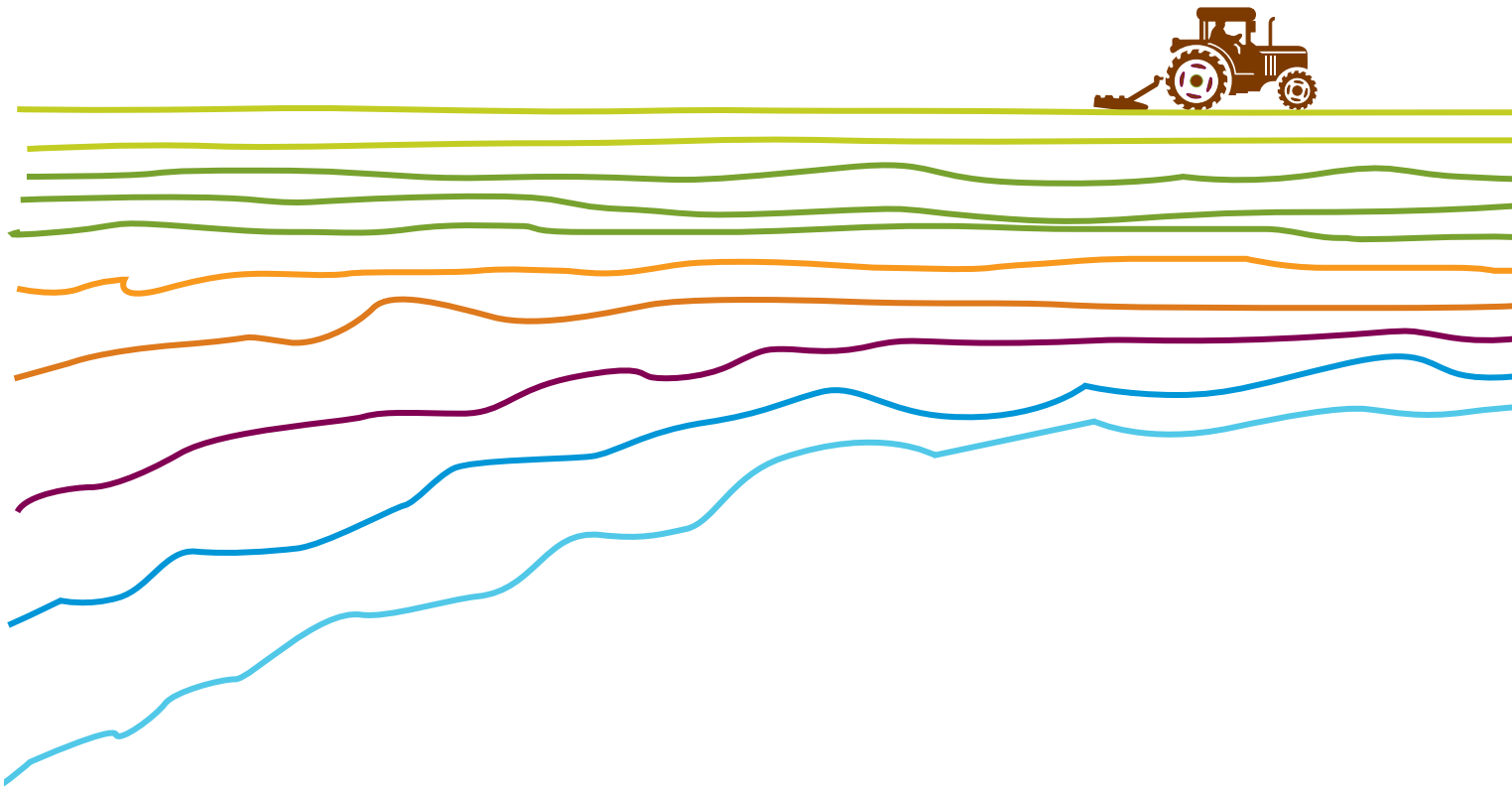
good farming, better environment



State of the farmed environment in England and Wales

We are the Environment Agency. It's our job to look after your environment and make it a better place – for you, and for future generations.

Your environment is the air you breathe, the water you drink and the ground you walk on. Working with business, Government and society as a whole, we are making your environment cleaner and healthier.

The Environment Agency. Out there, making your environment a better place.

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December 2006

Contents

Foreword

Successful, sustainable rural development and agriculture ultimately depend on high quality natural resources such as soil, air, water and habitats. They are all interdependent, so improvements in any one aspect will benefit the whole. What happens in farming matters – to the country, the countryside, and the wider environment. That is why we have produced this joint report.

Barbara Young
Chief Executive, Environment Agency

Richard Macdonald
Director General, National Farmers' Union (NFU)

Good farming is good for farm incomes, the environment and the rural economy. The introduction of measures to protect soil and water resources in the entry level agri-environment schemes is one opportunity to create a better environment, and reward farmers and growers for doing so.

Reform of the Common Agricultural Policy (CAP) and the effects of climate change are just two of the issues that mean that this is a time of great change for farming. In this report we show that much has been achieved already but there is much still to do. However, these achievements are the basis for further improvement and are an indication that farmers and growers can and will succeed.

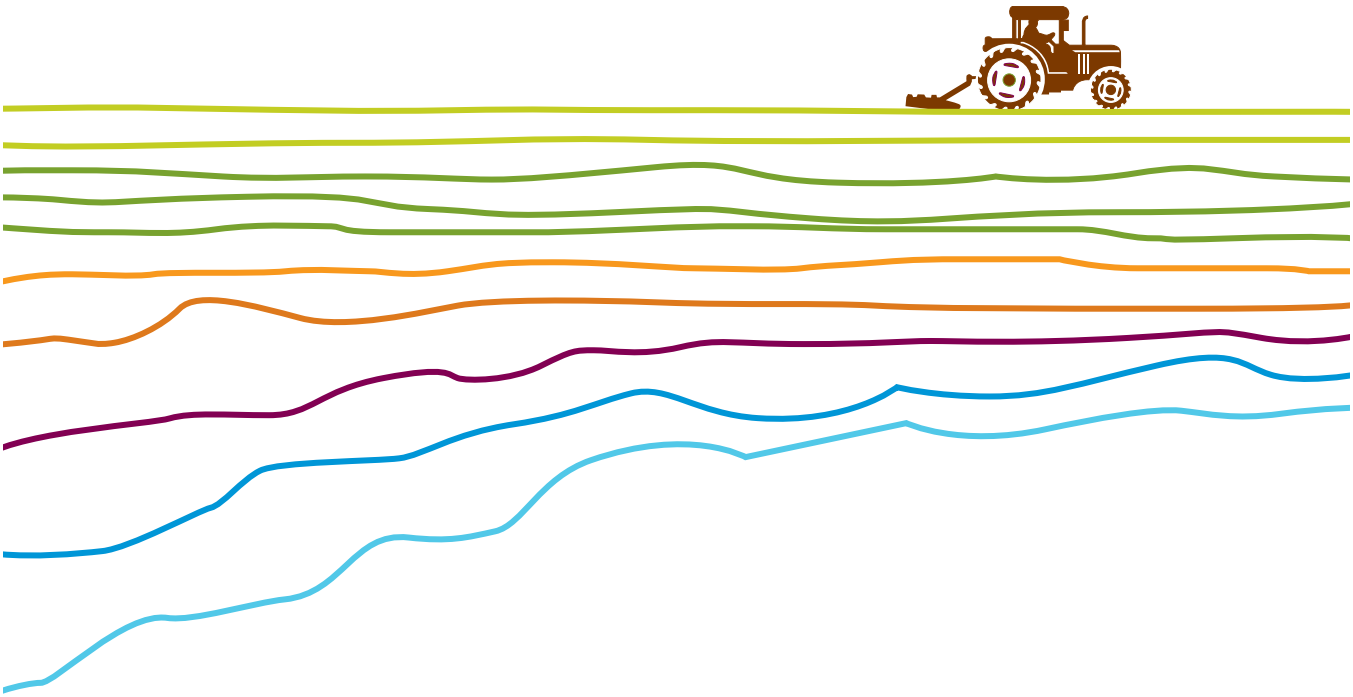
'Good farming, better environment' provides a summary of the current state of the farmed environment and is a baseline that can be referred to in the future. It is for anyone with an interest in farming and the countryside.

We firmly believe that to protect the farmed environment along with the health and the welfare of people who live and work in the countryside, government, agencies and the farming industry need to work together. It is clear that all need to take action to address the challenges facing the farmed environment and to make the most of the opportunities being offered.

Together, the Environment Agency and the NFU look forward to playing our role to support good farming and help create a better environment.

'Good farming, better environment' provides a summary of the current state of the farmed environment and is a baseline that can be referred to in the future. It shows that there is much good news but there are some areas of concern. There are also some things that we don't know enough about to complete the picture. We believe that government, agencies and the farming industry need to work together to address the challenges facing the farmed environment and to make the most of the opportunities being offered. This report is for anyone with an interest in farming and the countryside.

overview



How we know what the farmed environment is like:

To produce this report we (the Environment Agency and the NFU) have assessed the current state of the farmed environment using a combination of the Environment Agency's latest environmental monitoring data, environmental indicators, research and data from other sources. We provide the context for the farming industry by showing the changes that are taking place as well as the economic situation. Throughout the report we show where you can get the data we used and where there is more information available. This work will feed into Defra's Observatory[1] programme, which is concentrating on improving understanding of the environmental impacts of Common Agriculture Policy (CAP) reform. The Observatory relies on research and information being supplied by agencies and others.

There are signs of environmental improvement, for example:

- The numbers of pollution incidents caused by farming have fallen.
- Levels of pesticides detected in rivers have declined.
- The numbers of some farmland wildlife have begun to stabilise and recover.

On the whole we think that the CAP reforms and wider agri-environment schemes[2] will be good for the environment and good for farmers and growers. Farmers and growers will gain economic benefits, a strong sense of stewardship, as well as protecting the environment. The introduction of measures to protect soil and water (called resource protection measures) in agri-environment schemes is an opportunity to build on environmental improvements already made and farmers' traditional role as stewards of the countryside (see Farming changes on page 4). Many already farm in ways that protect the environment, so for them it should be 'business as usual.' We share with farmers and growers the desire for a sustainable, farmed environment that is both protected and productive.[3] There are examples of the benefits of good performance throughout this report.

Our top three concerns for the farmed environment are:

- Nutrients, pesticides and sediment from farms are still polluting some rivers, lakes and coastal water. The quantities from individual farms may be small but the combined effect of this diffuse pollution is large.
- Some wildlife, once common to the farmed environment, continues to decline although these changes are not wholly due to farming.
- Climate change will present new challenges for farmers and not enough is known, for example about the implications for future land use, crop selection and soil management.

These concerns and others are presented in more detail in the main sections of the report.

To ensure the best outcome for the environment certain things need to happen. Our views are presented in the report ('The way forward' sections). Some of the actions farmers and growers take now may not have a measurable impact on the state of the environment perhaps for a decade to come, but unless action is taken some of our natural resources will be irreparably damaged. Continued support for the environment and for farmers and growers is needed from the Government in Westminster and the National Assembly for Wales in Cardiff, from other agencies and from organisations like us.

There are three things that we want to see happen to support good farming for a better environment:

We want to see farmers and growers better able to rise to the environmental challenges so that the environment is an integral and instinctive part of their business.

We want to see wider recognition of farmers' and growers' unique role in producing our food, our landscape and our environment.

The Environment Agency will continue to improve its regulation of farmers and growers by finding the right balance between regulation, advice and incentives and by recognising good performance. It will focus on areas of highest risk and reduce the administrative burden of our regulation.[4] It will support farmers by promoting voluntary measures and monitor these so we know that they are working.

Farming changes

Since the implementation of CAP reform in 2005 the link between production and payments to farmers has been broken (often referred to as 'decoupling'). Instead, most farmers and land managers are given direct farm payments for every hectare of land farmed. Wales is using the historic method for determining single farm payments. Payments are not based on crop or livestock production, but depend on them achieving and maintaining certain basic environmental and other standards, known as cross-compliance.[5] Being found to be 'non-compliant' could result in a reduction in a farmer's or grower's payment, so it is fundamental for them and for the environment.

As well as meeting the cross-compliance standards, all farmers and growers can choose to join entry level agri-environment schemes to bring broader benefits for the whole environment. The schemes in England[6] and Wales[7] are different,[8] but they both reward farmers and land managers who maintain, enhance or create environmental, habitat or historic features. Some can sign up to higher level schemes[9] that will provide even greater protection of natural resources or biodiversity benefits in priority areas.

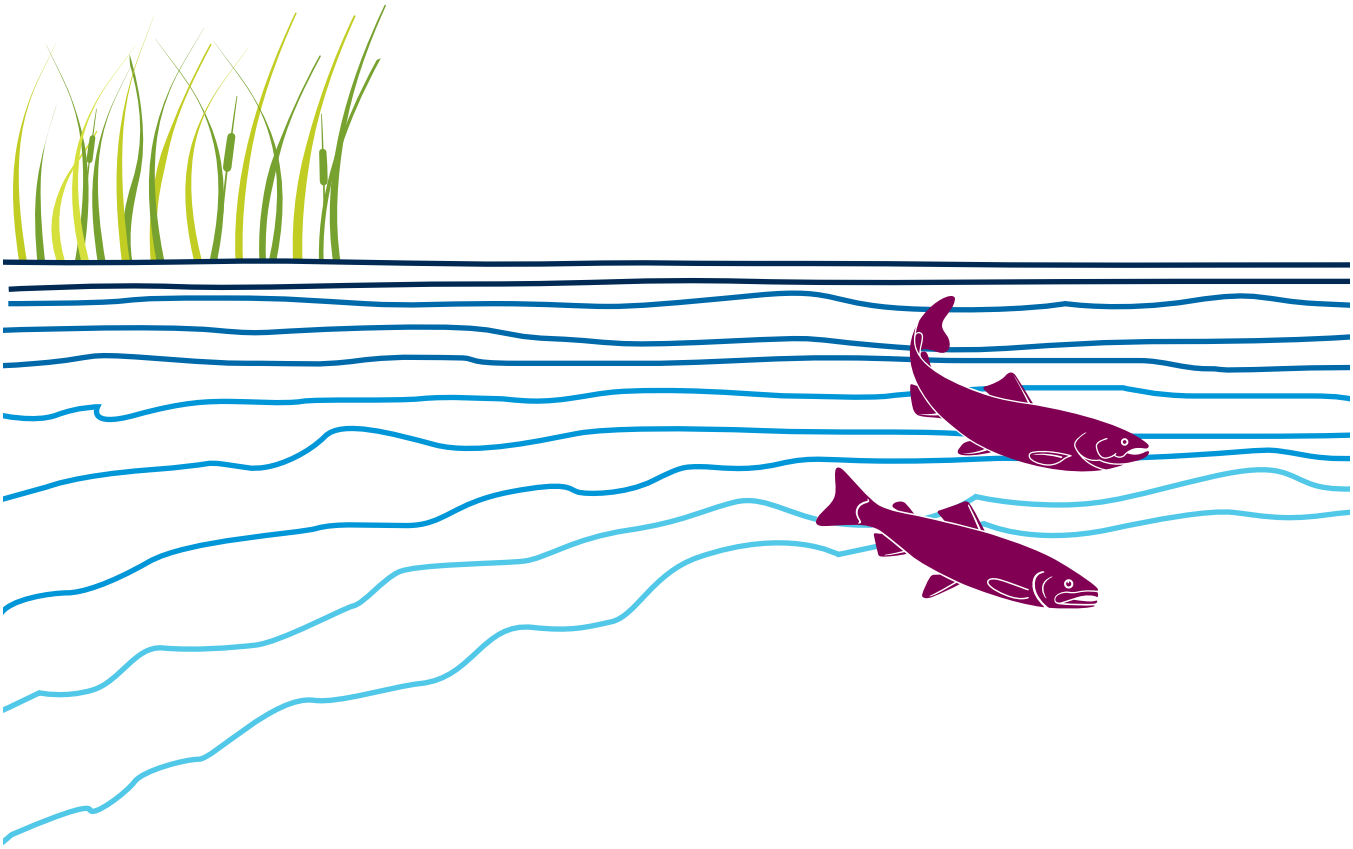
The implementation of the European Union Water Framework Directive is another challenge for farmers and growers. It requires all countries in Europe to look at the ecological as well as the chemical quality of our rivers, lakes, groundwater (water that supplies wells and springs), estuarine and coastal waters. Farmers and growers have an important part to play in developing solutions to improve the ecological quality of our waters, for example by farming in ways that reduce water pollution. The Environment Agency must also assess and take into account how meeting the objectives of this Directive will affect farmers and find ways to ensure that it is not disproportionately costly.

In context:

- About three-quarters of the land[10] in England and Wales is managed by 162,000 farmers.[11] The majority of this land is farmed by more than 70,000 farm businesses.[12]
- Almost two-thirds of the food we eat in the UK is produced here, but the money UK farmers receive as a proportion of the cost of food has fallen since the late 1980s. In 2005 farmers' share of the value of a basket of food items was about 36 per cent, down by around eight per cent since 1990.[13]
- During 2005 the total income from farming in the UK fell by about nine per cent to £2.5 billion. To put this in context, the total income from farming in 2005 has recovered from the low of 2000 (i.e. total income was 40 per cent higher than in 2000) but is still 60 per cent lower than the peak in 1995.[14]
- Actual incomes on individual farms vary widely[15] and many farmers and growers are under pressure. Prices for agricultural products were about nine per cent lower in 2005 than in 1990,[16] and the cost of inputs is increasing.[17] Estimates vary but one survey in 2004/5 showed that some lowland farmers lost £57 a hectare on food production and this loss is predicted to increase to over £100 a hectare by 2006/7.[18]
- Over half of all farmers in the UK add to their income by diversifying into a wide range of other business activities, including consulting, tourism, nursery schools and farm shops.[19]
- Many farmers and farm workers have left the industry. In 2005, there were 541,000 people working in agriculture; this is over 100,000 less than in 1990, and more than a fifth fewer than 20 years ago.[20]
- Farming is supported by payments from the Government and the European Union. In 2005 this was £1.8 billion in England and £0.3 billion in Wales.[21]
- The Environment Agency regulates farming activities through regimes such as the Nitrate Vulnerable Zone Action Programme,[22] groundwater regulations, water abstraction licences, discharge consents and agricultural waste regulations. It regulates intensive pig and poultry farms through Pollution Prevention and Control.
- The NFU represents farmers and growers in England and Wales. Its central objective is to promote successful and socially responsible agriculture and horticulture, while ensuring the long-term viability of rural communities.
- The Environment Agency and NFU have been working with other farming organisations to produce an Environmental Plan for the dairy industry.[23] The plan is voluntary and may reduce the need for future regulation. It may also serve as a model for other agricultural sectors. It's the Environment Agency's job to protect and improve the environment and make sure that air, land and water are looked after, so that tomorrow's generations inherit a clean, healthy environment.

Water quality has improved over the past ten years. However, inputs of nutrients, pesticides and sediment from the farmed environment, as well as from other sources, can still affect rivers, groundwater, coastal water and wetland wildlife (see wildlife and habitats section). The contribution from agriculture has become proportionately more significant as inputs from sewage and industrial effluents have fallen. Farming can be also affected by, and can have an impact on, the availability of water resources in some places. Climate change could make this worse.

water



> The good news

- **The number of pollution incidents caused by farmers has fallen.**
- **The vast majority of farmers are compliant with conditions in Nitrate Vulnerable Zones.**
- **There is evidence that pesticide concentrations in groundwater are declining in some areas.**
- **Fertiliser use has fallen and at the same time crop production has increased, suggesting that farmers are using fertilisers more efficiently.**[24]
- **Some farmers have voluntarily set up abstractor groups to work with the Environment Agency to address issues of drought and water scarcity in their catchments.**

< Our main concerns

- **Further work is needed in addressing nutrient management on farms, highlighting the benefits to the farming community as well as the benefits to the environment.**
- **Although water quality has broadly improved, water pollution from farms (nutrients, sediment, and slurry) is still a problem in some rivers and groundwater.**
- **Some places, such as in upland sheep rearing areas, still suffer from too many cases of sheep dip pollution. Many of these cases involve the routine use of sheep dip.**
- **Farmers are increasingly aware of water efficiency but we would like to see more work in this area. While farming uses only a small percentage of the water abstracted from the environment, most of this water is needed at times of low water availability.**

We know this because:

- In the fifteen years since 1990 the number of serious water pollution incidents caused by farming fell by 92 per cent.[25] But in 2005 17 per cent of the serious water pollution incidents were still caused by farmers.[26] Many of these incidents involved slurry, which is up to 100 times more polluting than untreated domestic sewage.
- There is some evidence that pesticide concentrations in groundwater are declining in some areas. The industry-led Pesticides Voluntary Initiative is a scheme that helps farmers improve the way they use pesticides. After five years, good results include: 76 per cent of land sprayed with pesticides is now done so with equipment that has been properly tested and 80 per cent of crops are sprayed by trained registered operators.[27] One fifth of arable land has a Crop Protection Management Plan (an environmental audit).[28]
- In 2004 70 per cent of farmers interviewed in England and Wales said that they had taken some measures to reduce pollution of rivers and groundwater.[29] However, during 2005 the Environment Agency prosecuted ten farmers for causing pollution with sheep dip. Environment Agency investigations show that poor practices in routine use are the most likely cause of pollution, which can be extensive. In one case, a small amount of cypermethrin dip, used to wash out a livestock lorry, polluted a 10-mile stretch of a river in Wales. In 2004 sheep-dip chemicals[30] caused one fifth of all failures of freshwater Environmental Quality Standards.[31]
- Over 80 per cent of bathing waters in England met the strictest EU standards in 2005, and in Wales over 90 per cent of bathing areas met this standard.[32] The success in Wales is in part due to the work of the Green Sea Partnership, made up of various organisations including farmers, who have been working for ten years to improve and protect the quality of Welsh bathing waters.[33]
- Although the Environment Agency's latest river survey shows an ongoing, if small, improvement in rural river quality,[34] the overall picture for rivers and wetland wildlife remains worrying. About 60 per cent of the nitrate[35] and 40 to 50 per cent of the phosphate[36] in rivers comes from farming, mainly linked to the use of fertilisers and farmyard manure.
- Nitrate levels are greater than 30mg/l in almost a third of rivers in England, that is over 7,000km of rural rivers in England in 2005. No rivers in Wales had similarly high levels.[37] Likewise in 2005 over 12,000 km of river lengths in rural areas had levels of phosphate above 0.1mg/l, although only two per cent of these were in Wales.[38] The Environment Agency believes these levels could trigger action under the EC Nitrates and Water Framework Directives.[39]
- In 2005 just four per cent of farms the Environment Agency visited in England and three per cent in Wales[40] failed to meet the nutrient management

conditions in Nitrate Vulnerable Zones (NVZs). These conditions require farmers to be careful about when they apply fertiliser and manure to fields, to reduce nitrate input to rivers and groundwater. To meet the cross-compliance conditions in England, all farmers must establish two-metre wide buffer strips along the edge of rivers and streams on their land, where they cannot cultivate or apply fertiliser or pesticides.

- Special advisors are working with farmers in forty river catchments in England and two in Wales to share advice and knowledge to reduce water pollution under the Catchment Sensitive Farming Initiative. As well as running workshops and farm demonstrations, advisors are working on a one-to-one basis with farmers, advising on, for example the use of fertilisers and livestock densities. The Catchment Sensitive Farming initiatives in England and Wales focus at the local level and pull together farmers, farm advisors, government agencies and other organisations.
- The Environment Agency encourages farmers to store water abstracted during the winter months[41] and use this for irrigation in the summer when demand for water is at its highest.[42] In 2004, 40 per cent of the water taken from the environment for farming was in the Environment Agency's Anglian Region in England.[43] Most of this water was used for irrigating high value crops, such as potatoes and root vegetables, and was mainly abstracted in the summer months.
- In 2006, farmers along the western River Rother abstracted water on alternate days to preserve flow levels and the wildlife.[44] Some of these farmers voluntarily agreed to reduce their water usage by half.[45] Voluntary reductions were also agreed with abstractor groups in other places to reduce the possibility of formal restrictions later in 2006. Some of these groups also offer guidance on water efficiency and water audits.[46]

›› Water: the way forward

1. We would like Defra, the Welsh Assembly Government, and the Treasury to extend Catchment Sensitive Farming beyond 2008 and to ensure that the importance of agri-environment schemes is reflected in the allocation of national funds. We believe this is essential to encourage farmers and growers to join the schemes.
2. We will work closely with farmers, with Government and other agencies to promote joined-up planning at river catchment-scale. These plans need to link Catchment Sensitive Farming in England and Wales with measures that protect soil, nutrients, and water resources in agri-environment schemes and, where appropriate, flood risk management plans. This approach is essential to meet the requirements of the Water Framework Directive and to make it easier for farmers to deliver the environmental improvements we want to see.
3. We want to see a nutrient management policy from the Government that optimises nutrient use and addresses pollution from and emissions of nitrate, phosphorus, ammonia and greenhouse gases in England and in Wales. This needs to be consistent with policies covering all sources of point and diffuse pollution.
4. We will promote to Defra, the Welsh Assembly Government and regional development agencies rural development measures that help agricultural holdings to modernise their management of manures and slurries.[47]

5. We know the number of pollution incidents from farming, in particular those that affect water, must continue to fall in order to reduce serious environmental damage and harm to wildlife.

6. We support the Pesticides Voluntary Initiative because we want levels of pesticides in rivers and groundwater to continue to fall. The Environment Agency, NFU, Veterinary Medicines Directorate and others have launched a sheep dip Pollution Reduction Programme.[48] This will help raise awareness and provide useful advice[49] for farmers and contractors to prevent sheep dip pollution. The resource protection measures in the entry level agri-environment schemes in England and Wales should also have a positive effect and help reduce levels of chemicals in the farmed environment.

7. The Environmental Plan for Dairy Farming[50] encourages farmers to develop and implement a Nutrient Management Plan. This consists of assessing the nutrient requirement of each field and crop and using the right amount of nutrients according to crop need and soil type, protecting the environment and saving money.

Many people associate the countryside with clean, fresh air. However, air quality can be poorer in rural areas than in towns. Not all of the air pollution that affects rural areas is produced there, but farming itself can contribute to air pollution. This can vary from local odours such as those from intensive livestock units, to the production of ammonia, which contributes to acid rain and the nutrient enrichment of terrestrial habitats.

air

> The good news

- **Emissions of ammonia from farming have fallen.**[51]
- **Releases of the greenhouse gases nitrous oxide and methane from farming have fallen over the past ten years.**

< Our main concerns

- **Air pollutants released by farming can damage the environment.**
- **Low level ozone (a product of traffic and industrial pollution) in the countryside affects health and can damage crops.**

We know this because:

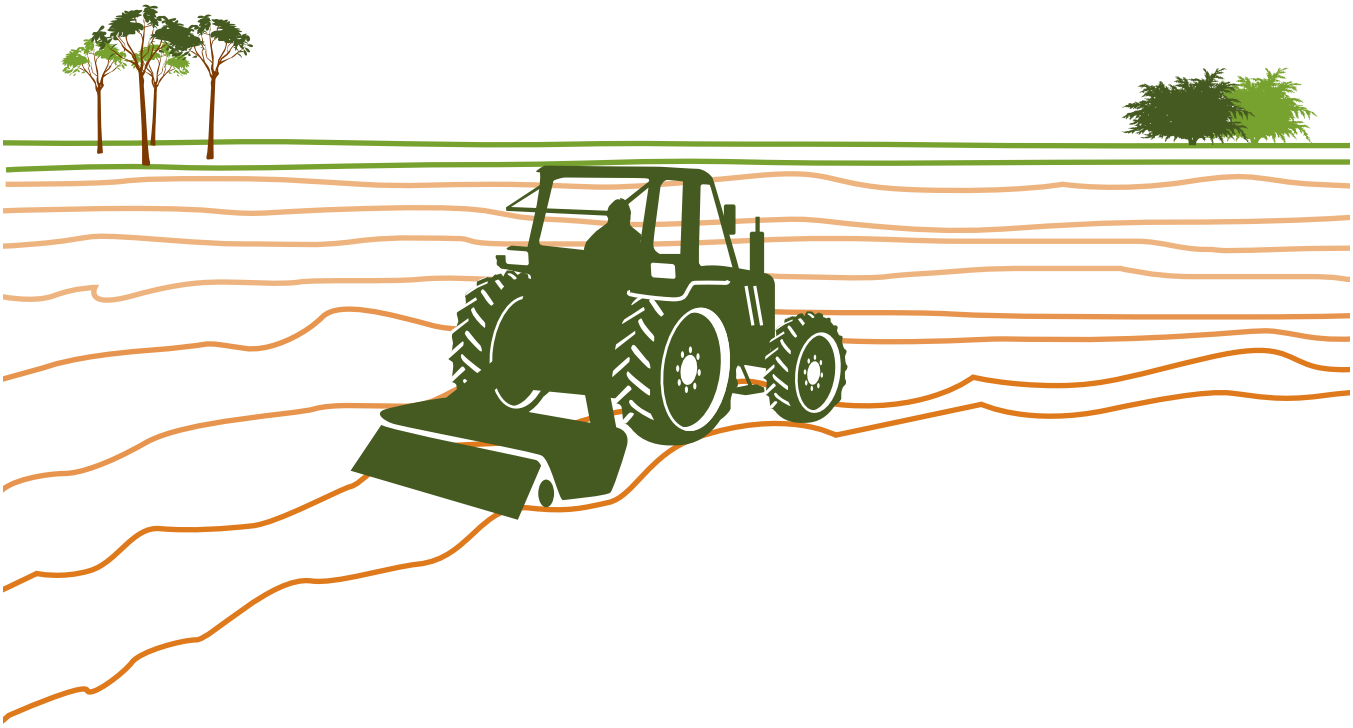
- In 2004 farm animals, fertilisers and soil released 84 per cent[52] of total ammonia emissions. Most is released from animal manure that can also cause local odour nuisance if it is not well managed. Over the past ten years ammonia emissions from farming have fallen by six per cent.[53]
- Ammonia is a less well-known air pollutant than those linked with traffic and industry but it can harm some plant habitats. High levels of ammonia can cause localised nutrient enrichment, for instance grass near to intensive poultry units has been shown to grow twice as fast as that 300 metres away. This kind of nutrient enrichment could harm native plant habitats that need nutrient-poor conditions.[54]
- Changes in temperatures and rainfall, as a result of climate change, mean airborne nutrient pollution could become even more harmful to habitats in the future.[55]
- About two-thirds of the nitrogen deposition that leads to over-enrichment and acidification of sensitive soils, habitats and fresh waters comes from agricultural ammonia.[56]
- Agricultural emissions of methane have fallen by 11 per cent and nitrous oxide by 13 per cent over the past ten years. The main impact of these important greenhouse gases on the environment is their contribution to climate change (* see climate change section).
- Pollution from traffic and emissions from industry can affect air quality in rural areas. As a result rural air quality has not improved over recent years, in contrast to urban areas.[57] Each year from 1987 to 2005 in the UK there have been between 21 and 64 days when rural air pollution has been moderate or higher, mostly because of high levels of ground-level ozone.[58]
- Ground-level ozone is formed by sunlight acting on emissions from traffic and industry. In urban areas, ozone reacts with oxides of nitrogen (mainly released from vehicles) to form nitrogen dioxide. As urban areas tend to have more traffic pollution than rural areas, ozone concentrations in rural areas are often higher than urban areas.[59] This ozone can harm health, damage habitats and cause significant reductions in crop production.[60] Damages are estimated to be about £82 million each year.[61]

>> Air: the way forward

1. We know that further reductions in releases of air pollutants from farming can be made through improvements in nutrient management. Better design of livestock buildings, manure and slurry stores and improved slurry spreading practices will help reduce ammonia emissions and odour.
2. We expect to see local air quality improving as a result of controls on emissions from large pig and poultry units through Pollution Prevention and Control.
3. We think that land and air quality in the countryside would benefit from less traffic pollution in towns and cities; better vehicle design, more alternatives to car use and schemes to reduce congestion will help to do this. We will encourage governments in Westminster and Cardiff to address these concerns.

Soils with a healthy structure are essential to maintaining crop yields and biodiversity, and protecting water quality. Healthy soils also reduce the impacts and costs of diffuse pollution on and off farm and of surface water flooding. Farmed land in England and Wales is remarkably varied, from the uplands dependent on grazing to the flat arable lowlands of East Anglia. The quality and character of the rural environment can be protected through high standards of land management.

land



> The good news

- All farmers have access to funding from agri-environment schemes that for the first time directly protect soil and water resources. Many farmers are joining these schemes, and are being recognised and rewarded for good environmental management.
- Integrated farming systems (like LEAF – Linking Environment and Farming) deliver a high quality environment that supports viable farming businesses and produces wholesome, affordable food. Farmers are using these schemes as a source of best farming practice and advice.
- Farmers play a vital role in re-using resources such as animal manure and biodegradable wastes on land. These provide valuable nutrients to the soil, add organic material and help maintain soil structure.
- Soil management is expected to improve because of the soil protection measures in cross-compliance and agri-environment schemes.

< Our main concerns

- The EU Rural Development Budget and modulated funds are likely to be insufficient to meet all the environmental objectives of agri-environment schemes without additional support from national budgets.
- Water pollution from eroded soil is a problem in some places. There isn't enough information about the state of soils. Many farmers do not see soil erosion as a problem.
- Increasing amounts of biodegradable waste are being diverted from landfills, which is a good thing, but not enough is known about the land's capacity to accept this material.

We know this because:

- In England, farmers' uptake of Environmental Stewardship Schemes since 2005 means the area covered by agri-environment schemes is just over four million hectares, about 45 per cent of available farmland. This is made up of three million hectares of land managed under 23,000 new Entry Level Stewardship agreements, on top of 1.1 million hectares of land already covered by the Environmentally Sensitive Areas and Countryside Stewardship schemes.
- Farmers in Entry Level Stewardship schemes in England are managing 13,000 hectares under specific resource protection options, 208,000 hectares of low input grassland, 21,000 km of ditch management and 5,500 hectares of rush pasture. In addition, there are 9,000 agreements with farmers undertaking soil management plans.[62] These new agreements will last for five years.
- In Wales, about 23 per cent of the total land area is managed within the Tir Gofal and Tir Cynnal schemes. The 3,000th agreement in the Tir Gofal scheme was signed at the Royal Welsh Show in July 2006.[63] Farmers in the scheme are actively managing and restoring 3,103 km of hedgerow, equivalent to a metre of hedgerow per person in Wales.[64] In August 2006, 3,117 farmers had Tir Cynnal agreements.[65]
- It is estimated that over ten million tonnes of organic material is spread on the land in the UK. More than 90 per cent of this is animal manure. The remainder is treated sewage sludge, green waste compost, paper sludge and organic industrial wastes. The rules governing this are carefully set to protect the health of people and the environment. The Environment Agency is consulting with farmers, the waste industry and others on a Quality Protocol for Compost. This is a quality control procedure for the production and use of compost made from waste biodegradable material that has been sorted at source.[66]
- Most of the sediment in rivers and lakes comes from arable and pasture land.[67] Increased rates of water run-off from fields can carry sediment, pesticides and nutrient residues into rivers and lakes (* see water section) and can increase the risk of flooding in some places. Damaged and compacted soils can erode more easily. The Environment Agency estimates that over a fifth of the land in England is at high risk[68] of soil erosion due to the vulnerability of some soils and/or land uses.

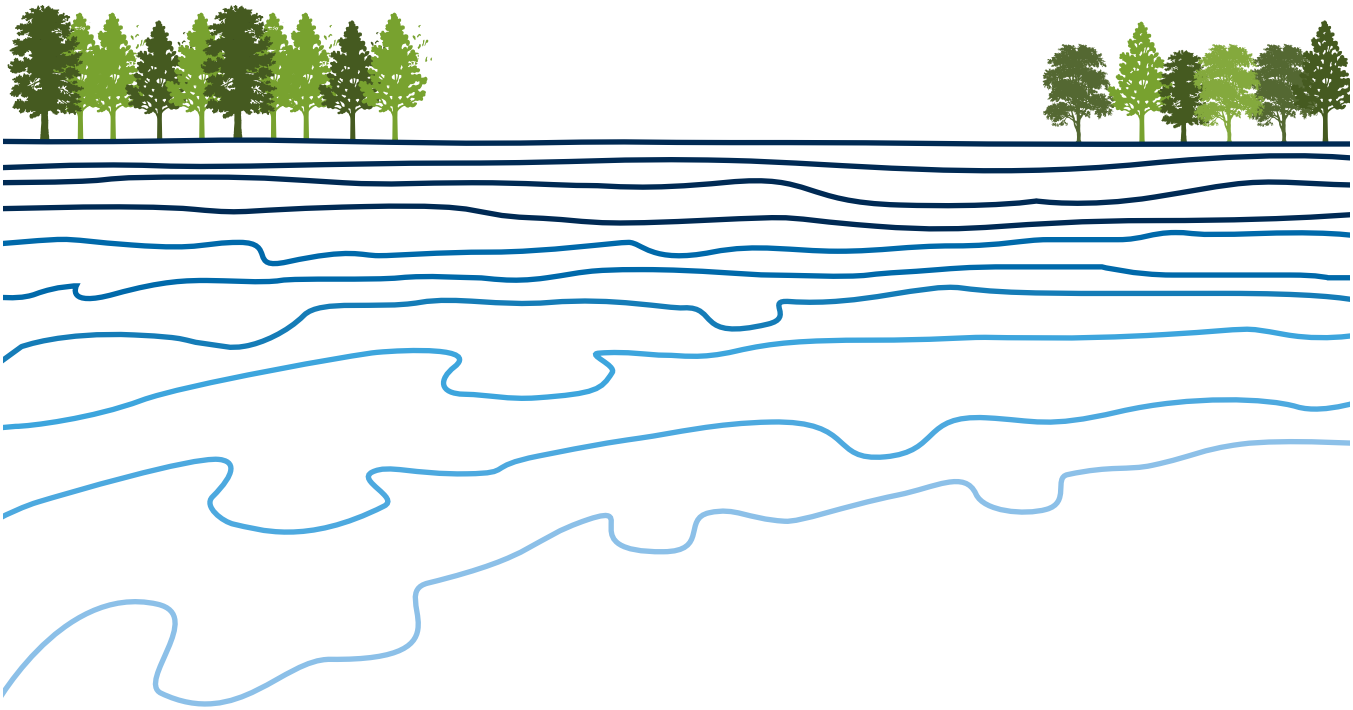
- Three quarters of farmers have told the Environment Agency that they do not see soil erosion as a problem.[69] Whilst erosion may not be significant for some crops, it can affect other functions like drainage. Each year soil erosion costs farmers in the UK around £8 million.[70]
- Environment Agency surveys of river habitats reveal that more than a third of river banks are affected by poaching (livestock trampling), and five per cent of the river sites the Environment Agency surveyed in 2004 were extensively trampled.[71] This damage releases sediment into the river, which can harm aquatic wildlife and contribute to flood risk.

›› Land: the way forward

1. We would like Defra, the Welsh Assembly Government, and the Treasury to make adequate national resources available for agri-environment schemes beyond the monies available through national modulation. We believe this is essential if we are to encourage farmers to join these schemes and maintain the benefits that they will bring for the environment.
2. We want to see more support and encouragement for integrated farming systems, for example LEAF, so that they can continue guiding farmers on best farming practice for producing high quality food with good yields and low environmental costs.
3. We support work to produce a consistent set of soil assessment tools,[72] as part of the Soil Protection Review in England and the Soil Assessment Record in Wales. These tools will tell farmers and growers, and others more about the current state of their soils and soil management as well as help identify actions that farmers and growers find easy to put into practice.
4. We need more information about the benefits and potential harm of land spreading more of the biodegradable material that has been diverted from landfills so that we can protect the environment.
5. We would like to develop a range of tools and training to help and support farmers, growers and their advisors to help them deal with new technical challenges, improve the environmental and business performance of farms, and prevent pollution to and from land.
6. The Environment Agency will continue to improve its approach to regulation to minimise the administrative burdens on farmers. We will also support new technologies, voluntary action, information exchange and adoption of good practice as alternatives to regulation where appropriate.

Farmland and wetlands in floodplains play a natural role in flood risk management. They absorb, retain and slowly release rain or floodwater, easing river water levels at critical times and reducing flood risk. Making sure that floodplains are able to work properly will be even more important in the future, as climate change will bring more intense rainfall (see land and climate change sections).

flooding



> The good news

- **Changing land management at the farm scale (to reduce runoff) can reduce flood risk and help create more space for floodwater.**

< Our main concerns

- **Climate change will increase the risk of flooding from rivers and the sea and the Environment Agency can't guarantee to continue to reduce flood risk to all farmland.**
- **Farmers need to be prepared for the impacts of flooding on their land, which could include damage to crops and soils.**[73]
- **Increased flood risk and funding uncertainties across England and Wales will force the Environment Agency to concentrate its flood risk management efforts in areas of greatest risk.**
- **Farming can increase the risk of flooding, partly through crop choice and also in areas where the soil becomes compacted or eroded. It is important that farmers continue to maintain good soil management (* see land section).**

We know this because:

- In Wales farmers in the Pontbren river catchment observed that overland water flow was reduced by the strips of trees they had planted to shelter their livestock. Research has since shown that infiltration rates in these shelterbelts can be up to 60 times higher than in pasture, so they help reduce overall runoff and also enhance water resources and river water quality at the local scale.[74]
- Stronger winter storms and sea level rise as a result of climate change means that flooding risks across the country will be up to four times greater by the 2080s. The risk of coastal flooding could increase by up to ten times over the same time period.[75] It is inevitable that the area of farmland at risk of flooding will increase but it won't be possible to protect all coastal farmland from flooding.
- There are 564 hectares of managed realignment[76] in England, mostly in East Anglia and Humberside.[77] Managed realignment allows previously reclaimed farmland on coasts and around estuaries to be flooded by the sea creating more space for water. This provides a valuable and effective natural defence against coastal flooding as well as creating habitats and supporting valuable fish spawning and nursery areas.
- There is some evidence that farming practices influence the frequency of small scale, local muddy floods.[78] The annual cost of these floods is difficult to assess, with previous estimates for costs in the UK ranging widely from £24-51 million[79] to up to £115 million.[80] Research is ongoing into the link between land management and more infrequent larger catchment scale flooding.

>> Flooding: the way forward

1. We encourage farmers to take up Tir Cynnal and the soil protection options in the Entry Level Stewardship scheme (For more information * see land section).
2. We would like more farmers and growers to take up options within the Higher Level Stewardship scheme in England that reduce flood risk. We think this scheme should be targeted in areas of highest risk. The Environment Agency will use its flood maps and management plans to help identify these areas. The approach in Wales is different but a proposed top tier agri-environment scheme would contribute to reducing flood risk.[81]

3. We believe that Natural England, Countryside Council for Wales, Welsh Assembly Government, Defra and Environment Agency advice to farmers and growers should better integrate flood risk reduction alongside resource protection and conservation.

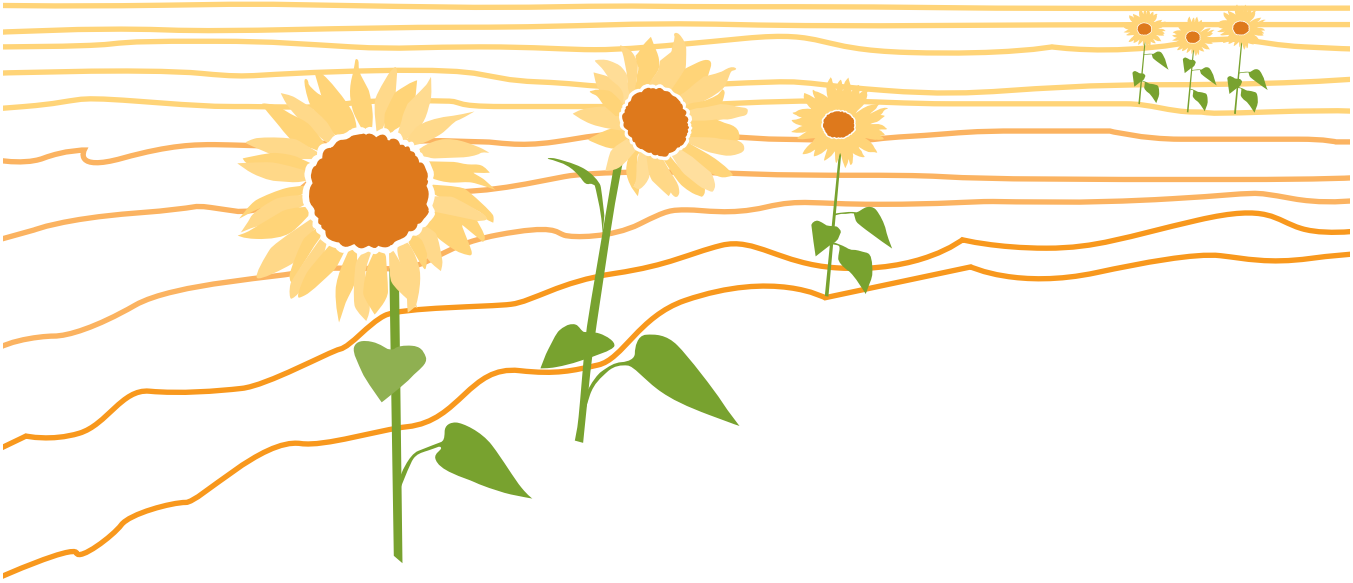
4. We want to see farmers and growers planning ahead to adapt for increased flood risk from climate change and helping to take action to reduce flood risk by creating more space for floodwater.

5. We will continue to work with Defra on the 'Making Space for Water' strategy, to help form and influence new government policy on flood and erosion management.[82] This includes investigating options to allow farmers, landowners and communities to play an active role in the use of farmland in floods and flooding and to help them adapt to the threat of increased flood risk. Such measures may include financial support, insurance, land acquisition and better use of the planning system.

6. The Environment Agency will carefully consider the future of maintaining flood defences but cannot guarantee to continue to reduce flood risks to all farmland. The Environment Agency will speak to affected farmers and work with them to look at options for future land management, including the potential to make more space for flood water.[83]

Climate change will increasingly affect farming, and farming itself contributes to greenhouse gas emissions. There will be more intense storms, drier, hotter summers, and wetter, milder winters and sea level will rise. The impacts will vary across the country, but all farmers face a variety of challenges and opportunities. Some could find it harder to grow certain crops because of reduced water resources. Others may diversify into growing energy crops and help reduce greenhouse gas emissions. Opportunities exist to reduce fertiliser use and other inputs, reducing costs, water pollution and greenhouse gas emissions.

climate change



> The good news

- Some farmers are helping to lessen (mitigate) climate change by:
  - Growing non-food crops that can be used for energy or renewable raw materials directly substituting fossil fuels and reducing carbon emissions.
  - Reducing fertiliser, energy and other inputs to reduce costs, water pollution and greenhouse gas emissions.
- Some farmers are acting now to adapt to climate changes by:
  - Growing different crops and varieties to suit the longer growing season and warmer temperatures.
  - Helping reduce flood risk by altering soil and crop management practices.
  - Using water more efficiently, this is important as demand is usually highest when less water is available (* see water section).
  - Changing cropping practices to suit the changing climate.
- Farmers' energy efficiency improved by 20 per cent in 2004, against an overall increase in industrial energy use of one per cent over the same period.[84]
- Emissions of greenhouse gases, including methane and nitrous oxide, from farming have fallen.

< Our main concerns

- Cause: Farming is an important source of greenhouse gas emissions. These are released from farm animals, fertilisers, and manure as well as carbon loss from soil (not enough is known about this).
- Effect: Reduced water availability and environmental changes will impact on ecosystems and farming practices and there will be implications for pest and disease control, livestock housing, storm and flood risk.

We know this because:

- Climate change could bring opportunities[85] – but only if there's enough water. Some farmers could use the longer growing season and warmer temperatures to expand or change their range of crops.
- Farming is now the biggest source of two important greenhouse gases. The digestive processes of grazing animals (mainly cows) release about 35 per cent of total UK methane emissions. In Wales this is even higher, with farm animals releasing 73 per cent of total methane emissions.[86] Soils and fertiliser use are the source of two-thirds of nitrous oxide emissions in the UK.[87] In Wales 82 per cent of nitrous oxide emissions are from fertilisers and soils.[88]
- Farmers and growers in the UK are working to reduce their contribution to climate change via the Climate Change Levy.[89] This scheme encourages industries to improve energy efficiency and reduce greenhouse gas emissions.
- Greenhouse gas emissions from farming have fallen by 12 per cent over the last 10 years. Emissions of the two most important greenhouse gases that are released on farms, methane and nitrous oxide, have fallen by 11 per cent and 13 per cent respectively over the same period.[90]
- Grass growth is starting earlier in the spring and continues for longer into the autumn.[91] About 60 per cent of farmers have said they have already seen the growing season lengthen.[92]
- The market for energy crops, those grown to be harvested and used to generate heat and electricity or to power vehicles, is growing.[93] This is being partly driven by UK Government targets[94] to generate more electricity and vehicle fuel from renewable sources. There is already a straw-fired power station at Sutton near Ely, East Anglia, which opened in autumn 2000.
- In future up to one million hectares of land, equivalent to the area of Lancashire, Surrey, and Powys combined, could be used for growing energy crops in the UK.[95] The *Miscanthus* (elephant grass) crop from just 1,100 hectares can provide enough electricity to power 2,000 homes.[96] By using biomass crops instead of fossil fuels to generate power, carbon dioxide emissions could fall by eight million tonnes each year.[97] It is essential that these crops are located and managed in places that minimise the impact on the surrounding environment, make the most of efficient supply chains, and that other environmental impacts are properly assessed.
- If the pace of climate change continues to quicken and temperatures and rainfall patterns respond, the range and behaviour of plants and animals will too.[98]

Some will adapt and some may not.[99] Acid grassland could be badly affected by drier summers. Upland hay meadows are particularly vulnerable.[100] New weeds, pests and diseases could have implications for pesticide use and biological control.[101]

- Heat stress and pressure on water resources could affect the welfare of farmed animals and wildlife.[102] The hot, dry summer of 1995 cost the UK farming industry about £457 million through reduced income and increased costs. Farmers who had already made adaptations and management changes were not so badly affected.[103]
- In warmer, drier summers the organic matter in soils could decompose faster, releasing yet more carbon dioxide. There is evidence that this is already causing soils in the UK to release more carbon than they absorb, at the rate of four million tonnes a year.[104]
- Higher rainfall could lead to soil waterlogging and flooding, which could make it more difficult to recycle slurry and manure on the land, and could also increase greenhouse gas emissions from this soil.[105] Damage from flooding in 2000 cost farmers in the West Midlands alone an estimated £6.7 million.[106] Increased storminess could affect farmers' ability to grow some crops, despite the longer growing season.

›› Climate change: the way forward

1. We want to see farmers adapting for climate change sooner rather than later. Some farmers are already experiencing the effects of climate change. Adaptation will be easier if farmers and others find ways to share their knowledge, experience and solutions. Increasing climate change knowledge among farmers and growers is the key to adaptation.
2. We think that environmentally sensitive biomass and biofuel development and energy crop production can help to meet emissions targets. This needs to happen alongside development of an efficient supply chain that allows farmers to sell their produce.
3. We encourage others to do more research to develop energy efficient technology for farmers, for example anaerobic digestion and Combined Heat and Power (* see waste section).
4. We believe policies for climate change need to be integrated with those that tackle other environmental issues (including water resources) so that they can be managed as part of agri-environment schemes.
5. We want to see more investigation into carbon loss and carbon storage in soils.
6. We would like to see more climate change monitoring because we, and others, don't know enough about how climate changes are already affecting farmers.

The farmed environment fulfils an essential role in waste management in England and Wales, recycling sewage sludge and some industrial wastes into valuable fertiliser for crops. Management of waste generated on farms is improving, but fly-tipping of waste on farmed land is a problem for many land managers.

waste

> The good news

- **Most farmers think that waste management is an important part of their job[107] and many farmers are already changing their waste management practices.**

< Our main concerns

- **Illegal waste activities on farmland. It is usually not farmers dumping this waste, but they often have to clean it up and their reputations can suffer.[108]**
- **Waste can be dangerous (to people and land) if put in the wrong place.**

We know this because:

- Nine out of ten farmers have told the Environment Agency that they consider waste management to be 'fairly' or 'very' important to their business. Over two fifths have improved their waste management practices in some way in recent years, for example: 74 per cent of farmers already use scrap merchants, 37 per cent return used syringes to their vet and 39 per cent return tyres to their supplier.[109]
- In 2005 the Environment Agency prosecuted 50 companies and individuals for illegal waste activities on farmland resulting in fines of over £300,000.[110] Many of these prosecutions related to illegal landfills and waste storage on farm holdings. The people involved were not necessarily farmers.[111]
- In 2005/6, local authorities and the Environment Agency dealt with over 4,000 fly-tipping incidents on farmland. There were a further 122,000 incidents along footpaths and bridleways, some of which would have been in the farmed environment. The most commonly dumped substance was household waste. Clean up cost an estimated £6.4 million.[112] These figures are likely to be conservative, as most fly-tipping incidents on private land are probably not reported. These costs mainly fall on farmers and other landowners.
- Although most soils have enough capacity to accept controlled amounts of biodegradable waste, such as sewage or paper sludges, too much can have a negative effect. Increasing amounts of waste are being diverted from landfills and used on land as compost, for example.
- Anaerobic digestion of animal manures from agriculture along with organic wastes from industry and domestic households can potentially deliver a number of benefits. As well as providing a good outlet for waste materials, biogas from the treatment process can be used to generate renewable heat and electricity and also reduces carbon emissions.
- More than a quarter (136,000 tonnes) of waste generated on farms is plastics such as wrap for silage bales and pesticide containers.[113]

>> Waste: the way forward

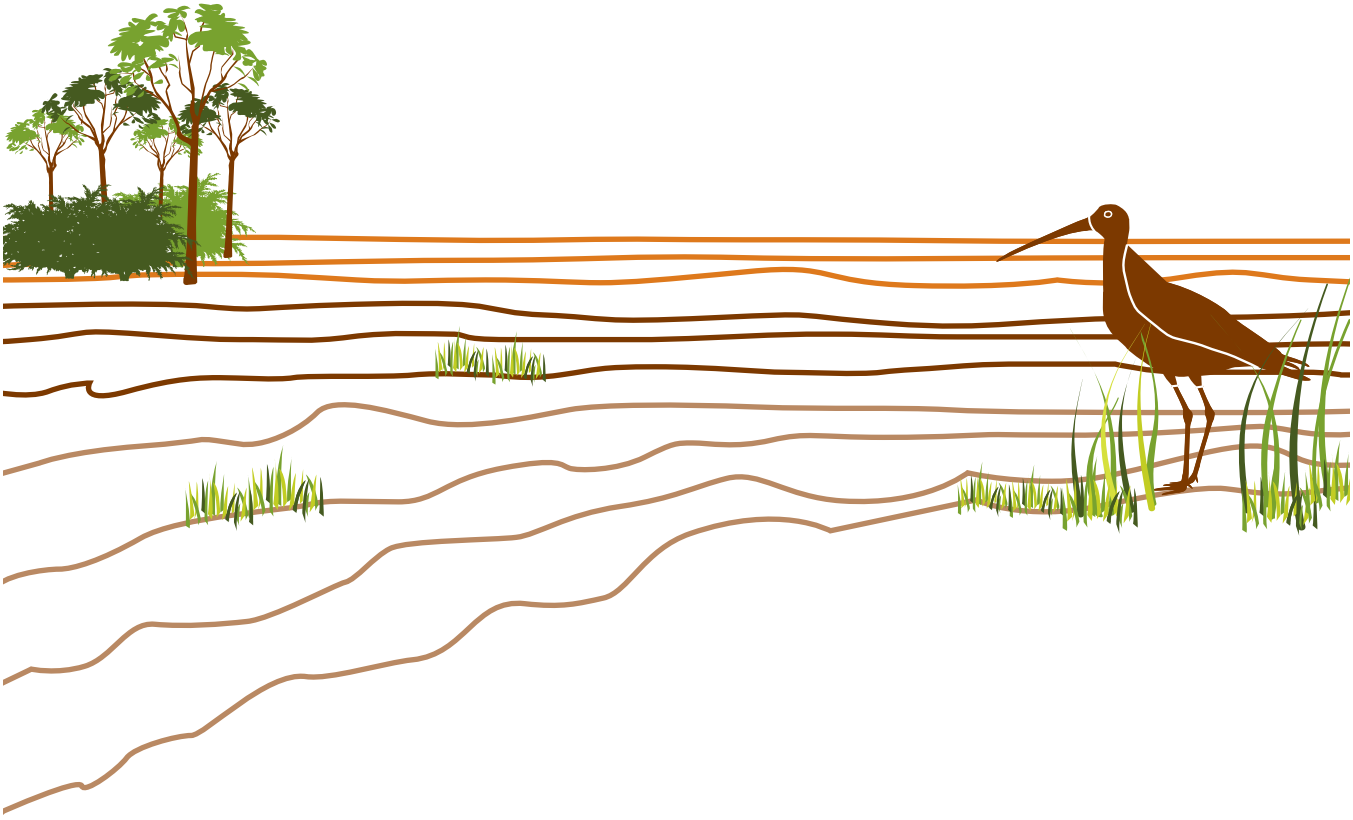
1. Farm waste must be managed conveniently, sensibly and legally.[114] New agricultural waste regulations came into force in 2006.[115] Farmers and growers have until 15 May 2007 to register for any waste exemptions.[116] The Environment Agency has an important role in helping farmers and growers adapt to these new requirements.
2. We support farmers seeking to diversify their existing business into waste management and collection of agricultural wastes such as plastics. In addition, the Environment Agency will work with local authorities and others to resolve planning controls that contradict agricultural waste exemptions for recycling and recovery.

3. The Environment Agency will set out a simple and straightforward licensing and exemption system for authorising disposal and recovery of waste to land that is easy for farmers and contractors to use so that it can concentrate its regulatory effort on the highest risk activities.

4. We want to see farmers working with local authorities, the Environment Agency and the Police to address fly-tipping problems. We have been working with the National Fly-Tipping Prevention Group to produce guidance on preventing and dealing with fly-tipping. We believe that ensuring resources are available to help enforcing authorities tackle fly-tipping and raising awareness amongst householders would go some way to solving and preventing the problem of fly-tipping.

Farmland provides a wide range of habitats for wildlife. Species like otters and barn owls are not only a spectacular sight in their own right, but are also indicators of the overall health of the farmed environment. Some intensive farming practices can harm wildlife and habitats and many of the once common farmland species have declined. Habitats, such as wet meadows, moorland and saltmarshes play an important role in improving water quality and reducing flood risk, as well as supporting distinctive and attractive wildlife. These all rely on environmentally sensitive management by farmers and other land managers.

wildlife and habitats



> The good news

- **Otter populations in England and Wales are increasing and this trend is expected to continue.**
- **The condition of most important wildlife sites in farmland is improving.**
- **Agri-environment schemes are helping biodiversity.**
- **Most farms are passing environmental elements of the cross-compliance farm inspections (* see land section).**
- **The numbers of farmers participating in agri-environment schemes in England and Wales is growing (* see land section).**

< Our main concerns

- **In some areas, biodiversity is being adversely affected by a range of factors, including some farming practices; habitats, insects, plants, birds and fish are all affected.**
- **The condition of our most important wetland sites is lagging behind that of other special sites in part because of water pollution from farms.**

We know this because:

- Cross-compliance, introduced as part of single farm payments schemes across the majority of agricultural land, includes a new environmental standard for farms by protecting a range of habitats and landscape features. In 2005, only six per cent of farms visited by the Environment Agency and the Rural Payments Agency failed under good agricultural and environmental condition (GAEC).[117] Most of the failures in England were under the requirement for farmers to have a two metre uncropped (and fertiliser and pesticide free) strip alongside hedgerows and water courses.[118]
- Agri-environment schemes will continue to make a real difference to wildlife by bringing about changes to land use and management.
- Otters have spread to over a third of river sites surveyed in England and 71 per cent in Wales.[119] Otter populations are likely to respond well where there is a range of habitats including areas of scrub, ponds and wetlands. This could also be supported where farmers choose options for wide, river bank buffer strips under the agri-environment schemes.
- In 2005, 60 per cent of the area of Sites of Special Scientific Interest (SSSIs) on agriculturally managed land in England were in good or recovering condition.[120] However, the state of wetland sites is still worrying. 17,000 hectares of the most important SSSI wetland sites for wildlife are in poor condition because of water pollution from agriculture.[121] These sites include rivers, lakes, freshwater and coastal wetlands, estuaries and coastal waters.
- The decline of some species of farmland birds in the UK has stabilised in recent years.[122] However, six of the nine most threatened or red-listed[123] farmland bird species (starling, turtle dove, yellowhammer, linnet, grey partridge, and skylark) continue to decline.[124] For example, the most recent bird survey shows that yellowhammer populations, which favours open farmland with plenty of scrub and hedges, continued to decline significantly in England and Wales in 2005/6.[125] Birds are regarded as a good indicator of the broad state of the environment and countryside land quality.
- Numbers of stone curlew, a bird that breeds on downland, heathland and sometimes arable farmland, have increased to 300 pairs and are now above the Biodiversity Action Plan target thanks to the joint efforts of farmers, the RSPB and English Nature (now Natural England).[126]
- Falling populations of corn bunting, yellowhammer and grey partridge, have been linked to pesticide use.[127] The links between birds and pesticides are indirect but is thought to be through the impact on the insects that these birds need when feeding their young.
- An area of farmland equivalent to about 760[128] football pitches has so far been returned to natural wetland, salt marsh and mudflat in managed realignment programmes.[129] As well as reducing flood risk to communities behind these areas, these habitats provide spawning and nursery areas for fish and are valuable for recreation, fishing and wetland birds.
- Organic farming can have a positive benefit for wildlife.[130] However, both organic and conventional farms have the potential to perform better for wildlife when well they are managed and are under agri-environment schemes.[131]

- Too much sediment in some rivers is clogging riverbed gravels, reducing the supply of oxygenated water to river plants and insects. The number of eggs that salmon lay in a spawning season can be badly affected by diffuse pollution, excess silt and degraded river channels, all impacts that can come from farming practices. In 2004, half of the most important salmon rivers were at risk.[132] This means that we are not deriving the economic and social benefits that healthy salmon fisheries should generate.[133]
- Contamination from sheep-dip chemicals has caused severe declines of insect populations in several rivers over recent years. The loss of insects, an important food source for fish, could have knock-on impacts on fish stocks. Trout fisheries may also suffer reduced fishing income because of reduced fly hatching.[134]

›› Wildlife and habitats: the way forward

1. We would like to see expanded funding for agri-environment schemes to sustain the creation and maintenance of important wildlife habitats especially where they provide other environmental benefits, for example protection of soil and water resources.
2. We will work to support integrated advice and schemes such as Catchment Sensitive Farming in England and Wales with resource protection (soil, nutrients and water) and, where appropriate, flood risk management plans. This will help to reduce diffuse pollution, create wildlife habitats and provide flood water storage.
3. We will continue to work with others including Natural England and the Countryside Council for Wales, as well as farmers, anglers and conservationists to protect the environment, wildlife, animal and human health. The Environment Agency, along with the NFU, the Veterinary Medicines Directorate and others has launched a sheep dip Pollution Reduction Programme[135] with useful advice for farmers to prevent sheep dip pollution.[136]

And overall?

There are some real success stories in the farmed environment, for example the falling numbers of pollution incidents caused by farmers. There are good signs in the recovery of some species of farmland wildlife. There is some success in river quality as levels of pesticides detected in rivers reduce. Some farmers are using resources more efficiently, including energy, water and chemicals.

While progress has been made there are many other issues where more needs to be done. These include diffuse water pollution, the decline of some farmland wildlife, managing the impacts of climate change and flood risk.

There are three things that we want to see happen to support good farming for a better environment:

We know many farmers are rising to the environmental challenges and building the environment into their business.

We want others to recognise the unique role that farming plays in producing our food and energy and caring for our landscape and our environment.

We will play our part in tackling the issues we have identified in this report. But everyone has to do their bit, with a mixture of innovative forms of regulation, advice, incentives and changes in behaviour to move forward to a better farmed environment.

Endnotes

1. www.defra.gov.uk/farm/policy/observatory/research/index.htm

2. In an agri-environment scheme the farmer is paid to manage certain aspects of the environment by linking good farming practice with environmental protection.

3. Sustainable farming integrates four goals – protecting the environment, using natural resources wisely, farm profitability, and prosperous rural communities.

4. Environment Agency (2005) *Delivering for the environment. A 21st century approach to regulation*.

5. The two main elements of cross-compliance are that land must be kept in Good Agricultural and Environmental Condition (GAEC) and that farmers must meet a number of legal requirements (known as Statutory Management Requirements). More information can be found at www.netregs.gov.uk

6. www.defra.gov.uk/erdp/schemes/es/default.htm

7. http://new.wales.gov.uk/topics/environment countryside/countryside_policy/

8. Entry Level Environmental Stewardship in England and Tir Cynnal in Wales.

9. Higher Level Environmental Stewardship in England and Tir Gofal in Wales.

10. Defra and Welsh Assembly Government websites. June agricultural census 2006.

11. Total number of farms the Environment Agency regulates in England and Wales.

12. Integrated Administration and Control System (IACS) registered farms.

13. Defra (2006) *Agriculture in the UK 2005*.

14. Defra (2005) *Economic position of the farming industry*.

15. See note 13.

16. See note 13.

17. See note 13.

18. Deloitte (2005) *Farm income survey 2005*. The survey is weighted towards larger, more efficient farms in the lowlands and the East of England. www.deloitte.com/dtt/press_release/

19. Turner, M. *et al*. (2003) *Farm diversification activities: benchmarking study 2002*. Centre for Rural Research, University of Exeter.

20. See note 13.

21. See note 13.

22. http://nvz.adasis.co.uk/maps/

23. www.environment-agency.gov.uk/business/444304/1224648/ 1224663/1224949/

24. Environment Agency environmental indicator: Use of inorganic fertilisers in the UK (data: Agricultural Industries Confederation). Since 1980 fertiliser use reduction: nitrogen by 30% and phosphate by 40% (Fertiliser Manufacturers Association Fertiliser Review 2003 and 1998).

25. Environment Agency data.

26. Environment Agency data.

27. www.voluntaryinitiative.org.uk

28. Environment Agency (2005) *Spotlight on business environmental performance in 2004*.

29. See note 28.

30. In February 2006 marketing of cypermethrin-based sheep dips was banned in the UK because of concerns about water pollution. More information: www.vmd.gov.uk/General/Sheepdip/148836.htm

31. Environment Agency data.

32. Environment Agency data.

33. www.keepwalestidy.org/english/default.asp

34. Environment Agency data.

35. Defra (2004) *Updating an estimate of the sources of nitrogen to waters in England and Wales*.

36. Defra (2004) *Developing measures to promote catchment-sensitive farming*.

37. Environment Agency data. Nitrate levels are reported as high where average concentration is >30mg NO_3/l.

38. Environment Agency data. Phosphate levels are reported as high where average concentration is >0.1mg P/l.

39. See: www.environment-agency.gov.uk/business/444217/444663/ 955573/1001324/1005861/1001338/ and http://nvz.adasis.co.uk/maps

40. Environment Agency (2006) *Spotlight on business environmental performance in 2005*.

41. For example, see page 14 Environment Agency (2004) *Spotlight on business environmental performance in 2003*.

42. www.environment-agency.gov.uk/savewater/

43. Environment Agency data.

44. See note 40.

45. Environment Agency data.

46. For example, the Broadland Agricultural Water Abstractors Group. An association of over 150 agricultural and horticultural water abstractors based around the Norfolk Broads and North Norfolk area of East Anglia.

47. Under Rural Development Regulation – EC 1698/2005 Article 26.

48. www.environment-agency.gov.uk/sheepdip

49. Industry led STOP Every DROP campaign www.nfuonline.com/x9623.xml

50. www.environment-agency.gov.uk/business/444304/1224648/1224663/1224949/

51. Because of a reduction in livestock numbers and in nitrogen fertiliser use.

52. National Atmospheric Emissions Inventory, AEA Technology.

53. See note 52.

54. JNCC website. Air pollution and ecosystem change. This pollution is one of the reasons intensive pig and poultry units are being brought under pollution prevention and control (PPC) regulation.

55. Battarbee, R. W. (ed.) *et al*. (2005) *The future of Britain's upland waters*.

56. NEGTAP (2001) *Transboundary air pollution: acidification, eutrophication and ground-level ozone in the UK*.

57. Defra website (2006) Sustainable development strategy indicator: days when air pollution is moderate or higher 1987-2005.

58. See note 57.

59. Defra website (2006) E-digest of statistics: air quality.

60. Benton, J. *et al*. (2000) *Agriculture, ecosystems, and environment, 78, 19-30*.

61. (2004 prices) Watkiss *et al*. (2005) *CAFE CBA: Baseline Analysis 2000 to 2020. AEA Technology Environment*.

62. Defra (pers. comm. August 2006).

63. Countryside Council for Wales (pers. comm. August 2006).

64. Countryside Council for Wales (2005) *Tir Gofal taflen wybodaeth information paper.*

65. Welsh Assembly Government (pers. comm. 2006).

66. The purpose of a Quality Protocol is to ensure confidence in the quality of products made from waste and so encourage greater recycling. This compost protocol is designed to reduce the administrative and regulatory burdens associated with making compost from source segregated biowaste, while continuing to protect the environment and health. The aim is to produce a final version by Spring 2007. See: http://compostQP.dialoguebydesign.net

67. Defra (2004) *Developing measures to promote catchment-sensitive farming*.

68. Environment Agency data.

69. Environment Agency (unpublished) *Diffuse pollution survey, January 2005*.

70. (2000 prices) Environment Agency (2002) *Agriculture and natural resources: benefits, costs and potential solutions*.

71. Environment Agency data.

72. For example, see Environment Agency (2006) *Identification and development of a set of national indicators for soil quality*. R&D Technical report P5-053/2/TR, Environment or Defra Soil Protection R&D programme projects at www.defra.gov.uk

73. O'Connell *et al*. (2004) *Review of impacts of rural land use and management on flood generation. Impact study report*. Defra/Environment Agency.

74. www.floodrisk.org.uk/content/view/89/1/ and http://bangor.ceh.ac.uk/English/reports/pontbren_report.htm

75. Office of Science and Technology (2003) *Foresight: future flooding*. Executive summary.

76. Managed realignment is when flood defences are removed and the limit of protected area is moved landward.

77. CIRIA (2004) *Coastal and estuarine managed realignment – design issues, and Environment Agency data*.

78. See note 73.

79. (1996 prices) Evans, R. (1996) *Soil erosion and its impacts in England and Wales*. Friends of the Earth Trust.

80. See note 70.

81. Countryside Council for Wales/Environment Agency (2006) *Identification of priorities for wetlands, flood risk and diffuse pollution control within future high tier targeted agri-environment schemes. CCW Policy Research Report No. 06/13. This report offers a possible way forward*.

82. This Forum was set up to represent the views of interested parties on flood management and coastal protection issues. Its aim is that these views will be mutually understood and where possible reconciled as well as influence Government policy. See: www.defra.gov.uk/environ/fcd/policy/strategy/governance.htm

83. There is more information about this in the Government's flood risk strategy 'Making space for water.'

84. Office of National Statistics (2006) Environmental accounts: energy use by economic sector, source and fuel, 1990-2004. www.statistics.gov.uk/STATBASE/Product.asp?vlnk=3698

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86. Welsh Assembly Government (pers. comm. September 2006). Also, Netcen (2005) *Greenhouse gas inventory 1990-2002* p.20.

87. See note 52.

88. See note 86.

89. HM Government (2006) *Climate Change the UK Programme 2006*.

90. Baggott, S.L. et al. (2006) *UK greenhouse gas inventory 1990 to 2004*. AEA Technology.

91. www.phenology.org.uk

92. See note 85.

93. Defra (2005) *Planting and growing miscanthus*.

94. There are separate targets in Wales as set by the National Assembly for Wales.

95. Biomass Task Force (2005) *Report to Government, October 2005*. This report was produced in an England context, because its remit covered matters that are devolved in Wales. However, the principles of the report are applicable to Wales, see: www.wales.gov.uk/subitradeindustry/content/consultations/ewrm-map-e.pdf

96. See note 93.

97. See note 95.

98. Harrison, P.A. *et al*. (Eds.) (2001) *Climate change and nature conservation in Britain and Ireland (the MONARCH project)*. UKCIP.

99. Visser, M.E. and Both, C. (2005) *Shifts in phenology due to global climate change: the need for a yardstick*. Proceedings of the Royal Society, Biological Sciences.

100. Nussey, D.H. *et al*. (2005) *Science*, 310, 5746, 304-306.

101. Defra (2005) *Review of Defra R&D on climate change impacts & adaptations (Agriculture) 20 July 2005*.

102. See note 101.

103. See note 101.

104. Pat, H. *et al*. (2005) *Nature*, 437, 245-248 and Heath, J. *et al*. (2005) *Science*, 309, 5741, 1711-1713.

105. See note 85.

106. Sustainability West Midlands and Entec UK Ltd (2003) *The potential impacts of climate change in the West Midlands*.

107. Environment Agency (2003) *Agricultural waste survey*.

108. See note 40.

109. See note 107.

110. Environment Agency data.

111. www.environment-agency.gov.uk/spotlight

112. Environment Agency/Defra. Flycapture: national fly-tipping database.

113. See note 107.

114. Environment Agency (2005) *Waste – you can handle it. New rules on agricultural waste: Duty of Care*.

115. Environment Agency (2005) *Cleaner land, healthier people: Creating a better farming environment. A summary of our approach to the new agricultural waste regulations during 2006 and 2007*.

116. Farmers should have stopped using farm tip/dumps, burning plastics and other materials. Farmers have a Duty of Care when storing or passing waste to someone else. See: www.environment-agency.gov.uk/business/444304/1224648/660279/241420/

117. See note 40.

118. Inspections made by the Environment Agency and other organisations.

119. Environment Agency data.

120. See note 13.

121. English Nature (pers. comm. March 2006).

122. BTO, RSPB, JNCC (2006) *The breeding birds survey 2005*.

123. Red list species are those that are globally threatened, whose population or range has declined rapidly in recent years (i.e. by more than 50% in 25 years), or which have declined historically and not recovered.

124. See note 122.

125. See note 122.

126. RSPB website (2005).

127. Pesticides Forum (2006) *2005 report of indicators reflecting the impacts of pesticide use*.

128. 564 hectares. Based on Old Trafford football ground.

129. See note 76.

130. Wickramasinghe, L.P. *et al*. (2004) *Conservation Biology*, 18, 1283-1292 and Bengtsson, J. *et al*. (2005) *Journal of Applied Ecology*, 42, 261-269.

131. Shepherd, M. *et al*. (2003) *An assessment of the environmental impacts of organic farming*. Defra.

132. Environment Agency data.

133. Environment Agency (unpublished) *The economic impact of inland fisheries in rural areas of England and Wales* and Environment Agency (2001) *Economic evaluation of inland fisheries in England and Wales*.

134. Environment Agency data.

135. www.environment-agency.gov.uk/sheepdip

136. See note 49.

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