particular to financial support for agriculture (under the Uruguay Round agreement) and to greenhouse
gas emissions, as well as biodiversity. There are also targets for the area of land to be entered into voluntary agreements under UK agri-environment schemes such as the Environmentally Sensitive Areas Scheme. Where such targets exist, they have been mentioned in the text accompanying the relevant indicators. For indicators where no explicit targets have been set, a broader indication of desirable development has been given where appropriate.

**The European background**

Agricultural policies are largely determined by the Common Agricultural Policy (CAP) of the European Union, which is agreed at EU level. As well as setting annual price support and direct aid levels, the CAP leaves member states with some national discretion in certain areas of agricultural policy. The UK has been pushing for CAP reform for a long time and, although the final conclusion of the Agenda 2000 CAP process did not go sufficiently far, it nonetheless represents a good outcome for the UK. Agenda 2000 will form the foundation of the Community’s negotiating position for EU enlargement and pave the way for forthcoming negotiations in the World Trade Organisation, leading to greater liberalisation of agricultural trade. The reforms will reduce farming’s dependence on market price support, increasing the industry’s competitiveness and helping to deflect the pressure for tighter controls over production. They offer farmers constructive help to enhance and diversify their businesses in response to changing market circumstances. The environment will benefit both from reduced reliance on market price support and the establishment of the second pillar of the CAP (the Rural Development Regulation) to which the Minister attaches great importance. The Rural Development Regulation represents the long term future of public support for farm businesses and the rural economy, demonstrates the Government’s commitment to rural communities and will set the agenda for further reform of the CAP in years to come. Following the comprehensive consultation process launched in January 1999 with farming, rural, environmental and other interest groups on how to implement the discretionary reforms in the UK, the Minister announced the Government’s plans for an ambitious seven year programme of funding on 7 December 1999. For England this would mean a total of £1.6 billion in expenditure, a 60% increase over seven years. The devolved administrations will set out their own plans for Scotland, Wales and Northern Ireland.

**Next steps**

It is generally intended to update and republish these indicators once every five years, although much of the data on which they will draw will be published more frequently in other documents (for example in the publication *Agriculture in the UK* or on the MAFF Website). Appendix II includes ideas about the future development of the indicators.

However, the first review of these indicators is planned for 2003. This early review will not only provide an indication of trends, but also give an opportunity to change or refine the indicators in the light of experience or new data and information. This will be especially useful in supporting those indicators for which data are currently incomplete. When the indicators are refined, this may give rise to policy implications. Other data relevant to some of the indicators are expected to be generated by research and development projects over the next couple of years.

This publication can be viewed on the MAFF Website: [http://www.maff.gov.uk](http://www.maff.gov.uk)
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Part II – Background

Presentation of the indicators

This part presents the five indicator groups in a little detail so as to highlight their role in the evaluation of agriculture's progress towards sustainability.

A. Agriculture within the rural economy and society

Agricultural structure and farm financial resources. A sustainable agriculture sector must by definition be economically viable. A sound financial structure, a motivated and flexible labour force and the opportunity for innovative newcomers to enter the industry will all help to secure this. Moreover, the present heavy reliance of agriculture on public subsidies and price support under the CAP cannot be regarded as sustainable in the longer term. An agreement on the Agenda 2000 CAP reform in March 1999 (the Berlin agreement) led to a number of changes. It was agreed to cut the level of price support to farmers (compensated as direct payments) and create an integrated rural development policy, including agri-environmental measures. In principle, these will provide the basis for a future shift of emphasis from production support towards environmental and rural development measures.

Agricultural productivity and employment. Measures of agricultural productivity provide an indication of the efficiency with which agriculture uses the resources available to it, including its labour force. Of course, keeping people employed in the agriculture sector is not an objective in itself, as the size of the agricultural workforce will be determined principally by market conditions and production technologies. It is recognised, however, that agriculture plays a role in the maintenance of viable rural communities and of the wider rural environment.

B. Farm management systems

Interest is increasing in the use of farm management systems that can help to ensure that individual businesses take account of the environmental impacts of their actions and decisions. These vary from those with a relatively narrow aim (for example the MAFF Farm Waste Management Plan) to those whose aim is to combine profitability with lowered environmental impact. Crop/livestock assurance schemes (e.g. the NFU/retailer assured produce schemes) aim to fulfil the need for assured quality produce. Several of these schemes also have an auditing function (e.g. the LEAF Audit) and others have external verification of the expected standards.

C. Input use

Pesticide use. Pesticides play an important role in modern agriculture in controlling pests, weeds and diseases. They also have significant non-agricultural uses. By their very nature, pesticides have the potential to cause adverse impacts on the environment and on human health. Developing reliable indicators on the impact of agricultural pesticides is very difficult, particularly given the total of 340 active ingredients approved for use in agricultural pesticide products in the UK. Each chemical used gives rise to a different level of risk to the terrestrial or aquatic environment and to human health. No indicator can fully reflect the complexities of the situation. It is Government policy that the amount of pesticides used should be limited to the minimum necessary for the effective control of pests. A key objective of this policy is to minimise the impact of pesticides on the environment and to continue to ensure that there are no risks posed by approved products to human health. Indicators can act as a potentially valuable tool in assessing the effectiveness of policy. None of the proposed pesticide indicators on its own provides
a direct or comprehensive measure of the impact of pesticides on the environment or human health. But taken together, the chosen indicators provide an overview of the risk posed by pesticides. Further development in the future will provide a better picture.

**Nutrients.** Nutrients, particularly nitrogen and phosphorus, are vital for plant and animal growth. Farming systems are not wholly efficient in their use of nutrients and losses to the wider environment are therefore inevitable. International work to develop indicators of nutrient and phosphorus use in agriculture has focused on nutrient balances that compare inputs of nutrients into production systems with outputs in food and other products. These nutrient balances are a useful indicator of the efficiency with which the farming industry uses nutrients. They have limited value, however, as indicators of environmental risk because the surplus or deficit figure does not show whether the extent and nature of any losses are such that they give rise to adverse environmental impacts. A more specific, although still indirect, measure of the impacts of nutrient use on freshwater quality is provided by a measure of nitrogen (in the form of nitrate) and phosphorus losses to water.

**Greenhouse gas emissions.** Climate change is one of the most significant global issues. Human activities are generating increased amounts of greenhouse gases and these in turn are causing the temperature of the earth’s surface to rise. This could have major effects on natural systems, leading to increased incidence of extreme weather conditions such as floods and droughts, and have damaging impacts on agricultural production. Agriculture is not only under threat from climate change it also contributes to the problem through input use that leads to emissions of greenhouse gases.

**Energy.** The energy used by agriculture currently represents less than 1% of overall UK energy consumption and in 1996 accounted for around 7% of total farm expenditure on inputs. Agricultural energy use can be classified into two categories: direct and indirect. Direct use of energy (including electricity) is that used for heating, motive power, etc. Indirect input takes the form of manufactured goods, fertilisers, pesticides and machinery, for example. Both aspects are presented here.

### D. Resource use

**Water.** In today’s highly competitive food market, retailers and consumers of products such as soft fruit, vegetables and potatoes demand produce of a constant and high quality. The area of cereal and grass irrigation has reduced and that of field crops such as potatoes and vegetables has increased. This trend is likely to continue and is representative of decisions by farmers to support the highest-risk end of the business, operating with the lowest levels of Government and EU support and maximum market exposure. A large proportion of water used for irrigation is abstracted from rivers and boreholes, under a licensing system operated by the Environment Agency that provides us with useful information.
Soil. Soil needs to be protected as a limited resource both for the production of food and other agricultural products and as a habitat for plants and animals. It also has other important functions, including the ability to neutralise potentially polluting substances that enter the soil from rainfall or as a result of human activities. Soil also acts as a sink for carbon dioxide, a reservoir for water and a physical base for buildings. External factors, such as atmospheric deposition of heavy metals emitted by industry and through waste disposal, can have significant impacts on soil. The indicators chosen are useful because they should provide early evidence of what is happening despite the fact that changes to soils can occur at very slow rates. They also reflect the issues that are currently of importance for agricultural soils. The further development of soil management indicators will be aided by two three-year research projects, commissioned by MAFF, that started in April 1997. One project is exploring the relationship between farming practices and soil physical characteristics. The other is seeking to identify the causes of upland erosion and then to propose abatement strategies. Few data are currently available on changes in soil management practice apart from various ad hoc studies. MAFF is considering using the forthcoming Farm Practice Survey and other options to address the main deficiencies.

Agricultural land. Using land wisely, whether for agriculture or other purposes, is a key consideration for sustainability. This section shows how much land is being lost to agriculture as a result of irreversible development and the area of remaining agricultural land along with its main types of cover.

Non-food crops. Non-food and energy crops are a sustainable source of raw materials for industrial and energy uses. They have the potential to provide farmers with an alternative source of income to conventional crops. The demand for these types of crops is expected to grow in the future.

E. Conservation value of agricultural land

The conservation value of agricultural land. Since agriculture has a major influence on the appearance and biodiversity of the countryside, a number of indicators reflecting the various aspects of conservation have been chosen. The most important aspects covered are the area of agricultural land under environmental conservation, the type of characteristic landscape features related to farmland, the habitats provided by modern farming systems and impacts on biodiversity. These are all important elements in securing the environmental and aesthetic value of the countryside and therefore play an important role in achieving a more sustainable farming sector.
## Part III – Indicators

### Summary list of indicators for sustainable agriculture

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In order to help sustain the economic viability of agriculture, a healthy balance needs to be maintained between agriculture’s assets and its liabilities. As a general rule, the value of assets should be more than sufficient to cover liabilities.

Total assets means fixed and current assets. Land and buildings represent the major part of fixed assets, but plant, machinery and vehicles, and breeding livestock are also included. Current assets means trading livestock, crops and stores, debtors and cash deposits. Liabilities consist of bank loans and overdrafts, and other long-term and short-term liabilities. The difference between total assets and total liabilities therefore represents net worth.

The graph indicates that UK agriculture borrows little in relation to its net worth. In 1996, the value of total assets exceeded total liabilities by a factor of around eight. The level of farmers’ liabilities has shown very little movement in real terms over the entire period shown and most of the variation in asset values is explained by fluctuations in land values.

It would not be meaningful to specify any particular target or range for agriculture’s capital assets or their relationship with liabilities. For the purposes of assessing the impact on the economic sustainability of the sector, movements in the ratio of assets to liabilities are probably as significant as the level of either. Sudden or sharp movements in either series may be indicative of some underlying financial difficulties facing the sector. Given the generally difficult conditions facing the sector, it is expected that the ratio of liabilities to assets will increase over the coming years.

Although there are no direct links between assets and liabilities and other indicators, there is likely to be some association between asset values, in particular agricultural land, and farm incomes (6).
A good spread of ages within the farming community should help maintain a balanced structure within rural society.

The age distribution of farmers (defined here as the person in whose name a holding is operated) has been fairly stable between 1985 and 1997, with little change in the relative shares of the different age groups. Almost one-quarter of farmers are aged 65 or over. For the total workforce in all industries, a similar proportion is aged over 50 and only 1.8% are aged over 65.

The new Rural Development Regulation agreed as part of the Berlin agreement on Agenda 2000 includes the provision of measures for early retirement, aid for younger farmers entering the sector and the provision of targeted training.

There is nothing to suggest that any specific age distribution in farming is more or less sustainable than, or is to be preferred on any other basis to, any other distribution. It would therefore be inappropriate to suggest targets. However, changes in age distribution over a relatively short period may be an indicator of other changes in agriculture.

This state indicator has no direct links to any other indicators.
Renting land provides a means for farmers to adjust the size of their business in the face of changing market conditions or personal circumstances. It also represents a possible route for new farmers to enter the industry. A flourishing rented land market is therefore likely to facilitate adjustments within the sector, allowing businesses to improve their competitiveness and thus enhance sustainability.

Since 1945, the percentage of tenanted land in Great Britain has decreased steadily, from around 60% in 1950 to 32% in 1998. The Government recognises the need for businesses to be able to adapt to changing circumstances. The 1995 Agricultural Tenancies Act should facilitate this process and, although no targets or guideline levels have been established, the Act is expected to introduce greater flexibility into the market for let agricultural land.

Although there may be links between this indicator and others in this section, the nature of the link and causality is sometimes far from clear. For example, while changes in agricultural profitability may change the demand for rented land, it is also likely to affect the supply of land that is offered for letting. The link between agricultural incomes and the proportion of tenanted land will therefore be far from obvious.
Agriculture within the rural economy and society

4. EU Producer Support Estimate (PSE)

Industries, such as agriculture, which have received extensive public support over long periods are unlikely to be sustainable in terms of their existing size and structure in the absence of continuing support. This indicator relates to the Produce Support Estimate (PSE) for the EU as a whole, reflecting the fact that agricultural policy is generally determined at EU level.

The PSE measures the amount of direct subsidies given to those engaged in agriculture, as well as the financial effects of schemes intended to enhance the prices of agricultural commodities. The level of PSE is affected, however, not just by the level of support provided in any country, but also by the estimated price of agricultural commodities on the world market. Thus, in interpreting changes in the level of PSE, account needs to be taken of movements in world market prices as well as in domestic subsidies.

The PSE measure rose rapidly in the mid-1980s, largely reflecting weak world market prices, in particular for cereals and dairy products. It then fell before rising again by 1990. For most of the early and mid-1990s the PSE was stable at between 47% and 49%. A sharp fall in 1996 was due to strong cereal prices on the world market.

As it is likely that this economic indicator will be substantially affected by events that are outside the direct scope of UK or even EU agricultural policy, it is considered inappropriate to set targets. It is, however, consistent with the Government’s objectives that reducing levels of agricultural support within the EU should lead to a fall in the PSE over time.

Links between the PSE and other indicators are not straightforward, as determining the level of the PSE depends upon world market prices as well as upon the level of domestic agricultural support. There is likely, however, to be some association with farm incomes (6) as these will be influenced by the level of support and, somewhat more indirectly, with the level of agricultural employment (9).
Direct payments for the enhancement or maintenance of environmental features are intended to compensate for the market’s failure to provide payment for these services which are much valued by society. Direct payments for specific actions are generally regarded as being less distortive than mechanisms that provide support through their effect on the market price. This indicator shows the payments to farmers for agri-environment purposes as a percentage of the overall CAP grant and subsidy expenditure administered in the UK.

The CAP guarantee expenditure figures include all agri-environment and forestry schemes that are currently running in the UK. In the 1997–98 financial year, over £130 million was spent on agri-environment measures, though this represented less than 3.75% of all UK expenditure on grants and subsidies administered under the CAP. The marked dip in the percentage share of agri-environment expenditure in 1996–97 was principally a result of increased spending on BSE-related measures. It should be noted that further funds made available to rural areas under Objective 5b of the Structural Funds Programme and LEADER II Community Initiative and funds from, for example, the Countryside Agency are not included in this indicator.

Any change in the balance of CAP expenditure payments is likely to be in favour of a more sustainable and better targeted method of support for rural areas. It is to be expected that the proportion of payments accounted for by agri-environment schemes will rise as total subsidy expenditure decreases. The Government believes that agriculture’s overall reliance on subsidies should fall.

The Government believes it is inappropriate to set national targets for this indicator as agri-environment payments are substantially affected by events outside the direct scope of UK agricultural policy.

This indicator is linked to agricultural productivity (8) and, possibly, the PSE indicator (4). Agricultural employment (9) might also be influenced because the labour input needed to fulfill the requirements of the various agri-environment schemes may be higher or lower than those of conventional farming practices.
**Agriculture within the rural economy and society**

6. **Total income from farming**

Total income from farming (TIFF) represents the aggregate return from agricultural activity to those with an entrepreneurial interest in the industry (i.e. farmers, partners, directors and their spouses and other family members who work on the farm). TIFF is recognised as a fundamental indicator of the economic health of the industry. Expressing TIFF per head allows the figures to reflect changes in the numbers of those with an entrepreneurial interest in agriculture. The downturn in TIFF and TIFF per head since 1995 reflects the combination of a number of factors: a strong pound, weak world commodity prices and over-supply for some commodities with poor harvests for others.

Between 1996 and 1997, the fall in total income from farming resulted from a decrease in the value of outputs, mainly caused by weakening prices, which was only slightly offset by a fall in input value.

Diversified income may come from other on-farm activities, for example running bed and breakfast accommodation. It may also come from off-farm activities. Income from diversified sources tends to be more stable than income from farming. As a result, when returns from agriculture are low, the proportion of income from diversified, non-agricultural sources tends to rise.

There is no specific target attached to this indicator but the Government believes that a competitive market framework would provide a more sustainable basis for determining agricultural prices and incomes.

There is likely to be some overlap between this indicator and others, either directly or indirectly. Associations may include capital assets (1), PSE (4), payments to farmers for agri-environment purposes (5), average earnings of agricultural workers (7) and agricultural employment (9).
An economically sustainable agriculture sector requires a highly motivated labour force with the skills and flexibility to respond quickly to rapidly changing conditions.

Agricultural wages are underpinned by minimum levels set by the Agricultural Wages Board and have fluctuated for most of the period shown in the chart within a fairly narrow range of between 70% and 80% of average manual workers' earnings. The percentage value was 77% in 1997.

The apparent difference in earnings between agricultural and manual workers may be accentuated slightly because the value of benefits in kind received by agricultural workers is not always fully reflected in the recorded earnings figures.

There are no specific targets regarding the average earnings of agricultural workers. Individual pay rates are a matter for negotiation between employers and employees, subject to the terms and conditions established by the Agricultural Wages Board.

There are likely to be links, although some will be rather indirect, between this indicator and farm incomes (6), agricultural productivity (8) the PSE indicator (4), capital assets (1) and, possibly, payments to farmers for agri-environment purposes (5).
Productivity indicators provide a measure of the efficiency with which agriculture converts inputs into outputs. Two measures are calculated: (i) total factor productivity measures the gross output per unit of all inputs, including fixed capital and labour; (ii) labour productivity (a more restrictive measure) is estimated as gross product per full-time person equivalent. Since 1973 the total factor productivity of the agricultural industry in the UK has increased by over 40% while labour productivity has more than doubled. Labour productivity seems likely to continue to rise more rapidly than total factor productivity, given the potential for substituting capital for labour and increasing the use of mechanical and chemical inputs.

The BSE crisis in 1996 set back productivity in the UK by approximately 3%, as cattle and calves removed from the food chain are excluded from production. Following the CAP reforms introduced in 1993, there has been a reduction in the rate of productivity gains across the EU. The fall in the UK rate of productivity growth was broadly in line with that in the EU as a whole (corrected for BSE effects). Overall, annual productivity growth broadly halved and, although not all of this is necessarily attributable to the introduction of production controls, such controls appear likely to have played a part with the introduction of set-aside in reducing the volume of output without a corresponding fall in the volume of inputs.

The Government aims to create the conditions under which agriculture is able to take advantage of opportunities to increase efficiency in its use of resources. However, specific targets relating to the rate of growth in agricultural productivity in the UK would not be appropriate as decisions on production technology are for the industry, rather than the Government, to take.

There is likely to be a fairly direct link between productivity growth and agricultural employment (9) but for most other indicators the link is more tenuous. There may be some association with total income from farming (6), area of agricultural land under commitment to environmental conservation (31), agricultural land area (28) and payments to farmers for agri-environment purposes (5) as well as links to the indicators under input use and resource use.
Agriculture within the rural economy and society

9. Agricultural employment

Agricultural employment (including self-employment) plays an important role in contributing to the maintenance of a viable rural population and the associated social fabric.

The data for this indicator include full-time, part-time and seasonal or casual workers. They do not include salaried managers or the spouses of farmers, partners and directors, who nevertheless contribute significantly to work on farms. It is clear that the total number of people working in agriculture has been declining for a very long period. There has, moreover, been a move from full-time to part-time working within the industry. While the number of full-time workers has declined since 1984, there has been a corresponding increase in the number of part-time workers, from 21% of the total in 1984 to 29% in 1997. The proportion of casual or seasonal workers within the total has remained stable over this period.

It would not be sensible to set a target for numbers of people employed in agriculture, as the labour requirements of the industry are largely determined by market conditions and available technology.

This indicator has links to agricultural productivity (8), producer support estimate (4) and average earnings of agricultural workers (7).
Farm management systems designed to ensure that businesses take account of the environmental impacts of their decisions and actions can play a significant role in the move towards sustainable agriculture. The aim of such systems varies since they meet different needs. Some have an internal auditing function while others have external verification of the standards expected. Integrated crop management (ICM) is one farm management system designed to maximise the efficiency of inputs and minimise their environmental impacts.

LEAF (Linking Environment and Farming) is active in promoting ICM. LEAF members represent only a small proportion of farmers using alternative management systems. Nevertheless the graph highlights a trend of increasing membership. Many farmers, who already follow the Codes of Good Agricultural Practice or have incorporated ICM into their farm systems, have yet to register in a scheme and as such do not figure in the statistics. The forthcoming Farm Practice Survey may shed more light on the actual number of farmers involved in the various farm management systems.

No specific target for numbers of farmers adopting more environmentally-friendly management systems has been set. The Government will continue however to promote farming according to the Codes of Good Agricultural Practice.

*This indicator can be linked to area converted to organic farming (11).*
It is widely recognised that organic farming is of great benefit to the environment. In particular, it provides a varied landscape and habitats in which biodiversity is actually encouraged by management practices rather than challenged by the use of synthetic fertilisers, herbicides and pesticides.

Organic farming clearly contributes to sustainable agriculture. It is firmly based on the principle of working with natural systems and not dominating them. It pays particular attention to maintaining soil health and fertility. It aims to use a minimum of non-renewable resources, to avoid pollution, to focus on animal welfare and to protect the farm environment and wildlife habitats.

The Government is supporting the conversion to organic farming by payments through the Organic Farming Scheme (OFS) launched in April 1999. OFS is an agri-environment scheme made under EC regulation 2078/92. Payments under the UK organic aid schemes amounted to just under £500,000 in the financial year 1996/97, rising to about £700,000 in 1997/98 and £1.3 million in 1998/99. Almost £16m was committed under the Organic Farming Scheme during the first half of 1999/2000. A further £10m is being made available for the UK aid schemes.

This indicator has links to many others in this set, for example those on soil (26, 27), pesticides (13–17 inclusive) and nutrients (18–21 inclusive) and the indicator on population of farmland birds (35).
The three MAFF/WOAD Codes of Good Agricultural Practice for the Protection of Water, Air and Soil respectively provide the farming industry with a benchmark of good practice. They give advice on how to avoid pollution while continuing to farm profitably. The Codes are targeted at farmers, advisers, consultants and enforcement agencies. They were first published between 1991 and 1993. In 1995, the Government commissioned a market study to examine awareness of the Codes, evaluate their use and hear views on them.

In this study (by Taylor Nelson AGB plc), some farmers claimed to own at least one of the Codes but could not actually confirm possession. The Water Code is the best known and most widely owned. On-farm use focuses on this Code, which has been extensively used by ADAS and the National Rivers Authority (the predecessor of the Environment Agency) during targeted advisory campaigns. The survey suggested that the Air and Soil Codes are less often referred to.

Revised Codes were launched in October 1998, together with a summary leaflet highlighting the key messages contained in the Codes. This leaflet is intended to provide a more reader-friendly document for farmers, encouraging them to make further reference to the Codes as necessary. The Environment Agency and ADAS actively promote the revised Codes on behalf of MAFF. The Codes have also been brought to the attention of local authority Environmental Health Departments, the National Farmers’ Union, the Country Landowners’ Association and other interest groups.

The Government’s aim is to raise overall awareness of and compliance with the Codes, although no specific target has been set.

There are links between this indicator and those on nitrate and phosphorus losses from agriculture (18) manure management (20) and organic matter content of agricultural topsoils (26).
There are currently around 340 active ingredients approved for use in agricultural pesticide products in the UK. This indicator reflects the percentage of samples taken by the Environment Agency that exceed the EC Drinking Water Directive limit of 0.1 µg/litre (i.e. 1 part per 10 billion).

Most pesticides detected in freshwater are found in very small quantities that are well within existing or proposed Environmental Quality Standards (EQSs). The very low limit set in the EC Drinking Water Directive for water used in public supplies has therefore been used as a benchmark. This limit does not apply directly to water in rivers nor does it indicate a particular level of health or environmental risk.

The graph above gives details for five herbicides and one insecticide. Herbicides are shown as they are the type of pesticides most commonly found in rivers, and the insecticide lindane is included because of its relative toxicity to aquatic life.

Although there can be marked annual variations reflecting weather and usage patterns, the percentage of isoproturon samples exceeding the monitoring limit remains significant, reflecting its very wide usage in cereal production. An EC pesticide review programme is currently examining the use of isoproturon. The number of atrazine samples in surface water exceeding the monitoring limit has fallen significantly since 1992 when authorisations for non-agricultural use of the compound were revoked. A similar decrease has occurred in relation to simazine.

It is Government policy that the amount of pesticides used should be limited to the minimum necessary for the effective control of pests. This indicator is useful in monitoring the effectiveness of pesticides policy, but is not sufficiently robust at present to be used as a basis for targets.
This indicator on pesticides has cross-linkages to a number of other indicators in this set, namely quantity of pesticide active ingredients used (15), spray area treated with pesticides (16), farm incomes (6), agricultural productivity (8), adoption of alternative farming systems (10), area converted to organic farming (11), area of agricultural land under environmental conservation (31) and area of cereal field margins under environmental management (33).
Pesticide use within modern agricultural practice can play an important role in protecting crops and in ensuring high quality food products. Regardless of farming practice and the degradation of pesticides in the soil, some residues may reach groundwater.

Recent amendments to EC pesticide legislation will require pesticide products to meet standards of a maximum level of 0.1 µg/l for potential contamination of groundwater. The graph above reflects the percentage of sites where at least one sample was found to exceed this limit. The indicator reflects cases of excess caused by both agricultural and non-agricultural use of pesticides.

Where excesses do occur, the pesticides concerned are detected only in very small quantities. Although the above graph does show some variance between years, analysis of the underlying data suggests that this is not indicative of any trend. Such variance is within that expected for the sampling protocol. The higher number of cases in 1993 and 1994 may be the result of sampling variations rather than changes in trends in occurrence. It does not necessarily mean that there was a significant increase in the amount of pesticides occurring in groundwater during these years.

The overall Government objectives are to ensure higher quality groundwater as a resource for drinking water and to reduce the number of sites where samples exceed the EC Drinking Water Directive.

This indicator shares obvious links with the previous indicator but also with others: quantity of active ingredients used (15), spray area treated with pesticides (16), farm incomes (6), agricultural productivity (8), adoption of alternative farming systems and organic farming (10, 11), knowledge of the Codes of Good Agricultural Practice (12), area of agricultural land under environmental conservation (31) and area of cereal field margins under environmental management (33).
The amount of pesticide applied to agricultural and horticultural crops in Great Britain is frequently used as an indicator. A number of EU countries have built specific reduction programmes around the quantity of pesticide applied or sold. But measuring the amount of pesticide used is not necessarily a good indicator of any adverse effects of pesticide use. Although the quantity used is significant, the toxicity of the individual active ingredient and the way in which it is used will also markedly influence risk.

Figures for sulphuric acid and for all other pesticides excluding sulphuric acid are shown above, giving a total of all pesticides used when added together. Sulphuric acid is used to kill potato haulms prior to harvest. Since it is applied in very high doses for each area treated, the pattern of its use tends to distort the overall picture (use of sulphuric acid on potatoes currently accounts for one-third of total pesticide usage by weight). The figures for all pesticides other than sulphuric acid show a downward trend in the tonnage of pesticide applied since the mid-1980s. This is due in particular to the introduction of new herbicides with lower application rates. There also appears to have been some levelling off of pesticide use in recent years.

No specific targets have been set for the quantities of active ingredient used but, despite the reservations mentioned in the first paragraph, the decline in overall use is welcomed by the Government.

Cross-linkages can be established between this indicator and pesticides in rivers and groundwater (13, 14), spray area treated with pesticides (16), farm incomes (6), agricultural productivity (8), adoption of alternative farming systems and organic farming (10, 11), knowledge of the Codes of Good Agricultural Practice (12), area of agricultural land under environmental conservation (31) and area of cereal field margins under environmental management (33).
Different farming practices require different amounts of pesticide (if any is needed at all), and this indicator has been chosen to reflect the average intensity of pesticide use on farmland. This indicator is calculated by multiplying the area treated by the number of sprays it receives. Thus, a tank-mix of two chemicals applied seven times in a season would be equivalent to 14 times the area sprayed. Such an indicator can provide a guide to the intensity of the treatment, although, as with other indicators, it does not measure the impact that pesticides may have.

Spray area has tended to increase over time, reflecting a gradual move towards more frequent treatments and more complex tank-mixtures. This is not an entirely negative trend since it reflects in part the use of less persistent compounds. It can also be seen against a background of lower rates of application. Future trends are difficult to predict, but they will be influenced by cropping changes which are themselves influenced by the CAP, weather patterns and the introduction of new pesticides.

No specific targets have been established for this indicator. The impact of pesticides varies according to type, amount used and frequency of use, rendering the development of an achievable target difficult.

Links can be made between pesticide spray area and the indicators on pesticides in rivers and groundwater (13, 14), quantity of active ingredient used (15), pesticide residues in food (16), farm incomes (6), agricultural productivity (8), adoption of alternative farm management systems (10), area converted to organic farming (11), knowledge of the Codes of Good Agricultural Practice (12) and population of farmland birds (35).
Input use

17. Pesticide residues in food

The Government is committed to ensuring complete food safety. To that end, it carries out a comprehensive monitoring programme of pesticide residues in foodstuffs. The Working Party on Pesticide Residues examines some 3–4,000 samples from a range of foodstuffs throughout the year, to assess whether the maximum residue levels (MRLs) set by the European Community are being exceeded.

An MRL is not a safety level but is designed to check that a pesticide is being used in accordance with its approval. The graph above shows the percentage of samples exceeding the MRL. As the regulatory regime develops and more MRLs are introduced, this percentage would perhaps be expected to rise. Despite a large increase in the number of MRLs in recent years the percentage of samples exceeding the MRL has remained fairly steady since 1991. A slight fall is evident if account is also taken of the number of MRLs. The rise in 1998 can be attributed largely to cases of excess residues in yams, since MRLs in yams are effectively zero because there is currently no import tolerance.

It is important to note that the Working Party’s surveillance encompasses both domestically produced and imported food. This provides a broad indicator of consumer exposure but is not a reliable indicator of compliance with approval conditions in the UK (and hence potential environmental impact) since some cases exceeding the MRL will arise through pesticide use overseas. An indicator might therefore be developed to reflect agricultural practice and exposures solely in connection to UK-produced food.

The fall in the percentage of samples exceeding the MRL is a positive factor in terms of sustainability. Even though pesticide spray area is increasing, the falling number of test samples exceeding the MRLs perhaps indicates that farmers are using pesticides in a more efficient and responsible manner.
It is not appropriate to set a target for this indicator, since, apart from staple foods, the types of food tested vary from year to year. Foods with and without an established MRL are tested and reflected in statistics. Relating targets to MRLs is therefore difficult.

There is some evidence of links between pesticide use and the numbers of certain farmland birds (35). There are also cross-linkages to the indicators on quantity of pesticides used (15), spray area treated with pesticides (16) and the agricultural productivity indicator (8).
There are concerns about the loss of nitrate and phosphorus from agricultural land where this leads to problems of water pollution. Agricultural losses do not always lead to problems because the concentration of nitrate in waters also depends heavily on the amount of rainfall diluting the inputs. Where concentrations are raised, drinking water sources may be polluted or the balance of freshwater, estuarine or marine ecosystems disturbed through eutrophication. As well as having environmental impacts, nutrient losses represent the loss of an economic resource to farmers. Catchments where waters are at risk of exceeding the nitrate limit of 50 mg/l set by the EC Nitrate Directive are designated as Nitrate Vulnerable Zones (NVZs).

An indirect measure of the impacts of nutrient use on freshwater quality can be achieved by modelling nitrate and phosphorus losses to water. The first graph above shows modelled nitrate losses from selected NVZ and comparable non-NVZ catchments. Although it is interesting to chronicle average nitrate losses across England and Wales only, this does not reveal the high degree of variability from catchment to catchment. Losses from catchments vary because of different farming practices, soil types and weather conditions. In addition, the time-scales over which nitrate losses have an impact on water can differ, with groundwater often taking years or decades to respond to changes in losses at the soil zone. This indicator uses data for two surface water catchments (Ouse/Leam/Cherwell NVZ and River Windrush) and two groundwater catchments (North Lincolnshire NVZ and East Cotswolds). The paired catchments have similar geology and land-use and in each case the NVZ catchment is losing less nitrate per hectare per year. Further reductions in losses in NVZ catchments might be expected as a result of farmers implementing NVZ action programmes.

Losses of phosphorus are to the field edge and only a proportion of those losses will reach a watercourse. Again, the national figure hides the high variability of losses from different catchments. The second graph compares two predominantly arable catchments (Ouse/Leam/Cherwell and North Lincolnshire NVZs) with two predominantly
Input use

18. Nitrate and phosphorus losses from agriculture to freshwater (continued)

Grassland catchments (Ribble and Lower Tamar). It shows higher losses from the arable catchments, particularly from the North Lincolnshire catchment which has more erodible soils.

The setting of targets for agricultural nutrient losses to water is complicated by the complex relationships between losses and impacts and the difficulty of differentiating between agricultural and non-agricultural targets. One possible target would be declining levels of nitrate losses once NVZ action programmes have been implemented.

Nutrient pollution is only one aspect of agriculture’s impact on the water environment. Overall nutrient management is covered directly by the indicator on manure management (20) and indirectly by adoption of alternative farm management systems (10). There are also links to area of semi-natural grassland (34) and knowledge of the Codes of Good Agricultural Practice (12).
Phosphorus and nitrogen are essential for all crops and grassland. These nutrients can be applied to the soil either as artificial fertiliser, through the spreading of manure or in the form of sewage sludge. Soil phosphorus levels have built up in many areas since 1945 as farmers have sought to increase the fertility of their land. Some areas have received a high manure loading. Excessive soil phosphorus accumulation represents an unsustainable level of phosphorus input. Raised soil phosphorus levels can cause a reduction of species diversity in otherwise biodiverse meadows, as vigorous species use the extra nutrients to out-compete slower growers. Phosphorus is the main cause of eutrophication of freshwater. Agricultural losses of phosphorus contribute to this problem. Voluntary measures are in place to encourage improved management, but reducing soil phosphorus levels can take several decades as the available phosphorus is replenished from reserves of unavailable phosphorus held in the soil. This effectively limits the potential for bringing about a reversion to previous levels over time.

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This indicator shows that while total phosphorus levels increased in both arable and grassland soils between 1979 and 1985, the amount of plant-available phosphorus declined in arable soils and remained stable in grassland soils. This could reflect increasing use of slow-release fertilisers and organic returns, which are gradually converted from unavailable to available phosphorus. Generally speaking, reduced available phosphorus levels, gradually replenished from the total phosphorus pool, represent more sustainable phosphorus management. However, unavailable phosphorus can be lost from fields with eroding soil particles or manure, becoming available in watercourses. Large total phosphorus increases still represent a cause for concern. Appropriate phosphorus management, linking phosphorus inputs to crop needs, is the most sustainable way of controlling accumulation.

Because phosphorus losses are related to soil phosphorus levels, which may be the result of several years or even decades of fertiliser addition, losses are unlikely to change dramatically in the short term. For that reason a sensible target might be to reduce the proportion of agricultural soils with high phosphorus levels (for example measured at
Input use

19. Phosphorus levels of agricultural topsoils *(continued)*

index 4 and above). Alternatively, a target reduction in eutrophication incidents could be set, which would be indirectly linked to soil phosphorus levels (among a range of contributing factors). Care would be needed not to attribute incidents falsely to losses from agriculture.

The indicator on soil phosphorus levels has ties with the indicators on adoption of alternative farm management systems (10), area converted to organic farming (11), knowledge of the Codes of Good Agricultural Practice (12), nitrate and phosphorus losses from agriculture (18) and manure management (20). There are also close links between this indicator and area of semi-natural grassland (34).
This indicator shows the proportion of livestock farmers using techniques to evaluate and/or conserve the nutrients in their manures. Poor manure management can result in increased losses of pollutants to the environment. Nitrogen in manures can be lost as nitrate, nitrous oxide (a greenhouse gas) or ammonia (a constituent of acid rain and a cause of terrestrial eutrophication). Phosphorus-rich manure particles can be washed into watercourses, and can raise soil phosphorus levels to levels where leaching of phosphorus begins.

Manure has often been falsely perceived as a waste product rather than a resource. But loss of manure nutrients also represents a financial cost to farmers. Sustainable agriculture requires that nutrients in manures and inorganic fertilisers are used in a complementary way. In this context, the number of farmers who estimate manure nutrient content and apply it according to soil/crop requirements is a key measure.

Ammonia emissions from manure can be reduced by incorporating manure into the soil soon after application and by using techniques such as injection or band-spreading. All losses can be reduced by applying manure when crops are actively growing and are able to take up the nutrients. Applications during the late autumn and early winter are the least efficient and lead to the largest losses.

Choice of nutrient management techniques will vary according to the site and to local conditions. Thus, targets are most appropriate on a specific farm or field basis. This would be outside the scope of this set of indicators. One national target that might be considered is the number of farmers sampling land and manure for nitrogen and phosphorus levels before spreading. A second might be the proportion of manure spread during the high-risk period from October until the end of January.

This indicator has links with several others, including area of agricultural land under commitment to environmental conservation (31), adoption of alternative farm management systems (10), area converted to organic farming (11), knowledge of Codes of Good Agricultural Practice (12), nitrate and phosphorus losses and levels (18, 19) as well as ammonia emissions from agriculture (21).
Around 80% of ammonia emissions in the UK derive from agriculture, mainly from manures and slurries and, to a lesser extent, from the use of inorganic fertilisers. Ammonia gas can increase both soil fertility and acidity.

Ammonia can cause two major types of environmental damage when it is deposited on land or water. First, as a source of nitrogen, it can increase soil fertility, thus disrupting the balance of some types of vegetation that exist partly because of naturally low levels of soil nitrogen. This effect is known as eutrophication and can also occur in waters that receive high nutrient levels. The second effect of ammonia is acidification. Although ammonia itself is not an acid, it contributes to acid rain along with sulphur dioxide and oxides of nitrogen because its breakdown in the soil produces acid. Excess soil acidity is damaging to certain types of vegetation, particularly sensitive upland vegetation.

Target emission levels for ammonia are currently under discussion within both the EU and the United Nations Economic Commission for Europe. Any eventual target would reflect both ammonia’s contribution to environmental damage and the cost-effectiveness and practicality of abatement measures. It does seem likely however that farmers will be required to change manure management in ways that will reduce ammonia emissions over the next 10–15 years.

This indicator has links to those on manure management (20) and on nitrate and phosphorus losses from agriculture (13). It is also linked to the habitat indicators: area of semi-natural grassland (34) and area of cereal field margins under environmental management (33), both of which are vulnerable to acidification, although the effects are localised and insignificant in comparison to the effects of artificial nitrogen application.
Agriculture is responsible for about 8% of all UK greenhouse gas emissions and in particular contributes to UK emissions of two specific greenhouse gases. About 37% of UK emissions of methane comes from agriculture (it is emitted by animals, particularly by the digestive system of ruminants, and from manure). Bacteria in soil, manure and slurry release around 52% of UK nitrous oxide emissions. Agriculture accounts for only around 1% of UK emissions of the main greenhouse gas, carbon dioxide, which is therefore not included in this indicator.

The graph shows the estimated emissions of agricultural methane and nitrous oxide between 1990 and 1997 and forecasts trends in emissions from 1998 to 2025. Emissions are expressed in terms of their global warming potential (GWP). Methane and nitrous oxide are, respectively, 21 times and 310 times more powerful than carbon dioxide. Expressing emissions in terms of GWP means that the contribution of different gases can be compared directly.

Agricultural emissions of methane and nitrous oxide are falling, largely because of reduced use of inorganic nitrogen fertilisers and falling numbers of cattle. More efficient use of inputs such as energy, fertiliser and animal feed has the potential to reduce greenhouse gas emissions from agriculture even further. These trends are expected to continue, resulting in agricultural emissions of methane and nitrous oxide at 10% below 1990 levels by 2010.
The UK is well on course to meet its target under the UN Framework Convention on Climate Change to return emissions of greenhouse gases to 1990 levels by 2000. Beyond 2000, the Kyoto Protocol, agreed in December 1997, commits the EU as a whole to reducing greenhouse gas emissions by 8% by 2008–12 compared with 1990 levels. As its contribution to this commitment, the UK has undertaken to reduce emissions from six greenhouse gases by 12.5% below 1990 levels. None of these commitments sets specific targets for individual sectors of the economy. MAFF is considering the potential contribution that energy crops could make to reductions in greenhouse gas emissions.

Greenhouse emissions can be influenced by a number of factors, and there are therefore links to agricultural productivity (8), adoption of alternative farm management systems (10), organic matter content of agricultural topsoils (26), area of agricultural land (28), manure management (20) and planting of non-food crops (30).
The energy used by agriculture currently represents less than 1% of overall UK energy consumption. In 1998, it accounted for 6.7% of total farm expenditure on inputs. Energy use in agriculture can be classified into two categories. First, there is direct use of energy (including electricity) for heating, motive power, and so on. Secondly, there is indirect input such as manufactured goods, fertilisers, pesticides and machinery. Direct use is covered here, and indirect use in the next indicator.

Direct energy consumption expressed as primary energy input is an appropriate sustainability indicator for UK agriculture since it takes into account the conversion efficiencies for higher quality fuels such as electricity. The use of direct energy by agriculture has remained relatively constant since the mid-1970s. The development of new or enhanced sustainable farming technologies such as minimum tillage should further help the sector improve its energy efficiency. On intensive pig and poultry farms, the implementation of the EU Directive on Integrated Pollution Prevention and Control (IPPC) will require increased energy efficiency. The amount of energy used by agriculture in any year will depend to some extent on factors outside the sector’s control, most notably the weather.

Direct energy use, in the form of primary energy consumed and emissions into agriculture, has changed by only 5% since mid-1978. However, the proportionate use of energy from different sources has seen significant change. The difference in use of petroleum fuel is most significant, with a 19% reduction since 1986.

Although, for both environmental and economic reasons, the objective of energy use in agriculture should be to optimise the use of energy inputs per unit of final output, establishing specific targets for energy use is problematic. For example, any increase in use might simply be the result of higher output or of changing consumer tastes that entail higher energy input at the production stage.

Cross-linkages can be drawn between this indicator and agricultural productivity (8) since energy use has stabilised while production has gone up, denoting higher energy efficiency in agricultural output. Links can also be made to the other energy indicators: trends in indirect energy inputs to UK agriculture (24) and planting of non-food crops (30).
In addition to examining direct energy inputs it is important to assess indirect energy use in the form of manufacturing goods, fertilisers, pesticides and machinery. Fertilisers represent the main component in indirect energy use within agriculture. They account for four times as much energy as any other single item.

At six times the amount of any other input, nitrogen fertiliser accounts for the greatest indirect energy input. Changes in farming practice towards more rational use of nitrogen and other fertilisers, together with integrated management of organic manures, could thus have a positive and substantial effect on the sustainability of energy use in UK agriculture.

Having been at significant levels, the percentage of indirect energy use accounted for by machines fell by a third between 1978 and 1995. This steady decline can probably be attributed to the adoption of fewer, larger, more efficient and more reliable machines on farms, as well as to reduced energy input in their manufacture. Another contributory factor is the lower frequency with which machinery is replaced. It is clear that the longer a machine is kept, the lower will be its indirect energy use per year of working life.

The energy required for animal feed production has gradually increased in tandem with changes in the number of stock in the pig and poultry sectors. Recent mergers and mill closures within the animal feed industry are likely to have affected transport elements of this commodity. On the other hand, it is possible that the unit cost per tonne of feed produced has been improved. Meanwhile, the general trend in the contribution of pesticides to energy inputs and emissions was a rapid increase from the mid-1970s to the 1980s followed by a steady decline since.
24. Trends in indirect energy inputs to agriculture (continued)

No specific targets have been established for indirect energy use in agriculture, but farmers are encouraged to follow the MAFF Water Code, which aims to prevent the excessive use of nitrogen fertiliser. Limits imposed under regulations in NVZs could lead to reduced fertiliser use and thereby to a reduced use of indirect energy.

In addition to the obvious link to the previous indicator on direct energy consumption (23), other links can be made to the indicators on agricultural productivity (8), adoption of alternative farm management systems (10), organic farming (11), knowledge of the Codes of Good Agricultural Practice (12), manure management (20) and quantity of pesticide active ingredient used (15).
Agriculture accounts nationally for less than 3% of all surface water and groundwater abstractions, although there are major regional differences (the east coast, central Midlands, East Anglia and southeast England are consistently drier than the west and north). Irrigation accounts for the most significant use of water in agriculture and the overall volume of water used for this purpose has been increasing steadily since the start of the 1980s. The increase is the result of a shift towards more water-dependent crops such as potatoes, vegetables and sugar beet. Spray irrigation is practised in the summer periods when rainfall is lowest. Other uses also place severe stress on water sources at a critical period for the environment.

Most produce is now grown under contract. Contracts generally stipulate that adequate irrigation water must be available to ensure quality and continuity of supply. This, combined with higher business risk resulting from growing higher value crops, has led to an increase in the number of irrigation reservoirs and in the amount of water stored. The volume stored (as a percentage of the 164 million m³ used in 1995 – the fourth driest year in the past 40 years) has risen substantially from 13% in 1982 to 39% in 1995.

Various forecasts have been made of future irrigation water demand and, although these are subject to considerable uncertainty due to climate change, CAP reform and market conditions, the consensus is that the level will reach 250 million m³ by 2021, an increase of 52% on 1995. In 1995, over three-quarters of crops were not supported under CAP, thus requiring UK farmers to compete with farmers in other countries at world market prices. The move towards irrigating only higher value output crops such as potatoes and vegetables makes better economic sense, as the use of irrigation water provides a higher return on investment than in the past. However, these higher value crops require greater inputs of nutrients and pesticides and this may create increased risks of pollution. On the other hand, these risks are likely to be minimised by the high level of management skills needed to grow the crops.
Farmers and growers are encouraged through such devices as MAFF Irrigation Scheduling and the MAFF Irrigation Water Assessment and Management Plan to use water more efficiently, thereby reducing water demand in areas short of supplies, particularly during periods of low rainfall.

Targets have not been established in this area, but might in future relate to the capacity of water storage on farms or to an ideal ratio between the amount of water abstracted for irrigation and water storage capacity. Any targets should probably relate only to eastern England, the main region in which crops are irrigated.

This indicator is linked with a number of others in the set. First, agricultural productivity (8), since the area of cereal and grass irrigation is reducing and that of such field crops as potatoes and vegetables, increasing. There is also a link to adoption of alternative farm management systems (10) since integrated farming practices should maximise water efficiency. Nitrate and phosphorus losses from agriculture (18) and pesticides in rivers and groundwater (13, 14) can also be affected by irrigation practice.
Soil organic matter is derived from plants (mainly crop residues in arable soils), organic manures and the microbial biomass in the soil. It also comes from root, microbial and fungal exudates and fragments, and other organic materials added to soils. Organic matter plays a key role in maintaining soil attributes such as fertility, structural stability, and water holding and buffering capacity, although the mechanisms by which it does so are not completely understood.

Soil management has a major impact on organic matter content levels and characteristics. Draining wet soils and cultivations raises mineralisation rates, lowering organic matter levels and increasing the rate of organic carbon oxidation to carbon dioxide, which is then lost to the atmosphere. Crop systems and manure handling determine the rate and quality of organic material returning to the soil. The beneficial effects of soil organic matter are derived from the young active fraction, while the older more humified material is largely inert. Mineral soils may therefore not be damaged by declining total bulk organic matter, provided the soil receives sufficient returns of fresh, active organic matter. This will not be the case for organic or peaty soils, where declining organic matter levels represents a loss of the soil itself.

Significant changes in organic matter concentrations are likely to be detectable only over long periods. Furthermore, national trends are not easy to identify as organic matter content changes at different rates in different soils, depending on soil type and management. Soil organic matter content tends to develop an equilibrium for a particular land-use and soil type.

Over the past 15 years, organic matter content levels have generally decreased by an average of 0.49% in the 904 arable or ley-arable soils resampled in the National Soil Inventory. Soils that have been under long-term arable management have generally been stable or only lose organic matter content very slowly. The largest decreases have
Resource use

26. Organic matter content of agricultural topsoils (continued)

been on grasslands ploughed up for arable use, and on cultivated peaty or organic soils. Some of the decline in organic matter may have been caused by dilution following deeper ploughing over the last 15 years.

Targets are not yet considered appropriate in relation to soil protection (except at the field or part-field scale) because of the imperfect state of knowledge of the highly diverse nature of soils and soil processes.

Nutrient concentrations are an indicator of both soil fertility and environmental risk (for example nitrate leaching, emissions of nitrous oxide and phosphorus loss) and there is therefore a link here to the indicators on nutrients (18–21 inclusive). Soil organic matter content is also influenced by adoption of alternative farm management systems (10) and organic farming (11). It will play an additional role in the indicators on emissions of methane and nitrous oxide (22) and accumulation of heavy metals in agricultural topsoils (27).
Heavy metals such as copper, zinc and molybdenum are essential trace elements for plants and animals. However, high soil concentrations of metals such as copper and zinc can damage soil fertility. Additionally, cadmium and lead can have adverse effects on human and animal health if they are allowed to accumulate in the food chain. The occurrence of high concentrations of heavy metals in agricultural soils is very localised. Metals in the soil originate from the parent material (underlying geology), mine wastes, atmospheric deposition from a range of sources, animal manures, sewage sludge and other wastes and agricultural chemicals.

The residence time of most heavy metals is very long. They tend to be immobilised in the soil and are often unavailable for uptake. Some can be removed through plant uptake and, to a lesser extent, leaching.

Data collected by the Soil Survey and Land Research Centre from the 904 arable and ley-arable sites resampled in the National Soil Inventory suggest that levels of heavy metals in topsoil have changed over the past 15 years. Due to the heterogeneous nature of soils and spatially variable metal sources, broad national trends are difficult to identify. However, the following changes were observed:

- Total topsoil zinc has decreased, possibly by dilution following deeper ploughing.
- Copper has increased on some light soils, and decreased elsewhere.
- Cobalt, cadmium and nickel have remained broadly stable.
- Chromium concentrations have only shown a significant change in organic soils, where they have risen. This may be due to carbon mineralisation causing concentrations to rise in the remaining soil, or to ploughing up chromium-rich subsoil.

No specific targets have been established because of the imperfect state of knowledge of the highly diverse nature of soils and soil processes and therefore of metal availability to plants and animals.

A link can be made between this indicator and organic matter content in agricultural topsoils (26).
A total of 76% of UK land is dedicated to agriculture. Changes in agricultural land-use can therefore have a significant impact on landscapes, habitats and biodiversity, as well as the general perception of the countryside. This indicator describes the changes in agricultural land-use and shows how agricultural land is used. Its value lies in helping to explain shifts in other indicators.

During the last 30 years, there have been no major changes in the respective shares of grassland, arable and rough grazing areas in overall agricultural land-use, despite changes in types of crops and in farming intensity. Changes in payments as a result of CAP reform could affect these shares, although the total area of agricultural land is not expected to change significantly. In addition, losses of agricultural land have tended to be balanced by land reclamation, for example by land restored to agriculture from landfill or mineral extraction use.

The area of agricultural land does not reflect the average size of the individual holdings. In this regard, the long-term trend in most agriculture sectors is towards larger enterprises, although the comparison for crop-growing enterprises will be affected by changes in the set-aside rate between 1993 and 1998. Some of the largest shifts in crop practice in recent years have been from barley to non set-aside oilseed rape and linseed. The area of barley growing decreased by 8% in 1998, reversing the 7% increase reported in 1997. Over the past two years, the total area of linseed and winter oilseed rape have increased by 104% and 42% respectively.

This indicator cannot give any direct guidance as to whether sustainable agriculture is being achieved. A target is therefore not appropriate. Instead, it is necessary to assess changes in how the land is managed, the level of intensification and production, and impacts on the environmental and aesthetic quality of the land.

This indicator has links to the indicator on change in land use from agriculture to hard development (29). There is also a link to the indicators accompanying the DETR’s Sustainable Development Strategy which includes indicators for a range of land-use measures, including land covered by urban development, household numbers, reuse of urban land and stock and reclamation of derelict land.
Agricultural land can be regarded as a basic resource that is valuable and finite and should therefore be monitored over time.

Ordnance Survey map revisions are used to collect the data for this indicator. This can give rise to anomalies in the year and rate of any loss of agricultural land to urban use. To eliminate these anomalies, a five-year moving average has been used, which, while it restricts the amount of data that can be given at present, paints a more accurate picture of the current trend. The graph shows a recent fall in the loss of agricultural land to urban use. This is expected to start levelling out.

The area of agricultural land needed to support agriculture will depend upon uncertain future circumstances, for example increases in biological yields, and it is therefore difficult to set targets. However, it is important to note that any irreversible change from agricultural use to hard development may limit the options for future responses to change in demand for food, fibre and other crops including timber.

This indicator has various links to other indicators in the set: farm incomes (6), agricultural productivity (8) and area of agricultural land in the UK (28). With increased yields produced in the land that is left, there are also links to the nutrient indicators (18–21 inclusive) and pesticide indicators (13–17 inclusive).
Interest within industry in using renewable raw materials from crops is increasing. Oils, starches and speciality chemicals can be produced from crops. Fibre crops are also grown to produce fibre for industrial uses. These crops are important to sustainable development since they provide new commercial opportunities for farmers and help support the rural economy.

MAFF seeks to encourage the development of crops for industry which have the prospect of becoming commercially viable. The Ministry also encourages farmers to take the opportunities offered by the availability of set-aside payments on land used to grow non-food crops, provided that there is a market outlet for them.

Energy crops have the potential to make a significant contribution to reductions in emissions of carbon dioxide, one of the greenhouse gases that drive climate change, and to the achievement of renewable energy targets. Short-rotation coppice is the crop best suited to UK conditions but there is increasing interest in developing miscanthus (elephant grass) for energy production. Plantings have, to date, been primarily for trials and research and development. The first wood-fired power station in the UK (Project Arbre) is now under construction in Yorkshire and commercial scale plantings are about to begin. The Government is working towards a 10% target for the generation of electricity from renewable sources and such a target would require a significant contribution from energy crops, estimated at around 125,000 hectares. Renewable energy projects and energy crops aid sustainable development through the provision of habitats which support biodiversity. In addition, farmer incomes may benefit and rural jobs be created.

The extent of non-food crops production is largely dictated by the market and it is therefore difficult for the Government to set targets. The Government does support the long-term development of renewable raw materials for industry and energy.

The planting of non-food crops has relevance to the indicators on farm incomes (6) and agricultural productivity (8).
The conservation value of agricultural land is a key sustainability factor since agriculture occupies 76% of the UK’s surface area. Agriculture has a major influence on the appearance of the countryside and has created a legacy of countryside features and wildlife habitats. Agricultural land also acts as a repository of much of the countryside’s archaeological heritage. But agricultural activities can damage this conservation value as well as create, maintain and enhance it.

This indicator reflects the number of farmers participating in schemes designed to conserve the countryside and the environmental heritage for which they are often the sole managers and the degree of that participation. A total of 10% of English agricultural land (1.1 million hectares) now lies within designated Environmentally Sensitive Areas (ESAs) of which approximately 60% is entered into actual ESA agreements. In total, 8,600 farmers in England are currently members of the Countryside Stewardship Scheme (CSS).

These agri-environment schemes seek to conserve and enhance important landscapes and habitats as well as key features such as stone walls and hedges. They offer payments at various levels to compensate the farmer for the costs of participation and to provide an incentive for participation. The indicator shows the area of agricultural land covered by management agreements under the two major farmland schemes operated by MAFF in England (ESA and CSS) as well as approved land under the Farm Woodland Premium Scheme (and its predecessor the Farm Woodland Scheme) and the Habitat Scheme. Substantial increases evident in the graph above for 1992–93 correspond with the launch of Stage III ESAs.

In May 1999, revised detailed uptake indicators and targets were published for consultation for the 16 Stage I–III ESAs in England. The Government wishes to see a continuing increase in the commitment to environmental conservation by farmers, as this plays an important part in the move towards a more sustainable agriculture sector. Greater commitment should contribute to the achievement of the targets set in the UK Biodiversity Action Plan.

This indicator has a number of links with others in this set, in particular to characteristic features of farmland (32), area of cereal field margins under environmental management (33), areas of semi-natural grassland (34) and populations of key farmland birds (35).
Hedges, walls and ponds can be attractive countryside landscape features, sometimes of historical importance. They provide a valuable habitat for wildlife. Ponds, for example, collectively support at least two-thirds of Britain’s freshwater plants and animal species. Hedges and walls, as well as being of benefit to animals and plants, may act as barriers against soil erosion.

As farming has become more intensive, hedgerows have been removed in some areas in order to facilitate the efficient use of machinery. Indeed all of these landscape features have declined in number because of the cost of management and their reduced usefulness in modern agriculture. In June 1997, Government regulations came into force to protect important hedgerows in England and Wales.

Between 1984 and 1993, the length of managed hedgerows in England and Wales decreased by nearly a third. In the latter part of that period, the decline slowed with the rate of new planting of hedgerows exceeding the rate of outright removal between 1990 and 1993. An increasing number of hedges became relict. The main cause of decline in field boundaries is lack of appropriate management. Overall numbers of lowland ponds have declined slightly but losses are largely compensated for by new ponds.

Agricultural policy in the UK has shifted from encouragement of boundary removal to support for restoration planting. The Countryside Stewardship Scheme and Environmentally Sensitive Areas Scheme both include payments for the protection, restoration and enhancement of landscape features.

The UK Biodiversity Action Plan has set targets to maintain the length and condition of ancient and species-rich hedgerows and the number of hedgerow trees.

In order to place this indicator in true perspective, it should be seen together with the indicators on change in land use from agriculture to hard development (29), area of agricultural land under commitment to environmental conservation (31) and populations of key farmland birds (35).
Cereals account for 51% of the total area of arable land in Great Britain. Cereal field margins can be managed in ways that will benefit wildlife, without adversely affecting yields on the remaining cropped area.

Field margins can provide and enhance wildlife habitats across arable farms without altering the cropping pattern. This indicator therefore illustrates an environmental benefit of sustainable agriculture. Margins can provide nesting and feeding sites for game birds, while many invertebrate species, for example butterflies and grasshoppers, are associated with such sites. Rare arable flowers are especially dependent on cereal field margins.

MAFF is the lead partner for Cereal Field Margin Habitat Action Plan. Under the terms of this Plan, this indicator relates to grass margins, conservation headlands, uncropped margins, stubble and crops grown as food and cover for wildlife.

The UK Biodiversity Action Plan has set targets for the maintenance, improvement and restoration of 15,000 hectares of cereal field margins by 2010. This is broken down into 12,725 hectares in England, 2,025 hectares in Scotland and 250 hectares in Wales.

This indicator is related to adoption of alternative farm management systems (10), manure management (15), area under environmental management (31), area of semi-natural grassland (34) and population of farmland birds (35).
Semi-natural grasslands in Britain provide both an important resource for agriculture and an important habitat for wildlife. The value of such grasslands for wildlife largely depends upon the way in which they are managed. On the one hand, too intensive management through fertiliser and herbicide applications, overgrazing, early cutting or drainage improvements will lead to a decline in habitat quality and eventual habitat loss. But on the other hand, lack of management can lead to scrub or bracken invasion and loss of specialist grassland species.

It is estimated that as much as 97% of semi-natural lowland meadows has been lost since the 1930s in England and Wales. Between 1984 and 1990, the area of moorland grass in Great Britain fell by about 4%. The area of other semi-natural grasslands was, however, largely unchanged according to the Countryside Survey in 1990. Losses of moorland grass were mostly attributed to afforestation. Between 1978 and 1990, the species diversity of unimproved grassland decreased by 13% in Great Britain as a whole. The decline in species diversity in moorland grass was not statistically significant.

The UK Biodiversity Action Plan has set targets for the maintenance and restoration of priority grassland habitats. Specific targets include:

- to arrest the depletion of unimproved lowland meadow (and restore 500 hectares by 2010) and unimproved upland hay meadow (and restore 500 hectares by 2010);
Conservation value of agricultural land

34. Area of semi-natural grassland (continued)

- to arrest the depletion of unimproved lowland acid grassland (and re-establish 500 hectares by 2010) and unimproved lowland calcareous grassland (and re-establish 1000 hectares by 2010); and

- to secure sympathetic management of at least 13,500 hectares of purple moor-grass/rush pasture by 2000 and initiate re-creation of 500 hectares by 2005.

The responsibility for achieving these aims is shared among a number of partner organisations, but MAFF’s agri-environment schemes will contribute to the restoration of these habitats in England.

This indicator has links to the following: area of agricultural land (28), area of agricultural land under commitment to environmental conservation (31) and populations of key farmland birds (35).
Many bird species are closely associated to or dependent on agricultural land. The graph above relates to some of the breeding birds in the UK that may be affected by agricultural activity. For some priority species, Biodiversity Action Plans have been published. These include the grey partridge, skylark, tree sparrow, linnet and corn bunting. Other species that are closely associated with agricultural land but which are not subjects of Biodiversity Action Plans also feature in the indicator.

There has been widespread loss of habitat diversity in the landscape as individual farms have become specialised in either livestock or arable farming. Pasture (a good source of invertebrate food) has been lost from the arable east and cereals from the pastoral west. Most unimproved grassland has been lost since the 1930s, thus reducing the variety and numbers of birds, especially in the west. Most cereal crops are now planted in the autumn, not the spring. As a result there are substantially fewer stubble fields, which are a good source of food over the winter. Both hedgerow removal and the loss of other uncropped habitats have also reduced nesting and feeding opportunities for some species.

Pesticide use is one of a number of factors implicated in the decline of farmland birds. Concern has focused on whether pesticides, by removing insect pest and weed species and thus reducing food sources, may have an indirect effect on some bird populations. MAFF has commissioned a five-year research project, involving collaboration with various conservation bodies, specifically to investigate the role of pesticides and other factors in the decline of farmland bird species.

The decline in farmland birds shown above is causing concern. The most marked recent falls occurred in the late 1970s and early 1980s and have been linked to the declines in farmland habitat quality as a result of intensification of agricultural practices. It should be noted, however, that some generalist farmland birds and certain specialist species that benefit from intensive farming are doing well (for example, stock dove and jackdaw). Some rare
farmland species not included in the indicator, such as the corncrake, stone curlew and cirl bunting, are responding well to conservation efforts.

A headline indicator based on the populations of certain species including these farmland birds features in the UK Sustainable Development Strategy. The objective is to reverse the long-term decline of these populations. Specific targets for individual farmland species have also been set up, as mentioned above, in the Biodiversity Action Plan.

This bird indicator has close links to farming practices and in particular agricultural productivity (8), adoption of alternative farm management systems (10), area converted to organic farming (11), spray area treated with pesticides (16), area of agricultural land (28), area under environmental conservation (31), characteristic features of farmland (32), area of cereal field margins under environmental management (33) and area of semi-natural grassland (34).
## Appendix I

**The DSR model:** a matrix of MAFF indicators categorised into the state, driving force and response model.

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Driving force</th>
<th>State</th>
<th>Response</th>
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</thead>
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<td>1 Agricultural assets and liabilities</td>
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<tr>
<td>2 Age of farmers</td>
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<tr>
<td>3 Percentage of tenanted land</td>
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<td>4 EU Producer Support Estimate (PSE)</td>
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<tr>
<td>5 Payments to farmers for agri-environment purposes</td>
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<td>6 Total income from farming</td>
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<td>7 Average earnings of agricultural workers</td>
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<td>8 Agricultural productivity</td>
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<td>9 Agricultural employment</td>
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<td>10 Adoption of alternative farm management systems</td>
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<td>11 Area converted to organic farming</td>
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<td>12 Knowledge of Codes of Good Agricultural Practice</td>
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<td>13 Pesticides in rivers</td>
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<td>14 Pesticides in groundwater</td>
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<td>15 Quantity of pesticide active ingredients used</td>
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<td>19 Phosphorus levels of agricultural topsoils</td>
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<td>20 Manure management</td>
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<td>21 Ammonia emissions from agriculture</td>
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<td>25 Use of water for irrigation</td>
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<td>28 Area of agricultural land</td>
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<td>29 Change in land use from agriculture to hard development</td>
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<td>30 Planting of non-food crops</td>
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<td>31 Area of agricultural land under commitment to environmental conservation</td>
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<td>33 Area of cereal field margins under environmental management</td>
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<td>34 Area of semi-natural grassland</td>
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<tr>
<td>35 Populations of key farmland birds</td>
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●: Primary type of indicator ○: Secondary type of indicator
Appendix II:  

Background information and further development

A. Agriculture within the rural economy and society

Economic indicators, in common with many other indicators, suffer from the problem that they do not measure the achievement of objectives precisely and unambiguously. With any set target, there is the danger that its achievement becomes the most important objective while the real policy objective becomes overlooked. Normally, indicators should provide optimum levels rather than absolute low or high levels. This optimum is difficult to define and will frequently depend upon the values taken by other target variables so that optimal values may be determined simultaneously rather than independently.

1. Agricultural assets and liabilities

Valuations of land, buildings and breeding livestock are at average market prices. Machinery and vehicle valuations are calculated as replacement cost, net of depreciation. Land and building valuations include both owner-occupied and tenanted land. Financial estimates of liabilities are derived in part from the Farm Business Survey.

2. Age of farmers

The Structure Survey is a sample survey. Measures of employment are for the spring quarter only. The holder of the holding is that person (natural or legal) in whose name the holding is operated. The holder can own the holding outright or rent it, be a hereditary long-term leaseholder, usufructuary or trustee. A person working on more than one holding will be represented more than once within the figures. For the years 1987–95 inclusive, the data have been rounded up or down to the nearest 10. Totals may not necessarily agree with the sum of their components due to rounding.

3. Percentage of holdings that are tenanted

Most land in Northern Ireland is owner-occupied but 29% of land is currently let out under the ‘conacre’ system of nominal tenures for 11 months or 364 days. In practice, some tenures can be extended beyond this. Data for each year exclude minor holdings, the definition of which has varied in the past. The current definition for England and Wales stipulates that the total area of a minor holding must be less than six hectares, and that there must be no regular full-time farmer or worker. The annual labour requirement on the holding must be less than 100 days and the glasshouse area less than 100 m². Finally, the occupier is not able to farm another building. In Scotland, a holding is currently classed as minor if the total area of agricultural land is less than or equal to one hectare or if the net value of crops and livestock is less than 1/3 European Size Units. It follows that year-on-year data are not strictly comparable but trends remain broadly unchanged.

4. EU Producer Support Estimate

The levels of PSE shown are in respect of 13 major commodities, accounting for around 65% of the total value of EU agricultural production. The estimates are net of excess feed costs to livestock sectors arising from cereals support.

Total PSE represents the total value of transfers to producers (from consumers and taxpayers) arising from agricultural policies in a given year. The term percentage PSE represents the total value of transfers to producers expressed as a proportion of the total value of production (valued at domestic producer prices).

The PSE is calculated regularly by the OECD for the 15 members of the EU and for a range of other developed countries. The level of PSE is affected by the level of support provided in any given country, as well as by the estimate of the price of agricultural commodities on the world market. Interpretation of changes in the level of PSE needs to take account of movements in world market prices as well as in domestic subsidies.

One way of expanding this indicator in future could be to look at the specific payments to UK farmers (from the EU budget) rather than the EU as a whole.

5. Payments to farmers for agri-environment purposes

CAP Guarantee expenditure on environmental programmes comprises the following schemes: Countryside Stewardship Scheme; Environmentally Sensitive Area Scheme; Tir Cymen; Countryside Access Scheme; Nitrate Sensitive Areas; Habitat Scheme; Moorland Scheme; Countryside Premium; Organic Farming Scheme; Farm Woodland Grant Scheme; and Farm Woodland Premium Scheme.
Areas qualifying for Objective 5b funds administered by MAFF (European Agricultural Guidance and Guarantee Fund) are the South West, Lincolnshire, Midland Uplands, East Anglia, Northern Uplands and the Marches.

Payments to Objective 5b areas for purposes other than agriculture are also made by DETR (European Regional Development Fund) and Department for Education and Employment (European Social Fund).

6. Total income from farming

Total income from farming is calculated by deducting interest payments, net rent and the cost of hired labour from net product. Changes arising from new methodologies have caused revision to previous years’ figures. Despite this, the trends remain broadly unchanged.

One of the principal objectives of sustainable development, as noted in DETR’s UK Sustainable Development Strategy, is to promote a healthy economy so as to generate the resources to meet people’s needs and improve environmental quality. This suggests that measures of gross domestic product (GDP) might form the basis for an economic indicator. While it is possible to do this for the UK as a whole, it is prohibitively difficult to measure this specifically for rural areas.

7. Average earnings of agricultural workers

Average earnings for agricultural workers include payment in kind for houses, board and lodging and milk, which are valued at rates set down by the Agricultural Wages Board. Pay for statutory holidays and employers’ council tax contributions from 1993 are also included. From 1982 to 1990 figures are based on earnings and hours during a given week in October.

Average earnings and hours for manual manufacturing workers include bonuses and overtime etc. before deduction of tax and National Insurance contributions. From 1982 onwards, workers on short-time were excluded. A new industrial classification scheme has been used since 1991, and figures are as given in April.

8. Agricultural productivity

The total numbers of full-time person equivalents engaged in agriculture is estimated for this series from the total number of full-time, part-time and casual workers, salaried managers, farmers and partners and directors (and their spouses) returned in the annual June Census, weighted by their estimated average annual hours worked. Cattle destroyed and calves removed from the food chain are not treated as production.

9. Agricultural employment

This indicator could be developed into a regional indicator, where high levels of unemployment in an area would suggest that labour should flow out of the area. Agricultural employment (as a proportion of the working population) in rural areas might provide an indication of the pressure for outward migration. A falling employment figure would normally equate with such pressure. It is also possible that, in particular areas, a high unemployment figure indicates a shift in the demographic profile and that the departing working population is being replaced by the retired. As previously, the definition of rural area makes it difficult to obtain a precise indicator.

B. Farm management systems

10. Adoption of alternative farm management systems

In 1998, LEAF had over 1200 individual, 130 corporate and 30 college members. LEAF farmers are encouraged to complete a self-assessed audit of their farming management practices, the aim being to encourage environmentally responsible farming in tandem with the running of a profitable business. Approximately 258,000 hectares of land are currently assessed under the LEAF audit.

Additional data on other farm management schemes will be collected through the forthcoming Farm Practice Survey in order to widen this indicator. Any shift of emphasis would be towards schemes that have an environmental content. Suggested schemes might be either internationally recognised standards, for example ISO 14001 (LEAF support the development of ISO and EMAS standards) or product-based quality assured schemes (for example FABPig).
Appendix II:

Background information and further development (continued)

11. Area converted to organic farming systems

Interest in organic farming has increased dramatically as farmers consider how best to adapt their systems to meet future demands and constraints. Conversion to organic farming might be developed into an indicator of the interest in and the effect of a particular type of low input farming. But this work will best be undertaken after the planned evaluation of aid for conversion to organic farming has been completed.

12. Knowledge of Codes of Good Agricultural Practice

The revised Codes (launched in October 1998) have been updated to take account of the legislative and technological changes that have occurred since they were first published. All three Codes have separate sections dealing with legislation.

Taylor Nelson conducted 1,155 telephone interviews with farmers in England and Wales to determine awareness and ownership of the Codes. As a follow-on, 264 on-farm interviews were held, 145 with farmers who owned one or more of the Codes and 119 with non-owners. Taylor Nelson also conducted 377 extended telephone interviews with farmers who did not comply with Taylor Nelson’s ‘performing good practice’ criteria and who did not own a Code.

It is hoped that the forthcoming Farm Practice Survey will provide accurate data on ownership and awareness of the Codes in future.

C. Input use

13–14. Pesticides in rivers and groundwater

These indicators are based on the number of sites where at least one sample exceeded the EC Drinking Water Directive limit of 0.1 µg/l.

Concentrations of pesticides in the aquatic environment are generally very low and may fall below the detection limit of current analytical techniques. Where they have been detected, they are normally well within the Environmental Quality Standards (EQSs) introduced under the EC Dangerous Substances Directive. It is thus difficult to illustrate any changes over time in terms of EQS standards. For this reason the indicator has been developed on the basis of the limit of 0.1µg/l in the EC Drinking Water Directive and in the Directive covering EC authorisation of agricultural pesticides. The proportion of samples containing key pesticides above this level is presented to illustrate both the relative frequencies at which pesticides are found and also any changes in levels over the last three years.

In general, smaller quantities of pesticide are found in groundwater than in rivers. Research is currently being conducted into better measures of pesticide risk to the aquatic environment.

15. Quantity of pesticide active ingredients used

Although the quantity of pesticide used is not necessarily a reliable indicator of the adverse impact of pesticide use, it does provide a useful overview of the general trend in pesticide usage by farmers and growers.

16. Spray area treated with pesticides

The area treated with pesticides can be presented in a number of ways. The method chosen here is the most useful. But while such an indicator can provide a guide to the intensity of the treatment it does not reflect the impact that pesticides may have.

17. Pesticide residues in food

In total, 3–4,000 samples are examined each year for a wide range of pesticides generating around 80,000 individual test results.
18. Nitrate and phosphorus losses from agriculture

The indicator is based on the results of ongoing work to model nitrogen and phosphorus losses at catchment and national level. Catchments are selected to provide a range of land-use and hydrological situations, and compared with non-NVZ catchments with similar land-uses. The model uses land-use data from the 1995 MAFF census. Additional variability is avoided by using 30-year average rainfall data and not individual yearly figures.

The second graph shows data on phosphorus losses on a national scale and within the same NVZs used in the first graph. The mainly arable NVZ catchments are compared with geologically similar catchments predominantly under grassland. The same rainfall data were used.

In the future, it may be possible to use more regular land-use data and annual rainfall figures over a longer time span to get an idea of annual trends in nitrate and phosphorus losses. A major question is the extent to which the model will be sensitive enough to pick up changes in nutrient use year on year, as a result of land-use change rather than rainfall variability. It may be necessary to choose between examining longer term national trends, and distinguishing between losses to surface water (where the environmental effect is fairly direct), losses to groundwater (where effects are normally delayed, gradual and cumulative) and different land-use types in a single ‘average’ year.

Catchments where waters are at risk of exceeding the limit of 50 mg/l set by the EC Nitrate Directive are being specifically tackled by the designation of NVZs. The modelled data will ultimately require validating.

19. Phosphorus levels of agricultural topsoils

The data on soil phosphorus levels were derived from analysis of the soils sampled in the National Soils Inventory (1980) and a resampling exercise of selected National Soils Inventory sites in 1994–95.

This indicator would seem to be less robust and useful in the short term than the indicator on nitrate losses. In comparison with the latter, there is still a good deal of uncertainty over the relative importance of the different phosphorus loss pathways (soil erosion, drain-flow, leaching and manure run-off) and over the contribution of grassland versus arable land in terms of catchment and national losses. It is also difficult to separate agriculture’s independent contribution from that of other sources. Further research has been commissioned in these areas by MAFF and the Environment Agency.

20. Manure management

The indicator focuses on key manure management practices which minimise nutrient losses to the environment through leaching, run-off or volatilisation, and which enable maximum crop uptake. Earlier stages in the livestock manure cycle are excluded, such as animal diet and housing.

This indicator is derived from data collected in the 1997 Animal Manure Practice Survey. More information, including fertiliser management data, will be collected in the future under the Farm Practice Survey, and the indicator will then be developed to cover nutrients from inorganic fertilisers as well as manures.

21. Ammonia emissions from agriculture

The inventory of agricultural emissions of ammonia has been compiled from measured emissions from different livestock manures and manure handling systems and fertilised crops and grassland combined with national statistics on animal numbers, manure handling and fertiliser use.

The inventory was improved during 1997 as research and development provided better information on, amongst other things, manure handling in Scotland and Northern Ireland.

The EU Directive on Integrated Pollution Prevention and Control (IPPC) which will come into effect this year requires businesses to take measures to reduce ammonia emissions. It applies to pig and poultry units if they have 2000 production pig places, 750 sow places or 40,000 poultry places. The Directive covers new or substantially changed businesses. This Directive will naturally require monitoring and as a result it may become possible in time to compare emissions from those businesses which are covered by the Directive with those from businesses which are not.
In the longer term it may also be possible to develop an indicator to show the extent to which agricultural emissions of ammonia damage sensitive habitats in the UK (and abroad).

22. Emissions of methane and nitrous oxide from agriculture

The indicator is based on data from spreadsheet models. The models follow internationally agreed guidelines produced by the Intergovernmental Panel on Climate Change. Modelling is inevitable because of the large number of diffuse agricultural sources, and because atmospheric monitoring cannot easily distinguish between agricultural emissions and those from other sources.

The models are currently based on emission factors for the various livestock types and agricultural activities combined with national activity statistics on, for example, animal numbers and fertiliser use. Work continues to obtain a more detailed understanding of the impact of different livestock feeding and farm management practices. Inventories are being improved continuously as a result of better calculation methods and ongoing research and development. A nitrous oxide inventory to model agricultural emissions across the country and throughout the year should be available from March this year.

The main greenhouse gas, carbon dioxide, is excluded from the indicator. This is because agriculture itself is more or less neutral with respect to carbon dioxide emissions: the carbon dioxide absorbed by growing crops is subsequently emitted once the crops are eaten and the residues decompose. Soil organic matter is a major sink for carbon, and agricultural activities can influence the sequestration or release of carbon dioxide from it. However, an indicator showing these changes would not be very useful given the time-scales over which the changes take place and their relative magnitude compared to national emissions of carbon dioxide. Emissions from fuel used by agricultural machinery etc. approximate to a mere 1% of total UK carbon dioxide emissions.

Land-use change (for which agriculture is a major driver) accounts for about 5% of UK carbon dioxide emissions. It is excluded on the grounds that it is uncertain and complex and that other factors (e.g. urbanisation) also contribute. Moreover, land-use change reflects policy and agricultural decisions made many years ago.

Additional indicators might be considered in relation to the impacts of climate change on agriculture. These could include, for example, an indicator on the increased area of warmth-loving crops such as maize, vines and sunflowers (although it would be necessary to isolate the impacts of climate change from the development of new plant varieties adapted to UK conditions).

23. Direct energy consumption by farms

All energy has been calculated as the primary fossil fuel consumed in its conversion and delivery to industry and agriculture.

Direct energy consumption on farms has been calculated from energy supplied to user groups as reported in the annual Digest of Energy Statistics. The energy inputs are achieved through conversion from primary fuels. The high ratio of primary energy supply for electricity consumption is dominant. Energy inputs to UK agriculture have been calculated from 1978 to 1997. One petajoule (pJ) = 10^{15} joules.

The primary energy inputs to the UK economy (according to the annual Digest of UK Energy Statistics) are coal, crude oil and natural gas. These primary fuels are then processed into secondary fuels and either used directly as fuel for agricultural production (e.g. diesel) or indirectly by industries supplying products to UK agriculture. Natural gas is the only significant primary fuel used in UK agriculture (horticulture).

The simplest method of calculating energy inputs into UK Agriculture would be to ascertain the energy content (or net calorific value) of the fuels consumed. However, in both environmental and energy terms there is a cost attached to converting (or refining) primary energy to secondary energy. Consequently, a knowledge of the production ratios between primary and secondary fuels is important for a true assessment of the environmental impacts of all primary sources of energy input to UK agriculture. An example of this would be petroleum fuels (diesel fuel, gas oil, LPG), where the ratio is recognised as 1:1.2. In simple terms, this means that producing a single energy unit of petroleum fuel takes 1.2 units of primary energy.

Petroleum fuel contrasts markedly with electricity, where the recognised ratio of 1:3.8 has been taken for all estimates in this paper. Efficiency improvements in electricity generation and changes in the proportion of different fuels used in electricity generation have resulted in changes in this ratio. Reductions in the ratio will lead to reduced primary energy use and emissions attributable to agriculture.
24. Trends in indirect energy inputs to agriculture

Indirect energy supply in the form of processed inputs into UK agriculture has been calculated from published data on energy for manufacture and the volumes of commodities supplied to agriculture. This is given in the form of primary energy consumed, since the energy source make-up of individual processes is not defined. Information on volumes of commodities can be obtained from the following sources:

- **Fertilisers:** British survey of fertiliser practice: MAFF, Scottish Office, Fertiliser Manufacturers Association
- **Animal feedstuffs:** United Kingdom Agricultural Supply Trade Association (UKASTA)
- **Tractor registrations:** Agricultural Engineers Association
- **Pesticides:** British Agrochemicals Association

Indirect energy consumption trends through purchases of commodities are directly connected to changes in the management and enterprise balance of UK agriculture. The quantities of primary energy accountable for the indirect energy supplied to agriculture has fallen back by 12% from a peak of 179.3 pJ in 1985.

The dominance of nitrogen fertiliser as a source of indirect energy greatly influences the trends. Use of nitrogen fertiliser has declined from peak usage in 1985–90. Energy inputs and percentage share of the indirect energy total for 1997 were:

Over the same period, the second largest energy use commodity, that of purchased stock feedstuffs, increased by 20%. This was influenced by agricultural production in the livestock sector. Increase in production of non-ruminant meat products at the expense of beef and milk is shown below.

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<td>853</td>
<td>791</td>
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<td>896</td>
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<td>15549</td>
<td>14096</td>
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<td>14400</td>
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</tbody>
</table>

Source: MAFF
Coverage: UK
Appendix II:

Background information and further development (continued)

The relative magnitude of direct and indirect energy trends is shown below.

![Energy Trends Graph]

Source: ADAS, Reports prepared for MAFF: Indicators for Sustainable Agriculture; Energy Indicators within UK Agriculture
Coverage: UK

Biomass energy production was also considered. The quantities of energy derived from agricultural products are equivalent to 2.2% of the indirect energy consumed and this is set to rise to 4.5% with the recently completed 38 megawatt Thetford power station fuelled by poultry litter.

D. Resource use

25. Use of water for irrigation

Agriculture obtains water either from mains supply, from licensed abstraction, from surface to groundwater sources or from rainfall. There are no nationally reported statistics on the quantity of mains water used in agriculture, although some figures are available through water company customer information databases. The Environment Agency, through the abstractions licensing system, collates information on water taken from surface and ground water sources. There is a wide range of uses of water on the farm from stock-watering, washing down yards, cleaning equipment, dilution of chemical sprays as well as irrigation of crops.

Most abstractions from inland and tidal waters in England and Wales must be licensed. Abstractions from surface waters of less than 20 m³ for domestic and agricultural purposes (excluding spray irrigation) are, however, exempt from regulation. DETR collects data from the Environment Agency and water companies that are published annually in its Digest of Environmental Statistics. However, the reliability of the data from the early years (pre-1991) is open to question. Spray irrigation is the only type of irrigation currently regulated and, for licensing purposes, is not classed as agricultural use but is collated separately. Data on spray irrigation going back to 1970 are presented.

The OECD has calculated that in the UK annual freshwater availability is 76 billion m³ of which 12 billion m³ are used for all purposes. Agriculture’s share is very small.

MAFF has carried out 16 irrigation surveys since 1955 and these provide a good quality data set with information on the volume of water used, the types of crops it is used on and other items such as equipment, reservoirs and sources of water. These data also include water used for trickle irrigation, which has gained popularity in recent years and is not recorded by the Environment Agency licensing system. The surveys also show the total capacity of reservoirs, lined and unlined, and of other forms of storage such as tanks from 1974 onwards (with the exception of 1977 when the data set was considered flawed and not published).
It is, however, acknowledged that this does not show the effect of irrigation on different crops, or regional variations. An additional indicator might be included on irrigation practice. This could show adoption of good practice in respect of the equipment used and timing of applications. It could later be split into the different types of irrigation. It might also reflect regional differences in irrigation. The indicator could be flanked by an indicator on total water use in the agriculture sector or even, in the long term, an indicator on water efficiency in agriculture. MAFF surveys provide information on the type of equipment used on farms but this is related neither to volume of water, nor area on which water is used and cannot therefore provide an overview.

26. **Organic matter content of agricultural topsoils**

Changes in the organic matter level, expressed here as organic carbon percentage of non-humose mineral arable and short-term grassland topsoils, have been assessed. A total of 900 National Soil Inventory sites, located on arable or ley-arable land were resampled in 1994–96 and the organic matter contents compared with the original samples from 1978–81. The resampling is being extended to another 782 permanent grassland sites and will be reported in further indicators.

In order to develop the indicator further, MAFF has commissioned a three-year project which started in April 1997 to establish whether there are thresholds of organic matter below which soils are at risk of irreversible damage.

27. **Accumulation of heavy metals in agricultural topsoils**

Different metals have different source profiles. Recent monitoring results by the University of Reading indicate that for zinc, copper and nickel, 25–40% of total inputs to agricultural land are from animal manures, 33–45% from atmospheric deposition and under 15% from sewage sludge. For lead, 71% is from atmospheric deposition and 8% from animal manures. For cadmium, 50% of inputs are from atmospheric deposition and 34% from fertilisers and lime, with 11% from animal manures. Chromium is mainly derived from industrial by-product wastes (37%), with sewage sludge, fertilisers and atmospheric deposition all contributing around 20%. Atmospheric deposition is the dominant source for arsenic (>50%) and mercury (>90%).

In future, the indicator could include estimates of areas subject to particular levels of metal loading. This will provide a better appreciation of pressures on the soil resource, particularly on a local or regional basis, than the periodic representative soil sampling exercises reflected by the existing indicator on heavy metal concentrations.

MAFF is considering whether to commission research to assess the scope for developing thresholds of heavy metals in agricultural soils. Any project would need to take account of thresholds that have already been published in the UK and abroad, for example, in relation to sewage sludge amended soils.

28. **Area of agricultural land**

It may be useful to give a more detailed picture of agricultural land-use. The following charts give breakdowns for the year 1998.
Appendix II:

Background information and further development (continued)

29. Change in land use from agriculture to hard development

This indicator defines ‘development’ as land which does not fall under LUCS categories A (agricultural land), B (agricultural buildings), D (defence), F (forestry/woodland), G (rough grassland and bracken), N (natural and semi-natural land), O (outdoor recreation) and W (water). With the exception of categories A and B, these represent all rural uses other than agriculture.

30. Planting of non-food crops

A change in emphasis is coming about as a result of the concern over climate change raised at the summit in Kyoto in December 1997. Renewable energy, including energy crops, will be one of the main options for EU member states to meet targets for reductions in greenhouse gases.

In addition, the Department of Trade and Industry has launched a review of the implications of generating 10% (as against 2% at present) of the UK’s electricity from renewable sources by 2010. There is no doubt that the 10% figure will be difficult to meet without a substantial contribution from energy crops.

E. Conservation value of agricultural land

31. Area of agricultural land under commitment to environmental conservation

The Environmentally Sensitive Areas Scheme was introduced in England and Wales in 1987 and covers 22 areas in England designated for their unique environmental features. Farmers who join and comply with the terms of the scheme are compensated for the cost of managing their land in ways which are less profitable but more sympathetic to the environment.

The Countryside Stewardship Scheme, which applies outside ESAs, was set up in 1991. It aims to encourage farmers to conserve and enhance some key English landscapes, features and habitats.

Land in set-aside provides environmental benefits to a wide range of wildlife, although set-aside is not an agri-environmental scheme with a conservation aim as such. Set-aside has therefore been incorporated into the indicator on cereal field margins under environmental management (34). This is appropriate due to its influence on these margins.
Appendix II:

Background information and further development (continued)

It is acknowledged that this indicator does not in itself reflect the effectiveness or impact of schemes in terms of environmental quality. In the longer term, it is hoped to develop the indicator in this direction. Equivalent schemes in Scotland, Wales and Northern Ireland could also be included in the next set of indicators.

It may also be helpful to include schemes operated by other public sector bodies that aim to deliver significant conservation benefits. These include, most notably, English Nature’s Wildlife Enhancement Scheme or certain schemes operated by local authorities or National Park Authorities.

32. Characteristic features of farmland

Ideally, the indicator on hedges, walls and banks should distinguish between losses due to agricultural activities and losses due to other factors such as road building and development. In the longer term, it will be possible to include an assessment of the condition of hedgerows and walls. An updated survey of field boundaries and ponds throughout Great Britain was undertaken in 1998 and the results will be published as part of the Countryside Survey 2000.

33. Area of cereal field margins under environmental management

The principal schemes containing cereal field margin measures for England are the Environmentally Sensitive Area Scheme, the Countryside Stewardship Scheme and the Arable Stewardship pilot. There are also margins established under initiatives encouraged by the Game Conservancy Trust as well as schemes set up by the Agricultural Departments in Scotland, Northern Ireland and Wales.

The Arable Stewardship pilot scheme is currently testing measures to bring additional cereal field margins into environmental management and will be monitored for its ecological effectiveness. There will be three-yearly reports on the developments under various Biodiversity Action Plan actions. Those developments reflecting habitat quality might be incorporated into this indicator at a later stage.

Although there was uptake of cereal field margin options under the Countryside Stewardship Scheme prior to 1996, the level was considerably less than in the years since 1996. It is only since the Habitat Action Plan was drawn up that the margins have been vigorously targeted under the scheme, which is why this indicator only focuses on 1996 and since.

34. Area of semi-natural grassland

Estimates for the extent and quality of semi-natural grassland in Great Britain are available from the Countryside Surveys of 1978, 1984 and 1990. A further survey was undertaken in 1998 but the results are not yet available.

The indicators are based on two replicated sets of data from the 1990 Countryside Survey: land-cover field survey (1984–90) and vegetation plots (1978–90). Data were obtained from a random stratified sample of one-kilometre squares throughout Great Britain.

The change in average species diversity per plot was calculated from 200 m² vegetation plots sampled in both 1978 and 1990 which were classified as infertile grassland or moorland grass mosaic in 1978.

The change in area of moorland grass and other semi-natural grassland was estimated from the changes recorded in the replicated sample of one-kilometre squares in 1984 and 1990. Moorland grass refers to the land-cover categories of moorland grass and purple moor grass dominated moorland. Other semi-natural grassland refers to non-agriculturally improved grass, calcareous grass, upland grass, dune and maritime vegetation.

The data used in this indicator will be updated with 1998 data from the same replicate squares and plots as part of the Countryside Survey 2000. It is intended that the Broad Habitats classification developed by the UK Biodiversity Group will be used for reporting the results and this should avoid the problem of using different classifications for measurement of habitat extent and habitat quality. This will also provide a framework for comparing the general trends in semi-natural grasslands with the specific targets set for priority habitats.

35. Populations of key farmland birds

Only species with more than 500 breeding pairs have been included.
Most of the species listed have similar needs. Adults feed on (weed) seeds in winter, the young are fed on invertebrates, and nesting occurs in a hedgerow, ditch or on the ground. Modern farming practices have severely reduced the availability of winter food, chick food and nest sites.

Both the numbers and range of the UK’s common bird species have been monitored since the 1960s. Many species associated with farmland are in steep decline. For example, tree sparrow numbers are down 87%; the grey partridge is down 78%; the corn bunting 74%; the reed bunting 64%; the turtle dove 62%; the skylark 60%; the yellowhammer 60%; the starling 45%; the lapwing 42%; and the linnet 41%. These figures relate to the period 1972–96.


The eight generalist farmland birds are: kestrel, woodpigeon, barn owl, yellow wagtail, jackdaw, rook, greenfinch and reed bunting*. This list includes one Biodiversity Action Plan Priority Species, marked with an asterisk. The categorisation of specialists and non-specialists follows Siriwardena et al. (Journal of Applied Ecology 1998, Vol. 35, pages 24–43).

Although it is desirable to have an indicator that covers the whole range of birds associated with farmed land, the Common Birds Census plots are concentrated in the southeast of England. However, the Breeding Bird Survey will in time provide representative bird indices for a wider range of farmed habitats. This Survey has only been in operation since 1994. The available time-series is thus rather short at present.

Two examples of targets for bird species within the Biodiversity Action Plan are:

- Skylark:
  - maintain present breeding numbers, wintering numbers and distribution throughout the UK;
  - reverse the population decline on lowland farmland and other habitats where found to be declining.

- Grey Partridge:
  - halt the decline by 2005;
  - ensure the population is above 150,000 pairs by 2010;
  - maintain, and where possible enhance, the current range of this species.
Relevant publications

- *Indicators for Sustainable Development for the UK* (DoE, 1996)
- *Developing a Set of Indicators for Sustainable Agriculture in the UK*, a consultation document (MAFF, 1998)
- *Getting the Best out of Indicators* (UK Round Table, 1998)
- *Opportunities for Change*, consultation paper on a revised UK strategy for sustainable development (DETR, 1998)
- *Sustainability Counts*, consultation paper on a set of ‘headline’ indicators of sustainable development (DETR, 1998)
- *Quality of Life counts: Indicators for a strategy for sustainable development in the United Kingdom: a baseline assessment* (DETR, 1999)