Agri-environment schemes in England 2009

A review of results and effectiveness

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Key facts from this report

- At present there are more than 58,000 agri-environment scheme agreements, covering over 6 million hectares – almost 66% of the agricultural land in England.
- AES currently pay about £400 million a year to farmers and land managers in return for them farming in a more environmentally sensitive manner.
- 84% (928,684 ha) of the area of habitats identified as a national priority for protection and restoration (Biodiversity Action Plan priority habitat) eligible for AES is under agreement.
- Targeted initiatives have seen breeding populations of certain nationally scarce farmland birds significantly increase; for example cirl bunting pairs by 130% (1992–2003).
- 41% of hedgerows in England are actively managed under AES with a further 6% having been restored in the last 10 years.
- 24% of stone walls in England are maintained under AES and 3% have been restored in the last 10 years.
- AES delivered a 78% improvement in condition and a reduction in risk for 1,515 scheduled monuments on East Midlands farmland (2005–2007).
- AES coverage of nationally important landscapes is significant. For example, in excess of 90% of the Lake District National Park is under AES agreement.
- The uptake of AES management options specifically designed to reduce soil erosion and diffuse pollution is significantly higher in catchments where addressing these issues is a priority.
- In 2007 AES supported over 6,800 educational visits to farms by more than 170,000 people. 99% of respondents stated that they enjoyed the visit and over 92% of schools reported that their children's knowledge had improved as a result.
- AES currently deliver green house gas savings of 3.46 million tonnes of CO_2 equivalent per year. This is an 11% reduction from the agriculture, forestry and land management sector in England.
- The economic value that people place on the environmental improvements associated with AES is significant. Studies of early AES showed the average net benefit per £1 million of expenditure was £25 million.
- AES support jobs and generate spending in the local economy. Results from research indicate that existing annual AES spend generates further annual spending in the economy of between £178 million and £847 million and sustains between 1,800 and 15,000 jobs.

Contents

Summary

This report provides a summary of the achievements of over 20 years of agri-environment schemes (AES) to date.

For the first time, the report brings together information about both scheme inputs and outcomes across all current AES agreements. These agreements are under the two classic schemes, Environmentally Sensitive Areas (ESAs) and Countryside Stewardship (CSS), and the newer scheme, Environmental Stewardship (ES).

The report also looks to the future and outlines some perspectives on the challenges facing AES and how the schemes might continue to evolve and develop in response.

History of the schemes

AES are voluntary agreements that provide annual payments to farmers and land managers to ensure they manage their land in an environmentally sensitive way that goes clearly beyond the minimum required of them by regulation. Natural England delivers AES in England on behalf of Defra.

AES in England started in 1987 with ESAs, as a response to rapid agricultural intensification and the associated loss of wildlife value and degradation of landscape character. Subsequently, in 1991, CSS, a national scheme, was launched to cover the most important areas outside the ESAs. After a major review in 2005 a new scheme, ES was launched and the ESA and CSS schemes (now collectively referred to as classic schemes) closed to new applicants (although there are still more than 19,000 existing agreements under these schemes).

The design of ES built on the wealth of experience from operating the classic schemes and on the extensive findings from research, monitoring and evaluation of the schemes. Like the classic schemes, ES, is a multi-objective scheme designed to:

- protect and enhance habitats and species, landscape character and quality, the historic environment, soils and natural resources;
- support the adaptation of the natural environment to climate change;
- contribute to mitigating climate change, reducing flood risk and conserving genetic resources; and
- provide opportunities for people to visit and learn about the countryside.

ES has two distinct tiers:

- Entry Level Stewardship (ELS) rewards straightforward environmental management and is open to all farmers and land managers. There is also an organic strand of ELS (OELS) tailored for organic farming systems. ELS agreements last for five years and provide a flat rate payment that relates to the size of the farm. From 2010 an additional uplands strand (UELS) will be rolled out. ELS is a key mechanism for addressing declines in widespread farmland species, such as farmland birds.
- Higher Level Stewardship (HLS) rewards much higher standards of environmental management and is targeted at the land and features of greatest environmental value. Agreements last ten years and payments vary according to the specific management undertaken. HLS is the main delivery mechanism to achieve targets for the condition of Sites of Special Scientific Interest (SSSIs), Biodiversity Action Plan (BAP) targets and a range of other national and international targets. These include, for example, the protection and management of landscape character and features under the European Landscape Convention (ELC) and the Water Framework Directive (WFD).

Inputs

AES are currently funded through part of the EU Common Agricultural Policy (CAP) known as the Rural Development Regulation (RDR) or

Pillar 2. In England the funding is co-ordinated through the Rural Development Programme for England (RDPE) which is a seven-year programme of funding for rural development. Defra is the managing authority for the programme with Natural England, the Forestry Commission and the Regional Development Agencies each responsible for delivering specific components.

The total budget available for AES under the RDPE for the seven-year programme period (2007–2013) is £3.1 billion. This equates to an average of £446 million a year over the life of the programme. The funding arrangements for AES are dictated by Pillar 2 of the CAP.

Uptake

Currently (August 2009) there are more than 58,000 AES agreements covering in excess of 6 million hectares (mha) in England. This represents over 66% of English agricultural land – approaching the 70% coverage target agreed between Natural England and Defra. By area, ELS-only agreements account for the majority (45%), classic schemes (10%), HLS (7%) and OELS agreements (4%). Regionally the proportion of agricultural land under AES varies between 61% in the South East and 81% in the North East.

Within ELS agreements, where farmers and land managers are free to choose any options from the scheme menu, three broad groups of management options dominate. Boundary options, especially hedgerow management (which involves reducing cutting frequency to enhance winter berry availability and restrictions on cutting dates to protect nesting birds), low input grassland options (restricting fertiliser applications and other management practices) and management plans (which are no longer available to new agreements following changes to the scheme to meet requirements of the RDR from 2007).

Despite its widespread take-up, the impact of ELS on food production is marginal. Only 18% of the total land area under ELS is under land management options and only 1% of the total area under the scheme involves a change in management that involves stopping agricultural production altogether.

A much wider range of options, including supporting capital items, are available in HLS. However, option choice is related to environmental features on the holding identified through an environmental audit process known as a Farm Environment Plan (FEP).

Summary of the outcomes

AES design has continually evolved in the light of experience gained. The design of ES incorporated the best features from previous schemes and sought to address known weaknesses. The main highlights and limitations of AES delivery to date are summarised below.

Highlights of delivery

There is continuing evidence that AES are effective in delivering solutions to specific issues at the site and local level:

- Arable options have helped to significantly increase breeding populations of nationally scarce farmland birds (for example cirl bunting pairs have increased by 130% and stone curlew pairs by 87%).
- AES have played a positive role in helping to significantly slow and in some cases reverse the declines of BAP priority butterfly species, especially those associated with short/medium turf.
- CSS has been shown to benefit black grouse. On sites with reduced grazing, numbers of displaying males increased on average by 4.6% a year and 54% of hens retained broods during the late chick-rearing period. This compared to an average 1.7% reduction in displaying males and 32% of hens with retained broods at normally grazed control areas.
- ES has significantly reduced the risk for scheduled monuments in AES, with a 78% improvement in condition of the 1,515 scheduled monuments in farmland in the East Midlands directly attributable to ES management.

There is good evidence that many of the options to benefit farmland birds and other farmland biodiversity that are available under both HLS and ELS are effective:

- Densities of seed eating passerines and skylarks were shown to be higher in winter on stubble and wild bird seed mixture prescriptions than on other arable fields.
- During the breeding season, key options provided nesting habitat and/or invertebrate/seed food and were selected by most field and boundary-nesting birds.
- Small undrilled patches in winter cereals increased skylark breeding densities and productivity, with a 50% increase in the number of chicks reared compared to conventional crops.
- Land-based schemes maintain higher densities of farmland bird species, especially during winter periods, compared to conventionally cropped fields.
- Bumblebee abundance and diversity can be significantly increased by sowing wildflowers or pollen and nectar mix as arable field margins at the local and 10km^2 scale, compared with sown grass margins, natural regeneration or conservation headlands.
- Grass margins have been shown to benefit a variety of species, particularly small mammals.
- Six metre grass margins in combination with hedgerow trees resulted in a substantially higher abundance and diversity of larger moth species, especially where a concerted effort was made to apply these options at a landscape-scale.

HLS has brought a renewed emphasis on the maintenance and pro-active restoration of existing habitats. The scheme has been the main mechanism used to increase the percentage of SSSIs in favourable or unfavourable recovering condition.

- 84% of eligible BAP priority habitat (for which a geographic inventory is available) is under AES agreement (13% under ELS only, 24% ELS-HLS, 23% CSS and 23% ESA).
- 93% of eligible SSSI is under agreement (10% under ELS only, 23% ELS-HLS, 23% CSS and 37% ESA). Of the eligible SSSI area covered by AES, 93% is classed as being in favourable/unfavourable recovering condition compared to 73% for non-AES sites.

HLS has also produced a definite improvement in the approach to habitat creation. This was a weak point of the classic schemes, with many habitat creation projects failing to achieve the anticipated benefits. The design of HLS benefitted from the experience of earlier schemes and adopts a much more targeted and selective approach.

ES has built on the achievements of the classic schemes and has enabled a large-scale expansion in the contribution that AES make to the management of field boundaries, archaeological features, traditional farm buildings and widespread species across far more of the farmed environment than ever before. Key uptake figures are as follows:

- 24% of the stone walls in England are actively maintained under AES and 3% have been restored.
- 41% of hedgerows in England are actively managed under AES, with 6% having been restored.
- Over 250,000 in-field trees are protected by AES and over 2,000 new parkland and hedgerow trees have been planted since 1998.
- In excess of 6,000 archaeological features covering more than 92,000 ha are currently actively managed under AES for their historic environment interest.
- 59% of scheduled monuments and 62% of undesignated monuments in agricultural land are on land under agreement (although not all are under specific management).
- Typically, archaeological features in agreements are better protected than those not in schemes and major improvements have been recorded since the introduction of ES.

- Since 1998 over 7,400 AES agreements have included the maintenance and restoration of historic farm buildings.
- Survey work has demonstrated that 74%-92% of these buildings would not have been restored in the absence of AES funding or would have been repaired to a lower standard.

AES are providers of educational visits and discretionary public access:

- In 2007 there were over 6,800 educational visits, which saw more than 170,000 people visit farms in the Educational Access programme.
- Over 99% of respondents stated that they enjoyed their visit and for over 92% of school visits it was reported that children's knowledge had improved as a result.
- AES currently provide over 7,500 ha and 4,500 km of permissive access targeted at routes that bridge gaps in the public rights of way network, link to national trails and public transport networks, and upgrade existing routes.

The schemes have made a major contribution to maintaining and enhancing landscape character:

- AES coverage of nationally important landscapes, as represented by National Parks, is significant. For example, in excess of 90% of the Lake District National Park is under AES agreement.
- Evaluation has demonstrated positive landscape impacts in the majority of agreements assessed, resulting in stronger landscape components when compared with areas outside the schemes.

The management that AES support makes a significant contribution to reducing the greenhouse gas (GHG) emissions from land management in England:

- AES currently deliver GHG savings of 3.46 million tonnes CO_2 equivalent per year, largely through supporting lower intensity farming practices. This represents about a 0.5% reduction of the annual GHG emissions for England and an 11% reduction from the agriculture, forestry and land management sector in England.

Oakridge Primary School visiting a farm near High Wycombe

Limitations of delivery and actions being undertaken to address them

ELS has not yet delivered the scale of intervention required to address the declines of widespread species of farmland birds:

- National populations of many common and widespread farmland species declined in the mid-1990s. These declines have continued for many species up to the present day.
- The area managed under arable options for farmland birds (138,00 ha with some overlap for wider biodiversity) is small in relation to the 4.9 mha of cultivated land in England.
- On average there is only one skylark nesting plot for every 275 ha of cultivated land.
- The free-choice design of ELS means that, despite high levels of uptake, the balance of options selected within many agreements is not ideal for achieving the desired outcomes. A programme of enhanced training and information support is being developed to help address this as the first agreements approach renewal during 2010. The industry-led Campaign for the Farmed Environment (CFE) should also help to secure the higher levels of option uptake needed and recapture the environmental benefits that were previously provided by set-aside.

Evidence is emerging that the popular hedgerow options in ELS may not be delivering the full benefits anticipated:

- Research prior to the introduction of ELS showed that a move away from annual trimming had positive effects on the production of winter bird food as hawthorn and other woody hedge species produce berries on second year growth. However, there is a risk that these benefits will not be fully realised if the hedges are cut in late summer of the second year before the berries can ripen and be eaten. The design of this option may need to be reconsidered in consultation with farming interests.

As yet, the flexibility incorporated into the design of HLS has not been sufficiently utilised to deliver the complex management required for successful habitat restoration and creation:

- A study in 2008 demonstrated that a high proportion of grassland maintenance and restoration options in early HLS agreements had not been sufficiently targeted or tailored to sites.
- This issue is being addressed through improved training and increased emphasis on structured follow-up visits.

The evidence base for the benefits afforded to landscape character is weak:

- Current evidence relies on the outputs provided by individual component features, land cover or habitats. Longer term monitoring of individual character areas is needed to assess the actual and cumulative impacts of schemes on the areas in context. Clearer evidence is also needed on the use of options that can conflict with landscape character to monitor usage and assist with guidance for advisers and land managers.

An unexpected consequence of the widespread adoption of AES is that the comparative uniformity of management that they impose can be detrimental to some species. For example, the trend of six specialist butterfly species associated with habitat mosaics was significantly worse on scheme sites than non-scheme sites. This issue can be addressed by using the flexibility available under HLS to deliberately create habitat mosaics and by encouraging ELS participants to choose a wider range of management options.

Future perspectives

The immediate challenge for AES is to overcome the limitations identified above and improve the standard of delivery while ensuring that the scheme remains attractive to farmers and land managers.

Looking forward, the scheme needs to demonstrate that it can not only continue to deliver its current objectives, but can also respond effectively to new challenges that will shape thinking about the next Rural Development Programme. This will require:

- action to maximise the potential for AES delivery across the full range of ecosystem services that are provided by the farmed environment, including climate change mitigation;
- the development of ways to target AES effectively in order to deliver landscape-scale objectives (especially climate change adaptation); and
- maintained investment in monitoring, evaluation, research and development in order to assess effectiveness and inform changes to scheme design.

Increased concern about food security, allied with continued pressure from competing land uses mean that work will be needed to optimise the delivery of both market (eg. food production) and non-market (eg. biodiversity) ecosystem services from land.

It seems likely that schemes are going to have to deliver in a climate of increased financial austerity. It is important to convince decision makers of the need to ensure the continued delivery of existing benefits, such as carbon savings, and to continue to invest in environmental land management at an appropriate scale. It is also important to continue to seek improvements in the cost-effective delivery of AES.

Skylark nest

Foreword

The concept of 'green farming' was pioneered in England. It's something we should be proud of and something we must advocate for the future good health of our natural environment, not only in this country but around the world.

The creation and uptake of agri-environment schemes has been a successful meeting of minds between farmers and conservationists for over 20 years. Their success and future role in sustainable land management is paramount. Created by conservationists and farmers in the 1980s they have evolved over the past two decades and now form an integral part of farming businesses.

Not only are these schemes helping us to consign the doom and gloom figures of biodiversity decline to the annals of history, but they are preparing our natural environment for climate change while ensuring that we make the most of the essential services of clean water, flood defence and carbon storage that we all take for granted.

Next time you take a walk in the countryside or you're on a train speeding through farmland, take a closer look. Admire the extent of margins around ploughed fields, the hedgerows and dry-stone walls, the wetland areas, the white horses carved into chalk downland – all of the features that make up the landscape that we love in this country are being retained and improved thanks to these schemes. Others are restoring woodlands and uplands – locking in carbon and providing natural security against climate change. You are now more likely to see scarce butterflies and birds in some areas thanks to the work of farmers. Cirl buntings in Devon and stone curlews being the pin-ups of successful farmland conservation work with black grouse and the chalkhill blue butterfly coming up close behind. How much more can we achieve?

Farmers and land managers clearly recognise that care for the natural environment is a vital part of a sustainable farming system. They have shaped the natural environment in the past and their role in ensuring its health in the future cannot be underestimated. Transforming the way we look after our land and wildlife alongside food production has been revolutionised thanks to the schemes we summarise in this report. Other countries around the world should take note.

Introduction

About this report

This report provides a summary of the achievements of over 20 years of AES in England to date. It brings together information about scheme inputs, results and outcomes across all existing AES agreements for the first time. It also looks to the future and outlines some perspectives on the challenges facing AES and how the schemes might continue to evolve and develop in response.

The schemes considered in this report are those schemes within the RDPE. Specifically:

Environmentally Sensitive Areas (ESA)
Countryside Stewardship Scheme (CSS)
} Collectively referred to as classic schemes.

Environmental Stewardship (ES)

Which includes:
Entry Level Stewardship (ELS)
Higher Level Stewardship (HLS)[1]
Organic Entry Level Stewardship (OELS)
Organic Higher Level Stewardship (OHLS)

And will also include Uplands Entry Level Stewardship (UELS) from 2010.

The analysis excludes the Wildlife Enhancement Scheme (WES), which is now closed. The WES is an English scheme providing funding specifically for SSSIs. It receives no EU funding. In the majority of cases expiring WES agreements will be funded through ES in future. Where appropriate the analysis has been adjusted to reflect land that is currently under WES agreements (and usually unable to enter ES). The small number of existing agreements under the closed Organic Farming Scheme (OFS), Habitats Scheme and Moorland Scheme are also excluded for simplicity.

The report draws on in excess of 170 data sources and integrates scheme uptake data with both academic research and findings from the large body of research on AES commissioned by Defra, Natural England and other organisations.

The Natural England data presented for land management represents all land currently under scheme management as at 1 June 2009, unless otherwise stated. The data for one-off capital investments represent the outputs from all investments over the ten years since 1999 (the period for which data is readily available). It is worth noting that significant capital investments were made before this date.

Where regional analysis is presented the regions used are Government Office Regions (GORs). In some cases analysis is presented for National Character Areas (NCAs)[2]. These 159 character areas comprise broad tracts of countryside that each exhibit a distinct and cohesive character.

[1] Including a small number of standalone HLS agreements.

[2] http://www.naturalengland.org.uk/ourwork/landscape/englands/character/areas/default.aspx

What are agri-environment schemes?

AES provide payments to farmers and land managers to look after the natural environment on their land. They have existed since the mid-1980s and have been particularly successful in preventing detrimental agricultural changes in key areas of wildlife, landscape and historic value across England. The current scheme in England is known as Environmental Stewardship (ES), although many agreements from the previous schemes, ESAs and CSS still remain in place.

The key features of AES are:

- They provide annual payments in return for a commitment to farm with more care for the environment. This might include, for example, reducing the amount of inputs used or the number of animals per hectare of land, leaving field margins uncultivated, creating ponds or other features, or planting trees and hedges.
- The management involved goes clearly beyond the minimum statutory requirements that apply.
- They are aimed primarily at farmers, but may also be suitable to other land managers.
- The agreements are voluntary, typically lasting for five or ten years.
- Funding comes from both the UK Government and the European Union.

Today AES are the largest part of the government and EU funded RDPE. AES in England are delivered by Natural England on behalf of Defra.

A brief history of AES – scheme evolution and development

The approach of paying farmers and land managers to prevent actions that might otherwise lead to environmental damage was pioneered in England. It started in 1985 in East Anglia, with a trial in the Halvergate Marshes, where many farmers were persuaded not to drain and plough grazing marshland.

The concept led in 1987 to the development of the first government-funded ESAs in areas considered to be of landscape, biodiversity and cultural importance. Each ESA had a suite of options or 'tiers' that were tailored to the needs and issues of that area. The simplest options aimed to maintain existing environmental value and more demanding levels intended to provide enhancements.

Halvergate Marshes SSSI, Norfolk

A national scheme, called Countryside Stewardship (CSS), was launched in 1991 to cover the most important habitats outside the ESAs. Most of the original ESA schemes were re-launched from 1992 and more ESAs were added, so there are now 22 ESAs across England. Between 2002 and 2004 most of the original ESA and CSS agreements were renewed for another ten years.

In 2003 a review of the English schemes recommended that the best elements of the ESA and CSS schemes be combined into a single new scheme. This was largely in response to criticisms that the original schemes had 'stemmed the tide' of environmental damage from agricultural intensification but had been less successful at maintaining and restoring high-quality wildlife habitats and features. This review also picked up the findings of the 2002 report of the Policy Commission on the Future of Farming and Food. The report recommended the establishment of a 'broad and shallow' agri-environment scheme to complement the existing schemes, which the report categorised as 'narrow and deep'.

In 2005 a revised scheme, Environmental Stewardship (ES), was launched and the ESA and CSS schemes were closed to new applicants. The ESA and CSS schemes are now collectively referred to as 'classic schemes' and although closed there are still more than 19,000 active agreements. These classic agreements will expire or transfer to ES over the next five years, with a peak of expiry between 2012 and 2013. The last classic agreements will end in 2014. Many of the classic agreements will have been in place for more than 20 years, and Natural England has a target to secure the transfer of 80% of classic agreement land to ES.

Current AES – Environmental Stewardship

Launched in 2005, ES is a comprehensive scheme for farmers and land managers across the whole of England. The scheme has five primary objectives:

- looking after wildlife, species and their many habitats;
- maintenance and enhancement of landscape quality and character;
- protecting the historic environment;
- protection of soils and reducing water pollution (natural resource protection);
- providing opportunities for people to visit and learn about the countryside.

In addition, the scheme has the two secondary objectives of flood management and conserving genetic resources. In 2008, climate change adaptation and mitigation was added as a new over-arching theme.

ES comprises three distinct tiers:

Entry Level Stewardship (ELS) – rewards straightforward environmental management and is open to all farmers and land managers across England. It provides a menu of different management options, each with a points tariff, from which farmers and land managers can choose.

ELS operates on a simple points threshold system – get enough points for environmental management and you are accepted into the scheme. Agreements last for five years and a flat rate of payment is given, proportional to the size of the farm. Example ELS management options, for each broad option group, are as follows:

- Soil protection: managing cultivated land at high risk from erosion.
- Range of crop types: establishing nectar flower mixtures (for insects) in grassland areas.
- Arable land: sowing wild bird seed mixture to provide food for birds.
- Buffer strips and field corners: establishing grass buffer strips along hedges in arable fields.
- Uplands: managing moorland and rough grazing.
- Lowland grassland: managing permanent grassland with very low fertiliser inputs.
- Historic and landscape features: taking archaeological features out of cultivation.
- Trees and woodlands: protecting in-field trees by reducing damage from cultivations and farming operations.
- Boundary features: managing hedgerows by restricting cutting during the bird nesting season and reducing the cutting frequency to develop larger and more varied hedges.

From 2010 there will be an uplands-specific strand of ELS, to be called Uplands ELS (UELS). Specific to farmers within the Severely Disadvantaged Areas (SDAs) of the uplands it will provide an extra suite of options and requirements specific to the needs of the uplands on top of those offered by ELS. In return UELS provides a higher level of payment for a greater commitment to environmental management.

Organic Entry Level Stewardship (OELS) – operates just like ELS but with management options designed to add to the environmental benefits of organic farming. OELS recognises the extra costs and benefits to the environment from farming to organic standards. It offers payments designed to help offset the costs incurred during the process of conversion to organic farming and a continuing, additional flat rate payment that reflects the cost of maintaining organic certification.

Higher Level Stewardship (HLS) – rewards much higher standards of environmental management. Building on ELS, this tier is much more highly targeted at the land and features of greatest environmental value. HLS seeks to encourage the maintenance, restoration and selective re-creation of these features. Agreements last for ten years and payments vary according to the specific management being undertaken. Example HLS options include:

- Maintenance and restoration of species-rich, semi-natural grassland. This option is aimed at maintaining grasslands that are already species-rich and in good condition by continuing, or making adjustments to, the current management. Management must include activities such as grazing by livestock and/or cutting for hay and no ploughing, re-seeding, application of inorganic fertiliser or installation of new drainage.
- Preventing erosion or run-off from intensively managed grassland. In fields identified as being at high risk, using these options will stabilise soils and reduce nutrient losses by the establishment and maintenance of either an unfertilised or a nutrient-restricted, fertilised grass cover. Maintaining a grass cover will help to improve soil structure and water infiltration, reduce surface run-off and protect against wind erosion. Zero or restricted inputs of nitrogen fertilisers and organic manures will reduce the risk of nitrate leaching.
- Floristically enhanced grass margins. This option is used to provide habitat and foraging areas for insects and birds by maintaining field margins that contain a mixture of grass and wildflower species. The margins can be located along field boundaries or as a buffer strip around in-field features such as ponds or archaeological features. Management must include establishing the margin by natural regeneration or by sowing an agreed seed mixture and, once established, cutting or grazing the margin to deliver the desired outcomes.
- Educational access. This option aims to encourage site visits by schools and colleges for curriculum studies at all levels, and by a wide range of other interest groups. It provides the opportunity to explain the links between farming, conservation and food production.
- Maintenance and restoration of fens. Fens can be easily damaged by inputs of nutrients or by scrub encroachment. In addition to high botanical diversity, many of these sites support a variety of birds and insects. These options can also help to protect archaeological features, particularly organic remains.
- Arable reversion by natural regeneration. This option is targeted at the most vulnerable archaeological features within arable or grass ley situations. The purpose is to protect sub-surface features by ceasing cultivation and establishing permanent grassland by natural regeneration.

HLS also provides grants for capital works that are essential to achieve the objectives of the agreement. This includes fencing to exclude livestock, gates for public access, hedge planting, historic building restoration and pond creation.

HLS agreements tend to be more complex and demanding. Applicants, therefore, often receive one-to-one advice from a range of organisations such as the Farming and Wildlife Advisory Group (FWAG), in conjunction with Natural England advisers. HLS incorporates a number of design features intended to help farmers and land managers achieve ambitious environmental outcomes. These features include:

- producing a Farm Environment Plan;
- monitoring the site's environmental condition; and
- the use of indicators of success to allow agreement holders and advisers to monitor the effectiveness of environmental management.

Great Rundle Beck, North Pennines AONB

HLS should enable a real improvement in the standard of environmental management. As such, it is one of the main tools to achieve the targets set by Defra for improving the condition of SSSIs as well as meeting BAP targets.

EU background

AES are funded through part of the CAP, known as the European Agricultural Fund for Rural Development (EAFRD). This is often referred to as Pillar 2 of the CAP or the Rural Development Regulation (RDR). This provides funding for a range of rural development activities, including AES, within the framework of measures set out in the European Council Regulation (2005).

The EAFRD requires all Member States to run a seven-year programme of funding measures for rural development. This is called the RDPE 2007–2013. Defra is the managing authority for the programme. Full details of the RDPE can be found on Defra's website[3]. AES are one of the suite of measures funded through the RDPE and provide the main source of funding for environmental management on farmed land.

[3] http://www.defra.gov.uk/rural/rdpe/index.htm

Scheme evaluation, monitoring, research and development

AES monitoring and evaluation programme

The need for rigorous monitoring was recognised from the introduction of AES in 1987. The key drivers for monitoring are:

- to demonstrate value for money in support of public funding;
- to enable reporting against scheme targets at national and EU level; and
- to understand the effectiveness of management and to feed this back into scheme development and design.

Monitoring effort has traditionally been divided between two separate programmes: compliance monitoring has investigated contractual aspects of delivery (see Chapter 2), whilst outcome monitoring has sought to develop an evidence base for environmental effectiveness across all scheme objectives. This report focuses in particular on the latter.

Natural England is responsible for monitoring the environmental effectiveness of AES, using an annual budget of around £0.9 million. Over 20 years this investment has enabled the collection of a significant body of evidence for scheme outcomes across all scheme objectives; with the use of fixed samples allowing accumulation of long-term data-series at key sites.

The development and delivery of monitoring programmes has reflected the structure and objectives of individual schemes, hence strategies and detailed approaches have evolved over time. The ESA schemes addressed specific environmental objectives within designated areas. Monitoring programmes were tailored accordingly to evaluate delivery against local objectives and performance indicators enabling reporting at the scale of the individual ESA.

In contrast, CS was a national scheme delivered within a framework of target landscapes. The objectives of each agreement were defined individually, and monitoring was also undertaken at the agreement scale, to enable assembly of a national overview of the potential of agreements to deliver against those objectives. This was complemented by a national study of the ecological quality of land under agreement, designed to provide estimates of the extent of key habitats being managed. This latter approach was subsequently extended to ESAs to obtain a complete national picture.

Since the late 1990s AES have increasingly been identified as key delivery mechanisms for external policy drivers, such as the UK BAP (1995). The scope for outcome monitoring has widened to encompass evaluation of the contributions made to such targets. This has led to the adoption of thematic approaches, providing evidence for the contribution of AES to a range of policy frameworks. Typically studies have looked at the quality of management delivered across common scheme elements (such as grassland management and creation, field margin management, building restoration, etc.)

For the RDPE (2007–2013), Member States are required to report to the EC via a common monitoring and evaluation framework that defines targets for a standard set of input, output, result and impact indicators. To provide a comprehensive evaluation of these indicators it is necessary to understand the links between inputs and impacts and to design monitoring programmes that deliver evidence against each link of the chain. This is reflected in the breadth of current monitoring activities, which range from targeted studies of the success of specific options, through holistic assessments of the potential of individual agreements to deliver against all scheme objectives, to support for surveillance activities monitoring environmental features that are expected to benefit from scheme management.

Case study: Farmland bird monitoring

A key policy goal at national and international level, which is dependent on the effective delivery of AES, is the conservation of farmland bird populations. A government target has been set to reverse the declines in farmland bird populations by 2020. The achievement of this target will require effective delivery of both ELS and HLS. But measuring the direct impact of AES on farmland bird populations is potentially complicated by a range of external factors such as changes in land use outside AES and the effects of weather and/or climate. A monitoring programme for farmland birds has therefore been designed to explore the effectiveness of delivery for a range of species and at different scales.

A sound research base has underpinned the development of ES, providing confidence that it contains prescriptions that should deliver the key year-round resources (ie. nesting habitats, summer food and winter food) for most declining farmland bird species (Vickery et al, 2004, Grice et al, 2004). This is supported by evidence that targeted conservation effort has led to the partial population recovery of three rare farmland bird species (Aebischer et al, 2000).

The challenge for ES is to demonstrate positive impacts on a suite of more widespread species, the populations of many of which (for example corn bunting, tree sparrow, skylark) have declined significantly since the mid-1970s.

Accordingly, research and monitoring have been targeted to explore the response of key species to the delivery of agri-environment management:

1. Primary research has been directed at modelling relationships between habitat provision and population responses for key farmland bird species.
2. Scheme management systems provide up to date information on the uptake and spatial distribution of management options used to deliver key habitats. These data are analysed in combination with spatial information on the distribution of target species, to understand the success of scheme targeting.
3. Targeted monitoring effort is directed at research into the effectiveness of management in the field at management option and farm scale. This includes assessments of the quality of delivery of key habitats, comparative assessments of bird densities on scheme and control farms, and evaluation of the use/effectiveness of key habitats by target species.
4. Surveillance data from national monitoring schemes (ie. Breeding Birds Survey for widespread species, Census Activity for range or habitat restricted species) are gathered and evaluated alongside uptake information to explore the observed impact of agri-environment delivery at landscape-scale. This enables investigation of the ‘footprint’ of scheme delivery, as well as exploration of counter-factual trends.

Taken together, these activities represent the ‘chain of causality’ by which the overall impact of AES on farmland birds will be evaluated.

AES research and development programme

This programme has a budget of £2 million a year and is jointly managed by Defra and Natural England. Its function is to support ES by providing the evidence base for scheme policy, design and delivery. There are currently around 20 projects in the programme. In 2009 they were re-grouped into four new assessment units:

- Horizon-scanning and cross-cutting – includes new work on soil structure and will increasingly accommodate ecosystem services and climate change mitigation and adaptation.
- Management and restoration of semi-natural habitats – covers lowland and upland species-rich grassland, heathland and wetland habitats. Includes strategic work to understand plant-soil interactions and grazing behaviour.
- Increasing the wildlife value of farmland – covers arable land and agriculturally-improved grassland. Strong focus on farmland birds and invertebrates.
- Landscape, historic environment and access – includes hedgerows and buried archaeology.

The programme has been running for almost 20 years and many projects are strongly applied in nature, aimed at developing techniques that better deliver the desired outcomes of the scheme.

Case study:
Identifying site potential for restoration using decision-support keys

Habitat restoration is key to achieving BAP targets and restoration options are some of the most widely-used in HLS. But research has shown that sites vary widely in their potential for restoration. For example, sites with soils exerting stress on plants, particularly via a low phosphorus status, have higher potential for species-rich vegetation. And to offer highest potential for wading birds sites must be more than 10 ha in size, free from vertical structures including power lines, and should have sufficient water and surface topography to retain wet areas until the end of May.

These criteria have been combined into several decision-support keys that are used to decide whether candidate sites have high, medium or low potential and hence define eligibility for restoration options. The keys are now published in the HLS FEP Features Manual and can be used by farmers and land managers and their advisers when putting together applications.

Case study:
Green hay technique for grassland restoration

In the mid-to late-1990s, scheme monitoring was showing that botanical diversification of grassland was extremely slow, and research found that it was strongly seed-limited. Techniques for introducing target species from purchased seed were developed; these were successful but expensive. A new technique was developed in the early 2000s in which donor meadows containing target species were cut around two weeks before normal, before the seed was shed. The same day as having been cut the green hay was then spread on prepared receptor sites.

This approach proved to be cheaper, easier for the farmer to undertake, and reliable. When HLS was launched in 2005 it included provision for capital payments to cover the costs of the green hay technique, which have since been widely taken up.

Snake Head Fritillaries, North Meadow NNR, Wiltshire


Cirl Bunting, South Devon

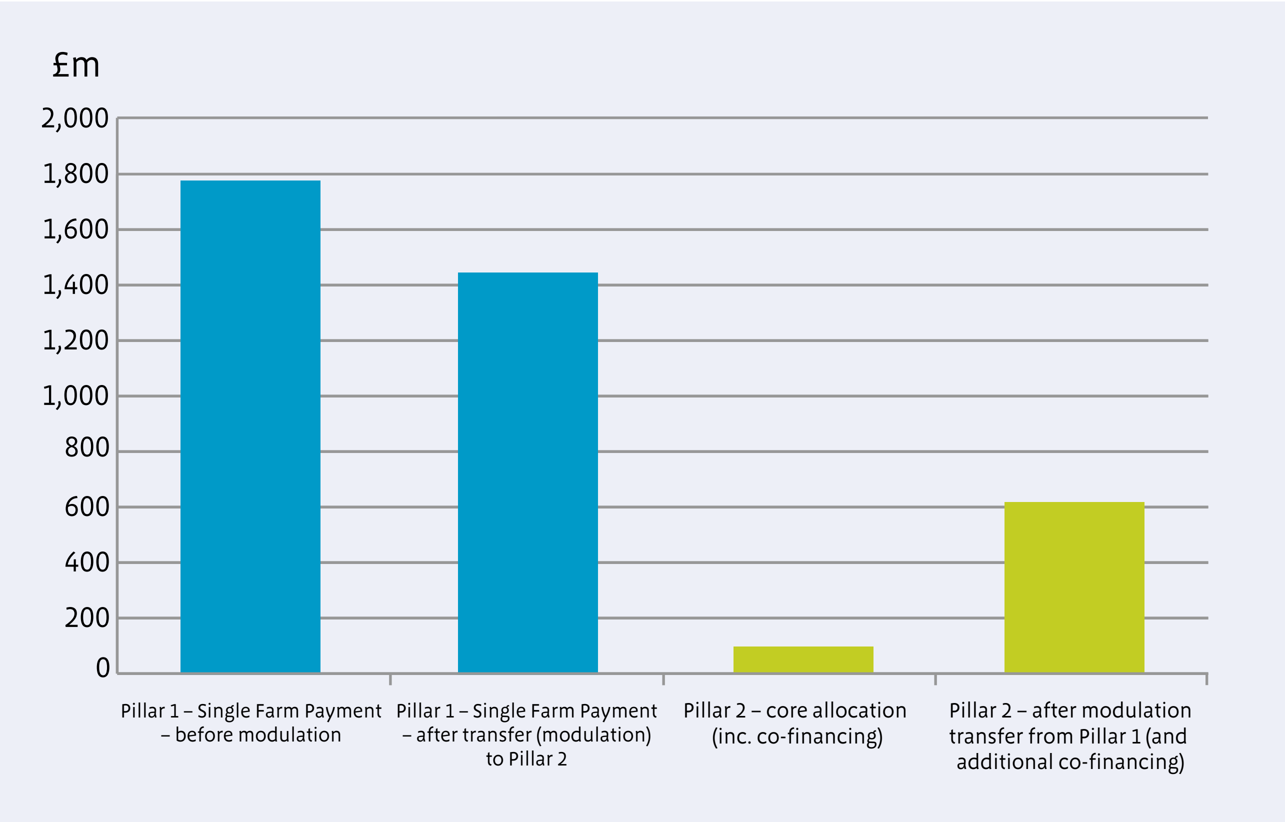
2. Scheme inputs

AES funding

Where does the money come from?

AES are funded from Pillar 2 of the CAP. Pillar 2 accounts for only 19% of the EU CAP budget with the majority dedicated to Pillar 1, the European Agricultural Guarantee Fund (EAGF). Pillar 1 provides direct income support payments to farmers, mainly in the form of annual payments (in England the Single Farm Payment – SFP), and wider support for agricultural markets. The average annual Pillar 1 and Pillar 2 allocations for England for the period 2007-2013 are illustrated in Figure 1.

Figure 1. Average annual CAP Pillar 1 and 2 funding in England (2007–2013) £1 : €1.16



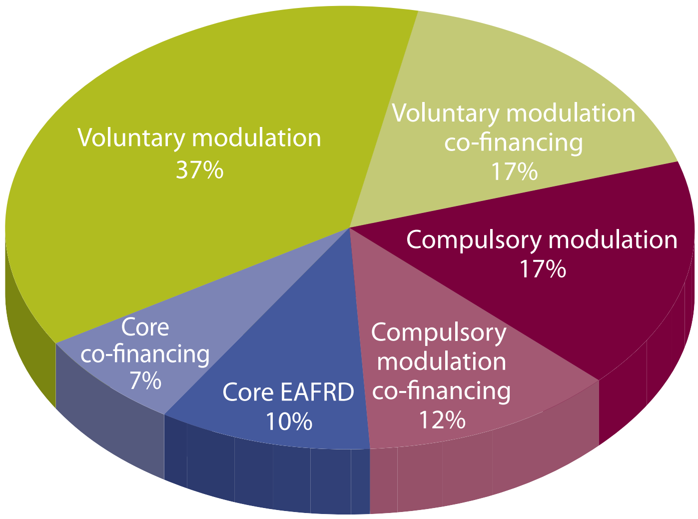
The funding for AES operating within Pillar 2 comes from three main sources:

- A core allocation from the EAFRD for the seven-year RDPE (2007-2013). The allocation between Member States is based on historic spending (on a range of similar activities and wider rural development pre-2000 for the EU15 (European Commission, 2006) not on any need-based criteria. The UK receives a relatively low allocation of 3.5%, compared to, for example, France (17.5%) and Germany (16.1%). This is mainly because the UK did not utilise EU funding for wider (non-AES) rural development measures prior to 2000.
- A transfer of resources (referred to as modulation) from the SFP that farmers receive under Pillar 1 of the CAP. Part of this is compulsory and levied across all EU member states (in 2009 the rate is 7%). In addition the UK is one of only two member states to make use of the provision for additional transfers known as voluntary modulation. In England the rate of voluntary modulation is currently 12%.

- Match funding, referred to as co-financing, from Defra for the RDPE. This is a requirement of the regulations for the core allocation and compulsory modulation. Defra has also provided significant co-financing for the voluntary modulation receipts. The rate is set out in the regulations and varies according to the activity funded and funding source, but is typically a ratio of 55:45 European:UK exchequer for AES.

The breakdown of the RDPE funding by source is illustrated in Figure 2. The EU Rural Development Programme core allocation plus associated co-financing only represents about 17% of the England budget. The remaining 83% is made up by compulsory and voluntary modulation and their associated co-financing. This highlights the major dependency of Pillar 2 funding, including AES, on both modulation and also co-financing from Defra.

Figure 2. RDPE Funding sources (2007-13) (Defra 2009)[4]



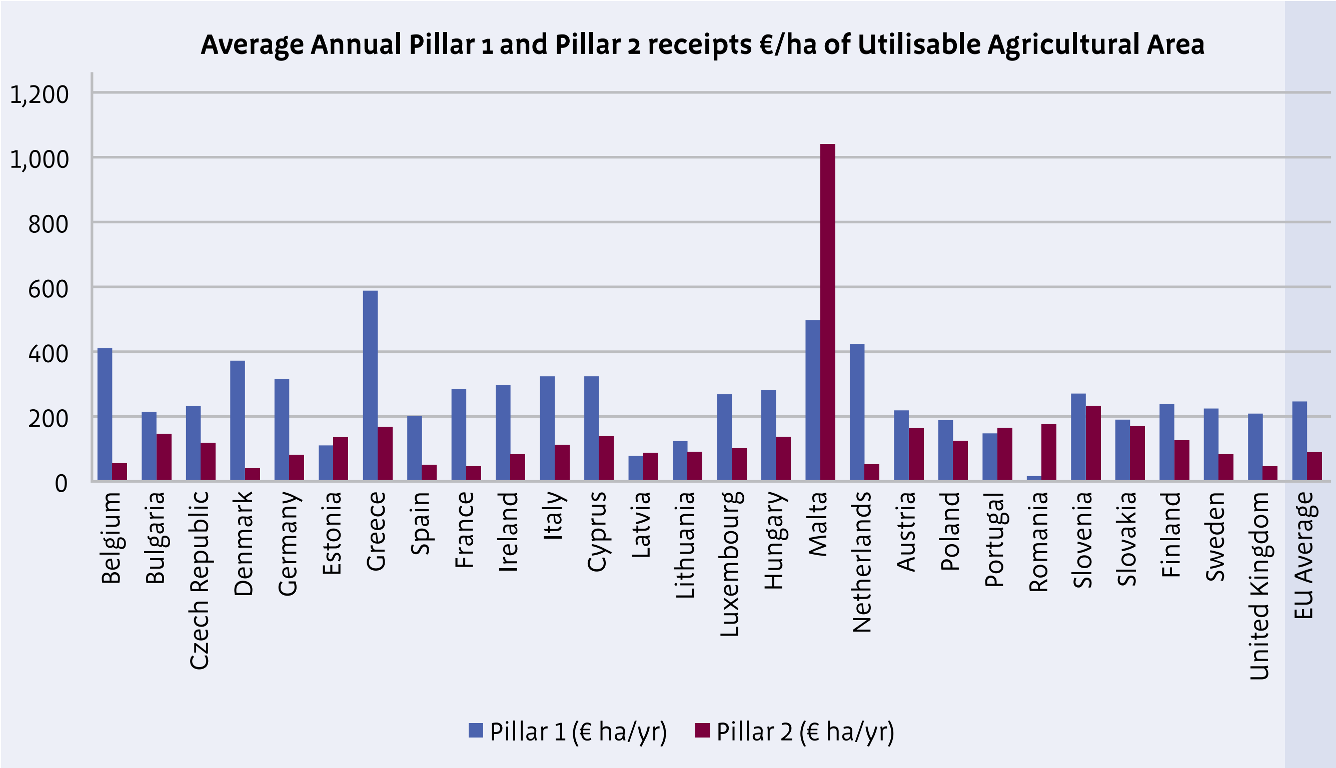
How much funding is available?

The total budget available for AES under the RDPE for the seven-year programme period 2007–2013 is approx. £3.1 billion[5].

- AES are the dominant component of Pillar 2 and equate to more than £400 million per year over the life of the programme – in excess of £1 million per day.
- Spread over the total utilisable agricultural area (UAA) of England this represents £48 per ha/yr. Comparatively the Single Farm Payment (SFP) (after transfer of compulsory and voluntary modulation) in England is still equivalent to £156 per ha/yr.
- There are considerable variations in Pillar 1 and Pillar 2 budgets, expressed per hectare of UAA, across the EU Member States (Figure 3). This is mainly because they reflect historic spending. In all cases, except for Malta, the Pillar 1 budget, which farmers receive as a direct payment (the SFP) is greater than the Pillar 2 budget. Even after additional receipts from voluntary modulation are added the UK still has one of the lowest per hectare budgets for Pillar 2.

[4] Provisional figures reflecting changes following the CAP Healthcheck and subject to EU approval.
[5] At current exchange rate of £1:€1.16. The precise value fluctuates.

Figure 3. Average annual Pillar 1 and Pillar 2 receipts across EU member states (European Commission 2009, European Council 2009)[6].



How are scheme payments calculated?

Payments to participants in AES are governed by the provisions of the EAFRD. This dictates that payments must be no more than 100% of the income forgone plus the additional costs incurred from undertaking environmental management (beyond the legislative minimum), such as the income lost by converting arable land back to grassland, or through reduced crop or livestock production from lower input systems, or the cost of providing access routes for the public across farm land. Additionally, the regulations set out absolute ceilings for payments and how the calculations are prepared and verified.

The process of calculating the scheme payment for particular agri-environment options can be broken down into three steps, each of which must be verifiable. Figure 4 explains the process in more detail.

[6] Based on budget allocations for 2013. UK figure shown before the transfer of receipts from voluntary modulation.

Figure 4. Overview of process for calculating income forgone and additional costs for AES.

Examine the detailed prescriptions for each scheme option and assess the changes that a typical potential participant, in the appropriate geographical area, would need to make to their farming system in order to comply. These changes are required to go beyond the relevant mandatory standards.

↓

Develop a range of financial data that is relevant to both the existing typical farming system and the changes identified in step 1 above. These will include enterprise gross margins, fixed costs including labour, machinery, interest charges and costs associated with new activities. The financial data used, which are annualised, are forecasts to ensure that the resulting payments are relevant in the period in which they will be made.

↓

The final stage is to combine the changes required with their associated financial data, both of which are expressed on an annual basis, to prepare the anticipated annual income forgone for a typical participant. These calculations, based on partial budgeting principles, set out the financial gains (extra income and costs saved) and losses (income lost and extra costs). The difference between the gains and losses represents the annual financial implications for the typical participant of adopting the option on their land.

How much is paid under agreements?

Annual agreement payments vary considerably (Figure 5). For ELS they directly reflect patterns of farm size, based on a per ha payment rate. The pattern for HLS and the classic schemes is more complex, reflecting farm size, the extent and type of annual environmental management undertaken and the level of associated capital works.

Figure 5. AES annual payments by scheme

	Agreement Annual Payment (£)[7]		
Scheme	**Average**	**Smallest**	**Largest**
ELS	4,000	20	180,000
ELS – HLS	18,000	200	327,000
OELS	10,000	20	291,000
OELS – HLS	33,000	990	272,000
CSS	7,000	50	>400,000
ESA	5,400	10	>1,000,000

[7] Average and largest rounded to nearest 1,000, smallest to nearest 10.

Management of the schemes

Natural England's role

Natural England delivers AES on behalf of Defra and undertakes:

- scheme processing;
- new application processing and approval;
- claim processing and authorisation;
- scheme support and promotion;
- scheme design and development;
- scheme targeting; and
- monitoring and evaluation (see Chapter 1).

Scheme processing

In 2007-2008 Natural England processed nearly 5,500 new applications for ES and over 100,000 claims associated with ES and the classic schemes.

All targets for scheme processing times were met or exceeded in 2007-2008, representing an improvement on 2006–2007. This was achieved against a background of significant improvements in efficiency over the same period (see Figure 6). However, the next few years will see very large numbers of classic scheme agreements expiring (and potentially transferring to ES) and the first renewals of five-year ELS agreements. This will represent a major challenge for delivery.

Figure 6. Natural England scheme processing activity 2006-2008

Scheme	Activity	Target	Actual 2006-07		Actual 2007-08		% change in staff time spent per agreement 2006-2008
			%	N	%	N	
ESA	Authorising payment of claims	90% within 2 months of receipt.	64	12,115	96	11,362	-22
CSS	Authorising payment of claims	90% within 2 months of receipt.	83	25,408	95	20,768	14
ES	Processing new applications	Process 90% within 3 months of receipt (O/ELS) and within 4 months of receipt for HLS.	100	8,475	100	5,480	ELS -14 HLS -35
ES	Authorising payment of claims	95% within 1 month of due date.	92	57,088	96	69,763	ELS -54 HLS -121

Scheme support and promotion

Natural England provides extensive support to scheme applicants, especially for HLS agreements, and ongoing support to agreement holders to help deliver the desired outcomes from agreements. Promoting the schemes to secure new agreements is also a key role.

Scheme design and development

Natural England also plays a key role in scheme design and development. ES was developed in extensive partnership with stakeholders and the new UELS is currently being developed through a similar process.

Scheme targeting

In 2008 Natural England conducted a detailed mapping exercise, in partnership with major stakeholders to find the best areas for HLS agreements. A decision was taken to concentrate most of the resource in the areas where there was the greatest potential for management to deliver against multiple objectives, and the greatest value in adopting a landscape-scale approach. Amongst the factors behind this decision was a desire to use HLS to increase the resilience and connectivity of surviving patches of semi-natural habitat in order to maximise their chances of surviving and adapting to climate change.

An extensive spatial analysis of numerous different environmental features and a consultation exercise with delivery staff and external stakeholders led to 110 target areas being identified (see Figure 7) for HLS across England. HLS will be actively promoted in these areas. Each target area has its own Target Area Statement explaining why it is seen as a priority and the kind of agreements being sought. Applications from farmers in areas outside the target areas will still be sought if they can help meet very specific criteria, and benefit high-value features or achieve other high-priority objectives. A series of 'Theme Statements' are available to help guide potential applicants[8].

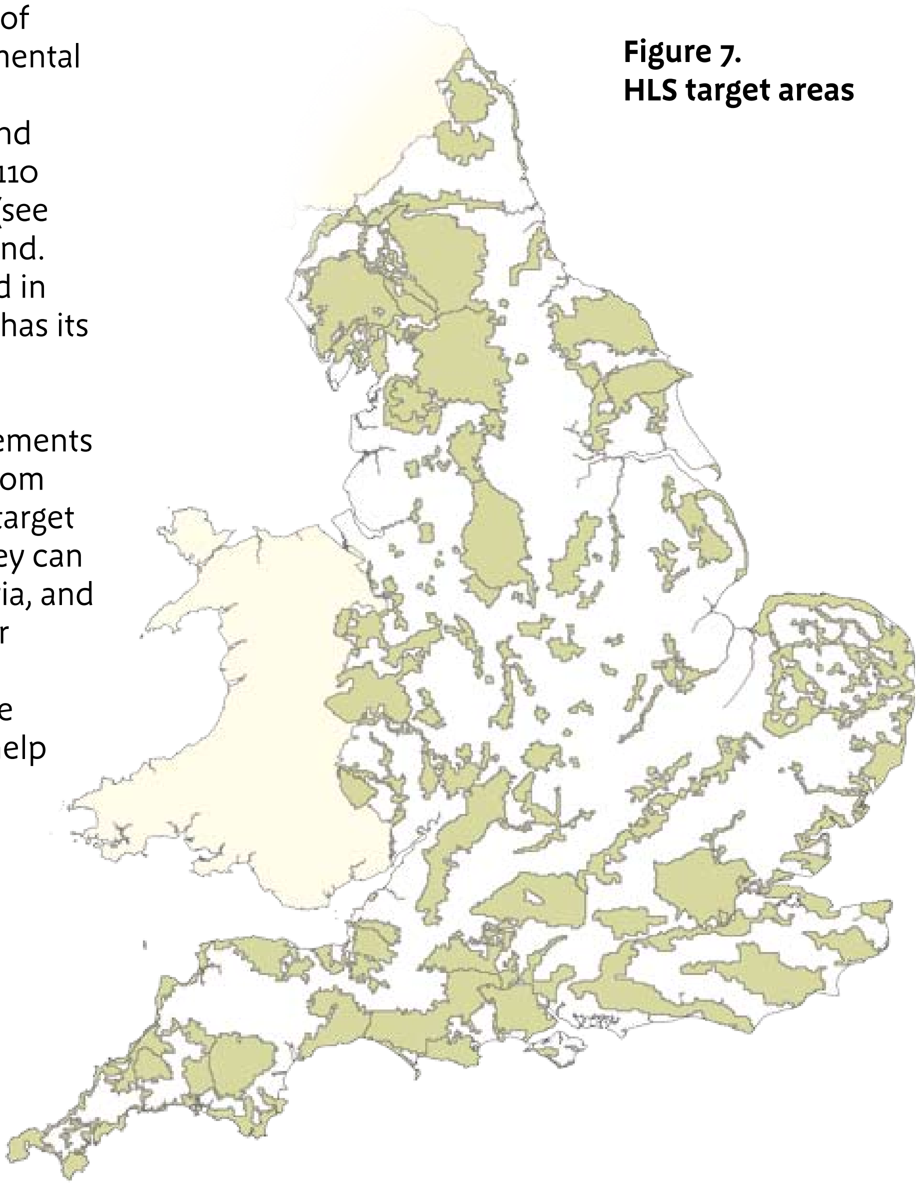


Figure 7. HLS target areas

[8] http://www.naturalengland.org.uk/ourwork/farming/funding/es/hls/targeting/default.aspx

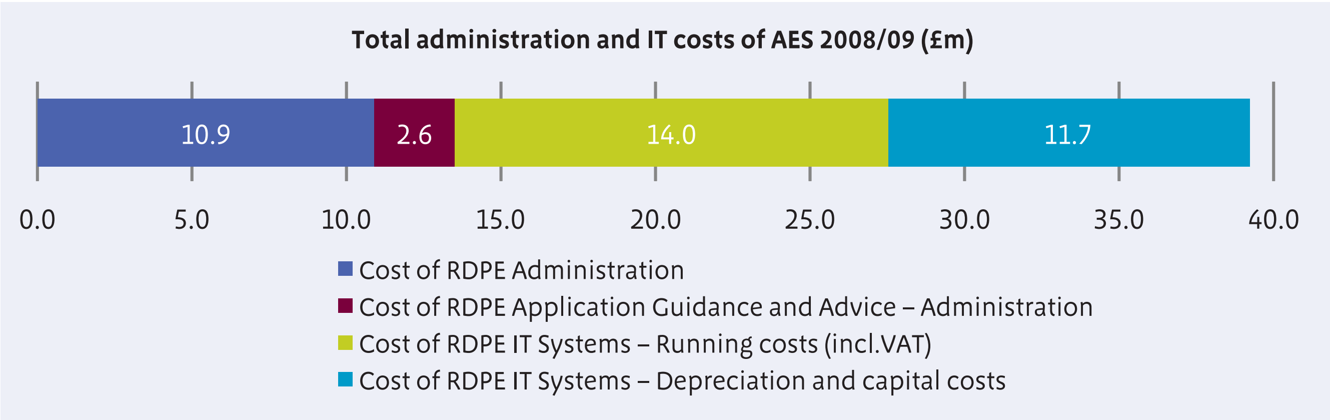
How much does it cost?

The total annual costs of Natural England administering AES during 2008–2009 were just over £13 million. This was met from Grant-in-Aid to Natural England from Defra (this activity is not eligible for funding from the RDPE) and is less than 4% of the average annual spend on AES. A further £25 million was spent on IT system development, operation and associated depreciation, reflecting the complex IT systems required to meet the EU requirements for administering AES funding.

Excluding costs associated with IT systems, the administrative component of the scheme costs can be broken down as follows:

- Classic schemes 48%.
- HLS 34%.
- ELS 18%.

Figure 8. Annual administrative and IT costs of AES 2008–2009 (Natural England, 2009a)



Are there any other costs?

The Rural Payments Agency (RPA) acts as the single paying agency for the RDPE, as required by the EAFRD, and issues payments following claim processing and approval by Natural England. The RPA also undertakes a selection of independent compliance monitoring inspections, to check that agreement holders have complied with the requirements of their agreements. The number and requirements for these inspections are set out in the RDR and associated regulations.

The RPA compliance monitoring costs for the 2008 year selection are set out in Figure 9. They represent less than 0.5% of annual scheme spend.

Figure 9. RPA compliance monitoring costs 2008 agreement year (RPA Inspectorate Management Information System, 2009)

Scheme	Inspections (n)	Cost (£)
CSS	654	405,738
ESA	275	178,759
ELS	1,583	986,447
HLS	119	125,028
OELS/OHLS	20	13,088
TOTAL	2,651	1,709,060

Corn Poppy flowering, Cley-next-the-Sea, Norfolk

3. AES results – an overview

This section is based on analysis of Natural England scheme uptake data as at the end of August 2009. More information about the locations and make-up of all current AES agreements is readily available[9].

9 http://www.natureonthemap.org.uk/map.aspx?m=aes

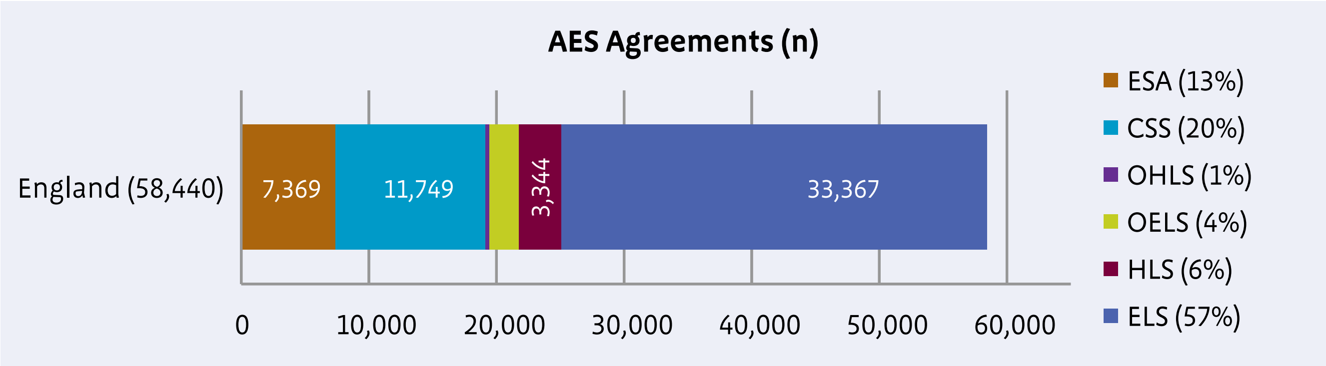
Scheme agreements

How many agreements are there?

In England there are currently over 58,000 AES agreements, as follows:

- The majority of these, 57%, are ELS only with a further 20% in CSS and 13% in ESA[10].
- ELS-HLS agreements currently account for 6%.
- Organic strand ES agreements account for 5%.

Figure 10. Number of AES agreements

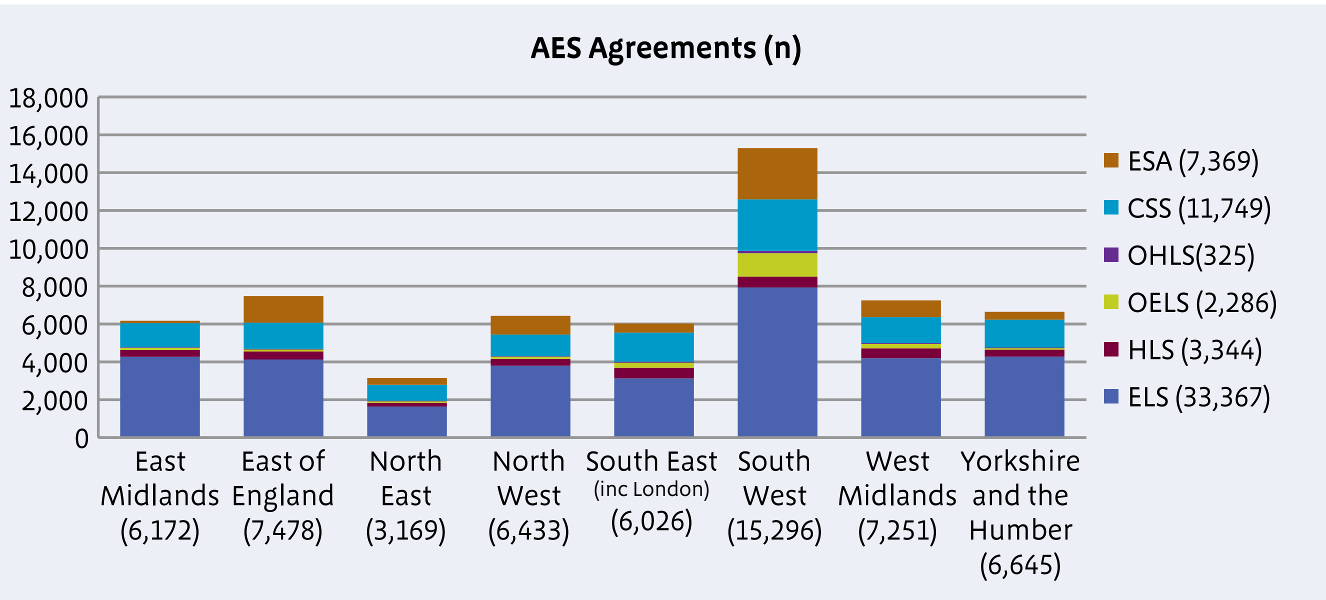


Regionally the numbers of agreements broadly reflect the numbers of farms in each region. Two key differences emerge:

- A concentration of ESA agreements in certain regions, especially the South West, reflecting the distinct geographical pattern of this scheme.
- A very strong concentration of organic agreements in the South West.

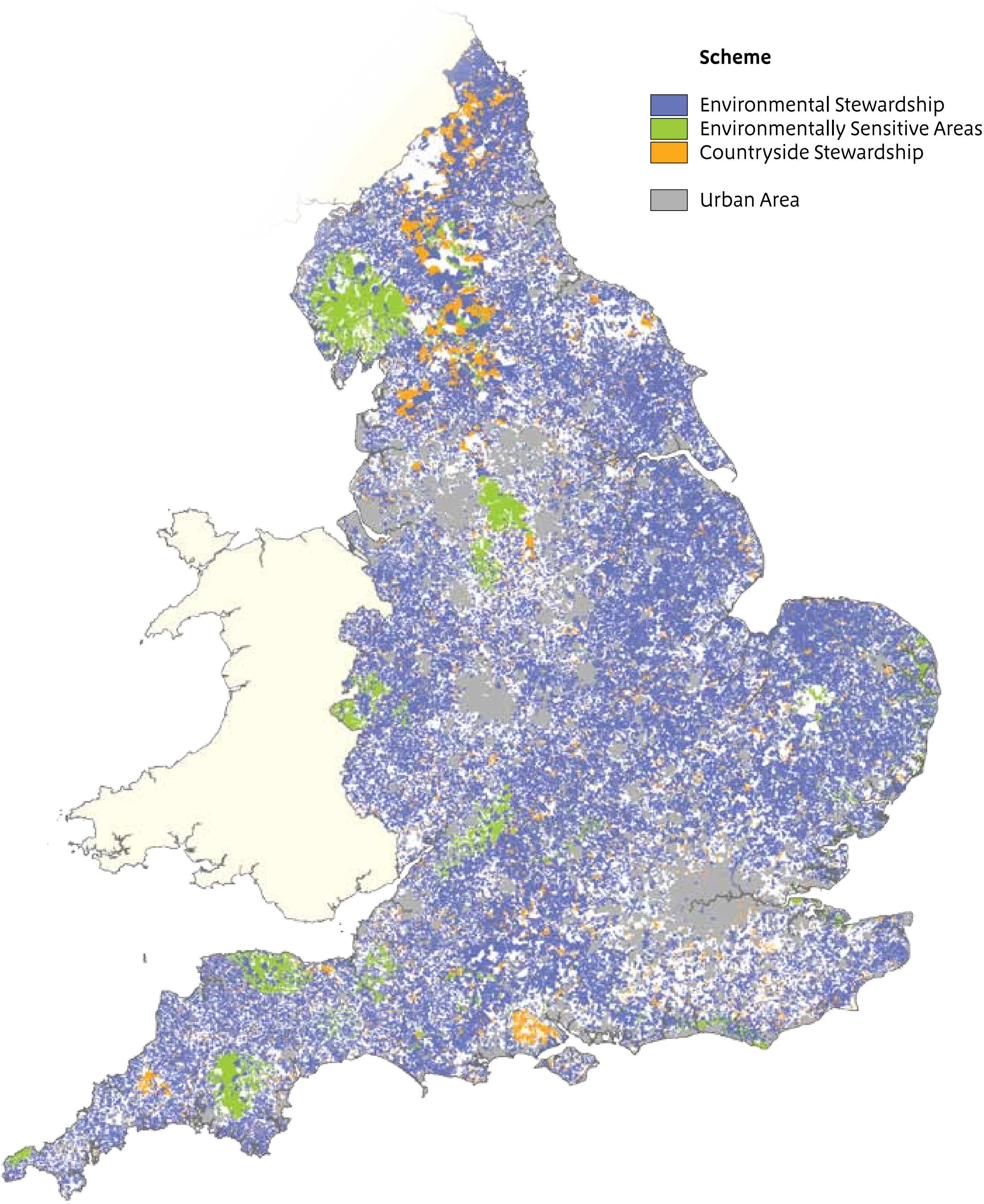
Figure 12 llustrates the geographical pattern of different scheme agreements

Figure 11. Number of AES agreements by region



[10] It is possible in some circumstances for a farm to have more than one agreement.

Figure 12. AES agreement coverage by scheme

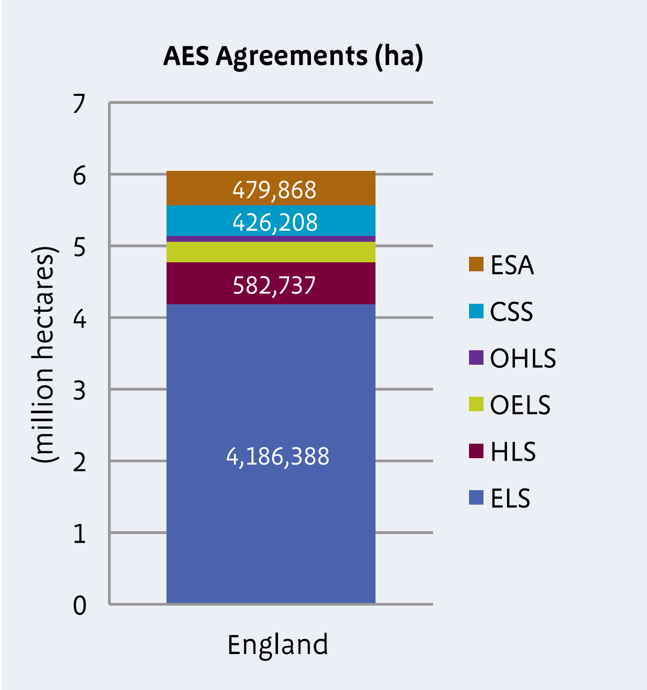


How much land do they cover?

Nationally (Figure 13):

- AES cover a total area of just over 6 million ha.
- This represents 66% of UAA, approaching the target of 70% UAA coverage.
- ELS only agreements account for the majority, about 4.1 million hectares – 45% UAA.
- ELS-HLS represent a further 7% of UAA.
- Organic agreements only cover 4% UAA.
- Classic schemes together contribute 10% of UAA.

Figure 13. Area of AES agreements



Regionally (Figure 14):

- The proportion of UAA under AES varies between 61% in the South East to 81% in the North East.
- The proportion of ES coverage is the lowest in the South West, North West and South East. This is offset to some extent by large areas under classic schemes, especially in the North West, that depress ES uptake.
- There are especially large areas under ESA agreements in the North West and South West.
- The North East has the largest proportion of land under CSS.

Figure 15 illustrates the total UAA coverage by National Character Area (NCA).

Figure 14. Proportion of UAA in AES by region

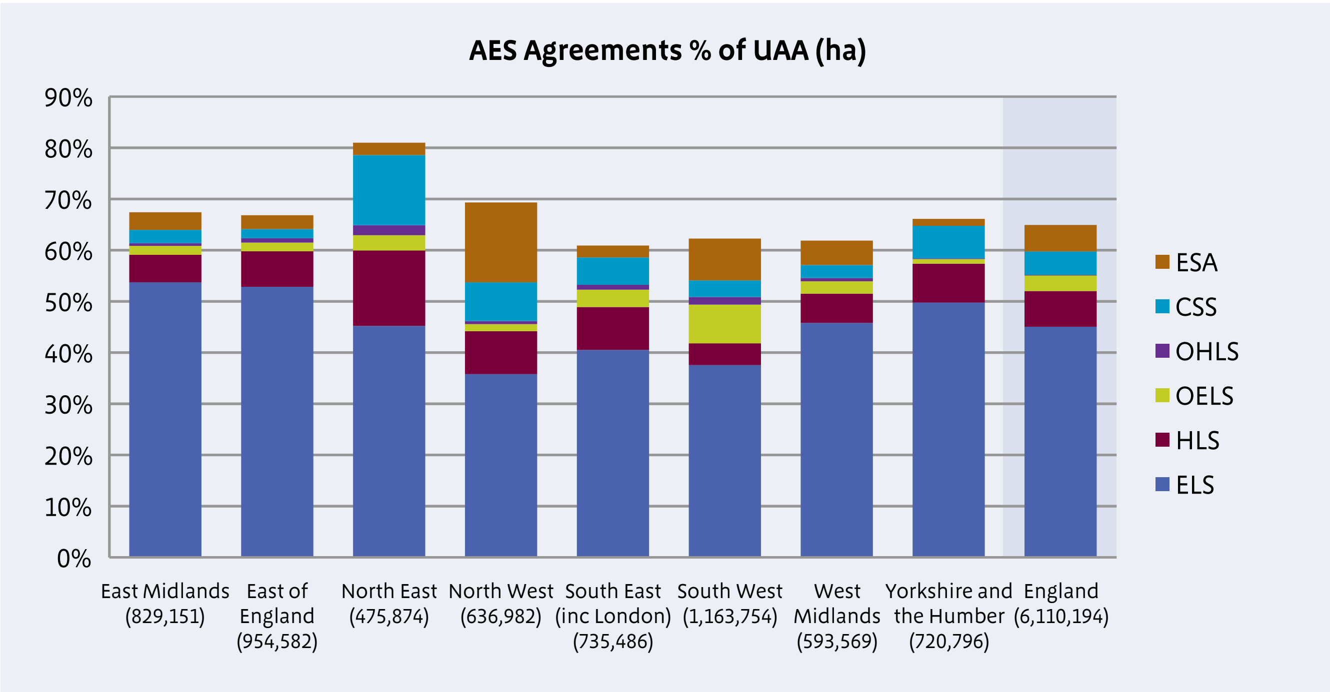
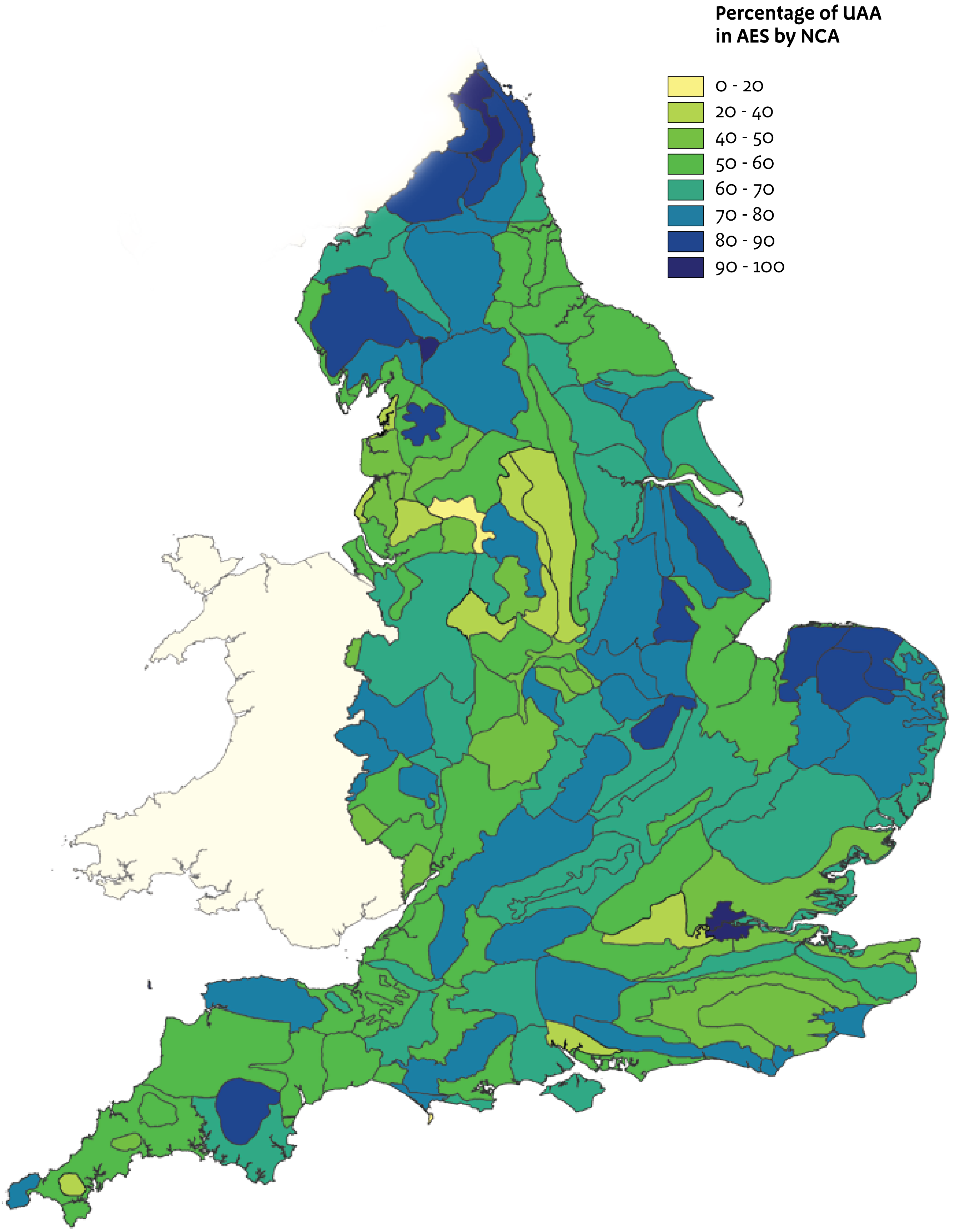


Figure 15. AES agreements as a % of UAA by NCA



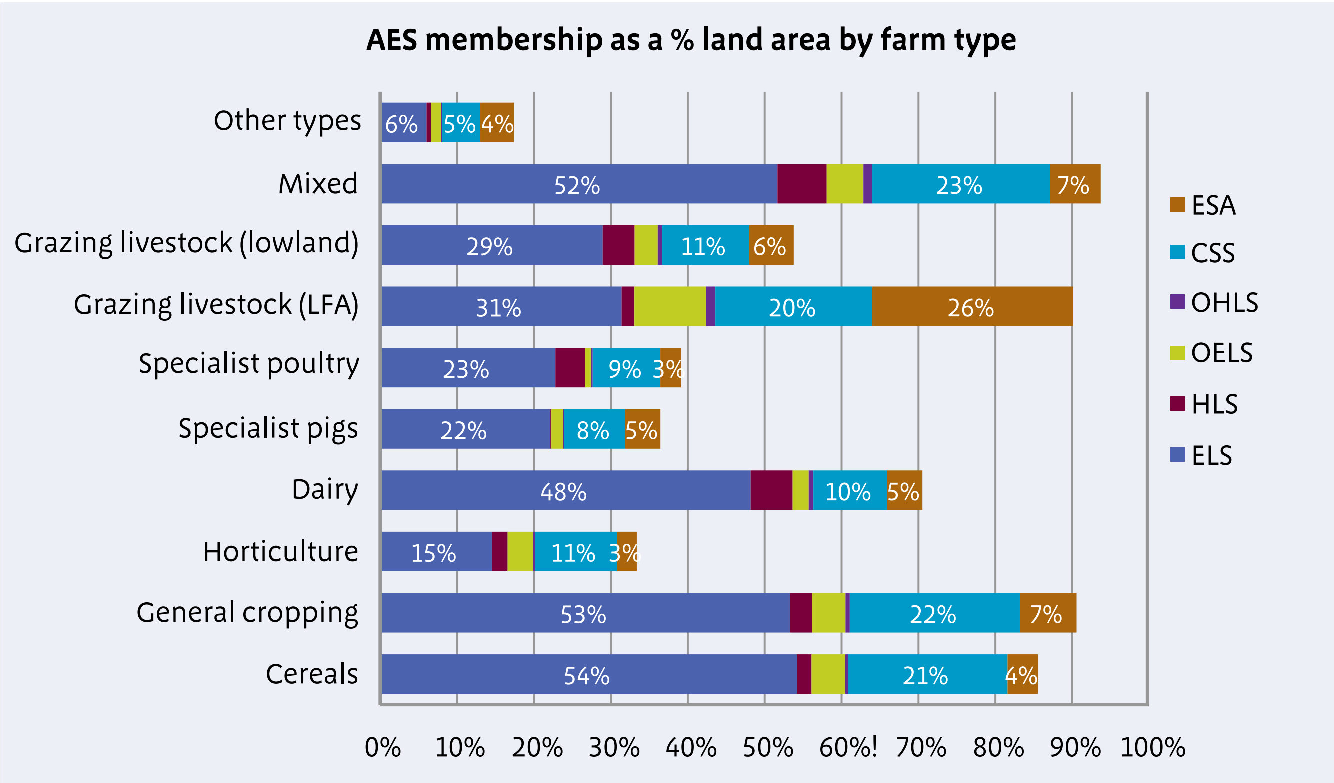
Are particular types of farms more likely to have AES?

There are strong patterns of adoption/non-adoption of AES by farm structural characteristics. Figures 16 and 17 present results of an analysis of AES membership by farm type classification and farm size classes[11].

In terms of farm type:

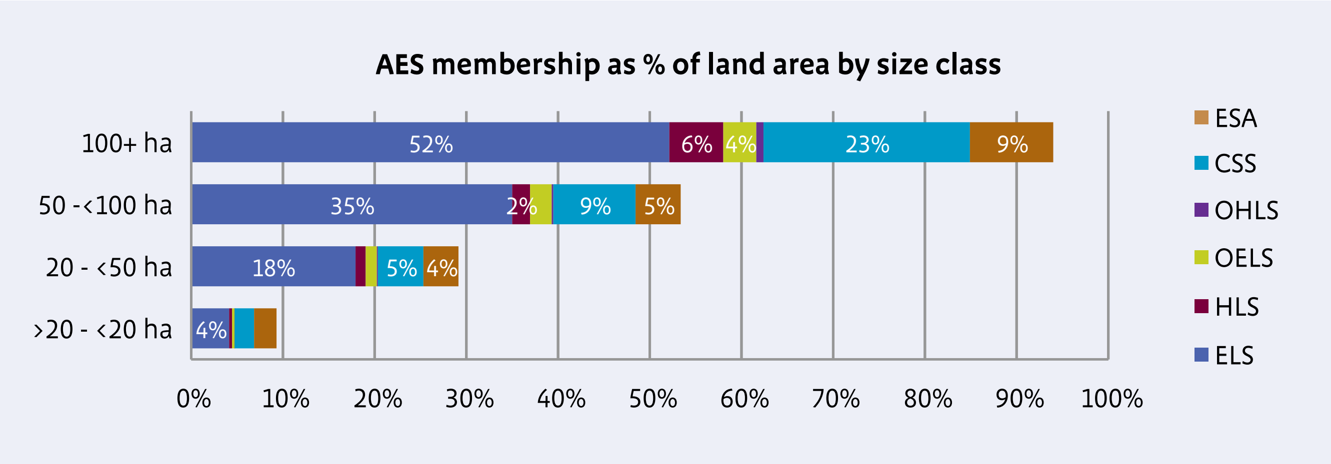
- Farm types most likely to have ELS agreements are: mixed, cereals, general cropping and dairy. Approximately 50% by area of these types are within agreements.
- HLS agreements are most commonly found on upland grazing livestock farms (9% of total area) despite the high levels of classic scheme coverage for this farm type.
- Organic agreements are more strongly associated with mixed and dairy farm types.
- Upland grazing livestock farms have very high levels of classic scheme coverage, especially ESA.
- The lowest levels of AES are associated with specialist pig, poultry, horticulture and other farm types. ELS take up as a % of land area under these types is 23% or less.
- AES are often less attractive for intensive production systems and smaller holdings.

Figure 16. AES membership by farm type (as a % of land area covered by each type)



[11] This information is derived by matching AES data with data from Defra's agricultural survey. The different dates of these sources means that about 15% of AES agreements cannot be matched. The analysis includes the whole holding area of classic schemes (unlike the previous UAA analysis). The overall totals also include a small element of double counting, where holdings have both ES and classic scheme agreements.

Figure 17. AES membership by farm size



The scheme payment calculations are based on average farming systems and, consequently, they cannot always compete with the higher returns from more intensive/specialised production. For smaller holdings the potential payments are typically relatively low and flexibility to change farming system may be limited (a large number of smaller holdings are found in the 'other' and lowland grazing farm types).

Management options within AES agreements

The information in this section is based on patterns of management option uptake within ES agreements. Broadly similar patterns of option uptake are found in classic scheme agreements.

Which are the most popular ELS and OELS options?

The ELS and OELS contain about 60 options from which farmers and land managers are free to choose.

- The average number of options in ELS agreements (excluding the compulsory farm environment record) is 6.4, with a minimum of 1 and a maximum of 25.
- The pattern of option uptake between ELS and OELS is very similar, and only a small number of differences emerge.

Three groups of options feature highly among the most popular ELS/OELS options (Figure 18).

- Boundary options, especially hedgerow management, but also ditch management and stonewall protection and maintenance. Hedgerow management includes reducing cutting frequency and restrictions on cutting dates.
- Management plan options are no longer available to new agreements. They were a popular option that was available prior to changes required as part of the approval of the current RDPE. They feature in many existing agreements.
- Low input grassland options are also popular. Typically these involve reduced fertiliser inputs.

Analysis in the ES review of progress (Defra and Natural England, 2008) showed:

- The six most popular options (in terms of points) account for 49% of all points scored, and the 20 most popular account for 90% of all points.
- 15% of ELS agreements score more than 70% of their points from lowland grassland options.

- 6% of ELS agreements score more than 70% of their points from boundary options.
- 40% of ELS agreements score more than 70% of their points from lowland grassland and boundary options.
- Limited uptake of in-field options, especially in arable areas.

ELS management options involve changes in management on a relatively small proportion of land:

- 18% of the total farm area under ELS is under land management options.
- Only 1% of the total farm area under ELS involves management that requires stopping food production.

Which are the most popular HLS options?

HLS contains a much wider range of options than ELS and also includes a wide range of capital items to support achievement of scheme objectives. Five broad groups emerge from the top 20 (Figure 19):

Boundaries

Hedgerow restoration and hedgerow planting feature in a large proportion of agreements, as do a range of stock-proof fencing capital items usually used to exclude livestock from grazing certain areas.

Grassland

Restoration of species-rich semi-natural grassland is the single most common option, featuring in 44% of HLS agreements. Other grassland options, including those to protect archaeological features, also feature strongly along with associated supplements for activities such as hay making, which are often important for the management of grassland sites.

Access

Permissive access features in about 20% of agreements.

Woodland/trees

Maintenance of woodland (24%), restoration of woodland (21%) and tree planting (15%) are a common element of agreements.

Arable

6 metre buffer strips, enhanced bird seed mix and fallow plots for ground-nesting birds feature
in 16–24% of agreements.

Figure 18. The 20 most popular ELS and OELS options (% of agreements containing option)

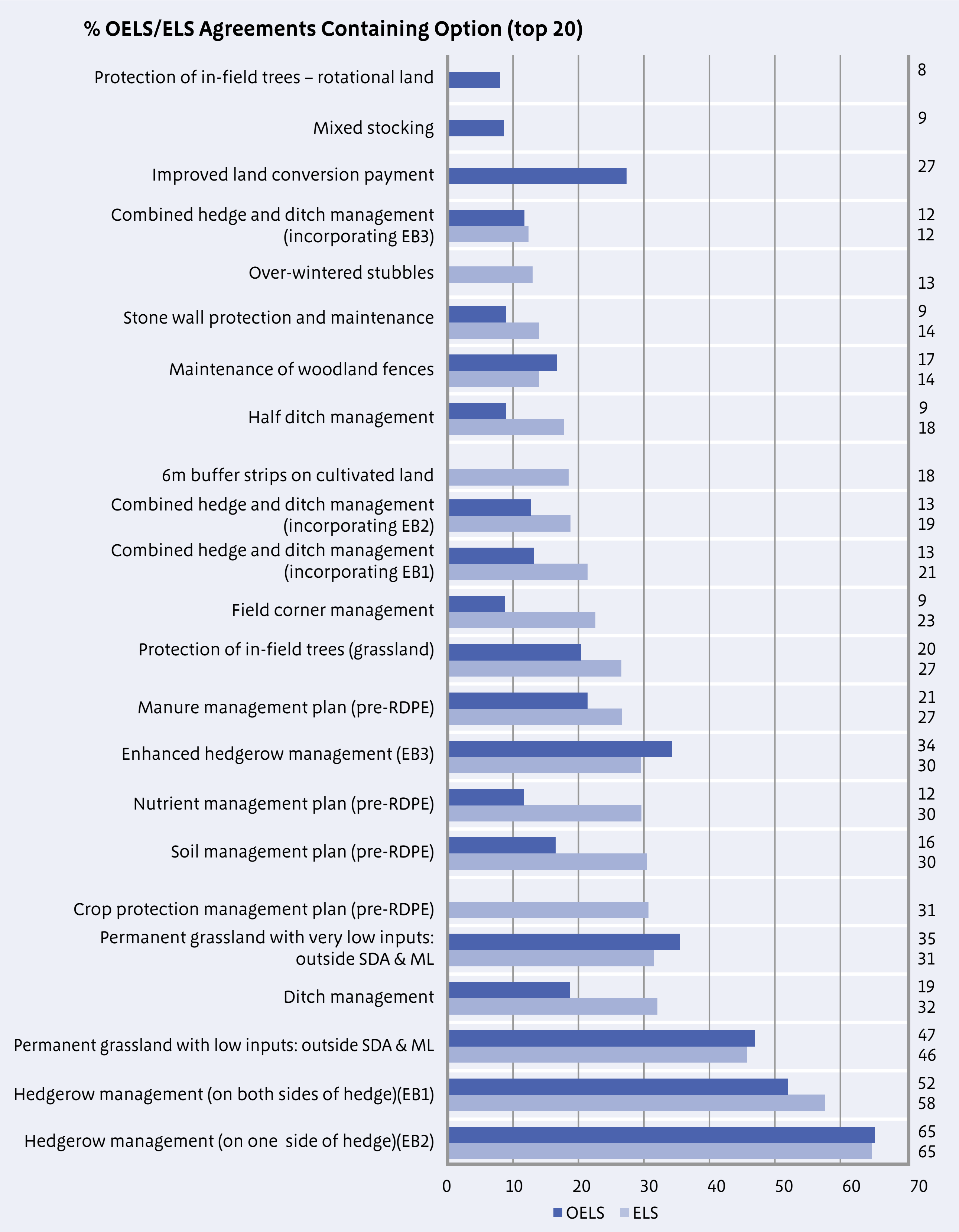
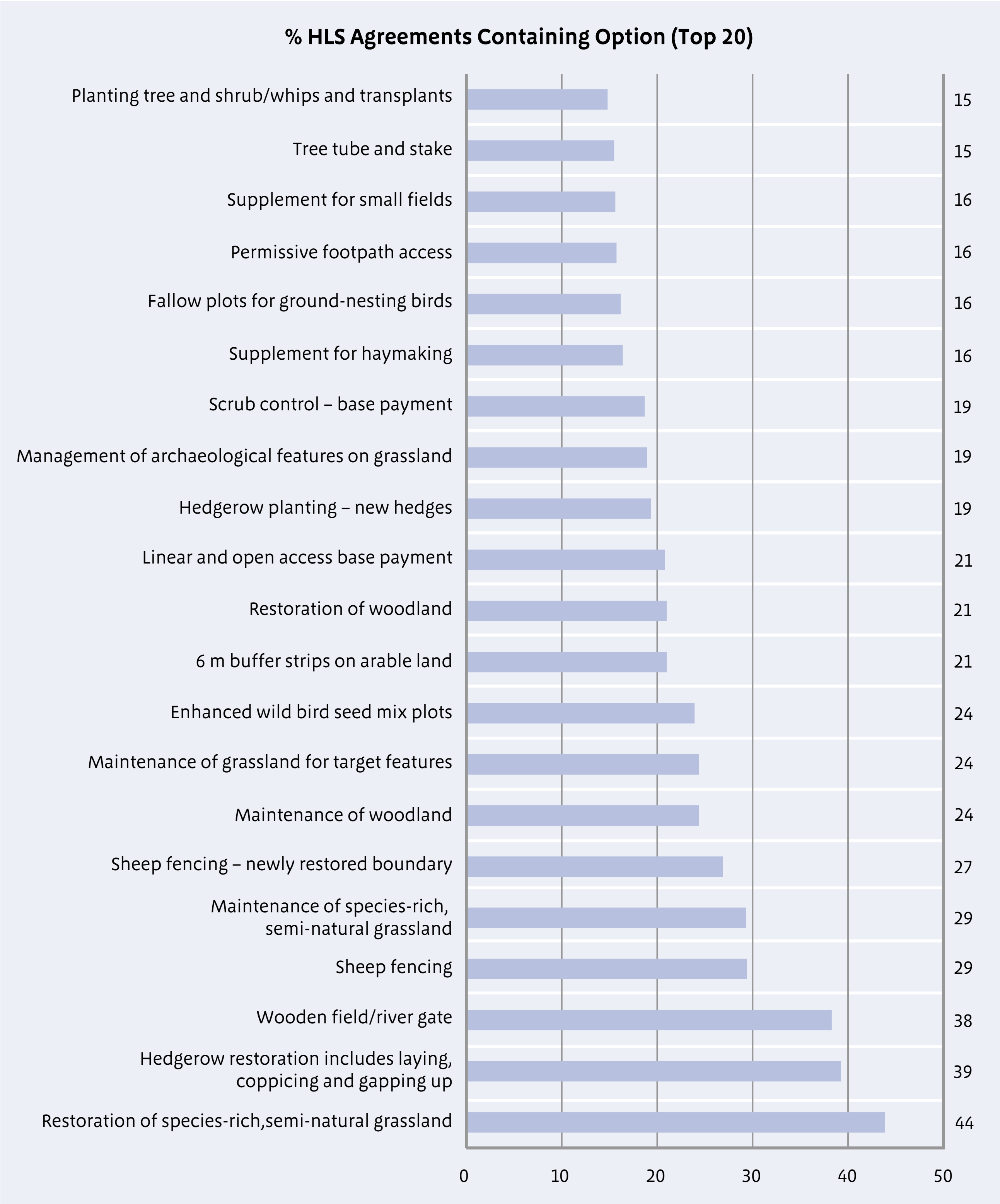


Figure 19. The 20 most popular HLS options (% of agreements containing option)



The Settled Estates Lincoln Red herd, Lincolnshire

4. AES results and outcomes – the details

AES results and outcomes – the details

AES are multi-objective in nature and many scheme options will deliver against two or more objectives. The analysis presented here is indicative and generally scheme uptake information is only presented once where it is most relevant. Unless specifically identified the option data for ELS and HLS is split based on the availability of options reflecting the nature of management involved (eg. ELS options are available in HLS agreements but reported here as ELS options). Figures for OELS and OHLS have been subsumed within the relevant ELS/HLS data for simplicity. The use of n/a denotes that the management option is not available in that type of agreement.

The data available for classic schemes is not always in a form that is directly comparable to ES. In addition there are a number of special projects that involve specially tailored management solutions for specific areas. Detailed breakdowns for activity funded under these special projects are not readily available and therefore do not feature in these totals. However, they have made significant impacts in certain areas, for example in the New Forest, and so the figures underplay the true extent of AES intervention.

Habitats and species

This section reviews the role of AES in relation to seven broad habitat types and their associated species. As the discussion refers to BAP habitats some background information on these is provided below.

The UK Government is a signatory to the 1992 Convention on Biological Diversity. As a result of this, the UK BAP, which describes the UK's biological resources and outlines plans for their protection, was published in 1994.

This plan identifies a number of priority habitats and species which require the most urgent action for their protection.

Priority habitats meet one or more of the following criteria:

- habitats for which the UK has international obligations (eg. under the EU Habitats Directive);
- habitats at risk, such as those with a high rate of decline over the preceding 20 years, or which are rare;
- areas (particularly marine) which may be functionally critical; and
- areas important for key species.

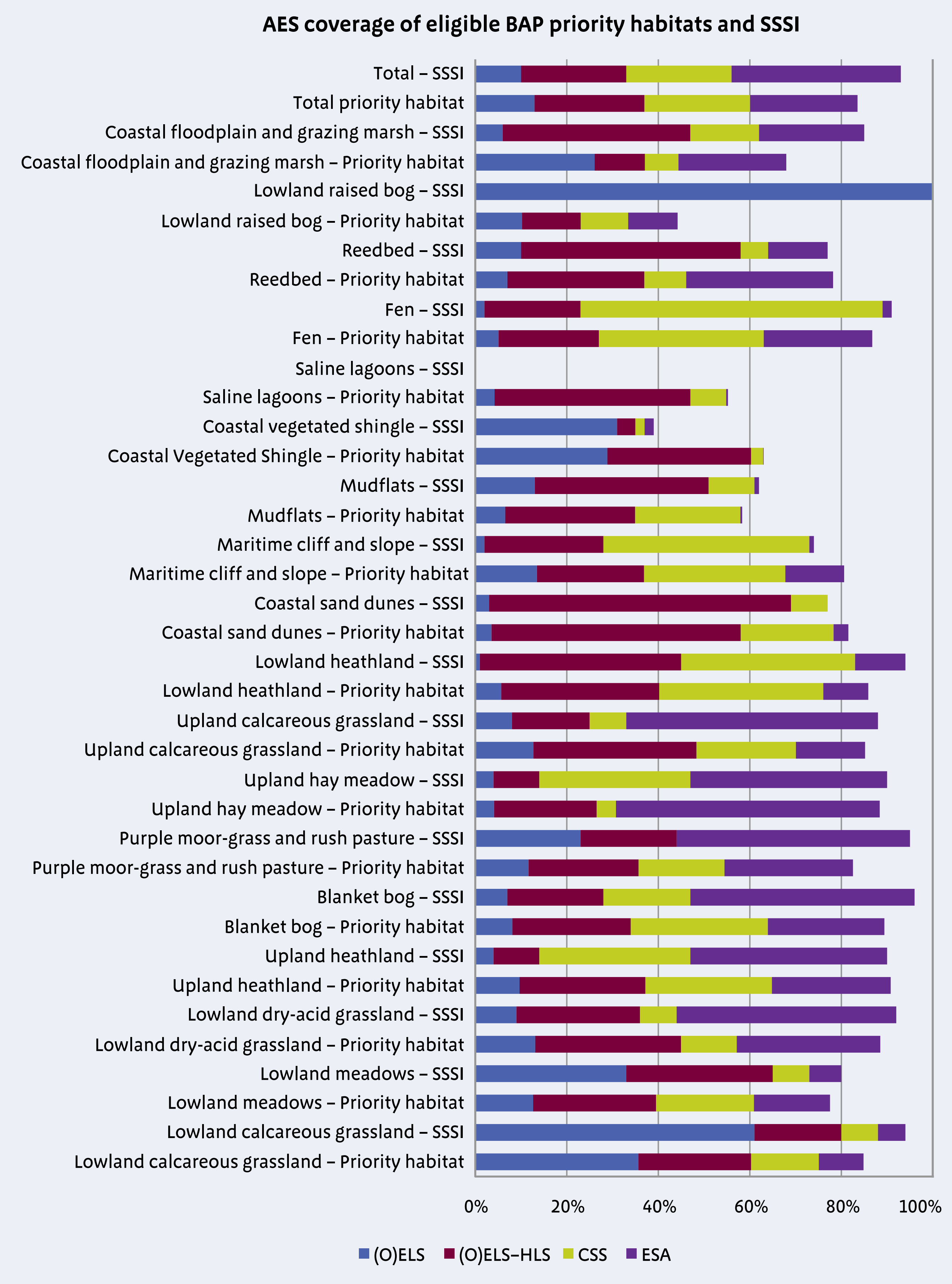
Additional priority habitats were added in 2007 as a result of a review of species and habitat priorities.

For each priority habitat, targets are set for maintaining extent, improving condition, and creating new areas of habitat, with a range of actions identified to facilitate and deliver these targets. For the majority of terrestrial habitats AES are the key funding and delivery mechanism.

The analysis of AES contribution to BAP delivery presented in Figure 20, and referred to in the subsequent sections, is based on scheme membership overlaid with the mapped inventories for the BAP priority habitats. The habitat inventories are the most definitive spatial habitat data sets available and have, therefore, informed BAP target setting. However, it is important to be aware of the limitations of this approach:

- The inventories are derived from a range of data sources, including field survey data, SSSI habitat maps and land cover data from satellite remote sensing, and the relative contribution of these sources varies between habitats. This means that in a proportion of land parcels lack of accurate mapping may result in an over-estimate of the area of the named habitat, or confidence in habitat definition may not be high.
- Inventories vary in the extent of coverage, accuracy and the time that has passed since a major update.

Figure 20. AES coverage of eligible BAP priority habitats and SSSIs



- In some cases inventories have been updated since the last review of BAP targets.
- Inventories are not yet available for all priority habitats.

AES are also a key delivery mechanism on SSSIs and a similar analysis, overlaying AES agreements with SSSI designations, has been undertaken. The results are presented in Figure 20.

In both cases:

- The figures presented are for the AES eligible area to reflect the fact that the land identified as BAP/SSSI is not all eligible for AES funding. Some areas are covered by other agreements, such as the WES, which mean that they are not currently eligible for AES.
- The coverage presented for ES also represents holding level agreement, rather than option, coverage. In the majority of cases appropriate management options will be in place but this analysis does not confirm this, especially for those ELS-only agreements. It does, however, provide a clear indication of the extent of AES coverage of these important areas.

Using this approach, 84% of eligible BAP priority habitat (for which a geographic inventory is available) is under AES agreement (13% under ELS only, 24% ELS-HLS, 23% CSS and 23% ESA) and 93% of eligible SSSI (10% under ELS only, 23% ELS-HLS, 23% CSS and 37% ESA).

Of the eligible SSSI area covered by AES, 93% is classed as being in favourable/ unfavourable recovering condition compared to 73% for non-AES sites (although the proportion classed as in favourable condition is higher on non-AES sites).

Salmonsbury Meadows SSSI, Gloucestershire

Enhancing arable habitats for farmland birds

Whilst the declines in several rare farmland bird species caused concern amongst UK nature conservationists in the 1980s, it was not until the mid-1990s that the precipitous population declines affecting many common and widespread bird species associated with lowland farmland emerged as a nature conservation issue (Fuller et al, 1995). Whilst the main period of decline was between the mid-1970s and early 1990s, many species continue to fall in numbers (Baillie et al, 2008, Risely et al, 2009). Out of 59 BAP priority bird species, 29 are associated with farmland and they are widely used as broad indicators of the health of biodiversity in the farmed environment.

AES are the main mechanism for creation and expansion of habitats that provide a wide range of benefits for these farmland birds. Classic schemes provided the foundation of arable options specifically targeted towards farmland birds and led to the partial population recovery of two rare farmland bird species in England (Aebischer et al, 2000). They also contributed to the successful development and implementation of simple but effective options for both ELS and HLS (Evans et al, 2002, Grice et al, 2004), allowing continued delivery of outputs required by declining farmland birds.

Options in ELS support a basic level of habitat management and creation across the arable and mixed farming landscape of England, through to highly targeted HLS where farmland bird options are spatially targeted to maximise output and species support. All AES have provided valuable tools to deliver year-round resources for most declining farmland bird species in arable landscapes (Vickery et al, 2004, Grice et al, 2004).

Options to support farmland birds are designed to contribute to one of three key areas, namely winter food (planted areas for bird seed, winter stubbles and unharvested cereal headlands), spring food/nesting (fallow plots) and summer nesting/foraging (skylark plots, conservation headlands/unfertilised cereal headlands).

Table 21. AES results – enhancing arable habitats for farmland birds

	ELS options	HLS options	Classics	Total
Planted areas for bird seed (ha)	5,450	1,999	4,564	12,013
Overwintered stubbles (ha)	66,594	n/a	31,414	98,008
Fallow plots for ground-nesting birds (ha)	n/a	2,822	n/a	2,822
Conservation headlands (ha)	1,573	1,687	4,140	7,401
Skylark nesting plots (n)	17,789	n/a	n/a	17,789

- The amount of cultivated land in England is considerable (4.9 Mha) (Defra, 2009), however, the area managed under arable options for farmland birds (with some overlap for wider biodiversity) is very small (120,000 ha, approx. 2.5%). Headlands and areas planted for winter bird seed are most often located on the least productive land (these have poor drainage, soil structure, shading, awkwardness) whereas in-field options for nesting and foraging are often located on in-field areas of reasonably good production.
- On average there is only one skylark nesting plot for every 275 ha of cultivated land.

Effectiveness – key evidence

- A CSS special project from 1992 to 2003 delivered key winter foraging habitat for cirl buntings (weedy overwinter stubbles) and increased territory density by 146% on CSS land compared to 58% on non-CSS land. The national breeding population increased from 319 pairs in 1992 to nearly 700 in 2003 (Peach et al, 2001; Wotton et al, 2000, 2004).
- A CSS special project from 1998 to 2005 in central Southern England created fallow nesting plots for stone curlews and increased the number of breeding pairs in the area from 63 in 1997 to 103 in 2005 (Grice et al, 2007).
- During the Arable Stewardship Pilot Scheme (ASPS), key options providing nesting habitat and/or invertebrate/seed food were selected by most field and boundary-nesting birds (Bradbury et al, 2004; Stevens & Bradbury, 2006). Grey partridge productivity was significantly higher on ASPS farms compared to control farms in East Anglia (Bradbury et al, 2004).
- Small undrilled patches in winter cereals increased skylark breeding densities and productivity. At 2 plots/ha, total chicks/ha increased by 50% (Morris et al, 2004).
- Grey partridge brood sizes were nearly doubled by leaving the outer 6m of cereal fields unsprayed by pesticides (Rands, 1985., Thomas et al, 2001).
- Between 2001 and 2004 in the Game and Wildlife Trust's[12] Partridge Restoration Project, CSS and set-aside management combined to increase spring grey partridge densities by 66% and autumn densities by 158% (Aebischer and Ewald, 2004).
- During the ASPS, spring/summer fallows provide lapwings with nesting habitat throughout the breeding season, increase nest survival and can provide chick-rearing habitat in some instances (Sheldon, 2002; Sheldon et al, 2007). A survey of fallow plots provided by CSS and HLS in 2007 found that 40% were used by lapwings, with breeding suspected on 25% (Chamberlain et al, in press).
- A recent review concluded that evidence supported the effectiveness of land-based schemes for maintaining higher densities of farmland bird species, especially during winter periods, compared to conventionally cropped fields (Roberts & Pullin, 2007).
- A winter survey of seed-eating birds in two areas of England by the RSPB during winter 2007–2008 found that wild seed mixture crops delivered through ES supported the highest densities of granivorous birds (Field et al, in press). The highest skylark densities were found on the ELS stubble option EF6.
- A major survey by the British Trust for Ornithology (BTO), building on the Breeding Bird Survey, found a dearth of evidence for any beneficial effects of ELS to date on widespread farmland birds such as skylark and yellowhammer (Davey et al, in press). It concluded that the pattern of option uptake may be limiting the benefits of ELS, and that time lags in option maturation and bird population responses mean definitive conclusions about the success or failure of the scheme cannot be reached at this time.

[12] Now the Game and Wildlife Conservation Trust.

Case study:
HLS arable management, the Norfolk Estate, Arundel, West Sussex

This ES (ELS and HLS) agreement was created in 2007 and covers four farms managed by the Norfolk Estate's Estate Manager. The land across the four farms had previously been in environmental management under separate ESA and CS agreements dating from 2003 and 2004. The current, single HLS agreement has simplified paperwork whilst providing much greater scope for grassland and arable management tailored to the Estate's needs.

The farm has a diverse mix of grassland and arable areas and includes two SSSIs, wet grassland beside the River Arun and some historic features that are all managed as part of the ES scheme. The total area of land in agreement is 1,589 ha. The Estate focuses on arable management, with a breeding sheep flock and some external graziers providing sheep and beef cattle to graze the grassland areas.

The ES agreement makes the most of a combination of ELS and HLS management options and capital items to manage the land for the greatest benefit of farmland birds. These include buffer strips, over-wintered stubbles and unharvested conservation headlands. Next to headlands, strips of wild bird seed mix and beetle banks provide a variety of food sources and cover for birds, insects and small mammals, whilst the main crop area remains conventionally managed. Options for grassland management and protection of historic features have also been used to create a diverse and multi-objective agreement.

The Estate benefits from monitoring undertaken by local wildlife expert, Dr Dick Potts who has recorded wildlife levels in detail each year since 2003. He assesses breeding bird numbers annually from mid-March to mid-July, with game birds monitored separately in spring and after harvest. Surveys of arable weeds and insects are also carried out annually. Neighbouring farms that are still entirely conventionally managed provide a control. Initial results from monitoring have been highly encouraging. Grey partridge and skylark have responded best to the agri-environment measures, especially the in-field habitat improvements provided by beetle banks and hedging, seed mixes and unsprayed headlands, and have done so to a similar extent across all four of the Estate's farms.

Since 2003 grey partridge numbers have increased by over 250% per year, corn buntings over 100% per year and skylarks 71% per year. Other farm birds such as lapwing and yellow hammer have shown less dramatic responses but the overall trend is for improvement. Overall, Dr Potts estimates that 26 'pairs' of birds were added per square kilometre (100 ha) per year as a result of agri-environment measures and associated management. Mammals have benefited as well, notably brown hare has shown year-on-year increases. Raptor and owl numbers are also up, partly it is thought in response to greater numbers of voles living on the beetle banks. Arable wildflowers and associated insects have responded well in the unsprayed conservation headlands (Potts, 2008).

Conservation headland with wild bird seed mix

Enhancing arable habitats for wider biodiversity

AES are the main mechanism for creation and expansion of habitats that provide a wide range of benefits for arable farmland biodiversity. They provide a valuable tool in ELS to support a basic level of habitat management and creation across the arable and mixed farming landscape of England, through to highly targeted HLS where options are spatially targeted to maximise output and species support (especially important for range restricted or site-specific species).

Wider biodiversity includes rare arable plants, invertebrates as sources of food for farmland birds, bumblebees and butterflies and BAP mammals such as brown hare.

Classic schemes provided the foundation of arable options specifically targeted towards wider biodiversity in the mid-2000s and led to the development and successful implementation of simple but effective options for both ELS and HLS agreements, allowing them to continue to deliver the outputs required to maintain the considerable range of biodiversity found on farmland in England.

AES options to support wider insect biodiversity can operate successfully at a landscape-scale of delivery but do require co-ordination/proximity between sown areas to minimise risks to population survival from failure of sites to produce nectar. Rare arable plants may require more specific targeting to capture site-specific populations (this may involve depth and timing of soil cultivations, reductions in herbicide use). Many of the AES options for farmland birds also deliver benefits for wider biodiversity such as overwintered stubbles (brown hare), planted areas for bird seed (pollinators use flowering weeds in these areas) and fallow plots/ conservation headlands for rare arable plants.

Results

Figure 22. AES results – enhancing arable habitats for wider biodiversity

	ELS options	HLS options	Classics	Total
Planted areas for insects – including beetle banks, pollen and nectar mix (ha)	3,036	n/a	3,464	6,500
Management supporting rare arable plants (ha)	736	392	n/a	1,128

- The total area of options supporting wider biodiversity objectives in arable habitats is very small (7,628 ha).

Effectiveness – key evidence

- AES have provided significant support for rare and uncommon arable plants (RAPs) by providing arable field margin sites to allow them to complete their seed production life-cycles. Walker et al (2007) assessed the effectiveness of three AES options for conservation of arable plants. Two hundred and sixty four plant species typical of arable and disturbed habitats were recorded in the sample of uncropped cultivated margins (highest diversity), spring fallow and conservation headlands (lowest diversity) and within them 34 RAPs were recorded including dwarf spurge, Venus's-looking-glass and round-leaved fluellen.
- Conservation headlands for butterflies provided improved habitat areas with reduced pesticide contamination. This resulted in more butterflies being found there compared with sprayed areas (Longley and Sotherton 1997) (Dover, 1997).
- Bumblebee abundance and diversity were significantly increased by sowing of wildflowers or pollen and nectar mix as arable field margins at the local and 10 km^2 scale, compared with sown grass margins, natural regeneration or conservation headlands. Bombus lapidarius and Bombus pascuorum, the most commonly recorded, were 15–35 times more abundant on the sown forage patches than control areas. Legume mixtures attracted the highest total abundance and diversity of bumblebees, including the rare long-tongued species (Bombus ruderatus and Bombus muscorum). Diverse mixtures of native wildflowers attracted more shorter-tongued Bombus spp. and provided greater continuity of early season forage resources (Carvell et al, 2007).
- Work on brown hare compared numbers on East Anglian farms with agri-environment agreements to control farms with no options and found significantly higher densities (+35%) on those farms with AES. However, numbers remained similar between the two farm types in the West Midlands (Browne and Aebischer, 2003).
- Merckx et al (2009) showed that six metre grass margins in combination with hedgerow trees resulted in substantially higher abundance and diversity of larger moth species, especially where a concerted effort was made to apply these options at a landscape-scale.

Hive in organic meadow, Chilterns

Maintaining and restoring species-rich grassland

Unimproved grasslands of the types now considered BAP priority habitat declined in extent by 97% in the second half of the 20th century (Fuller, 1987). These habitats also support a range of priority invertebrate species (such as chalkhill and adonis blue butterflies). Wading birds reliant on wet grassland (particularly lapwing, redshank and snipe) have also declined substantially (Wilson et al, 2005).

HLS aims to maintain existing priority habitat in good or favourable condition through options that encourage sensitive management practice, including appropriate grazing and cutting regimes, and prohibit or restrict operations that reduce habitat quality such as application of inorganic fertiliser. HLS aims to achieve targeted restoration of degraded priority habitat through the introduction of appropriate management. Capital payments can be made to cover additional costs such as scrub control and seed introduction. HLS options can take account of site-specific objectives, including grassland species requirements.

ELS includes options that provide a basic level of protection to a range of grassland types, including unimproved or species-rich grasslands, through restrictions on fertiliser inputs and other operations, although the ability to specifically target these is limited. A new prescription with sward height and structure targets aims to allow plants to flower and seed and encourage habitat diversity to benefit invertebrates and other taxa.

More restrictive classic scheme options, such as higher tier ESA and specific grassland CSS options were aimed at maintaining unimproved grassland habitats and have contributed to restoration in some cases, but with limited scope for site-specific interventions. These schemes have at least maintained sites that can be targeted for active restoration through HLS.

Results

Figure 23. AES results – maintaining and restoring species-rich grassland

	ELS options	HLS options	Classics	Total
Maintenance and restoration of species rich grassland (ha)	n/a	28,530	32,203	60,733
Maintenance of low input, extensive grassland (ha)	428,946	n/a	294,007	722,954

- AES options cover approaching 800,000 ha of grassland, which represents about 20% of the permanent grass area in England.
- AES agreements cover the majority of the eligible area of grassland BAP priority habitats: lowland calcareous grassland 85%; lowland meadows 78%; lowland dry-acid grassland 89%; upland hay meadow 88% and coastal flood plain and grazing marsh 68%.
- They are also important in relation to SSSIs covering: 94% of lowland calcareous grassland; 80% of lowland meadows; 92% of lowland dry-acid grassland; 90% of upland hay meadow; and 85% of the coastal flood plain and grazing marsh SSSIs.

Effectiveness – key evidence

- Classic schemes have largely succeeded in maintaining grassland sites of high existing value (eg. Hewins et al, 2008a; Manchester et al, 2005a). In a review of botanical monitoring of a number of ESAs in the UK, Critchley et al (2003) showed that quality of semi-natural grassland was maintained or improved in the majority of ESAs. In a sample study of non-designated grassland BAP priority habitat sites, Hewins et al (2005) found twice as many sites in favourable condition inside agri-environment agreements as those outside. This may be due to targeting or prioritisation of good quality sites for agreement, or some degree of improvement within schemes. Lack of baseline data meant that this could not be assessed. Carey et al (2002) found that land in CSS had a much higher proportion of high value grassland and other semi-natural habitats and was much more likely to be typical of low fertility situations than the English countryside as a whole.
- Evidence of successful restoration towards BAP habitat has been found in classic schemes, on calcareous grassland (Hewins et al, 2008a), and hay meadows (Kirkham et al, 2004; Critchley et al, 2004), although it has been relatively slow and inconsistent partly due to these options not being solely focused on botanical restoration. Critchley et al (2003), from a study of botanical monitoring in a number of ESAs, showed that some improvement was most likely where fertiliser inputs were reduced or prohibited, or grazing intensity reduced. We know from the ES research and development programme that successful restoration is more likely on sites with low soil phosphorus, and is often limited by absence of seeds in the soil and/or dispersing onto the site, and availability of microsites for germination and establishment. This can be overcome by pro-active management (Pywell et al, 2007), although results will depend on intensity of intervention and timescales.
- The results from monitoring of grasslands in AES and from associated research has strongly influenced the design of HLS, including improved targeting of sites with high restoration potential, and the development of management prescriptions, guidance and indicators of success to deliver key grassland outcomes (Stevenson et al, 2007, Critchley et al, 2007). However, Hewins et al (2008b) demonstrated that a high proportion of grassland maintenance and restoration options in early HLS agreements had not been sufficiently targeted or tailored to the site. This is being addressed through training and increased emphasis on follow-up visits.

Managing grassland for priority species

A number of BAP priority species, and other notable species, are reliant on grassland habitats for all or part of their life cycle. Some butterflies in particular, such as marsh fritillary and adonis blue, have strong associations with plants found in unimproved grassland and their requirements can be incorporated into the options for species-rich grassland. Other invertebrate (eg. bumblebee), bird (eg. barn owl), herpetile (eg. great crested newt) and mammal (eg. brown hare, bat) species require grassland with a degree of botanical and structural diversity for food and cover. Where such grassland is not of priority habitat quality or potential, it can be managed through options that focus on maintaining and restoring conditions for key species and other features.

In addition, specific options and supplements are aimed at maintenance and restoration of wet grassland habitat for breeding waders (eg. snipe, redshank) and wintering waders and wildfowl (eg. Brent geese). These are targeted at flat, open sites on which a mosaic of wet patches and/or open water can be reliably maintained in winter and, where necessary, through until early summer. This may require maintenance or reinstatement of sluices in ditches, with regular observation and adjustment. Sites invariably require grazing by suitable livestock at very low stocking rates during the nesting season but often more heavily thereafter to maintain a varied structure of short and long patches of vegetation (for example through mixed cattle and sheep stocking). It may also be desirable to create surface topography in the form of scrapes or shallow channels (grips, foot-drains) and capital payments are available for this.

Some of the habitats and species mentioned above will not come into HLS, which is competitive, because farmers and land managers may not wish to commit to the scheme. However, they are often prepared to enter ELS. The grassland options in ELS are partly aimed at these habitats and species, and also those of local importance. These options can be particularly valuable for a wide range of invertebrates (eg. spiders, leafhoppers, bugs), and for farmland bird species (eg. yellowhammer) for which sward structure and food sources such as nectar, seeds and insects, rather than plant species-richness, are required.

Results

Figure 24. AES results – managing grassland for priority species

	ELS options	HLS options	Classics	Total
Management of wet/rushy grassland for priority bird species (ha)	4,467	16,833	8,681	29,981
Management of grassland for target features (ha)	n/a	17,790	n/a	17,790
Scrapes created (n)	n/a	266	3,174	3,440
Seed and nectar mix (ha)	252	n/a	n/a	252
Mixed stocking (ha)	223,981	n/a	n/a	223,981

- AES agreements cover the majority of the eligible area of the purple moor grass and rush pasture priority habitat (83%) and 95% of eligible SSSI area of this habitat.
- A proportion of Countryside Stewardship Scheme land counted within maintenance of low input, extensive grassland (Figure 23) will be aimed at maintaining wet grassland for birds.
- The options for managing grassland for target features have a range of possible objectives. A significant proportion (approx. 50%) involves site-specific management for priority species.
- The significant area under mixed stocking results in swards which are more structurally diverse than single-species grazing and this benefits insects and other invertebrates, which in turn benefit birds and other taxa.

Effectiveness – key evidence

- Monitoring of AES has shown little evidence overall of increases or decreases in wading bird populations (Boatman et al, 2008). Dutt (2004) demonstrated that ESA and CSS options were poorly targeted at wader habitat, or prescriptions were too general to achieve ideal conditions. But several studies (eg. Wilson et al, 2005; Wilson et al, 2007) conclude that more expensive options including controlling water levels are most effective. Wilson et al (2005) also suggested that wader populations were generally higher and had declined less in designated areas, including ESAs. In the Upper Thames ESA, McVey et al (2005) found that curlew have increased across the catchment; lapwing and redshank also increased, largely due to increases at RSPB Otmoor. Relevant HLS options are carefully targeted and adopt a similar approach to habitat restoration and creation to that used on such reserves.
- AES have played a positive role in helping to significantly slow and in some cases reverse the declines of BAP priority butterfly species, especially those associated with short/medium turf (Butterfly Conservation, 2005). Brereton et al (2008) highlighted the role of AES in halting the decline of the chalkhill blue butterfly. This effect is not apparent across all butterfly species, and the trend of six specialist species associated with habitat mosaics was significantly worse on scheme sites than on non-scheme sites. However, good examples of management tailored to species requirements were apparent across the full range of species (Brereton et al, 2007). The increased flexibility of HLS options should help deliver a wider range of species requirements.

Creating grassland

HLS aims to achieve targeted creation of priority habitat through natural regeneration, use of native seed sources and/or green hay. This can be supported by capital payments. Eligibility is assessed using a decision key published in the FEP Features Manual. Created grassland will benefit a range of generalist species, and specialists as the habitat develops. The UKBAP has targets for expansion of each grassland priority habitat, with a significant proportion in places where it extends and links existing priority or semi-natural habitat. In some situations, where the potential for creation of priority habitat is low, grassland can be created to provide food sources and cover for target species, such as barn owl and great crested newt and generalist invertebrates such as the garden dart moth, or to augment existing areas of habitat. Specific options exist for creating wet grassland in river valley floodplains for breeding and wintering waders, and wintering wildfowl.

Some grassland created from arable under ESA and CSS options may develop into priority habitat over time, but most was not targeted to achieving BAP objectives. It does, however, provide benefits for species, historic features, and resource protection.

Female Chalkhill Blue butterfly

Results

Figure 25. AES results – creating grassland

	ELS options	HLS options	Classics	Total
Creation of species-rich grassland (ha)	n/a	2,373	n/a	2,373
Wet grassland creation for priority bird species (ha)	n/a	2,578	757	3,335
Arable reversion to grassland (ha)	n/a	6,828	67,988	74,816

- In excess of 80,000 ha of grassland have been created by AES since 1998.
- The HLS options for creation of species-rich grassland are aimed solely at creation of BAP habitat and have benefited from improvements in targeting and restoration methods.
- A proportion (approx. 30%) of arable reversion under HLS is aimed at creating grassland habitat for priority species other than wet grassland birds and delivering other objectives such as resource protection.
- An estimated area of over 8,000 ha currently in arable reversion towards calcareous grassland under classic schemes is aimed at species rich grassland creation.
- AES are making a major contribution to the current BAP target to expand the area of lowland grassland Priority Habitat by 9,181 ha by 2015.

Effectiveness – key evidence

- CABI (2003) showed that CSS sites sown with a chalk grassland mix had developed greater botanical and structural diversity than ESA sites sown with a basic grass mix. However, few were classed as BAP habitat.
- Kirkham et al (2006) demonstrated that relatively few ESA and CSS sites that had been in arable reversion for at least five years met BAP definitions for lowland calcareous grassland or lowland meadow. A significant proportion was comparable to poorer semi-improved grassland and may develop over time. Objectives for these sites, however, were not always aimed principally at biodiversity, and/or targeting was poor.

Case study:
CSS grassland creation, Nunburnholme, Pocklington, York

Martin and Jean Stringer farm 94 ha in the Vale of York at the foot of the Wolds. They have had CSS agreements since the mid-1990s. The wider landscape is predominantly arable and the Stringer's farm has several CSS arable options. But in 2001 they converted three cereal fields, on very heavy clay, to grassland. Martin Stringer is a keen naturalist and decided to attempt to create species-rich swards by spreading green hay taken from meadows in the Derwent Ings SSSI.

The year prior to the grass being sown, the field was left fallow and was worked to create a fine tilth. In 2001 the fields were sown in late August /September with a grass mix specified in the CSS. In the first year, the fields were cut to control annual weeds. The following year part of the grassland was spread with green hay collected from the Derwent Ings and a field at Bishop Wilton which is also SSSI. A different section of the field had green hay spread over it for the following three years. Martin found that the best take of the target species from the green hay was during the first year when the grass sward was not so dense.

During the course of the meadow creation Martin has worked very hard to establish the grassland and maintain it. He undertook a lot of work in the early years to control injurious weeds such as docks, thistles and ragwort. Some spot spraying has been carried out and a lot of hand pulling. The fields are cut for hay, in sections, from 15 July until around the middle of August each year. The hay is big-baled and sold for horses. The fields are aftermath grazed with sheep (and sometimes yearling beef cattle).

Assessing the swards using Key 2a in the FEP Features Manual they now qualify as species-rich grassland, and using Key 2b they meet the minimum requirements of the BAP Priority Habitat 'Lowland Meadow and pasture'.

Common knapweed and yellow rattle are frequent/abundant throughout. Meadow vetchling and pepper saxifrage are occasional. Blue green sedges, marsh orchid and greater bird's foot trefoil are locally frequent and there are a number of other high value indicators which are rare in occurrence, including devil's bit scabious, cowslip and great burnet.

Derwent Ings wildflowers

Maintaining, restoring and creating moorland habitats

There were considerable losses of moorland in the last century through reclamation, improvement, drainage, afforestation, overgrazing and too frequent burning, with an estimated 27% of heather moorland lost in England and Wales between 1947 and 1980 (Anon, 1998). Reviews and surveys in the early 1990s showed that much of that remaining was heavily grazed and in relatively poor condition (Felton and Marsden, 1990; Bardgett & Marsden, 1992; Bardgett et al, 1995). In part, this led to the introduction of new upland ESAs in 1993–1994 and a range of new CSS upland options in 1999, as well as the introduction of a (now closed) Moorland Scheme for stock reductions in 1996 and overgrazing cross compliance controls attached to the livestock subsidy schemes from 1992 (Condliffe, 2008).

HLS is targeted primarily at nationally or internationally important habitats and species, particularly the UK BAP priority habitats of upland heathland, blanket bog and upland calcareous grassland. The UK holds internationally important areas of these habitats, all of which include habitats of European importance (Thompson et al, 1995; Anon, 1998). HLS moorland agreements also have potential to deliver appropriate management for another priority habitat, limestone pavement, and the new upland priority habitats of inland rock outcrop and scree, mountain heaths and willow scrub, and upland flushes, fens and swamps.

HLS aims to maintain existing priority habitat already in favourable/good condition through the moorland maintenance option to rehabilitate/restore degraded habitat by encouraging appropriate moorland management practices (in particular grazing, burning, scrub and bracken management), and by prohibiting or restricting operations likely to result in deterioration of habitat condition/quality through the moorland restoration option. Various supplements are also available, including for burning or cutting, re-wetting, livestock exclusion, cattle grazing and shepherding. Habitat management can be tailored to key species,

Swayling near Halsway Post, Quantock Hills or some species, such as breeding waders, can be targeted through specific options and supplements. It also aims to achieve targeted restoration/creation of upland heathland through natural regeneration of heather and other dwarf shrubs from suppressed plants or the seedbank with reduced grazing (restoration) or through intervention measures including the introduction of heather seed (creation) through the creation of upland heathland option.

ELS (and in future UELS) provides basic moorland management prescriptions which in some cases will maintain habitats already in favourable/good condition. It does not, however, address stocking levels (although from 2010 a new UELS strand will introduce a minimum stocking level aimed at avoiding undergrazing and abandonment).

The more restrictive classic scheme options, such as ESA moorland higher tiers and specific CSS upland heather moorland, rough grazing and limestone grassland options, were aimed at maintaining (and in some cases restoring/rehabilitating) moorland habitats, particularly upland heathland and upland calcareous (limestone) grassland.

Results

Figure 26. AES results - maintaining, restoring and creating moorland

	ELS options	HLS options	Classics	Total
Moorland maintenance and restoration (ha)	126,547	122,220	302,644	551,411
Moorland creation (ha)	n/a	580	15,998	16,578

- The total of 551,411 ha in moorland options represents 69% of land above the Moorland Line, of which most (55% of land above the Moorland Line) is in classic scheme or HLS agreements, with the remainder in ELS.
- Not all of this is priority habitat or areas being restored to it, although more than 80% of land in the upland heathland and blanket bog habitat inventories and more than 70% of upland calcareous grassland is under AES agreements. Thus, these agreements are making a major contribution to the UK BAP targets for maintaining the extent of these habitats.
- An even greater proportion of eligible moorland SSSIs are under AES agreement: upland heathland 90%; blanket bog 96%; and upland calcareous grassland 88%.

Effectiveness – key evidence

- ESA and CSS moorland options have generally been successful in halting further habitat deterioration and to a more limited extent in habitat enhancement, eg. through bracken and scrub, and burning management plans/ programmes, in some cases grip-blocking, and in creating improved structural diversity through reduced grazing pressure (eg. ADAS, 1997a-d; 1998a-b; Ecoscope, 2003; Kirkham et al, 2005).
- AES have generally been less successful in restoring heath and bog habitats (eg. Dale, 2002; Ecoscope, 2003; Kirkham et al, 2005; Boatman et al, 2008). However, there are some good examples of successful heath restoration, mostly associated with greater stocking reductions (often involving off-wintering or stock removal), particularly under higher tier ESA agreements and CSS (eg. Holland, 2002a; Darlaston & Glaves, 2004; Nisbet, 2007). Glaves (2008) reviewed moorland AES monitoring results and suggested that restoration success depends on the starting point of individual sites, in particular the cover, distribution and age of existing heather and other dwarf shrub plants (or seedbank), which can have a major effect on the impact of a given grazing pressure. Thus, sites in poor condition are less able to withstand moderate or heavy grazing pressure.
- Upland heath creation has had variable success (eg. Holland, 2002b), although more recently, improved techniques and more intensive efforts have proved successful in at least establishing heather cover in some large-scale projects, most notably in the Peak District (eg. Anderson, 2002; Anderson et al, 2008).

Managing moorland and rough grazing for breeding waders and other species

Moorland also supports a range of priority and other notable species eg. golden plover, hen harrier, a cranefly (Tipula (Savtshenkia) serrulifera), the moths (Semiothisa carbonaria, Xestia alpicola alpina and Xylena exsoleta), yellow marsh saxifrage and juniper, some of which are scarce or in decline (eg. Anon, 1998). Birds, particularly an assemblage of breeding waders (snipe, curlew, lapwing and redshank), reliant on moorland and rough grazing (as well as wet grasslands) for breeding have also declined substantially (Sim et al, 2005; Fuller et al, 2002; Baines, 1988; Fuller and Gough, 1999). Black grouse and twite, two further UK BAP priority upland bird species, occupying extensive upland habitat mosaics have witnessed massive range contractions and are now geographically restricted to the Pennines in England (Warren and Baines, 2008; Raine et al, 2009).

AES management is targeted at allotments, intakes and newtakes and semi-improved fields in the Less Favoured Area (LFA) that support or have the potential to support breeding waders. HLS options are designed to provide suitable sward structure and other habitat conditions, and reduce nest losses through stock trampling by specifying reduced summer stocking rates. ELS upland grassland options can also potentially provide suitable management for breeding waders. The HLS moorland restoration and management options covered in the previous section should be sufficiently flexible to be able to take into account the needs of other species features occurring on moorland.

Results

Figure 27. AES results - moorland and rough grazing for breeding waders and other species

	ELS options	HLS options	Classics	Total
Management of rough grazing and rush pastures (ha)	19,394	11,832	46,077	77,303

- In addition to the significant areas under AES moorland management (Figure 26) in excess of 77,000 ha in the uplands is under management tailored towards specific species.

Effectiveness – key evidence

- There have been (re)surveys of moorland breeding birds in most upland areas, including some funded as AES monitoring in ESAs (eg. ADAS, 1997a,b; Geary, 2002). These have shown varied results, with many species stable or in some cases increasing (eg. stonechat), although some have shown declines at least in some areas, eg. snipe, lapwing, whinchat and ring ouzel.
- Geary (2002) concluded that on Dartmoor ESA moorland management prescriptions were having a positive effect on most moorland bird populations, but that localised overgrazing, burning (swaling) and scrub encroachment may be affecting tree pipit, whinchat and ring ouzel.
- Calladine et al (2002) compared numbers and breeding success of black grouse in ten areas with reduced grazing treatments (<1.1 sheep/ha in summer and <0.15 sheep/ha in winter) under CSS (or equivalent private initiatives) in the north of England with paired sites that had 2–3 times higher grazing densities. On sites with reduced grazing, numbers of displaying male black grouse increased on average by 4.6% per annum, compared to an average 1.7% reduction on control areas. On reduced grazing sites, 54% of hens retained broods during the late chick-rearing period, compared to 32% at normally grazed reference areas.

Curlew and Black Grouse, Upper Teesdale, Co Durham

Case study: Upland heathland restoration under ESA agreement at Winsford Allotment (Badgworthy Land Company), Exmoor

This privately owned enclosed moorland 'allotment' covers c.100ha, adjacent to unenclosed moorland. It forms part of the South Exmoor SSSI and was classed as being in unfavourable recovering condition in 2001. Prior to 1993 the site was subject to an overgrazing case with out-wintered cattle, plus year-round sheep with a mean summer stocking rate of 0.33 Livestock Units (LU)/ha and in winter 0.68 LU/ha (from Darlaston & Glaves, 2004).

The site entered an ESA agreement in 1993 under moorland restoration (Tier 2 Part 1). As a result grazing was reduced to only summer sheep at a stocking rate of 0.10 LU/ha, with none in winter. The restorable heath area was restricted to c.45 ha on peat loam over shale with grassland, bracken and scrub grading to woodland on the remainder. The effects of the ESA agreement over ten years, 1993 to 2003, were as follows:

- A decline in mean heather grazing index (shots grazed) from 88% to 10% (highly significant $P<0.001$).
- An increase in mean heather cover from 5% to 29% (highly significant $P<0.001$).
- An increase in mean heather cover in heather only quadrats from 10% to 43% (highly significant $P<0.001$).
- An increase in mean dwarf shrub height from 5 cm to 23 cm (highly significant $P<0.001$).
- Increasing vegetation types: heath from 9% to 52%, bracken 1% to 7% and scrub 1% to 2% (see Photos 1 and 2).
- Decreasing vegetation types: bent-fescue/rough acid grassland from 89% to 39%.
- Increasing breeding populations of skylark (0 to 13 individuals), linnet (0 to 9 individuals) and stonechat (0 to 1 territory).
- Meadow pipit showed little change (9 to 8 individuals), but wheatear declined slightly (from 1 territory to none).

Photo 1: Aerial photograph of Winsford Allotment prior to ESA agreement, June,1992. (1992 AP: ADAS, © Crown Copyright.)

Photo 2: Aerial photograph of Winsford Allotment showing restored heath on the plateau, May 2001 (2001 AP: Licensed to Natural England for PGA, through Next Perspectives™)

Maintaining, restoring and creating lowland heathland

Of the 58,000 ha of lowland heath in England only about 32% is assessed as in favourable condition. Maintaining lowland heathland in favourable condition for its valuable plant communities and associated wildlife is achieved by appropriate, active management through HLS. For example, the control of scrub or undesirable species and the creation of bare ground can be achieved by regular cutting, burning or grazing, or a combination of these methods. HLS also aims to improve the condition of heathlands that have been degraded to varying degrees (usually due to neglect) through the introduction of appropriate management. This is undertaken to restore lowland heathland on sites that have become degraded by scrub, bracken or woodland encroachment. Fragments of heathland vegetation will still be evident.

Support is also available through HLS for shepherding, permissive access, control of invasive species and other costs. Capital payments can be made to cover fencing, scrub management or other work in relation to grazing. Management can be tailored to key species, or restoration of habitat for some species, eg. stone curlew plots, can be targeted through specific options and supplements.

HLS also aims to achieve targeted creation of heathlands through natural regeneration or use of native seed sources. This can be supported by capital payments, for example for clear felling of woodland to allow heathland creation. Created heathland will benefit a range of generalist and specialist species, as the habitat develops. Recreating heathland is only practical on light, infertile soils with low organic matter content or on acid soils where residual fertility is low. It will be most successful on land that adjoins existing, good quality heath or has supported it in the not too distant past. It may apply to land that has been in arable systems or in a grass ley for less than five years and also, in some circumstances, worked mineral sites.

Results

Figure 28. AES results - lowland heathland

	ELS options	HLS options	Classics	Total
Lowland heath creation (ha)	n/a	117	1,036	1,154
Lowland heath maintenance (ha)	n/a	4,684	3,872	8,556
Lowland heath restoration (ha)	n/a	15,012	21,473	36,485

- In excess of 46,000 ha of lowland heath is under AES, with the balance in classic schemes.
- AES cover a significant proportion of the area of lowland heath priority habitat (86%) and 94% of the lowland heath SSSI resource and are making a significant contribution to the BAP targets for maintenance and restoration.

Effectiveness – key evidence

- Funding through AES has allowed the clearance of many hectares of scrub, bracken and trees; grazing by cattle and/or sheep has also been reintroduced. Some areas of ex-arable land have been reverted by reducing the nutrient loads and reducing the soil pH.
- An evaluation of the impact of CSS (Carey, 1999) found that the agreements were likely to maintain and probably enhance the ecological and landscape interest of lowland heathlands, but not the archaeological features. However, Hewins et al (2007) found no heathlands in favourable condition within a sample survey of non-SSSI heathlands, using the threshold for SSSIs. The sample contained both sites under and outside agreements. Similar results were obtained when monitoring the ESA heathlands in West Penwith (Toogood et al, 2006). Surveys of the achievements in terms of the landscape, wildlife, historical and overall environmental aims in the Breckland ESA (ADAS, 1997e) and West Penwith ESA (ADAS, 1996) concluded that the objective of avoiding further degradation had been achieved but there were no signs of any improvements in the habitat condition.
- In an assessment of the success of schemes to re-create lowland heath, Walker et al. (2004) recorded variable success in establishing dwarf shrubs, with former land use found to be the most important determinant. On former arable, and to a lesser extent improved grassland, previous management had caused significant changes to seed bank and soil properties. As a result, regeneration of heather heath had been minimal, even on sites where appropriate management had been undertaken and heathland species introduced. In contrast, former plantation seed banks and soils were similar to heathland controls, and, as a result, rapid regeneration of heath had taken place. It was concluded that conifer removal provides the most practical and cost-effective means of re-creating heath. In contrast, re-creation on former agricultural sites requires effective management to reduce soil pH, fertility and the abundance of competitive species as well as the introduction of heathland propagules. Given limited resources, it was suggested that "a more realistic objective for these sites is likely to be reversion to an acid grassland or grass-heath".

West Penwith

Case study:
Dorset Urban Heaths Grazing Partnership

An Urban Heaths Grazing Partnership was formed in September 2005 from local authorities, nature conservation bodies and Natural England working together to address habitat management problems on Dorset's urban heaths, in particular to secure traditional grazing.

The urban heaths in Dorset comprise over 1,700 ha of internationally designated heathland sites. These are located in and around the conurbations of Poole and Bournemouth in south east Dorset. Despite the fragmented nature of the heaths some large areas remain. There is a widespread concern and commitment to manage these sites to safeguard their future, and to manage them for nature conservation. The urban heaths are also of vital importance as natural greenspace in and around south east Dorset and its coast.

Dorset's heathlands face a number of problems:

- Close proximity to large urban areas leads to undesirable impacts, eg. arson, disturbance, off-road bikes causing erosion, fly tipping etc. People pressures are particularly difficult to manage on those heathlands that are totally surrounded by an urban environment, mostly housing.
- The need to restore habitats degraded by neglect/lack of resources.
- Securing sustainable management including bringing back traditional practices.
- Changing management is controversial and achieving local community consent is time consuming.
- Tree and scrub encroachment is an ever present problem.

Management of the heathlands is essential to conserve the range of specialist animals and plants that live there, such as Dartford warblers, nightjars and the full range of British snakes, lizards and amphibians. A significant number of the urban heaths in Dorset are now in seven HLS agreements started in 2007. This will fund activities such as fencing, water supply, tree removal, scrub and bracken control and non-native plant species removal (particularly Gaultheria shallon, a plant that particularly likes heathland conditions and is extremely difficult to kill). It is still early days but more sites are coming under positive integrated management.

Excavation for Sand Lizard management, Wareham Forest, Dorset

Maintaining, restoring and creating native woodland

Although the main mechanism for woodland expansion and management is through the English Woodland Grant Scheme (EWGS) (administered by the Forestry Commission) AES provide a valuable tool to support small areas of farm woodland as part of a broader agreement and make a valuable contribution to woodland maintenance and restoration targets. New woodland is needed to buffer existing sites from adverse edge effects, expand the area available for woodland species and to improve the connectivity between woodland sites.

The management options have commonly been used to improve woodland boundaries to address the problem of over-grazing of woods by livestock; small-scale coppicing and ride management are also favoured. More complex and larger scale management works are more often dealt with through the Forestry Commission's EWGS.

Results

Figure 29. AES results – maintaining, restoring and creating native woodland

	ELS options	HLS options	Classics	Total
Management of woodland edges (ha)	1,801	n/a	n/a	1,801
Woodland maintenance/ restoration (ha)	n/a	8,656	5,038	13,694
Woodland creation (ha)	n/a	358	n/a	358

- The area of farm woodland is c305,000 ha, (both conifer and broadleaved) so that the area brought under maintenance/restoration represents about 4% of the total.
- Similarly this represents only a small contribution to the woodland BAP targets, however, this is not surprising, since as noted elsewhere, the main delivery vehicle is the EWGS.

Effectiveness – key evidence

- Woodland creation and management has not been a major part of schemes in the past, but over the last few years has increasingly been used. There is only limited systematic monitoring information for England (Boatman et al, 2008).
- Anecdotal evidence points to individual schemes which have been particular successes, eg. expanding woodland and scrub patches for black grouse; using cattle poaching (trampling to the ground) to create conditions in woods for touch-me-not balsam as food for the netted carpet moth; reducing grazing around high-level woods in the Lake District.

Maintaining, restoring and creating wetland and coastal habitats

Wetland habitats declined in extent and quality in the latter part of the 20th century. The main reasons for losses were drainage, nutrient enrichment and neglect. BAP targets have been developed for the wetland habitats reedbed, lowland fens and lowland raised bog (Hume, 2008). These habitats also support a wide range of priority species, such as the white-faced darter dragonfly, large heath butterfly and fen orchid.

HLS aims to maintain and restore existing wetland habitats and associated species through options that encourage sensitive management and prohibit or restrict operations that reduce habitat quality. Degraded habitats can be restored through the introduction of appropriate management, such as grazing and cutting, and reversing the effects of drainage. Capital payments can be made to cover costs such as installation of water control structures and scrub removal. Management and restoration can be tailored to the needs of priority species such as the bittern or large heath butterfly, and can be targeted through specific options and supplements. A limited number of classic scheme options were aimed at maintaining wetland habitats. Additionally, a range of resource protection options are available in ELS and HLS to help deliver sympathetic catchment management around wetland sites. HLS also aims to achieve targeted creation of priority habitat, particularly around existing wetlands. This can be supported by capital payments. Created wetlands will benefit a range of generalist species, and specialists as the habitat develops. Only a small area of wetland habitat was created under ESA and CSS.

Coastal habitats have been under a range of pressures since we first began to engineer the coastline. Many previously extensive intertidal areas have been reclaimed for agricultural purposes, with some of the most recent reclamation taking place as recently as the 1980s. Coastal squeeze is the result of fixed hard defences preventing roll-back of intertidal habitats as sea levels rise. Other coastal habitats such as sand dunes and shingle have also been affected by development and extraction as well as agricultural intensification, or, in some cases, by reduction in use for grazing. Coupled with airborne nutrient enrichment, this

Wetland restoration, Baston Fen Farm, Lincolnshire can result in increased growth of rank grassland and scrub which reduces the quality of the habitat and the associated species.

HLS aims to restore coastal priority habitats through options that encourage the re-introduction of sustainable grazing practices and other management that will allow the coastal environment to be more responsive to coastline evolution. The coastal options were designed to accommodate existing pressures due to the effects of climate change as known at that time, eg. creation of intertidal and saline habitats by realignment, creation of sand dunes and shingle by allowing roll-back rather than defending the line.

The targeted creation of coastal habitats on land that is adjacent to existing habitats and in the coastal flood plain or on cliff tops is also a priority for HLS. HLS intertidal creation is also being considered as a long-term option for landowners where maintenance of sea defences is to be withdrawn. The option for an unmanaged breach also provides an alternative to landowners who might otherwise want to maintain seawalls at their own expense. The HLS options for coastal habitats, especially inter-tidal habitat, largely evolved from the experience gained from the Habitats Scheme (1994–2000). One key aspect of these options is that inter-tidal habitat creation is fairly permanent and consequently these agreements will run for 20 years, rather than the usual 10.

Results

Figure 30. AES results – maintaining, restoring and creating wetland and coastal habitats

	ELS options	HLS options	Classics	Total
Ponds restored/maintained (n)	n/a	266	3,174	3,440
Ponds created (n)	n/a	175	2,450	2,625
Maintenance/restoration of fen and reedbeds (ha)	n/a	2,097	3,036	5,133
Creation of fen and reedbeds (ha)	n/a	185	n/a	185
Restoration and maintenance of lowland raised bog (ha)	n/a	180	n/a	180
Maintenance/restoration of sand dunes (ha)	n/a	1,762	949	2,711
Inter-tidal habitat restored/ maintained (ha)	n/a	6,203	3,718	9,922
Inter-tidal habitat created (ha)	n/a	39	43	82

- Wetland and coastal habitats were not a major target of classic schemes and some interventions were funded by other schemes, for example inter-tidal habitat creation was previously funded by the habitats scheme.
- AES cover a significant proportion of eligible wetland and coastal BAP priority habitats: fen 87%; reedbed 78%; lowland raised bog 44%; coastal sand dunes 82%; maritime cliff and slope 81%; mudflats 58%; coastal vegetated shingle 63%; and saline lagoons 55% – making a major contribution to the targets to maintain the total area of these habitats.

Effectiveness – key evidence

- Fen and Reedbed – current survey work in the Broads will provide information on the effectiveness of the Broads ESA Fen tier, which has been by far the most significant in terms of fen and reedbed conservation. As yet, there is little scientific evidence from other studies that AES have benefitted fens and reedbeds. Uptake in CSS and ESA that would benefit these habitats was low, although it was not targeted to any significant extent.
- The addition of a range of fen options in HLS has resulted in better uptake of fen habitat into schemes. The use of resource protection and extensive grassland management options to buffer and link fens has not been assessed, although there are good examples of this. However, there are many fens, including SSSI and Special Areas of Conservation (SACs), where the surrounding land is in far from desirable management and owners will not enter beneficial options largely due to payment rates that do not adequately compensate for loss of productive land.
- Lowland raised bog – classic schemes provided little benefit to raised bogs (indeed there was no option for raised bog management) although a small number of sites entered CSS and the Lake District ESA and did benefit. There has been no monitoring on raised bog under CSS or ESA. The addition of raised bog options to HLS has provided only limited benefits to date, as ownership is often complex and management is also very difficult due to terrain, the need for specialist equipment and lack of agricultural return from this habitat.
- Management of surrounding land is critical to restoration of raised bog, the marginal peatland often having been converted to pasture or arable. Current incentives generally do not seem sufficient to bring this land into agreement. The main obstacles appear to be effective loss of land from production (the peat soils need to be saturated) and provision of appropriate compensation. Direct payment may not always be the best option – provision of alternative land may be more successful.

Raised bog at Glasson Moss, Cumbria

Case study:
West Midlands Meres and Mosses

The West Midlands Meres and Mosses are an internationally important wetland complex (notified as SAC and Ramsar), collectively forming one of the most significant wetland landscapes in England (English Nature, 1998). The area, occupying hollows and basins amidst the hummocky post-glacial landscape of north Shropshire, west Staffordshire, Cheshire and the eastern-most extremity of Wales, contains hundreds of wetlands ranging in size from Fenn's and Whixall Mosses at 950 ha to less than 1 ha.

These wetlands support a wide range of rare habitats, including open water bodies, wet woodland and lowland raised bog, and associated BAP priority species such as the white-faced darter dragonfly, floating water-plantain and water vole. The peatlands have also revealed fascinating finds from the past including a mammoth and Bronze Age canoe, while some of the meres are well used for recreational activities such as fishing and boating.

The condition of many sites, including SSSI, is poor with once-linked wetlands now isolated from one another by intensively-managed dairy grassland and arable land. The water quality of the pools and peatlands has deteriorated following land-use intensification in catchments, with the result that some meres now support very few, if any, water plants. Peatlands have been drained allowing scrub and tree cover to develop, which has resulted in loss of fen and bog habitats. The need to address catchment management in the Meres and Mosses has long been recognised.

In recent years CSS and HLS have been successful in implementing beneficial management in the catchments of many of the SSSI meres and mosses. This takes the form of reversion of arable land to permanent low-input grassland, withdrawal of fertiliser application from intensive grassland and planting of buffer areas.

Berrington Pool is an example, one of the original Habitat Scheme sites, it now has around 90% of its water catchment in no-input grassland through a CSS agreement – whereas ten years ago the entire catchment was in arable production with attendant soil run-off and regular fertiliser application. These changes should lead to major improvements in water quality in the pool. Peatland sites are also under restoration through HLS and CSS, with drains being blocked, trees and invasive species removed and wetland species returning.


Berrington Pool, Shropshire

The Meres and Mosses has recently been identified as one of the four England Wetland Vision landscape-scale wetland restoration projects. The widespread and effective use of ES options for wetland restoration and resource protection is of critical importance to the achievement of the project's long-term objectives.

Maintaining and restoring field boundaries and hedgerow/in-field trees

Hedgerows are the most widespread semi-natural habitat in England. Over large parts of the lowlands they are the main surviving semi-natural habitat, and are critical to the existence of numerous plants and animals. They are particularly important within areas of intensive farming, and for the survival of widespread yet declining species which are dependent on woodland edge, scrub or rough grassland habitats (Hedgelink, 2009). Walls also contribute to the biodiversity of the countryside, offering habitat for a range of species, in particular lichens, mosses, invertebrates, reptiles, birds and mammals.

Hedgerows in England provide significant habitat for 125 priority BAP species. Of these, 70% are species which while still relatively numerous and widespread are known to be declining rapidly. Of the 19 birds included in the Farmland Bird Index (a key government indicator for the state of farmland), 16 are associated with hedgerows, with 10 using them as a primary habitat (Wolton, 2009). Hedgerows are also important for 10 out of 18 terrestrial mammals listed as priority species in the UK BAP, for food or enabling them to move through the landscape (Wolton, 2009).

Field boundaries are also defining features of the landscape, creating the characteristic structure and pattern of the landscape. Around 25% of the countryside has hedge trees, shelterbelts and field boundaries as essential features of the landscape (Stokes and Hand, 2004). There are many local variations of hedgerow and walls, with distinctive ecological and/or cultural associations. Hedgerows and walls are also of great historic value, representing farming activity and traditions over many centuries (Countryside Agency, 2000).

Hedgerows provide significant buffering in the landscape and prevent loss of soil, fertilisers and pesticides from fields, either by reducing wind erosion or by acting as a barrier to water-borne run-off and drift. This is particularly so in arable areas, both where the land is flat and prone to wind-blow as in the Fens of East Anglia, and in hilly areas where loss of soil following heavy rain can be a major problem. For example, Davis et al (1994) showed how hedgerows are very effective at intercepting pesticide spray drift and create a shelter zone of up to 15 metres in adjacent crops.

Results from Countryside Survey 2007 (CS) (Carey et al, 2008) indicate that the extent of field boundary features is not stable. In particular the length of 'managed' hedgerow decreased by 6.1% (26,000 km) in England between 1998 and 2007. A large proportion of these managed hedgerows have turned into

Hertfordshire hedgerow with many ages of tree lines of trees and relict hedges, reflecting a lack of appropriate management. The length of walls also decreased by 1.1% (902 km) in England during the same time period. This loss mainly occurred in the uplands and was attributed to walls becoming derelict through lack of management. CS (2007) also reported on the favourable condition for 'biodiversity' of hedgerows for the first time, using criteria developed by the UK Hedgerow HAP Steering Group. This looks at attributes such as height, width, cross sectional area, gappiness (vertical and horizontal), width of undisturbed ground/perennial vegetation and the presence of non-natives (both woody and herbaceous). Based on a sub-set of attributes CS (2007) found that only 32% of managed hedgerows were in favourable condition.

Hedgerow trees are an important associated feature of many boundaries. The presence of mature or veteran trees significantly increases the biodiversity value of hedges, in particular of invertebrates (Stokes and Hand, 2004). CS (2007) indicated that there has been a dramatic decrease in trees in the youngest age class (1–4 yrs) – which means there will be a smaller generation of mature hedgerow trees. The population of 1.6 million hedgerow trees is a 3.9% decrease since 1998 (Carey et al, 2008).

Key AES management options for field boundaries include:

Stone wall management, re-creation and restoration – options which aim to maintain stone walls as an important feature in the landscape. Maintenance options can be placed on walls already in good condition and the walls must continue to be maintained as such. Stone walls can also be rebuilt using capital items payments under HLS.

Hedge management, re-creation and restoration – these options aim to maintain and enhance the hedgerow network. ELS options very much focus on the biodiversity value of hedges and management, in particular the provision of nesting habitat and a winter food source for birds through non-annual trimming and setting minimum height targets. The HLS options aim to secure specific management for target species such as the brown hairstreak, which lays its eggs on young blackthorn twigs. The options require hedges to be managed on a 3-5 year trimming rotation or a seven-year coppicing or laying rotation. HLS capital items cover management techniques such as laying and coppicing which are critical for the long-term survival of hedges, and also planting to reinstate old or create new hedgerows.

Stone-faced hedgebank/earthbank management, re-creation and restoration – these are significant features in specific areas of the country such as the South West. ELS includes options to manage these features and HLS capital items can contribute to their restoration and creation.

Ditch management – these options aim to encourage the establishment of a varied bankside and aquatic vegetation, and an undisturbed wildlife habitat adjacent to the ditch. Ditches of very high environmental value are particularly characteristic of a number of lowland grazing marsh ESAs (for example the Broads, Somerset Levels and Moors and the North Kent Marshes), supporting uncommon species such as water soldier, greater water-parsnip and shining ram's-horn snail.

In-field and hedgerow trees – these options can help in-field trees in arable and grassland by protecting them from harmful agricultural operations such as root damage by ploughing and fertilisers, and pesticides. Hedgerow trees can also be planted, protected and managed using new ELS options and HLS capital works items. Similarly schemes can also be used to manage grazing in wood-pastures and parkland, and for work on veteran trees in them, for example tree surgery and protecting trees from overgrazing.

Results

Figure 31. AES results – field boundaries and hedgerow/in-field trees

	ELS options[13]	HLS options	Classics	Total
Hedge management (km)	158,982	681	4,048	163,712
Hedge restoration and creation (km)	n/a	1,418	20,317	21,736
Ditch management (km)	43,430	n/a	n/a	43,430
Ditch restoration and creation (km)	n/a	314	2,122	2,436
Stone-faced hedgebank management (km)	2,437	n/a	n/a	2,437
Stone-faced hedgebanks restoration and creation (km)	n/a	15	1,797	1,812
Stone wall maintenance (km)	18,021	n/a	n/a	18,021
Stone wall restoration and creation (km)	n/a	198	2,034	2,232
Protecting in-field trees (n)	253,708	n/a	n/a	253,708
Planting parkland/hedgerow trees (n)	n/a	188	1,986	2,174

- 24% of all stone walls in England are actively maintained under AES[14].
- 3% of all the stone walls in England have been restored in the last 10 years.
- 41% of all hedgerows in England are actively managed under AES[15].
- 6% of all the hedgerows in England have been restored in the last 10 years.

Newly planted hedge

[13] Where management of one side of a boundary has been undertaken this has been counted as equivalent to 0.5 of total length.
[14] CS 2007 total length of walls in England 82,000 km.
[15] CS 2007 total length of managed hedgerow 402,000 km.

Effectiveness – key evidence

- Species – The main impact of the ELS options in terms of hedgerows has been the relaxation of trimming, with 69% of farms cutting some or all of their hedges once every two/three years (Defra, 2008). Although not directly comparable due to differences in the format of question this compares favourably with the figure of 54% in 2006 (Defra, 2006). Research undertaken in 2000 indicated that 79% of farmers and land managers cut their hedges annually (Brit et al, 2000). Significantly, research has shown that a move away from annual trimming has positive effects on the production of hawthorn berries (Croxton and Sparks, 2002) as hawthorn and other woody hedge species produce berries on second year growth. These berries are an important food supply for many overwintering birds and other animals (Marshall et al, 2001a/b). However, there is a risk that these benefits will not be fully realised if the hedges are cut in late summer of the second year before the full benefits of berries are realised (R. Pywell pers. comm.)
- Classic schemes were found to have had a positive impact on historic field patterns and boundaries, both in terms of the quantity and quality of work but also in the protection of their historic value (Bickmore, 2004 a & b). Schemes were found to have targeted the field boundary resource well, with management mainly appropriate to achieve protection, and the CSS boundary option being most successful in landscape terms, with 9 out of 10 agreements being 'effective' at maintaining and enhancing landscape in agreements (Boatman et al, 2008; Ecoscope, 2003). ES has built on this positive impact on historic field patterns and boundaries.
- In the absence of ESA and CSS grants much drystone wall restoration would not have been undertaken or the work would have been done to much lower standards or the boundary would have been replaced by post and wire fencing (Courtney et al, 2007).
- A survey of ditch management and condition in two ESAs (McLaren et al, 2002) concluded that in general ditches were reasonably well managed, with a range of successional stages present on many sites. It did, however, recommend that more site-specific advice was provided to individual land owners and that management was more strictly tied to the needs of species present on the site. Ditch management in ELS and its environmental benefits were considered in Boatman et al (2007b). No difference was found in species richness between ditches in ELS and those not in AES agreements, although the scheme had not long been in place. Survey of management practices suggested that 30% of ELS participants would be reducing ditch cutting frequency as a result of the scheme, and this was expected to result in environmental benefits.

Repairing a section of drystone wall

Protecting and enhancing historic environment features

The countryside today is the product of thousands of years of farming, working and shaping of the landscape. Tracing the physical remains of our ancestors in this landscape – through traditional buildings, monuments, earthworks, parklands, field boundaries and buried archaeological remains – helps us to understand the organisation of society and how humans interacted with and harnessed natural resources in their environment over time, and how they adapted to ongoing climate, economic and technological change.

Land managers are the principal stewards of our rural heritage, with farmers in England owning over half a million traditional buildings, thousands of miles of historic field boundaries and the great majority of archaeological sites.

Since 1945 changes in agricultural policy, technology and practice have particularly affected the condition of the historic environment. More than half of our nationally important archaeological sites are at risk from agriculture and over 45% of historic parkland extant in 1918 has been lost (English Heritage, 2005a).

A core feature of AES since their inception has been the protective management of historic resources on farmland. AES provide a key incentive to maintain or enhance the beneficial management of rural historic environment features such as archaeological sites, traditional buildings, ancient field patterns and designed landscapes, all of which make a significant contribution to the conservation of landscape character. AES established a sound basis for alerting farmers and land managers to the historic environment interests of their holding and now, in ES, it is a general scheme requirement to identify and then 'retain and protect' these historic features. In addition, a broader suite of land management options are available which are designed specifically to provide enhanced management or changes to existing farming practice to conserve features.

In ES, the ability to tailor management to individual circumstances allows the use of a large suite of additional options, including grassland and buffer strips, for the protection of historic environment features. In addition, many options are designed to benefit more than one environmental interest. However, at present the direct and indirect benefits of these options are not easily measured.

Protecting archaeological features

In the last 60 years, agriculture has been the cause of the outright destruction of 10% of the recorded archaeological resource and 30% of piecemeal loss (Darvill and Fulton, 1998). Agriculture and natural processes – many of which can be controlled through environmental land management practices – are the two greatest threats to nationally important archaeological sites, together comprising 66% of recorded vulnerabilities affecting scheduled monuments (English Heritage, 2005b).

Arable cultivation is a particular problem, with 2,209 scheduled monument areas being actively ploughed, the equivalent of 9% of the national total (English Heritage, 2009c) – even one instance of ploughing can damage or destroy hidden archaeological remains. Whilst scheduling provides a degree of protection against damaging operations, only around 5% of England's archaeological monuments are designated (Association of Local Government Archaeological Officers, 2008). This leaves a huge number of nationally, regionally and locally important archaeological sites under cultivation which would benefit from action to halt or minimise the effect of ploughing. ES now provides this opportunity through management which includes taking archaeological features out of cultivation or reduced depth, non-inversion ploughing on sites where removal from cultivation is not practicable.

Archaeological sites in grassland management have tended to survive in far better condition. However, unmanaged natural processes, such as scrub and bracken encroachment, erosion and burrowing animals are the principal concern for 30% of all scheduled monuments. These factors, alongside overstocking or inappropriate placing of feeders, can cause significant physical damage. Of the scheduled sites in grassland, 14% of those in pasture and 21% of those in semi-natural grassland are rated as being at 'high risk' (Holyoak, V.2009 pers. comm). ES provides the incentive to maintain these sites through:

- Scrub management to help prevent the expansion of trees and shrubs which can cause disturbance to archaeological features through root penetration, wind throw, or by attracting burrowing animals or sheltering stock.
- Management of grazing on grassland to avoid direct physical damage from livestock by stock rotation and careful placement of feeders, etc.

The known wetland archaeological resource is estimated at 13,400 monuments in England, in addition to a significant number of unidentifiable monuments and palaeo-environmental material that remain deeply buried.

Over the last 50 years, by far the greatest land use issue concerning wetlands has been agriculture – the number of wetland monuments that have suffered from damage, desiccation and partial destruction is estimated at 7,500. This includes mainly sites in alluviated lowlands and lowland peatlands that have been damaged through drainage (5,000 monuments), and ploughing (2,180 monuments are now under arable instead of pasture), while 360 sites are no longer protected by upland peat (Van de Noort et al, 2002). Preventing the desiccation of waterlogged archaeological remains and the re-wetting of areas suffering from drainage can be achieved through specific scheme options.

Tumuli on Devil's Dyke, South Downs

Results

Figure 32. AES results – protecting archaeological features

	ELS Agreements	HLS Agreements	Classics	Total
Management of archaeology under grass (ha)	62,073	10,634	Data not available	72,707
Management of archaeology under arable (ha)	10,326	8,202	67	18,596
Management of scrub on archaeological features (ha)	1,058	390	Data not available	1,448
Management of wetland archaeology (ha)	n/a	2.66	Data not available	2.66
Protection of archaeological or historic features (ha)	n/a	90	637	727
Total (ha)	73,457	19,319	704	92,751
Area of Scheduled Monuments (in agricultural land) (%)	37		22	59
Area of undesignated monuments (in agricultural land) (%)	44		18	62

- 59% by area of scheduled monuments and 62% of un-designated monuments are on land under AES agreement.
- New options in ES have addressed key detrimental indicators for archaeological features including: over 18,500 ha of monuments in arable areas have had the impact of cultivation reduced; 72,000 ha of grassland have livestock management on grass; and over 275 monuments are being managed specifically to prevent scrub encroachment.

Effectiveness – key evidence

- English Heritage time series data based on the 1,515 scheduled monuments in farmland in the East Midlands shows a reduction in risk for those in AES, with a 78% improvement in condition between 2005 and 2007 directly attributable to ES management (Boatman et al, 2008).
- Both undesignated and designated monuments within ES have increased protection to those in classic schemes: the multi-objective emphasis of the new schemes means that even if an option does not lead to a land use change, the more positive management attributed to ES reduces monument vulnerability and has an impact on risk (English Heritage, 2009a).

[16] Natural England's dataset of eligible undesignated sites is provided to land managers in ELS and is currently being enhanced in a project in conjunction with ALGAO and English Heritage.

Case study:
Improved management of historic environment features in the West Midlands (Bretherton, 2008)

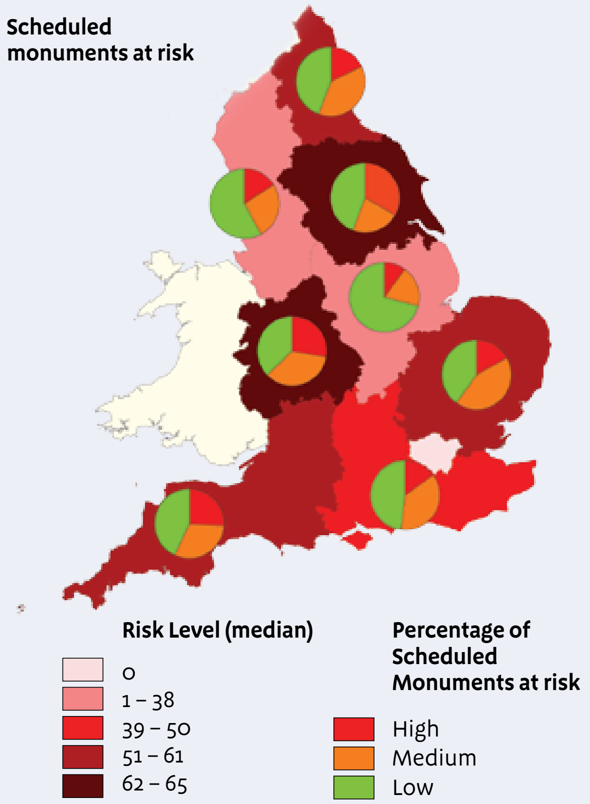
In 2007 English Heritage completed the Government's Heritage At Risk Survey which identified the main threats to the condition of scheduled monuments, and their overall risk level. The survey demonstrated that scheduled monuments in the West Midlands were more likely than all others to be at high or medium risk, with many of the causes attributed to land management practices such as arable ploughing and erosion caused by livestock.

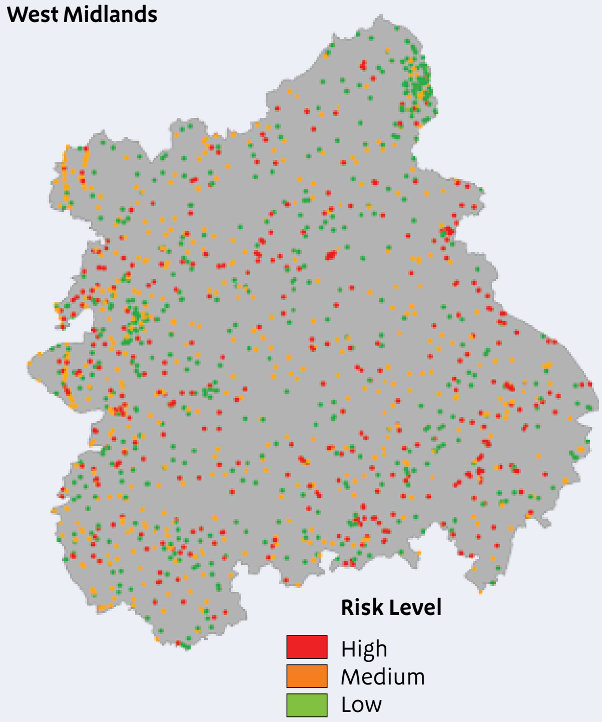
Regional patterns show the cultivated monuments, and those in 'marginal' locations are most at threat.

With help from English Heritage, advisers monitored 82 classic and HLS schemes with scheduled monuments at high or medium risk. This monitoring concluded that HLS can be viewed as a major step forward for delivering outcomes for archaeological sites.

All of the scheduled monuments monitored were in better condition, compared to those under classic scheme agreements, reflecting the fact that HLS was designed with a clear historic environment focus. New options for minimum tillage, increased payments for reverting arable to grass, and a suite of guidance has ensured its success. Consulting with the local authority Historic Environment Record and increased adviser knowledge clearly helps farmers and land managers to positively manage their historic environment features, and to share those benefits with the public. Additional support was provided to classic scheme agreement holders through this programme and as a result 83% of sites surveyed were assessed as improved or improving.

At the start of this monitoring programme, many nationally-important archaeological sites were thought to be actively damaged whilst in AES. Engaging with agreement holders has allowed Natural England and English Heritage to turn the management of these scheduled monuments around, with the result that 83% can now be seen to be improved or improving.





Conserving and enhancing designed landscapes/historic areas

Parklands are complex artificial 'designed' landscapes that form an integral part of the English countryside and make a unique contribution to its character, biodiversity and cultural heritage. In many cases they are the product of several phases of design over several centuries and, like many other historic environment features, are vulnerable to changes in farming and silviculture practices. In 1995, more than 45% of the historic parkland identified in 1918 had been lost, a total of 185,365 ha of land; and in 2009, 96 of our nationally designated historic parks and gardens are at 'high risk' (English Heritage, 2009a).

Key issues facing parkland include changes in stocking levels which can lead to under or overgrazing, arable cultivation of former parkland, the loss of boundary features such as ha-has and hedges, poorly designed new planting, the silting up of lakes and growth of secondary woodland or scrub.

Other historic areas of importance include battlefields which, where they survive, are not only of cultural and military historical significance but can also contain important topographical and archaeological evidence which can increase our understanding of the events that took place on their soil. Of the 43 battlefields on the national register, 7 are at high risk, one of which is a direct result of ongoing arable cultivation (English Heritage, 2009b).

Opportunities for the maintenance and restoration of designed landscapes and historic areas are provided through ES options, many of which are designed to meet historic environment, landscape, access and biodiversity objectives. These include:

- The maintenance and restoration of wood pasture and parkland to maintain or restore the wildlife, historic and landscape character.
- The suite of grassland maintenance, restoration and creation options which make it possible to maintain, enhance or reinstate pastoral elements of designed landscapes and historic areas.
- Funding for the development of parkland management plans which evaluate the development of parklands and the significance of features and views, and plan for any issues to be resolved before restoration is initiated.

Sheep grazing open parkland at Duncombe Park NNR

Results

Figure 33. AES results – conserving and enhancing designed landscapes/historic areas

	ELS options	HLS options	Classics	Total
Maintenance and restoration of wood pasture and parkland in designed landscapes (ha)	n/a	3,629	170	3,799
AES Parkland restoration/ management plans (ha)	n/a	50	Data not available	50
Reversion and management of pasture in designed landscapes (ha)	n/a	4,406	Data not available	4,406
Maintenance and restoration of woodland in designed landscapes (ha)	n/a	346	Data not available	346
Maintenance and restoration of heathland and moorland in designed landscapes (ha)	n/a	4,668	Data not available	4,668
Maintenance of built water bodies in designed landscapes (ha)	n/a	1.4	Data not available	1.4
Eligible registered parks and gardens (by area, %)	33		10	43
Eligible registered battlefields (by area, %)	49		5	54

- A significant proportion of historic areas are in agri-environment schemes. As with archaeological features, designations are the tip of the iceberg and there are many more regionally and locally important parklands and historic areas.

Effectiveness – key evidence

- AES funding has made a significant contribution to the restoration of historic parklands and to meeting UK BAP wood-pasture and parkland targets (Ecoscope, 2003).
- AES have directly contributed to reducing 'risk' to nationally important parklands. The Heritage at Risk 2009 survey revealed that 45% of registered sites are now covered by conservation management plans and highlighted the importance of ES in that process (English Heritage, 2009c).

Conserving and enhancing historic buildings and structures

Historic farm buildings are one of our most dominant landscape features and are as important to the 'character' of the countryside as the field patterns, boundaries and settlements around them. Modern farm practices have caused many changes within farmsteads – new machines require larger buildings, animal welfare and hygiene demand new building standards, and economic pressures may have caused buildings or steadings to become redundant or amalgamated. As a result, traditional farm buildings are the single largest category of 'at risk' building on local authority risk registers. It has been estimated that the costs of repair for all historic farm buildings defined as being in 'immediate risk' is £1,026 million and for the buildings in 'slow decline' about £1,683 million (Gaskell and Owen, 2005).

AES provide the opportunity to restore and conserve non-domestic historic buildings and structures which contribute to the character of the landscape, including:

- weatherproofing/maintaining as weatherproof traditional farm buildings – an option developed for ES in an effort to prevent the further decline of buildings currently in sound condition.
- restoration of historic buildings – a capital item for buildings requiring considerable repair work, with management tailored to individual circumstances, using traditional materials and techniques and based on the principle of 'minimum intervention'.

Results

Figure 34. AES results – conserving and enhancing historic buildings and structures

	ELS (Maintenance)	HLS (Restoration)	Classics (Restoration)	Total
Agreements (n)	1,807	75[17]	5,543	7,425
Spend (£m)	3.13	1.8	54.9	59.7
Area of buildings (m^2)	819,783	Data not available	Data not available	819,783

- Data collection methods do not enable identification of the number of buildings being maintained under ES, but it is estimated that the figure equates to more than 8,000 buildings – assuming an average size of building of 100 m^2.
- Large numbers of buildings have been restored by AES, particularly in ESAs.
- There has been very little research on the number, distribution and condition of traditional farm buildings and therefore it is very difficult to gauge the extent of the threat.

[17] Natural England is currently managing a ring-fenced £8m budget for historic building restorations in HLS. The long lead time for many of these projects means that the number underway are not fully reflected here.

Effectiveness – key evidence

- Prevention of the dereliction and loss of a significant proportion of rural historic buildings – survey work of CS and ESA agreements found that buildings would not have been restored in the absence of AES funding in 92% of cases (ADAS, 2003) and a survey of Pennine Dales ESA identified that 74% of buildings would not have been maintained without grant aid (Courtney et al, 2007).
- Increased quality of work – survey data shows that, in the absence of financial assistance, buildings would have been repaired to a lower standard, often not using traditional materials, (Courtney et al, 2007).
- Protection of historic landscape character – studies into the repair of almost 1,000 traditional farm buildings over a ten-year period in the Lake District and Pennine Dales ESAs found that, in the absence of AES grant aid, the restoration and repair of traditional farm buildings (where it occurred) would not have been in keeping with local character (Roberts et al, 2005; Courtney et al, 2007). The scale of intervention means that the impact is not limited to individual features but also has significant benefits for enhancing and protecting wider landscape character.

Protecting soils and reducing water pollution

Soil conservation and reduced water pollution (also known as natural resource protection – NRP) was introduced as one of the five primary objectives in ES at the launch of the scheme in 2005. NRP had not previously been a specific objective of AES in England, although many land management options in these classic schemes will contribute to achieving NRP objectives.

The Water Framework Directive (WFD), and river basin management plans (RBMP) linked to the Directive, mean that the ecological status of water bodies must be maintained and, if necessary improved, to meet the defined quality targets. Agriculture in particular faces major challenges to reduce and prevent phosphorus and sediment losses into freshwater bodies. About 60% of nitrate (N) and 25% of phosphates (P) in English waters originate from agricultural land. These nutrients can cause eutrophication, which harms the water environment. Up to 75% of sediment input into rivers can also be attributed to agriculture – reducing water clarity and causing serious problems for fish, plants and insects.

A range of regulation, including nitrate vulnerable zones (NVZs), establishes baseline standards for resource protection. In addition, the England Catchment Sensitive Farming Delivery Initiative (ECSFDI) provides advisory support and a range of additional capital support measures in targeted catchments.

There are specific options in ES that go beyond the basic regulatory requirements and are aimed at reducing soil erosion/run-off from agricultural land. These options are designed to protect watercourses by reducing diffuse pollution and are targeted at high risk areas and priority catchments. They buffer sensitive habitats and protect areas that replenish groundwater, by reducing the risk of soil erosion and phosphorus transport. They include:

- Changes in management practice that reduce soil erosion, for example: specific post-harvest management of soil after maize crops; the seasonal removal of livestock from areas prone to compaction and run-off; and reduced fertiliser inputs in intensive improved grassland where there is a high risk of nutrient loss.
- Changes in land use to prevent erosion or run-off, for example arable reversion to grassland.
- The use of a range of capital items in support of land management changes, for example:
    - Relocating gates to lower risk areas (away from the bottom of fields) to – reduce connectivity and reduce sediment on roads and tracks.

- Cross drains under farm tracks – these are designed to intercept and conduct surface run-off away from tracks. This will reduce its erosive impacts further down the track, reducing track erosion and connectivity to watercourse.
- Fencing can be used to exclude grazing livestock from watercourses. This should improve water quality by reducing faecal contamination, stream bank damage and erosion.

Other options will assist in more general resource protection throughout the farmed landscape. For example, simple ELS options that primarily focus on delivering biodiversity can contribute to NRP objectives. These mainly involve reduced fertiliser inputs, such as low input extensive grassland, or the introduction of grass buffer strips in arable land (including field corner management, and beetle banks).

Results

Figure 35. AES results – protecting soils and reducing water pollution

	ELS options	HLS options	Classics	Total
Grass buffer strips in arable land (ha)	44,377	1,640	27,695	73,713
Grass buffer strips in arable land (km)	59,658	1,953	55,159	116,771
Cropped buffer strips in arable land (ha)	1,573	1,687	4,140	7,401
Arable reversion to grassland (ha)	n/a	2,152	30,468	32,620
Buffer strips in grassland (ha)	3,291	7	n/a	3,298
Management of high erosion risk cultivated land (ha)	8,923	n/a	n/a	8,923
Management of maize crops to reduce soil erosion (ha)	9,217	n/a	n/a	9,217

- Uptake of all the options specifically targeted at NRP issues is significantly higher within ECSFDi priority catchments:
  - 1.1 – 1.34 times for ELS options and 1.44 – 1.87 times for HLS options.
- AES are currently supporting over 116,000 km of grass buffer strips in arable areas.

Effectiveness – key evidence

Resource protection is a relatively new objective of current AES. Consequently there is relatively little evidence yet of scheme effectiveness in this area, although there is some experimental evidence and results from modelling work:

Conversion of arable land to extensive grassland

- Nitrate losses from grassland are typically lower than those from arable systems, so reverting arable land to grassland is usually beneficial to water quality.
- A 50% reduction in the loss of P in the absence of grazing and a 42% reduction under extensive grazing. Conversion to ungrazed grassland reduces nitrate losses by over 95% (Cuttle et al, 2006).

Leaving autumn seedbeds rough

- Leaving a rough surface after maize harvest can reduce run-off (Anon, 2001). However, erosion and run-off can occur in some cases even after the removal of surface compaction because of sub soil compaction.
- Reduced the soil component of P loss by 35% and 25% for sandy loam and clay loam soils, respectively (Cuttle et al, 2006).

Establishing in-field grass buffer strips

- For N the benefits are equivalent to those for arable reversion to grass (proportionate to area). In-field grass buffer strips (covering 10% of field area) reduced the overall P loss by 40% on both soil types. The benefit was confined to the buffer strip area on the clay loam soil but was effective over 100% of the area on the sandy loam (Cuttle et al, 2006).
- In-field grass strips can be more effective at reducing erosion and leaching in arable fields compared to buffers next to water courses but require careful siting (Blackwell et al, 1999).

Establishing riparian buffer strips

- For N the benefits on free draining soils are broadly equivalent to those for arable reversion to grass (proportionate to area). On soils where there is lateral water movement there may be additional N reduction by denitrification. Riparian buffers were estimated to reduce all components of the baseline P loss by 30% on a sandy loam soil, effective over the whole farm area. The baseline P loss was reduced by 90% on the clay loam but the benefit was restricted to the area within the strip (Cuttle et al, 2006).

Limiting fertilizer input/grazing intensity

- Limiting nitrogen fertiliser input to 100kg N/ha in grasslands has been shown to reduce nitrate leaching (Lord et al, 1999). However, this is only likely to result in a significant benefit in intensive grassland systems where inputs were higher than this prior to scheme entry.
- Grazing intensity is also a significant factor contributing to nitrate leaching (ADAS, 2007a) and typically low fertiliser input systems are associated with reduced grazing intensity.
- Modelling work for ELS suggests a 2.09-4.27% reduction in nitrate losses per ha, and a 4% reduction in phosphate losses per ha, as a result of current take-up of ELS land management options (excluding management plans) compared to a non-ELS baseline (Boatman et al, 2007a).

Modelling work suggests that both widespread action and targeted management at catchment and farm scale will be required to achieve a substantial reduction in the losses of diffuse nutrients and that the options currently available in AES provide only part of this solution.

Case study:
River Frome Catchment – ES agreements enhanced with the ECSFDI

Resource protection is an important objective in the Frome and Fleet catchments due to the 'unfavourable' SSSI condition status of these water bodies (partly due to elevated levels of phosphate and sediment). ES agreements represent an opportunity to buffer and generally safeguard adjacent aquatic habitats from diffuse water pollution from agriculture.

The ECSFDI is part of Defra's Catchment Sensitive Farming (CSF) Programme which aims to tackle diffuse water pollution in order to meet the objectives of the WFD. The ECSFDI also contributes to the achievement of domestic and international environmental targets, in particular targets for SSSI condition. The initiative was initially rolled out in April 2006 in 40 priority catchments in England, and will continue to at least 2010-11. In October 2008 an additional 10 priority catchments were added to the existing 40, and extensions were made to 7 of the existing catchments. The main components of the initiative are:

- A capital grant scheme providing funding for farmers and land managers to make relatively low-cost infrastructure investments to tackle pollution (which are not available in ES/outside ES agreements).
- A dedicated network of Catchment Sensitive Farming Officers (CSFOs) who work closely with local farmers and land managers providing advice and support.
- An extensive programme of farmer events and farm visits.

The ECSFDI is seeking to achieve reductions in diffuse water pollution from agriculture by: encouraging best practice in the use of fertilisers, manures and pesticides; promoting good soil structure to maximise infiltration of rainfall and minimise run-off and erosion; protecting watercourses from faecal contamination (eg. with fencing and livestock crossings), and from sedimentation and pesticides (eg. with buffer strips); reducing stocking density or grazing intensity; reverting to grassland, etc.

In its first two years of operation the ECSFDI delivered advice to over 6,000 farmers, and land managers representing 15% of farm holdings (23% by area) within the original 40 priority catchments. Advice was delivered through more than 500 group events, and over 4,700 one-to-one farm visits. More than 14,000 farm-specific recommendations were made for measures to tackle diffuse pollution. Over 80% of farmers and land managers receiving advice from the ECSFDI confirmed that their knowledge of water pollution had increased, and that they had taken, or were intending to take, action to tackle it.

In the Frome catchment the CSFOs were involved in the prioritising and placement of ES options adjacent to the Fleet. This required the CSFO to be knowledgeable about the area, soils, cropping and topography in order to make the most of this opportunity. As a result most of the West Fleet is buffered from agricultural pollution and the SAC has now been classified as 'recovering'. In addition to the management implemented through ES, additional support has been provided to address the risk of pollution from livestock and manure-handling facilities in the catchment.

Chesil and The Fleet SSSI

Promoting public access and understanding

Creating new permissive access

Providing access is an important way of enhancing public enjoyment of the countryside. The open access and linear access options (only available in HLS) complement the Public Rights of Way (PRoW) network by:

- Creating new access routes to currently inaccessible features of interest such as riversides, historic features and areas of wildlife or landscape interest.
- Improving countryside access for walkers, cyclists, horse riders and those with limited mobility by creating new routes, routes that;
  - bridge gaps in the PRoW network;
  - give access to landlocked areas of Countryside and Rights of Way Act (CRoW) open access land;
  - join areas of CRoW Act open access land or link to long distance footpaths, national trails or coast paths, and where possible link to public transport networks; and
  - provide upgrades to existing CRoW access for higher rights users (ie. horse riders, cyclists and those with limited mobility).
- Creating new areas of open permissive access (as opposed to CRoW Act land) where this is seen as a local priority.

Results and effectiveness

Figure 36. AES results – creating new permissive access

	ELS options	HLS options	Classics	Total
Permissive access areas (ha)	n/a	1,968	5,534	7,502
Permissive linear access routes (km)	n/a	1,448	3,130	4,579
Footbridges (n)	n/a	231	934	1,165
Gates and stiles (n)	n/a	1,485	4,937	6,422

- The proportion of HLS agreements with permissive access options is about 4% and linear access options 16%.
- Reviews of access within the classic schemes concluded that value for money was low because too few agreements linked in to the existing network and/or provided routes that met public demand (Garrod et al, 1998). Changes in the targeting of access provision under HLS have been designed to address these weaknesses, but there has not yet been any assessment of their effectiveness.

Providing educational access

The educational access option encourages visits by schools, colleges and by a wide range of other interest groups, and provides an opportunity to illustrate the links between farming, conservation and food production. It also allows people to see and enjoy the environmental improvements being made as a result of AES. Associated support for farmers and teachers, for example preparation of teaching packs, to help maximise the benefits of educational visits is also available.

Results and effectiveness

Figure 37. AES results – providing educational access

	ELS options	HLS options	Classics	Total (2007 scheme year)
Farms providing educational access (n)	n/a	395	481	876
Educational visits (n)	n/a	2,095	4,779	6,874
Visitors (n)	n/a	78,268	95,660	173,928
Average group size (n)	n/a	25	25	25
School children (n)	n/a	21,753	49,623	71,376
Schools visits (n)	n/a	788	1,797	2,586

- Just over 10% of HLS agreements contain educational access.
- In 2007 there were over 6,800 visits which saw more than 170,000 people visit farms.
- In 2007 over 870 farms took part in the Educational Access programme.
- On average each farm hosted 8 visits during the year.
- Around 50% of the visits were from schools and other education providers.
- Over 99% of respondents stated that they enjoyed the visit and over 92% of school visits reported that their children's knowledge had improved as a result.
- An evaluation of educational access by ADAS (2007b) found that teachers valued the opportunity that ES offered through educational access but that other factors, such as transport costs, were limiting the potential.

Case study:
Educational access, Broxfield Farm, Northumberland

Run by David Thompson and his family, this 265 ha organic farm near Alnwick in Northumberland produces beef, cereals and lamb. About 100 ha are under arable production, and the remainder is clover grassland and some ridge and furrow permanent pasture grazed by suckler cows and their calves, and sheep. The Thompson family have been tenants of Northumberland Estates since 1820.

In 2001, Broxfield Farm entered into a ten-year CSS agreement which included educational access. The farm hosts visits for around 700 children a year, many from the inner cities who have never visited a farm before. David and the farm are accredited under the Countryside Education Visits Accreditation Scheme (CEVAS) which provides an assurance to teachers that health and safety has been considered and that the educational experience is valuable.

"We show the children how food is produced, and where it comes from. We also show how farmers produce affordable, wholesome food and at the same time look after the environment. We want to reconnect children to farming in the North East, so that they can make more informed decisions about what they eat, and understand how the countryside works."

During farm visits groups can choose from a variety of topics including art and creativity, sensory experiences, ecology, teambuilding and problem solving. The farm is ideal for studying food chains, life cycles, food webs, habitats and other subjects on the national curriculum. David's father, James, is also able to tell the children what it was like on the farm during the Second World War when evacuees came from Newcastle upon Tyne to the farm. The farm is home to many types of mammals, birds, and other animals, including brown hare, red squirrels, golden plover, foxes, lapwing, skylark, grey partridge, oyster catchers, bats and butterflies.

Special projects include the conversion of an old forge into an indoor classroom, assisted by grants from Natural England and the Northumberland Coast Area of Outstanding Natural Beauty (AONB). This provides a space for teaching and demonstrations, especially when the weather is poor. As well as classrooms, the farm has toilets and hand washing facilities.

More recently, David has received the Future of Farming Award 2008 in the North East region for his contribution to conserving wildlife, landscapes and providing children with a valuable learning experience and access to the natural environment.

School visit to Broxfield Farm, Northumberland

Maintaining and enhancing landscape quality and character

From their inception, AES have included landscape maintenance and enhancement as a cornerstone of scheme design and implementation, although individual schemes have contributed to this at different levels. In ESAs, schemes were focussed on defined areas of of inherently high landscape quality, largely dependent upon the continuation of traditional farming practices. CSS was designed for wider application and provided enhanced management of specific landscape types including uplands, waterside, arable and grassland landscapes (Dwyer & Kambites, 2005).

A primary objective of ES is to maintain and enhance the intrinsic character of landscapes. The use of land management options and capital works will invariably have an effect on the landscape, even though they are not necessarily selected for specific landscape objectives or a particular site. Therefore, they should be applied appropriately in a way that both respects and enhances the distinctive historic and landscape character of the local area. For example, it is important to ensure that options used to create buffer strips or fenced areas within field boundary patterns or alongside watercourses, are sensitively designed and located to avoid having a negative visual impact on the landscape.

In many situations where the choice of options is perhaps primarily aimed at wildlife conservation they also have a significant benefit for landscape character and historic features. For example, the use of arable options that include reversion of arable land to permanent grassland in chalk landscapes can restore both wildlife habitat and the downland landscape character whilst helping to protect the archaeological features associated with those landscapes such as barrows and other earthworks. This integrated approach to delivering AES agreements where the options chosen have multiple benefits is well suited to the use of landscape character assessments as a way to take a landscape overview and to inform land management decisions.

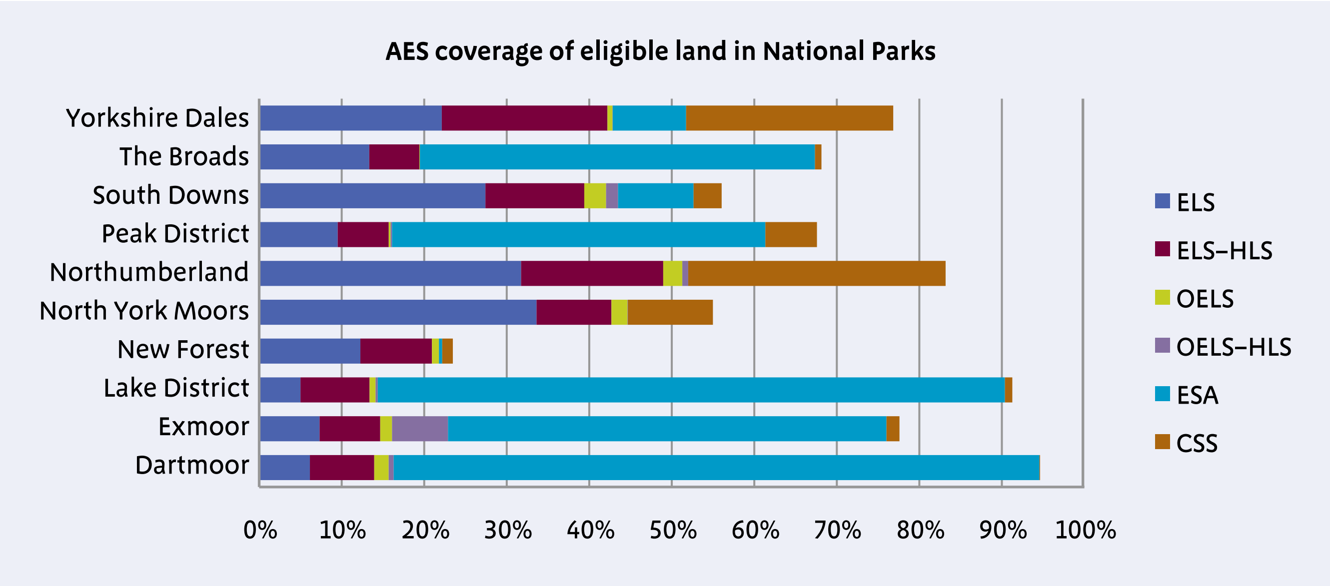
At a broad level, landscape characteristics most typical of an area are identified in the relevant National Character Area statements which identify the predominant features and patterns that make up landscape character. ES provides the opportunity to maintain and strengthen these landscape characteristics through the proactive management and enhancement of habitats and features that are key elements of local landscape character – from land cover through to traditional farm buildings, boundaries and historic parklands. For example, in a predominantly enclosed, pastoral landscape featuring grassland fields bounded by hedgerows and containing ridge and furrow earthworks, the appropriate options would be selected to maintain or restore those features.

To date evidence for the impact of AES on landscape has tended to focus on measuring outputs on landscape components, such as the appropriate management of land cover or landscape features, rather than providing a holistic understanding of the impacts of AES on landscape character (Boatman et al, 2008). Although this has provided a benchmark for evaluating changes on certain landscape elements which contribute to landscape character, there is currently little understanding of how such changes add up to impact on the overall character and quality of the landscape. The identification and evaluation of such changes requires professional interpretation and judgement against a landscape character baseline (Dwyer & Kambites, 2005) which, although less straight-forward to achieve, would be extremely valuable evidence.

Results

Agri-environment measures have contributed significantly to maintaining nationally important landscapes, as well as those valued more locally.

Figure 38. AES coverage of eligible land in National Parks[18]



Effectiveness – key evidence

- Robust evidence of positive scheme results for maintenance of landscape character in England and, to a lesser extent, enhancement have been provided by the ESA monitoring programme, indicating clear additionality in most cases (Boatman et al, 2008).
- CSS has encouraged positive landscape impacts in most agreements and short-term CSS monitoring has found the quality of maintenance was higher on agreement land (Boatman et al, 2008).
- AES are contributing positively to the maintenance and enhancement of landscape quality, with the great majority of agreements resulting in strengthening of landscape components, when compared with areas outside schemes (Dwyer & Kambites, 2005).
- Intention surveys show that, in the absence of schemes, the condition of the fundamental components of landscapes, such as field boundaries, would have deteriorated (Courtney et al, 2007).
- A number of surveys have reported on thematic areas or key characteristics of landscape types in terms of change to point (eg. ponds, field barns) and linear landscape features (ADAS, 2000b). These have shown evidence of positive change for the extent and condition of features as a direct result of scheme uptake.
- In the Lake District and Pennine Dales ESAs, an investigation into the repair of traditional farm buildings over a ten-year period was able to show clear benefits, not only for the individual features, but also for the wider landscape (Courtney et al, 2007).

[18] Digital boundaries are not available for classic scheme special projects and so the analysis under-represents these. These make a significant contribution in some areas, especially the New Forest.

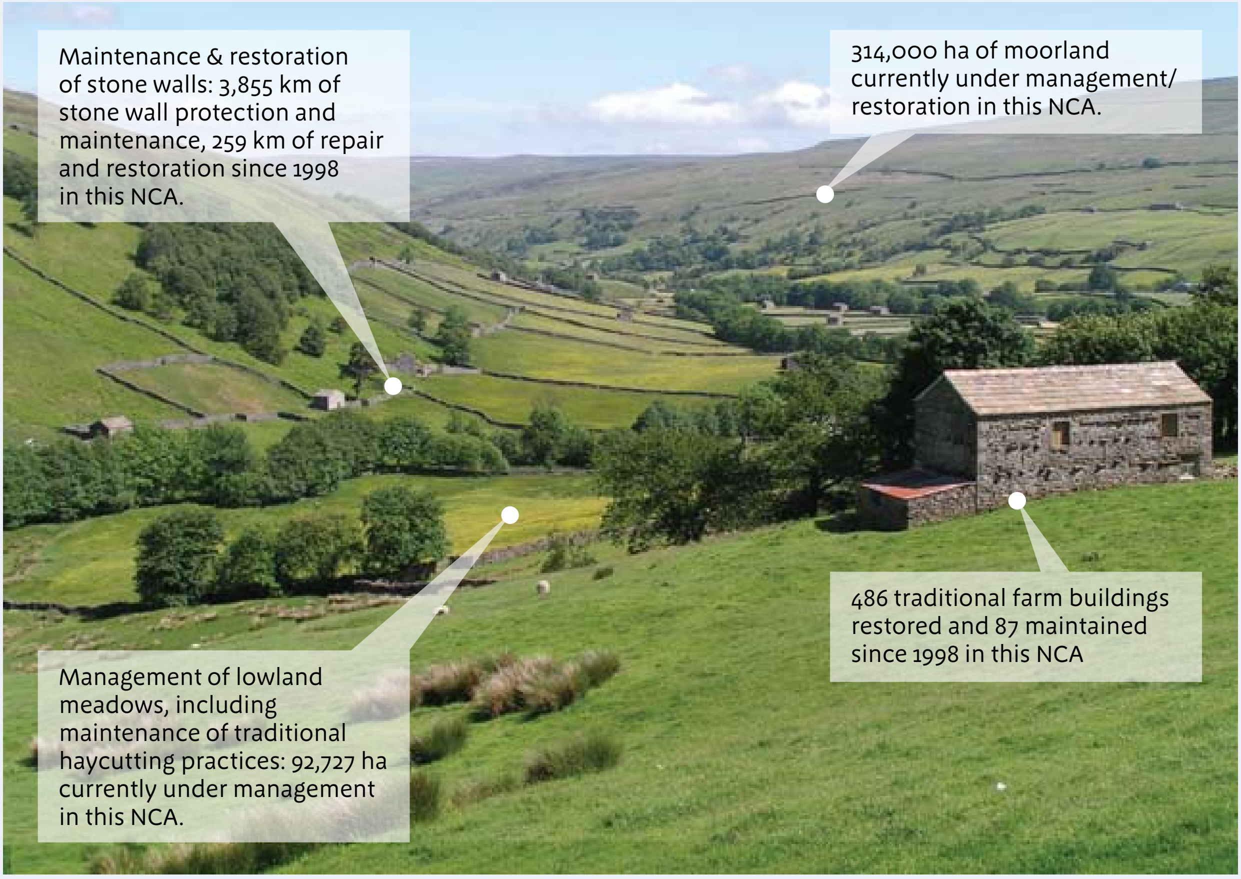
Case study:
Contribution of AES to reinforcing and enhancing landscape character. Swaledale, Yorkshire Dales

The Yorkshire Dales provide a striking example of a landscape of strong character, dependent on the continuity of traditional farming practices. Over twenty years ago the threat posed by more intensive farming was addressed by designation of the Yorkshire Dales Environmentally Sensitive Area – one of 26 ESA's across England by 1994.

The 'whole farm' approach to ESA agreements in this area helped to ensure that a significant proportion of the enclosed farmland within the Dales came under agreement including the maintenance and restoration of key features such as stone walls, field barns and hay meadows which define this landscape. A landscape character assessment for the ESA provided a baseline for monitoring change as well as a cornerstone for landscape management guidance. More recently, Environmental Stewardship has helped to further landscape conservation in areas such as Swaledale.

Through both ELS and HLS the enclosed farmland and open moorland can be managed appropriately to maintain and enhance the whole landscape as defined by the key characteristics described in the Yorkshire Dales National Character Area. The NCA provides valuable information on key features, their distribution and patterns in the landscape. Where more detailed and localised landscape character information is available, this can also be used to refine the use of land management options.

The example at Swaledale also demonstrates how a landscape character approach can provide an integrated overview of the area – showing how wildlife habitat is an integral part of the historic landscape.



Credit: Natural England/Dave Key

Swaledale, illustrating the contribution of AES to landscape character in the Yorkshire Dales National Character Area.

Adapting to and mitigating climate change

Responding to climate change was introduced as a new overarching theme of ES in 2008 (Defra and Natural England, 2008). By meeting the scheme objectives ES will also:

- support the adaptation of the natural environment to climate change; and
- enhance the contribution of agriculture and land management to climate change mitigation, for example by reducing GHG emissions, and providing and protecting carbon storage (the alterations to the land use and management practices as a result of management within ES may also have implications for climate change mitigation).

Mitigating climate change

There are two main ways in which AES reduce GHG emissions:

By reducing emissions of:

- Nitrous oxide (N_2O) which is released from soils, from livestock manures and during the manufacture of inorganic N fertiliser;
- Carbon dioxide (CO_2) from fossil fuel consumption in farming operations and input production; and
- Methane (CH_4) from ruminant animals and livestock manures.

Peatland restoration work, Peak District

And by increasing the carbon stored within the land, either as:

- soil organic carbon (SOC); or
- above ground carbon (AGC).

A recent study (University of Hertfordshire, 2007) quantified the GHG mitigation delivered by all ES options compared to a baseline scenario of production if there were no scheme[19]. It concluded that per unit of option:

- 6% of options provide significant benefits. This was usually as a result of a major change in land use from intensive production to low or zero input systems, for example: unfertilised, uncultivated buffer strips in arable and grassland and other options taking land out of cultivation (field corner management, beetle banks, archaeological features); and habitat creation in HLS, especially where management involves re-wetting of peat soils (increased SOC) and tree planting (increased AGC).
- About 20% of options provide small positive benefits. Typically these were options involving continued arable production but at a lower intensity, such as conservation headlands with reduced fertiliser and pesticide inputs.
- About 45% of ES options were neutral or had a slight positive effect.
- 25% were slightly negative, and only one option was highly negative. Typically these were options that involved an initial loss of vegetation (eg. scrub removal) and therefore associated AGC.

[19] The results do not account for a displacement (from additional food imports or increased production intensity elsewhere on the holding) in production within the calculated GHG balance.

Results and effectiveness

Figure 39. AES results – climate change mitigation

	ELS options	HLS options	Classics	Total
GHG saving ($MtCO_2e/yr$[20])	1.10	0.23	2.13	3.46

- AES currently deliver GHG savings of 3.46 $MtCO_2$ equivalent per year.
- This represents:
  - approx. 0.7% reduction of annual GHG emissions for England.
  - an 11% reduction from the agriculture, forestry and land management (AFLM) sector in England.
- In absolute terms, accounting for current patterns of ES uptake, a small number of options made major contributions to the reduction in GHG emissions: 30% of the overall reduction came from changes in practice to manage archaeological features on grassland; 28% from restoration of moorland; 10% from changes in hedgerow management; and a further 10% from buffer strips (mainly arable). Options increasing GHG emissions equal only 1.6% of reductions and in absolute terms 82% was related to restoration of heathland.
- These results reflect the existing contribution of the schemes prior to the introduction of climate change mitigation as an overarching scheme objective. Further work is in progress to reflect this change and adjust scheme delivery accordingly.

Ribble Estuary, Lancashire

[20] Each of the GHG listed has a different potential to cause global warming but these may be standardised on a single scale as tonnes of CO2 equivalent (CO2 e).

Adapting to climate change

Best estimates are that temperatures in UK regions will warm by approximately 2–3°C by 2050[21], with more frequent summer drought, higher winter rainfall and rising sea levels (Jenkins et al, 2009). These changes will have complex impacts upon the natural environment and on farming, causing adaptions to cropping and animal husbandry, as well as losses of land to the sea (Mitchell et al, 2007). A major challenge for AES is to support the adaptation of the natural environment to climate change. A wide range of adaptive actions are likely to be required to increase the capacity of the natural environment to climate change (Smithers et al, 2009). For example:

- Increasing areas of semi-natural habitat to support larger, more resilient populations and to buffer against pressures in the wider landscape, such as localised pollution, and in some cases maintain distinctive microclimates.
- As species change their abundance, distribution and habitat preferences the risks of local or national extinction are likely to be minimised by maintaining ecologically varied landscapes, and also opportunities for species to move within them.
- Increased flood risk could be addressed by managing land to reduce surface run-off and setting aside areas on which flood water is temporarily stored, for which provision is already made in AES.
- Risk of summer wildfire may increase land management, such as grazing, which reduces flammable material in the countryside. The encouragement of more fire resistant types of vegetation, or even fallows, may also play a part.
- Managed coastal realignment to create natural defences and targeting of scheme options to allow coastal habitats to migrate or develop in response to sea level rise.

The current schemes, particularly HLS, are already delivering beneficial climate change outcomes by improving the quality of semi-natural habitats, especially where this is targeted to increase heterogeneity and connectivity between patches within a landscape. However, there is potential to achieve much more and there is a need to develop a strategic approach to climate change adaptation that is embedded at the heart of AES. This requires both fundamental research into the way climate change impacts on fragmented landscapes and the development of specific options.

It is also important to assess current schemes to ensure they are robust to climate change. For example, when creating or restoring habitats it will be increasingly important to ensure that species are planted which are tolerant of the range of climatic conditions likely to be experienced in the future.

[21] Based on UKCP09 projections with a medium emissions scenario and 50% probability level.

Case study:
Natural England climate change adaptation pilot studies (Natural England 2009b)

The purpose of the Character Area Climate Change Project is to identify the vulnerability of environmental assets and features in specific landscape areas of England to the effects of climate change and the appropriate adaptation responses for those areas. The results of the project will help Natural England develop landscape-scale adaptation strategies that will enable us to maintain the benefits we obtain from an ecosystem or landscape in the face of inevitable changes. ES provides the main mechanism by which these adaptation strategies can be put into practice.

Four NCA climate change adaptation pilot studies have been completed and a further five are being undertaken in 2009–2010. The four pilot NCAs were selected to represent a range of habitats and landscapes that are vulnerable to the impacts of climate change in different ways. A brief summary of findings for one of these, the Cumbria High Fells, is presented below.

Cumbria High Fells is a mountainous landscape likely to be vulnerable to an increase in temperatures. England's peat soils store around 300 million tonnes of carbon and significant amounts of carbon will be emitted if the drier summers and heavier rain expected from climate change are allowed to dry out or erode peat supplies. Improving the condition of all existing upland habitats and water resources is a priority, particularly for high carbon ones like blanket bog.

Therefore, like many upland areas, the Cumbria High Fells are a 'carbon time bomb' needing to be specifically managed as a future carbon store. Many species in the area are likely to expand their range – the ruddy darter and the hairy dragonfly have been present in Cumbria since 2001 and the heath fritillary butterfly may colonise the area. Garlic mustard and cow parsley will benefit from a warmer environment, although others species will decline, such as the stiff sedge plant, the ice age relic fish the arctic char, and the mountain ringlet butterfly, which faces local extinction. More extreme cycles of wetting and drying may also affect the foundations of walls and historic buildings, iconic features of this region.

a) Cumbria High Fells, visualisation based on current landscape

b) Cumbria High Fells, visualisation based on possible impacts of climate change

Conserving genetic resources

Conserving genetic resources is a secondary objective of ES that is delivered alongside the scheme's primary objectives. Specifically, ES has the potential to contribute to the maintenance of the genetic diversity of native wild plants and animals, farm animals and fruit trees.

Both the classic schemes and ES have numerous options that aim to maintain and restore surviving areas of semi-natural habitat by offering payments to support their management. These habitat-based maintenance options contribute to the conservation of the genetic diversity of wild plants and animals, particularly as the schemes are national in their coverage and go wider than the statutory sites. This breadth and depth of coverage means that these maintenance options can help maintain populations of native wild plants and animals across their whole range.

ES offers a supplement for the use of native breeds at risk in the grazing management of wildlife habitats. This supplement covers the use of 42 breeds of sheep, 27 breeds of cattle and 2 breeds of goats. It currently covers grazing over 13,000 ha. This supplement not only helps to maintain the numbers of a range of breeds in danger of being lost from commercial farming, but also encourages their use on less productive, more challenging pastures, which may help retain the characteristics that are of potential value.

AES encourage the conservation of traditional orchards and the retention of traditional varieties of fruit tree, including apple, pear, cherry, plum, damson and cob nuts. The HLS option for the restoration of traditional orchards seeks to prolong the life of existing orchard trees and encourage the planting of new trees using traditional varieties. Currently these options cover 2,140 ha of orchards.

Effectiveness – key evidence

Restoration of habitats in ways that maintain the genetic diversity of wild plant populations:

- Experimental evidence (CAER, 2005) has shown that the use of green hay or brush harvested seed can effectively enhance the botanical diversity of grassland swards using seed of local provenance. Both methods were successful at enhancing the botanical species richness and similarity to the desired target community in chalk grassland and lowland hay meadow experiments.

Providing habitat for widespread but declining species in ways that do not disrupt the genetic diversity of native wild plants:

- Using mixtures of agricultural cultivars to provide habitat for widespread species can be effective. However, such mixtures are by their nature uniform, and so do not support the full range of insect species that could potentially benefit. The challenge is to improve understanding of and engagement with the aims of these options amongst farmers and land managers and to explore ways of providing a greater diversity of habitats that are compatible with genetic conservation and also do not produce unacceptable weed burdens.

Safeguarding crop wild relatives:

- Recent research has highlighted the range of wild plant species that are related to crop plants and which are potential sources of useful genetic material to assist in the development of new crop varieties, especially varieties suitable for growing in changed climatic conditions. Conservation of these species may therefore yield economic benefits in the longer term. A total of 250 crop wild relative species have been identified in Britain as a priority for genetic conservation (Maxted et al, 2007) and many others have potential for improvement of crop plant varieties. No fewer than 1,955 species (65% of the British flora) are related to plants of economic importance. Crop wild relatives occur in a wide range of habitats. Some, such as wild asparagus are found only in isolated undisturbed habitats and plants in these situations may have high importance, as they are less likely to have cross bred with commercial varieties and lost some of their genetic diversity. Others such as wild parsnip are frequently found in more disturbed places and may have weed-like characteristics. A series of action plans have been prepared for priority crop wild relative species (Codd, 2008). A preliminary analysis of these plans (Radley, 2009) suggests that ES may already be benefitting some of these species, and it has the potential to make a bigger contribution. It also suggests that there may be some cases where crop wild relative populations may be unwittingly damaged as a side-effect of otherwise beneficial ES options.

Traditional orchard, Yarcombe, Devon

Managing flood risk

Managing flood risk is a secondary objective of ES that is delivered alongside the scheme's primary objectives. Specifically, ES has the potential to contribute to reducing flood risk by:

- Changes in land management practice that:
  - slow the drainage of water, for example blocking drainage channels (known as grips) in the uplands;
  - maximise the infiltration of water into soils, reducing the risk of overland flow (which also minimises potential soil erosion), for example by reducing soil compaction in both arable and grassland; and
  - reduce the risk of surface run-off, for example by establishing cover crops on bare soils and undersowing open crops such as maize.
- Changes in land use that:
  - slow the passage of water, for example by planting new woodland/hedges or creation of grass buffer strips;
  - provide areas for temporary flood storage by holding back flood water for later release; and
  - provide buffering against flood risk from high tides by creating inter-tidal wetland through managed realignment of the coast.

A wide range of AES options can therefore contribute to managing flood risk. The existing take-up of these options has been covered elsewhere.

Effectiveness – key evidence

The evidence to support the benefits of AES in relation to flood management is limited, in part because of its relatively recent inclusion as an AES objective. However, some relevant evidence is available:

- Alkborough Flats on the Humber Estuary where sea defences were deliberately breached in 2006 creating 370 ha of new wetland, including 180 ha of inter-tidal habitat, and in the process reducing extreme water levels by 150 mm (Land Use Consultants, 2009).
- A reduction of around 40% in the peak flow from surface run-off at a field and small catchment scale by optimal planting of trees and hedgerows (Wheater et al, 2008).
- Modelled predictions of restoring flood plains on the River Cherwell suggest that this could reduce peak flow by about 10–15% (Acreman et al, 2003). However, other evidence suggests that restoring flood-plain wetlands may reduce storage capacity for peak flow events (Acreman et al, 2007) illustrating a potential conflict between provision of temporary storage and permanent habitat change.

Overall, there is currently a lack of good scientific evidence on the land use changes needed to produce flood risk management benefits at the catchment scale. However, there is considerable scope for AES to address more localised flooding issues subject to appropriate targeting. There are also examples where targeted intervention has been effective for specific sites, eg. managed realignment of coastal sea walls resulting in new intertidal habitat creation and benefits for flood risk management.

Delivering social and economic benefits

Before considering the socio-economic benefits of AES in detail it is helpful to draw a distinction between two broad types of benefit:

- The welfare benefits gained by people resulting from environmental improvements, for example improvements to the landscape, reductions in diffuse pollution in water courses, increased levels of biodiversity (typically expressed in willingness-to-pay (£) per person/ study population).
- The incidental benefits in terms of direct, indirect and induced economic activity that result from government spending on schemes, for example the 'boost' to local and regional economies through job creation and/or gross-value added and the development of transferable skills and social capital.

Non-market (welfare) benefits

The economic rationale for AES is based around the concept of market failure. Markets fail to deliver the socially desirable level of environmental goods and services (ie. the level that would yield the greatest benefits to society) for a number of reasons: the 'public good' characteristics of the environment; the negative impacts imposed on others by agricultural practices (eg. so called negative externalities from the use of agricultural inputs); and information failures, eg. around complex notions such as biodiversity (CRER and CJC Consulting, 2002). The basic economic rationale of agri-environment policy is to correct these market failures and in doing so, make society better off.

From an economic point of view, the success of agri-environment policy can be measured by the extent to which schemes are able to deliver environmental goods and services that society values, above and beyond the costs incurred in supplying them. Economic valuation studies have shown that people place a considerable value on the natural environment (GHK and GFA-Race, 2004). Similar studies have also confirmed the economic value that people place on the environmental improvements associated with AES. Figure 40 provides an overview of the existing economic valuation evidence for AES in England.

Figure 40. Economic valuation evidence for AES in England (after Hanley et al, 1999)

Study	Benefit estimate per person (£)	Net value (£m) (after scheme costs and payments)	Net benefit (£m) per £m scheme spend
South Downs ESA	1.98 – 27.52	-0.71 – 78.9	-0.73 – 81.3
Somerset Levels and Moors ESA	2.45 – 17.5	-1.76 – 50.1	-0.94 – 26.9
Norfolk Broads ESA	142-150	Not known	Not known
Nitrate Sensitive Area	16.2	12	8
Organic Aid	17.6	16.58	39.47

The vast majority of studies date back to the 1990s and are focussed on classic schemes – mainly ESAs. There is not yet any valuation evidence for ES, which is a reflection of its relative newness. However, a joint Natural England-Defra research project is currently underway which will provide an up to date value for the non-market benefits of ES.

The estimates of net benefit per £ million of scheme spend are varied and range from -£0.94 million to £81.3 million. However, in the majority of cases the value of the benefits significantly exceeds scheme costs.

Incidental benefits

In addition to the welfare benefits generated by AES the scheme expenditure has an incidental impact on farm businesses and local and regional economies through spending on, for example, labour and materials and development of transferable skills and social capital. The following definitions based on the New Economics Foundation (NEF) LM3 model (NEF and the Countryside Agency, 2002) provides a useful analytical framework for discussing these incidental socio-economic effects:

- Direct effects – these accrue to the agreement holder as a result of AES payments. For example: payment for own labour; development of transferable skills; self-worth; social interactions with farmers and non-farmers as a result of AES; impacts on farm costs, revenue and incomes; farm labour profiles and succession patterns; work off-farm and scope for related on-farm diversification; and changes in decision making behaviour/attitudes beyond the scope of the agreement.
- Indirect effects – these are generated as a result of spending by the recipient business, for example on: employees; sub-contractors; materials; consultants; and the associated maintenance of cultural/artisan skills.
- Induced effects – these result from further spending in the economy by employees/sub-contractors.

There has been little recent evaluation of the incidental socio-economic contribution of AES, with no scheme-wide evaluations. However a current Defra-Natural England research project is exploring the incidental socio-economic benefits of ES and will report shortly. Figures 41 and 42 present a summary of the evidence from earlier studies in England for the income and employment effects of AES (CCRI, in press). Based on these figures an injection of £1m of AES spend results in a total income effect of between £0.4m and £1.9m spending in the economy and between 4 and 35 jobs supported. Extrapolating these figures for existing AES annual spend gives a range of total income effects in the local economy of £178m–£847m and 1,784–15,610 jobs supported (created initially, then sustained). Research indicates that the economic footprint of many of these benefits is likely to be concentrated in certain areas, coincident with high levels of scheme uptake, and previous studies have demonstrated the relatively low levels of leakage of these benefits outside these areas.

In addition to the incidental economic benefits of scheme expenditure there are significant social benefits, such as underlying attitude change as a result of scheme participation. AES membership has been shown to increase participation in training, environmental awareness and knowledge, and involvement in group activities. This in turn can have wider positive benefits through enhanced social networks and increased business confidence.

Figure 41. Comparison of income effects of agri-environment activities per £m of scheme spend

	Income effect (£m) per £m scheme spend			
Study	**Direct**	**Indirect**	**Induced**	**Total**
ESA Traditional Farm Building repair agreements in the Lake District (Edwards et al, 2005)	0.5	0.6	0.2	1.3
Grant-funded farm building restoration in the Yorkshire Dales (Courtney et al, 2007)	0.8	0.5	0.0	1.3
Grant-funded traditional drystone wall restoration in the Yorkshire Dales (Courtney et al, 2007)	1.0	0.8	0.1	1.9
Hedge restoration schemes in Devon (Mills, 2001)	1.1	0.3	–	1.4
Countryside Stewardship Scheme (Harrison-Mayfield et al, 1998)	0.4	–	–	0.4

Figure 42. Comparison of employment effects of agri-environment activities per £m of scheme spend

	Jobs supported per £m scheme spend			
Study	**Direct**	**Indirect**	**Induced**	**Total**
ESA Traditional Farm Building repair agreements in the Lake District (Edwards et al, 2005)	2.3	1.3	0.4	4.0
Grant-funded farm building restoration in the Yorkshire Dales (Courtney et al, 2007)	2.3	0.9	0.3	3.5
Grant-funded traditional drystone wall restoration in the Yorkshire Dales (Courtney et al, 2007)	4.8	0.4	0.5	5.7
Hedge restoration schemes in Devon (Mills, 2001)	14.6	3.3	–	17.9
Countryside Stewardship Cirl Bunting agreements (Hewit and Robins, 2001)	–	–	–	15.4
Countryside Stewardship Scheme (Harrison-Mayfield et al, 1998)	–	–	–	34.7


Skylark singing, Hertfordshire

5. Conclusions and future perspectives for AES

Conclusions and future perspectives for AES

A report commissioned by the Land Use Policy Group (LUPG) (Boatman et al, 2008) described the prospects for the current generation of AES and the challenges they face in the following terms:

"There is good evidence that the much increased coverage, and the kinds of management option now being used within the UK agri-environment schemes, will deliver significant benefits for biodiversity, landscape quality, the protection of historic features and the provision of new or enhanced access opportunities. As a result of experience gained from the evaluation of earlier schemes, the targeting of scheme prescriptions has improved considerably, with greater scope for management tailored to the needs of individual sites. Outstanding successes have been recorded where such targeted management has been applied to implement well-researched solutions to specific issues; the challenge is to achieve the same level of benefits on a broader scale."

Highlights of scheme performance

Chapter 1 of this report highlights the enormous achievement of the early AES in defusing long running tensions between farming and environmental interests and providing a way of maintaining many of our most cherished traditional landscapes, even during a period of agricultural intensification. This history of achievement should not be forgotten when considering the more recent achievements of the schemes, especially now that there is renewed interest in increasing domestic agricultural production.

The review of results in Chapters 3 and 4 provides evidence that AES are continuing to develop and make progress across the full range of the schemes' environmental objectives. The review also highlights some examples of outstanding success.

The design of ES incorporates a large number of lessons learned from experience with the earlier schemes. It is intended to tackle the two major weaknesses of the classic schemes, which were:

- their limited impact on the wider countryside; and
- their limited success in maintaining, restoring and re-creating the most complex environmental features.

ELS and OELS were intended to maintain and enhance the wider farmed environment in ways that could fit alongside productive farming. Chapter 3 demonstrates that these elements of the scheme have proved popular with farmers and land managers and agreements are now in place, covering 66% of farmed land. This is a dramatic increase from the levels achieved before the introduction of ES. This expansion has given many more farmers and land managers experience of environmental management and it has the potential to build much greater knowledge of environmental management and appreciation of its value within the farming industry.

One aspect of ELS design is to work alongside HLS and provide habitat that would benefit widespread but declining bird species. Chapter 4 of this report demonstrates that ELS and HLS together are providing year-round resources for declining bird species in arable landscapes. There is clear evidence that birds are benefitting from these resources at a local level.

Other individual ELS options are emerging as having proven value:

- Chapter 4 shows that well managed pollen and nectar and wild bird seed mix options do support larger concentrations of beneficial insects and do provide both winter food for birds and summer chick food.
- Grass margins have also been shown to benefit a variety of species, particularly small mammals. Combinations of different ELS management options, providing a

variety of habitat types over a wide area, may well prove to be particularly valuable. Merckx et al (2009) showed that six metre grass margins in combination with hedgerow trees resulted in a substantially higher abundance and diversity of larger moth species, especially where a concerted effort was made to apply these options at a landscape-scale.

HLS has demonstrated that it can build on the achievements of the classic schemes and its targeting has been greatly improved. The structure of HLS also means that there is now much greater clarity about what features are under management and what the management is trying to achieve.

HLS has brought a renewed emphasis on the maintenance and restoration of existing habitats. The scheme has been the main mechanism used to increase the percentage of SSSIs in favourable or unfavourable recovering condition. Results presented in Chapter 4 show that coverage of BAP priority habitats, and the contributions made by agri-environment schemes to BAP maintenance and restoration targets are considerable.

HLS has also produced a definite improvement in the approach to habitat creation. This was a weak point of the classic schemes, with many habitat creation projects failing to achieve the anticipated benefits. HLS has learnt from the experience of earlier schemes and adopts a much more targeted and selective approach. HLS offers a range of habitat creation options that are carefully targeted and designed to achieve specific and defined outcomes. They emphasise the use of seed from suitable, local donor sites rather than bought-in seed mixes of unknown provenance. This new approach means HLS can have a useful role in increasing the resilience and linkage of surviving habitat patches, thus contributing to climate change adaptation.

Evidence is continuing to accumulate that, where AES are targeted to implement well-researched solutions to specific issues in a specific area, they can be extremely successful. The cases of the cirl bunting and the stone curlew, highlighted in Chapter 4 are well known, but this review highlights a number of other examples, including that of the black grouse and the chalkhill blue butterfly.

Chapter 4 also shows that ES as a whole has stimulated a step change in the scale of action to protect specific features in the wider landscape. A huge length of field boundary is now under management, many more field monuments are now safeguarded and a large number of otherwise redundant traditional farm buildings are now being maintained. HLS has also produced a step change in the scale of action to protect historic parklands and wood pastures, which are of value for their history, as landscapes and as reservoirs of biodiversity for many specialised species.

The approach to the provision of access in AES has progressed in recent years. In the early days of CSS, discretionary access was heavily criticised for being placed where few people knew of it or wished to use it. Recent changes to HLS targeting should increase the usefulness of this option, with a new emphasis on providing access 'where people live' and 'where people like'. Educational access has also continued to expand, making a valuable contribution to educating people, especially children, about farming and the countryside.

Assisting with the response to climate change became an over-arching objective of ES after the scheme was launched. Chapter 4 presents evidence showing that agri-environmental management is already making a substantial contribution to reducing the GHG emissions from land management. It reviews the ways in which the scheme could help with climate change adaptation. It also highlights the changes already made to HLS targeting to improve the resilience and connectivity of surviving areas of semi-natural habitats in order to give them and the species they contain the best chance of adapting to climate change over the next few decades.

Areas where the scheme has yet to fully deliver, with a summary of actions being taken to address these issues

This report has also highlighted that there are a number of areas where AES have yet to achieve all of their stated aims.

Widespread farmland species

Despite the success that ES as a whole has had in providing resources for farmland birds, reported in Chapter 4, national populations of a number of widespread species have yet to mount a sustained recovery. It is extremely difficult to relate specific changes in management to changes in national populations. There have been many other parallel changes since ES was introduced in 2005, not least the abolition of compulsory set-aside in 2007. Some of these changes have probably had an adverse effect on farmland birds (BTO, 2008a & 2008b) and may, therefore, have been working against ELS.

There is good evidence that ELS contains all the options necessary to provide for the habitat requirements of farmland birds, and that these birds do benefit where these resources have been provided at a sufficient scale at a local level. The overall scale of intervention achieved so far does not however appear to have been sufficient to offset the other pressures that these species face and reverse their national population declines.

At first sight this seems odd, especially in view of the high uptake of ELS. However, Figure 18 illustrates one of the limitations of the original ELS concept. It shows that, whilst ELS has been effective in bringing field boundary features into agreement, there has been a comparatively low uptake of the most potentially valuable in-field options. This is a consequence of the design of ELS, which allows farmers free choice of options and provides rather little support to them whilst making these choices. This problem was recognised during an initial review of ES in 2007. It was decided to retain the principle of free choice, which is much appreciated by farmers and land managers, and helps keep overheads low. However, measures are now being taken to try to persuade farmers and land managers to adopt a wider and more appropriate range of management options using substantially enhanced training and information inputs.

More recently the Campaign for the Farmed Environment (CFE) has been developed as a voluntary approach to mitigating the environmental impacts of the loss of set-aside. The goal of the Campaign is to retain and exceed the environmental benefits provided by land formerly required to be set-aside under the Single Payment Scheme. The Campaign will promote activities by farmers and land managers which secure a geographical spread of the following environmental benefits:

- Farmland birds, to address the three key requirements of wild birds, namely over-wintering feeding habitat, spring/summer breeding sites and spring feeding opportunities.
- Resource protection, to address soil conservation and water protection by locating uncropped areas, buffer strips and/or adopting agronomic practices which minimise the risk of erosion and diffuse pollution to water.
- Biodiversity provision, to retain/create areas of uncropped or open habitat that diversify the arable landscape and provide opportunities for open ground species, and feeding and breeding sites often for more common species.

Pearl-bordered fritillary

The Campaign includes targets which will be secured through the additional actions both within and outside ES, by farmers and growers, their advisers and agronomists.

These include:

- To double the current uptake of key ELS in-field options – this equates to an additional 40,000 ha of these options.
- To retain and increase the area of uncropped land from the 1 January 2008 baseline by 20,000 ha – this equates to a total area of 179,000 ha.
- To increase the area of land managed voluntarily by 30,000 ha above current levels (to be established by survey this autumn), with a shared commitment to try to go beyond this towards 50,000 ha.
- To seek to help achieve Natural England's target of 70% of farmland within an agri-environment agreement by March 2011, including by encouraging farmers with expiring agri-environment agreements (ELS and classic scheme agreements) to renew.

It is hoped that the CFE will reinforce the efforts being made by Natural England to persuade more farmers to choose options that allow ELS to fulfil its environmental potential and achieve the threshold levels of farmland bird habitat provision needed to allow populations of the widespread but declining species to start recovering.

Hedgerow management

Some issues are also emerging with the ELS hedge management options. Although these do appear to be helping to maintain hedgerows evidence reported in Chapter 4 suggests that it is still possible for cutting regimes that are allowed under the ELS hedgerow management options to remove the vast majority of fruit before it can ripen and be eaten. This means that the hedgerow management options may not be delivering all the environmental benefits that they were originally intended to. The design of these options may have to be reviewed in consultation with the farming industry.

Understanding the effect of AES on landscape character

To date there has been a tendency to focus on measuring outputs on landscape components, such as the appropriate management of land cover or landscape features, rather than providing a holistic understanding of the impacts of AES on landscape character. Whilst this has provided a benchmark for evaluating changes on certain landscape elements which contribute to landscape character, there is currently little understanding of how such changes add up to impact on the overall character and quality of the landscape. The identification and evaluation of such changes requires professional interpretation and judgement against a landscape character baseline which, although less straight-forward to achieve, would be extremely valuable evidence.

Delivering the complex management required for successful habitat restoration/creation

There is evidence that HLS has yet to achieve all of the hoped for improvements in the quality of maintenance and restoration management for complex habitats such as species-rich grasslands and species with demanding habitat requirements such as breeding waders.

HLS was designed to overcome some of the limitations identified with the classic schemes. Many of these related to the very generalised management prescriptions available under these schemes, and to the fact that the schemes relied on a prescriptive approach to management, which did not focus on environmental outcomes. It was hoped that HLS would allow a step change in the quality of maintenance and restoration management for complex habitats but the early evidence presented in this report suggests that this has yet to happen.

Although there is good evidence that these habitats fare better under agreement than they would otherwise, there is evidence that the standard of management applied is still variable. There are still examples where the botanical quality of species-rich grasslands is deteriorating under agri-environmental management and the hoped for increases in breeding wader performance have yet to be consistently achieved. This is probably because the design features built into HLS to try to ensure a focus on environmental outcomes have yet to be consistently used to their full potential because:

- Some agreements have been found to contain prescriptions and indicators that have not been adequately tailored to local conditions.
- The regular cycle of monitoring, feedback and adjustment that HLS was designed to facilitate has not so far taken place.

These problems have now been recognised and action is underway to strip out unnecessary complexity. This should free-up adviser time to undertake the feedback cycle whilst simultaneously building up their environmental management skills.

Uniform management

An unexpected consequence of the widespread adoption of AES is that the comparative uniformity of management that they impose can be detrimental to some species that depend on habitat mosaics. Research and anecdotal evidence is accumulating from a number of sources that too much standardisation of management can have unintended adverse consequences for some species.

This issue can be addressed by using the flexibility available under HLS to deliberately create habitat mosaics and by encouraging ELS participants to choose a wider range of management options.

ES set out to achieve the level of benefits delivered by the best of the classic schemes on a much broader scale. It is too early to say for sure how successful ES has been in overcoming these weaknesses but many positive indicators emerge from the evidence presented.

Future perspectives

The previous section of this chapter has reflected on the achievements of over 20 years of AES in England to date. The emphasis in this section turns to the future. The thoughts presented here reflect Natural England's role and experience both as scheme deliverer and environmental adviser.

The first challenge is to address and overcome the limitations identified in the previous section and ensure that ES can fully deliver its environmental potential by the end of the current RDPE in 2013. To do this it is also necessary to make sure that the scheme remains attractive to farmers and land managers.

However, this alone will not be sufficient to ensure the future role of AES as a major instrument of land management policy. Work is also needed to demonstrate that the schemes can meet the 'new challenges' identified during the recent EU CAP Health Check, particularly the need to safeguard ecosystem services and respond to climate change. The main challenges for ES in the future are summarised below, and explored in more detail in the subsequent sections:

Scheme scope and reach

- Maximise the potential for AES delivery across the full range of ecosystem services that are provided by the farmed environment.

Scheme delivery

- Continue improvements in the cost-effective delivery of AES.
- Optimise the delivery of both market (eg. food production) and non-market (eg. biodiversity) ecosystem services from land.
- Develop ways of targeting AES effectively to address landscape-scale objectives (especially climate change adaptation).
- Secure scheme, and option, uptake to deliver co-ordinated landscape-scale outcomes.

- Maintain investment in monitoring, evaluation, research and development to assess effectiveness and inform changes to scheme design.

Scheme funding

- Secure sufficient funding to:
  - ensure the continued delivery of existing benefits in the future.
  - deliver the full potential scope and scale of benefits from the farmed environment.

Scheme scope and reach

Farmland accounts for about 70% of the land area of England and delivers a wide range of ecosystem services. Existing AES play a significant role in under-pinning many of these services (Land Use Consultants, 2009). These include:

Regulating services:

- Pollination of crop plants and natural pest control by insects, (both of which are improved by conservation and enhancement of wildlife habitat in the surrounding landscape).
- Water regulation, including flood alleviation and coastal protection.
- Water purification and management of vegetation and soils to reduce the risk of soil erosion.
- Climate regulation, (greenhouse gas mitigation through carbon storage in soil and vegetation).
- Erosion regulation and soil quality.
- Land capable of sustaining the large scale growing of food, fibre and timber.

Cultural services:

- Landscape conservation/Cultural heritage.
- Education.
- Open space for relaxation and recreation.

The extent to which existing AES address the delivery of these different services, in terms of scope and reach, varies considerably. Some are long-standing scheme objectives, while others, such as resource protection, are relatively recent additions. Some are secondary scheme objectives and some not explicit objectives of current AES. The scope of AES to address the delivery of these services also varies considerably. This is, in part because of limitations on the activities that can be funded through EU co-financed rural development programmes. Importantly, in most cases, we already have some practical experience of their delivery through existing scheme options even if it has not been possible to deliver fully because of limitations in scheme reach.

There is, therefore, considerable potential for AES to fully integrate the delivery of a broader range of ecosystem services from farm land. Exploiting this scope may require changes to a future EU Rural Development framework.

Scheme delivery

Continue improvements in the cost-effective delivery of AES

Significant improvements in the cost-effective delivery of AES have already been made, and further major changes are in hand. For example, the introduction of enhanced training and information to support ELS. However, pressure on public finances is likely to lead to an ongoing need to deliver improvements in the cost-effective delivery of AES. In this context further consideration may need to be given to alternative delivery mechanisms, such as reverse auctions – where land managers bid to provide a defined service/outcome. These have been shown to be economically more efficient (Lactacz-Lohmann and Schilizzi, 2005) but may be less suited to:

- the delivery of multiple objectives (because they require a clear specification of the outcomes to be delivered to allow bids to be compared on a like-for-like basis); and
- situations where the defined services/ outcomes are concentrated in certain geographical areas (because a small

number of bidders may control a significant proportion of the delivery – effectively an oligopoly exists).

Target schemes to optimise the delivery of a range of ecosystem services.

It is likely that on many farms the provision of such services is similar to, or exceeds, the economic value to society of food production, particularly on poorer land. Furthermore, there is evidence that functional diversity (related to the delivery of ecosystem services) may decline more rapidly than species diversity as intensification increases (Flynn et al, 2009). Therefore, they should be a central consideration in farm management decisions. However, many of the services are public goods from which many in society benefit, but for which farmers and land managers would receive no payment in the absence of AES.

As AES have developed they have become increasingly multi-objective, a recognition of the fact that a wide range of ecosystem services can often be delivered simultaneously from the same piece of land. Scheme targeting has become more sophisticated to reflect this. A major challenge now is to continue to develop scheme targeting and decision support systems that identify how to optimise the delivery of these non-market ecosystem services at all scales from the farm to the broad landscape and alongside market-led food production. In particular we need to:

- Understand how the non-market ecosystem services supported by AES, such as pollination, contribute to supporting food production.
- Consider if it is possible to incorporate payments for new emerging environmental markets, eg. carbon mitigation, in to AES.
- Identify quantities and patterns of option uptake that deliver the desired level and distribution of ecosystem services with the minimum impact on agricultural production.
- Develop a culture in which managing land for services other than solely food production (eg. carbon storage, wildlife, flood storage, aquifer recharge) is embraced by landowners, government and the public.

Target schemes to address landscape-scale objectives

Major changes in the targeting of AES, especially HLS, have already taken place with the introduction of a geographical approach that targets areas that yield multiple environmental benefits. Further development of approaches to scheme targeting at the agreement and option scale will be increasingly important to deliver:

- Ecosystem services that are spatially dependent and require co-ordinated uptake across a large area to be effective, for example raised water levels, resource protection, flood management.
- Effective adaptation of the natural environment to climate change, for example by reducing habitat fragmentation and increasing permeability at the landscape-scale.
- Co-ordination in the wider farmed environment outside of HLS target areas. To effectively address certain issues, such as populations of widespread species in the farmed environment, evidence suggests that the scale of intervention required (eg. certain scheme options) is significantly higher than that currently being achieved and that patterns/balance of option uptake are also important.

Secure scheme uptake to deliver landscape-scale outcomes

Effective scheme targeting is critical to provide the framework for delivering landscape-scale outcomes. However, AES are voluntary agreements and delivery of these outcomes is dependent on securing scheme and option uptake. This means that:

- Scheme design and payment rates must continue to be sufficiently responsive and flexible to ensure that AES remain attractive and compatible with food production for agricultural businesses operating in the context of, often volatile, world agricultural commodity markets. This is particularly important for those agreements that are approaching renewal – there is a danger that the long-term commitment will be lost if AES look uncompetitive at that point in time. Where permanent land use change is required (for example inter-tidal habitat creation) additional work may be needed to design incentives that adequately compensate for this type of change or alternative approaches may need to be developed.

- It may be necessary to consider alternative scheme delivery mechanisms that promote effective co-ordinated delivery. Common-land agreements are one such example that currently exist. There are also others examples from elsewhere in Europe, for example environmental co-operatives in Holland (Franks and McGloin, 2007). New approaches such as the use of agglomeration bonuses (Parkhurst and Shogrun, 2007) or similar economic mechanisms may need to be developed and piloted. Holding restructuring through land reparceling/exchange should also be explored.
- Targeted information and training will be required. There is evidence that support is an important factor in securing optimum patterns of scheme and option uptake (Boatman et al, 1997b). The current programme to increase the provision of additional training and information, especially for ELS, should help secure more balanced co-ordinated, geographically literate patterns of ELS option uptake.
- Training for agreement holders to help them deliver scheme options within their agreements is also important. There is increasing evidence (Lobley et al, 2009) that supporting AES agreement holders through training and advice can have a significant impact on the delivery of environmental outcomes.

Ongoing monitoring, evaluation, research and development.

Findings from monitoring, evaluation, research and development have been critical in informing the evolution and development of AES. A joint Defra-Natural England review of the monitoring and evaluation programme has recently been carried out (Defra-Natural England, 2009). Key priorities for future work included:

- Climate change – there are many uncertainties about the rate of climate change and the even more complex changes in natural and farming systems that will result. ES has the potential to make a significant contribution to climate change mitigation and adaptation. Further work is needed to understand the contribution that ES already makes and how it could be maximised.
- Ecosystem services – further research is needed to better understand the scale of our existing delivery at the scheme and option level, the extent to which the provision of different services is spatially determined, conflicts between the provision of services and ways in which they can best be delivered on farmland (including additional options, targeting or other scheme changes).
- To continue to develop our understanding of the scale and nature of intervention required to achieve specific outcomes.

Scheme funding

Incentive-based AES are funding dependent. While there may be limited scope to use other mechanisms, such as developing new economic markets to address certain issues (eg. for carbon credits) and expanded environmental regulation, most of the problems addressed by AES are not suited to these approaches.

Funding is currently provided through the RDPE (2007–2013) as a combination of EU and Defra sources. Preliminary discussions about future EU funding post 2013 are already underway. Securing sufficient funding is critical to:

- Maintain the delivery of the huge range of existing benefits outlined in this report, and allow time for the schemes to fully realise and demonstrate the benefits associated with relatively new objectives, such as resource protection, and changes in scheme design and delivery, such as HLS targeting.
- Extend the reach of ES in the delivery of the scope and scale of intervention required to meaningfully address existing objectives, especially climate change mitigation and adaptation, by developing new scheme options.
- Enable the potential of AES to be the primary delivery mechanism for a wider range of ecosystem services than is currently the case.
- Allow the scheme to provide the co-ordinated support necessary to help the natural environment adapt to climate change.
- Provide continuity and assurance to agreement holders and support targets that involve land use changes that are difficult and costly to reverse and/or require long-term commitment, eg. habitat creation and restoration, coastal realignment.

A number of studies have attempted to estimate the scale of the funding required to deliver a range of environmental non-market benefits from the farmed environment. For example the annual cost of delivering the AES relevant UK BAP targets (for habitats and species) was estimated as £324 million (RSPB, 2006).

Securing this level of funding through a future Rural Development Programme, after the end of the current programme in 2013, will be challenging, especially given the extent to which existing funding for AES in England is dependent on modulation receipts (both compulsory and voluntary). At an EU level this is likely to require significant changes in the way a future Rural Development Programme is funded. These could include:

- A permanent shift in resources from Pillar 1 to Pillar 2, ensuring that public money is used to support the delivery of public goods.
- Changes to the criteria that are used to allocate rural development funding between Member States.

This report has drawn on a wide range of sources to present a comprehensive review of the effectiveness of agri-environment schemes in England.

However, many monitoring and evaluation projects are currently underway and new evidence is constantly emerging, especially in relation to the effectiveness of the current scheme, Environmental Stewardship, which has only been operating for a relatively short time. Further reviews, such as this, are therefore anticipated in the future.

Somerset Levels

Black tailed godwit, Nene Washes, Cambridgeshire

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