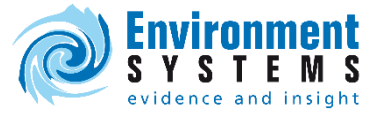


LUC

Natural England

**Assessment of Arable
Reversion Retention**
Environmental Stewardship
Monitoring & Evaluation
Framework



Final report

Prepared by LUC in association with CCRI and ESL

December 2020



Natural England

Assessment of Arable Reversion Retention
Environmental Stewardship Monitoring &
Evaluation Framework

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December 2020

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Executive Summary

What are the issues?

Agri-environment schemes (AES) include options to convert arable land to grassland ('arable reversion'), to provide benefits for resource protection, historic environment, biodiversity and landscape. In 2013, Natural England commissioned research (contract LM0427) to better understand farmers' attitudes to arable reversion created through agri-environment schemes. The research considered strategies to secure and increase the environmental benefits from reversion land. The results from this previous research suggested that farmers with reversion options were likely to retain the land as grassland in the future without AES payments because they have a use for the grassland and it fits with their farming system. This new research aims to understand the effectiveness of arable reversion options – exploring where and why the arable reversion has subsequently been abandoned and what impact this may have on ecosystem services.

What are the aims of the project?

The overall aims of this project are to:

- Provide evidence on the current status of environmental assets supported through arable reversion within AES and the effects where assets have fallen out of a scheme.
- Evaluate the overall effectiveness of arable reversion on the different environmental assets under AES.
- Identify where land use has changed after the loss of AES payments.
- Draw conclusions on how the range of Natural Capital benefits could be supported better in the use of arable reversion.

This project is underpinned by two main research stages:

- An analysis of spatial and remote sensing data to quantify the retention and loss of grassland established through AES at the end of Environmental Stewardship agreements.
- A survey of 107 land managers and AES agreement holders to assess the impacts of arable reversion and the reasons for its retention and loss.

In addition, a high-level analysis of the potential delivery of ecosystem services by retained grassland is presented.



A field under arable reversion option HK8: Creation of species-rich semi-natural grassland (copyright: LUC)

Which policy areas will the research inform?

AES are one of the key delivery mechanisms for delivering the government's environmental objectives as set out Defra's 25-year plan.

The research should inform the implementation of current, and development of future AES schemes to deliver for the environment.

Arable reversion can provide benefits across multiple scheme objectives, including resource, protection, historic environment, biodiversity and landscape.

What are the results from the project and how will they be used?

Spatial analysis to assess arable reversion:

- Crop Map of England (CROME) and agri-environment option data was used to assess change in crop type at the end of an Environmental Stewardship agreement.
- The continued presence of CROME land use classifications which fully, or mostly, represented grassland indicated arable reversion had been retained. Additionally, the assessment distinguished between options which covered whole parcels and only part parcels.
- Overall, a narrow majority (56%) of arable reversion parcels were retained following the end of agreement. This included the retention of whole parcel options (37%) and retention of part parcel options (19%).
- After the end of an agreement, cereals commonly replaced grassland (57% to 67% depending on the year). However counterintuitively, grassland also replaced grassland in parcels considered to have lost arable reversion (10%). This suggests where arable reversion has been classed as lost, there may be partial retention of grassland, as opposed to complete loss.

Survey of agreement holders with AR options:

- Land manager surveys of agreement holders with AR options used the 1,474 parcels identified in the spatial analysis, which equated to 442 agreement holders. From this, a total of 107 agreement holders were interviewed.
- According to the respondents, large parts of the grassland reverted from arable (65%) remain.
- In total, 64 respondents (60%) stated that they had retained all of the grassland established under ES.
- AR options were found to be very effective in establishing a sward and fitting with the farming system.
- Advice in the build-up and at the start of the agreement was widespread (88%) but less common on long-term management (46%)
- Those with Historic Environment-themed agreements were the least likely to receive advice at the start or end of the scheme.
- Those with no previous experience of AES were also more likely not to enter into a follow-on agreement.
- The most frequent change requested by agreement holders was for more flexibility, for example in dates for cutting and the management of weeds.
- A perceived lack of understanding of the practicalities of implementing arable reversion (including long-term management) within NE and the RPA led to some respondents to say that they would not be applying in future.
- Knowledge exchange and peer-to-peer learning by land management advisers, recognising the high levels of intervention required by arable reversion options.
- Broader appreciation of the ecosystem services delivered by arable reversion grasslands over the long-term, which can be maximised by careful targeting. For cultural heritage, reversion back to arable can have irreversible consequences (i.e. the damage or total loss of features through cultivation practices).
- A clear route into subsequent AES options once the grassland is established, to maximise the continued delivery of ecosystem services and environmental outcomes provided by the grassland.
- Digitisation of AES option records into a spatial format such as a geodatabase to allow for direct monitoring of the options through remote sensing or other desk-based techniques.

High-level ecosystem service analysis findings:

- Ecosystem services which benefit the most from arable reversion are climate regulation, cultural heritage, biodiversity, erosion regulation, water regulation and landscape.
- Variations in option uptake across ALTs results in differences in ecosystem service delivery, e.g. options have a greater relative impact on cultural heritage in the lowlands and a greater relative impact on erosion regulation in the uplands.

The study concludes with a series of overall findings to help inform the design and implementation of future AES which include actions for arable reversion. These include the need for:

- Long-term advice and support (and continuity of that support), particularly for 'first time' agreement holders.

Chapter 1

Introduction

Introduction to this study

1.1 In 2013, Natural England (NE) commissioned research to better understand farmers' attitudes to arable reversion created through agri-environment schemes (AES)¹. This project explored arable reversion in the context of protecting natural resources, maintaining and enhancing landscape quality and character, protecting the historic environment and conserving wildlife. It also considered strategies to secure and increase the environmental benefits from reversion land.

1.2 The results from this 2014 research suggested that farmers with reversion options were likely to retain the land as grassland in the future without AES payments because they have a use for the grassland and it fits with their farming system. The ten-year duration of Higher Level Stewardship (HLS) agreements was also believed to encourage retention of the reversion grassland. The study also suggested that the plan – at that time - to move to five or seven-year agreements under Countryside Stewardship presented a risk to the retention of the reversion grassland.

1.3 As a result of these earlier research findings, NE commissioned this new assessment to understand the effectiveness of arable reversion options – exploring where and why the arable reversion has subsequently been abandoned (ploughed-out) and what impact this may have on ecosystem services.

1.4 LUC, together with Environment Systems Ltd (ESL) and the Countryside and Community Research Institute at the University of Gloucestershire (CCRI) were commissioned in 2019 to undertake this research.

1.5 The overall aims of this project are to:

- Provide evidence on the current status of environmental assets supported through arable reversion within AES and the effects where assets have fallen out of a scheme.
- Evaluate the overall effectiveness of arable reversion on the different environmental assets under AES.

¹ ADAS (2014): Securing and Maximising the Environmental Gain from Arable Reversion through Agri-Environment schemes. Natural England research report LM0427.

- Identify where land use has changed after the loss of AES payments.
- Draw conclusions on how the range of Natural Capital benefits could be supported better in the use of arable reversion.

1.6 This project is underpinned by two main research stages:

1. An analysis of spatial and remote sensing data to quantify the retention and loss of grassland established through AES (undertaken by ESL with the results summarised in **Chapter 2** and full report supplied as a separate project output²).
2. A survey of land managers and AES agreement holders to assess the impacts of arable reversion and the reasons for its retention and loss (undertaken by CCRI with the overall results and discussion points set out in **Chapter 4** and feeding into further analyses in **Chapter 5**).

Structure of this report

1.7 The remainder of this report is set out as follows:

- **Chapter 2** presents a summary of the analysis of spatial and remote sensing data to quantify the retention and loss of grassland established through AES.
- **Chapter 3** utilises data produced by the first research phase (summarised in Chapter 2) to provide an analysis of the potential impacts of arable reversion retention/loss on ecosystem service delivery.
- **Chapter 4** contains a report and various analyses of the farmer and land manager survey.
- **Chapter 5** provides further analyses utilising information from both the data analysis and farmer interview research. This includes an exploration of farmer and land manager motivations, specific situations where arable reversion has persisted, and the impacts on environmental/natural capital assets.
- **Chapter 6** sets out the headline conclusions and recommendations arising from this research.

Arable reversion options considered

1.8 For reference throughout this report, the following ES options are considered as relevant to arable reversion (showing the key themes in brackets).

Table 1.1: ES options considered relevant to arable reversion

ES option code	Option name (and theme(s))
ED2	Take archaeological features out of cultivation (Historic environment)
HD2	Take archaeological features out of cultivation (Historic environment)
HD7	Arable reversion by natural regeneration (Historic environment)
HJ3	Reversion to unfertilised grassland to prevent erosion/run-off (Resource protection)
HJ4	Reversion to low input grassland to prevent erosion/run-off (Resource protection)
HK13	Creation of wet grassland for breeding waders (Biodiversity)
HK14	Creation of wet grassland for wintering waders and wildfowl (Biodiversity)
HK17	Creation of grassland for target features (Biodiversity/Resource Protection/Historic Environment)
HK8	Creation of species-rich, semi-natural grassland (Biodiversity)
OD2	Take archaeological features out of cultivation (Historic environment)
OHD2	Take archaeological features out of cultivation (Historic environment)

² Environment Systems Ltd and LUC (March 2020) *ESME Assessment of Arable Reversion Retention: Phase 1 Interim Report*.

Chapter 2

Spatial analysis of the retention and loss of arable reversion

This chapter provides a summary of parcel-level analysis of the loss and retention of arable reversion across England.

Headline findings

2.1 The main headline findings from the spatial analysis set out in this chapter are as follows:

- A small majority (56.3%) of arable reversion options were classified as retained. Of the parcels classified as losing arable reversion (43.7%), the majority of this area was lost in 2017 (72.2%) which indicates immediate loss of arable reversion following the end of scheme in 2016.
- There were clear differences in arable reversion loss and retention across the different ES options, with HD2, HK13 and HK14 showing higher rates of retention than other options. The highest rates of loss were found for HD7, HJ3, and HK17.
- Looking at the distribution of arable reversion across different Agricultural Land Classification (ALC) grades, rates of retention were similar for Grades 2-5 (43-45%), but considerably higher for Grade 1 land (57%). However, given the small number of parcels in Grade 1 these results may not be statistically significant.
- Considering the Agricultural Landscape Types, the data reveals that retention was slightly higher for South East Mixed, Western Mixed and Upland; all classes where dairy and sheep farming are noted as being prevalent.

Overview

2.2 Spatial patterns of arable reversion loss and retention across England were explored using a combination of Natural England agreement records and spatial data together with a parcel-level analysis of the Crop Map of England (CROME). A full report on the data, methodology and results of this analysis are provided in a separate, stand-alone report³. In

³ Environment Systems Ltd and LUC (March 2020) *ESME Assessment of Arable Reversion Retention: Phase 1 Interim Report*.

this chapter, a summary is provided of the datasets and methodology used in this analysis, as well as a selection of the most important results and implications for this study.

Identifying arable reversion candidate parcels

2.3 Eligible arable reversion parcels were identified from three spreadsheets provided by Natural England that linked agreements from the historic Environmental Stewardship (ES), Classic Countryside Stewardship Scheme (CSS) and Environmentally Sensitive Areas (ESA) to the current Countryside Stewardship (CS) agreements. These spreadsheets provided information at the parcel-level using Rural Land Register (RLR) Parcel IDs, and were provided with a spatial location and extent by the 2015 RLR geodatabase.

2.4 Arable reversion candidate parcels were identified by filtering these spreadsheets according to the following criteria as agreed with NE:

- Parcels must contain a relevant ES option (see previous Table 1.1).
- The ES option must have ended by 31 October 2016 in order to have a suitable time period for evaluating land use following scheme end.
- The parcel must either not have transferred to CS or, if it had transferred to CS, must not contain a relevant CS option.
- The parcel must have an RLR ID that links with spatial boundaries found in the 2015 RLR geodatabase.

2.5 The ESA and CSS spreadsheets were likewise filtered, for eligible arable reversion options. However, the majority of these did not have an RLR ID that matched with the available RLR parcels. As only 15 CSS and three ESA agreements were found that matched available parcels, the CSS and ESA data was not analysed in further detail.

2.6 Of the 8,125 parcels that contained relevant ES options, 6,548 were discounted for having ES end dates after 31 October 2016, 22 for transferring to a relevant CS option, and 33 for having no match in the RLR geodatabase. This created a final subset of 1,474 candidate parcels for evaluating arable reversion loss and retention.

2.7 For each parcel the total area of each ES option was calculated and the total area used to separate parcels into whole versus part parcel options. Whole parcel options had greater than 90% of the parcel covered by ES options, while sub parcel options had less than 90%. This distinction was

necessary to reflect the increased uncertainty in assessing arable reversion retention/loss for parcels with small ES areas as the specific location of options within each parcel was not available digitally.

Identifying arable reversion loss and retention from the Crop Map of England (CROME)

2.8 The Defra Crop Map of England (CROME)⁴ is a satellite and machine-learning based crop classification map that covers the whole of the country. The map identifies 81 different land uses across a hexagonal grid with a cell size of 0.41 ha, which allows variations in land use to be easily visualised. The overall accuracy of the 2016 map was evaluated to be 84%, and it is expected that as the 2017 and 2018 follow the same methodology they have similar levels of accuracy.

2.9 Supported by Sentinel-2 satellite imagery from 2018, the CROME Land Use Classification (LUC) codes were aggregated into two classes:

1. those that fully, or mostly, represented **grassland**, and therefore indicated arable reversion retention (PG01, FA01, HE02 NA01);
2. versus LUCs representing some **other** land use, and therefore indicating arable reversion loss.

2.10 The reclassified CROME map was intersected with each arable reversion candidate parcel, and the area of grassland versus other land use calculated for each parcel. Arable reversion was considered lost if the parcel had an area of grassland substantially lower than the ES option in either 2017 or 2018. Conversely, if the parcel had an area of grassland that was similar to the ES option in both 2017 and 2018 then arable reversion was classified as retained.

2.11 Four arable reversion classes were subsequently defined, with the following rules (and codings) applied to separate parcels into each class:

- Whole parcel options:
 - **A: AR Lost.** Grassland < 50% of the parcel in either 2017 or 2018
 - **D: AR Retained.** Grassland >= 50% of the parcel in both 2017 and 2018
- Part parcel options:
 - **B: AR Probably Lost.** Grassland < 80% of the ES option area in either 2017 or 2018

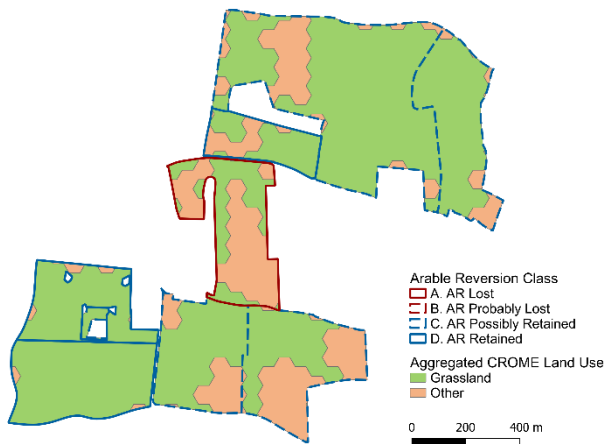
⁴ CROME, 2016, Crop Map of England Product Specification-v.2016.2

- **C: AR Probably Retained.** Grassland \geq 80% of the ES option area in 2017 and 2018

2.12 The thresholds used to separate parcels into each class were initially set at 80% for classes A and D, and 90% for classes B and C. However, the results of Phase 2 farmer interviews suggested that this was leading to significant over-estimation of arable reversion loss. Consequently, the area thresholds were modified to 50% (classes A and D) and 80% (classes B and C) to make the arable reversion loss and retention results closer to the observed.

2.13 An example of how this approach has been used to classify parcels into the different AR classes is shown below.

Figure 2.1: AR parcels showing aggregated CROME land use and arable reversion class for each parcel



2.14 The holding in this example has fields containing both whole-parcel and sub-parcel options. For three of the whole parcel options shown the classification is straightforward with $> 90\%$ of each parcel are either grassland (D. Retained) or other (A. Lost). For the topmost whole parcel, 31% of the parcel is classified as other which is below the 50% AR Loss threshold, hence the parcel is assigned a class of D: Retained.

2.15 For the four fields containing sub parcel options, the grassland area is above the threshold of 80% of the option area, and class of C: Possibly Retained has been assigned accordingly. Of particular note is the lower right parcel which has 63% more grassland in 2018 (7.43 ha) than the option area (4.57 ha).

2.16 The rest of this section considers the effect of option type, land classification and landscape type on patterns of loss and retention. In each case there were categories containing very low numbers of parcels which are likely to be subject to 'skewing' due to small sample sizes. However, as this is a true representation of the data available they have been included for completeness and are highlighted where relevant.

Arable reversion loss across the different ES options

2.17 The results of the spatial analysis of the 1,474 candidate parcels are as follows:

- A. AR Lost: 354 parcels (24%)
- B. AR Probably Lost: 289 parcels (19.6%)
- C. AR Possibly Retained: 282 parcels (19.1%)
- D. AR retained: 549 parcels (37.2%)

2.18 Of the 43% of the total area that was classified as loss (i.e. classes A and B), 72% of this area was identified as lost in 2017. Although overall a small majority of parcels retained arable reversion, these results indicate that a significant amount of arable reversion was lost immediately following cessation of payment.

2.19 Looking at the distribution of loss and retention within each option (Figure 2-2), we can see that the dominant option by area was *HK17: Creation of grassland for target features*, representing 30% of the total area of AR options. *HD2: Take archaeological features out of cultivation* and *HK8: Creation of species-rich, semi-natural grassland* were the next most abundant, at 16% and 13% respectively.

2.20 The highest AR retention rates (class C and D combined) were found for HJ4, HK13, HK14, and HK8 with these options each retaining greater than 65% of the total option area. OD2 has the highest retention rate (100%), but as this option only contains a small number of parcels these figures are not considered representative but are included for completeness.

2.21 The highest rates of loss (class A and B combined) are found for options HD2, HD7, HJ3, and HK17; in each of these cases greater than 45% of the total option areas have been identified as lost.

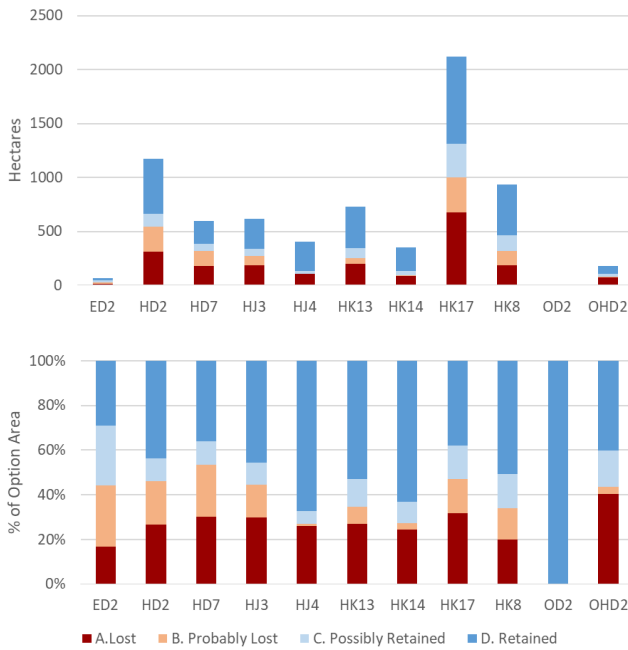
2.22 Differences in fertilisation regime may explain the substantial difference in retention between HJ3 and HJ4. HJ3 must be unfertilised, which would likely lead to poor grasses dominating the sward, and thus leading to a higher loss rate than land under the fertilised HJ4 option. Variations in fertiliser application does not seem to be a common theme between retention/loss across the other options.

2.23 Again, the fact that the grass was unfertilised would likely lead to poor grasses dominating the sward, thus leading to a higher loss rate than land under the fertilised HJ4 option.

2.24 Natural England also suggests that a possible explanation could be that early agreements with HD2 specified a different seed mix requirement than those in later years (usually low quality, low-yielding grass species). The implementation of HD7 would have likewise resulted in poor

quality grass that led to it not being retained following agreement end.

Figure 2.2: Total hectares of each AR class separated by ES option code (top), and normalised by the total area of each ES option code (bottom)



Arable reversion loss versus Provisional Agricultural Land Classification

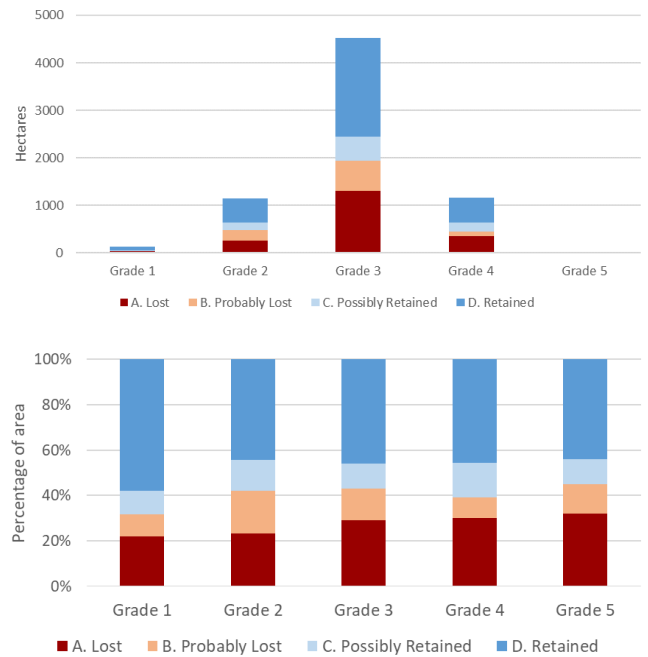
2.25 The relationship between land quality and arable reversion retention/loss was explored by comparing results against the Provisional Agricultural Land Classification (ALC). This framework separates land into the following five grades:

- 1: Excellent quality agricultural land
- 2: Very good quality agricultural land
- 3: Good to moderate quality agricultural land
- 4: Poor quality agricultural land
- 5: Very poor-quality agricultural land

2.26 Figure 2-3 below shows the the total area and percentage distribution of each arable reversion class for each ALC grade. The total area of AR parcels in Grades 1-4 largely follows the overall distribution of agricultural land across these grades, with grade 3 containing the majority of parcels. Grade 5 is underrepresented in AR schemes when compared against the total area (~10% of England agriculture).

2.27 Looking at the percentage distribution of AR across the grades, we can see that rates of retention (AR class D) were similar for Grades 2-5 (43-45%), but considerably higher for Grade 1 land (57%). This may suggest that, although fewer parcels were placed into arable reversion in Grade 1 land, once under AR it was more likely to remain as grassland than other ALC grades.

Figure 2.3: Total hectares of each AR class separated by ALC (top) and normalised by the total area (bottom) for each ALC grade



Arable reversion loss versus Agricultural Land Type

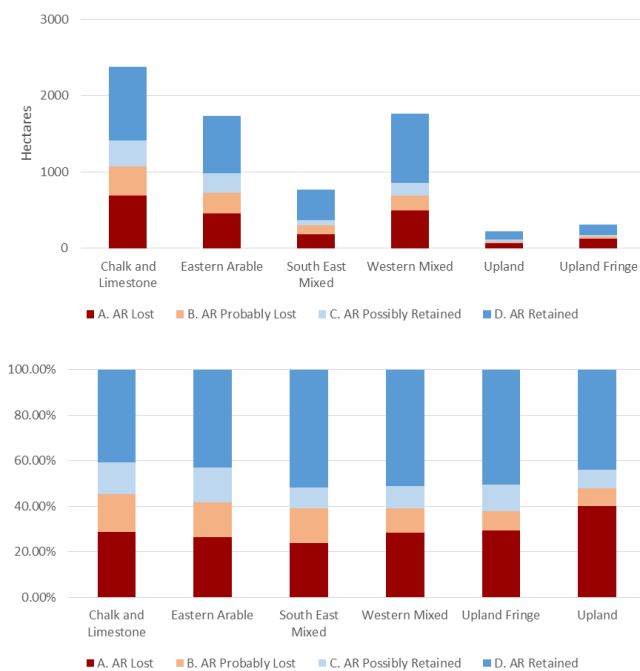
2.28 Arable reversion was compared against the Agricultural Landscape Type (ALT), a spatial framework that groups landscapes of a similar type across England as follows:

- ALT 1: Chalk and Limestone Mixed
- ALT 2: Eastern Arable
- ALT 3: South East Mixed (wooded)
- ALT 4: Western Mixed
- ALT 5: Upland Fringe
- ALT 6: Upland

2.29 Figure 2.4 shows the total area of arable reversion parcels across each ALT and the relative distribution of AR classes within each ALT class. Looking at the overall distribution, the majority of parcels are found in Chalk and Limestone, Eastern Arable and Western Mixed ALTs, and very few parcels are on Upland or Upland Fringe.

2.30 Patterns of relative loss and retention are similar across all ALTs, but the highest rate of retention is seen for Western Mixed, South East Mixed and upland fringe, with ~50% of option area falling into AR Retained (class D) for these ALTs. These classes all have pasture as a major component. The highest rate of loss is seen for Upland, with 47% of the option area assessed falling into AR classes A or B. Again, given the small overall area of AR parcels in these ALT classes, it is difficult to draw strong conclusions.

Figure 2.4: Total hectares of each AR class separated by ALT (top) and normalised by the total area (bottom) for each ALT grade



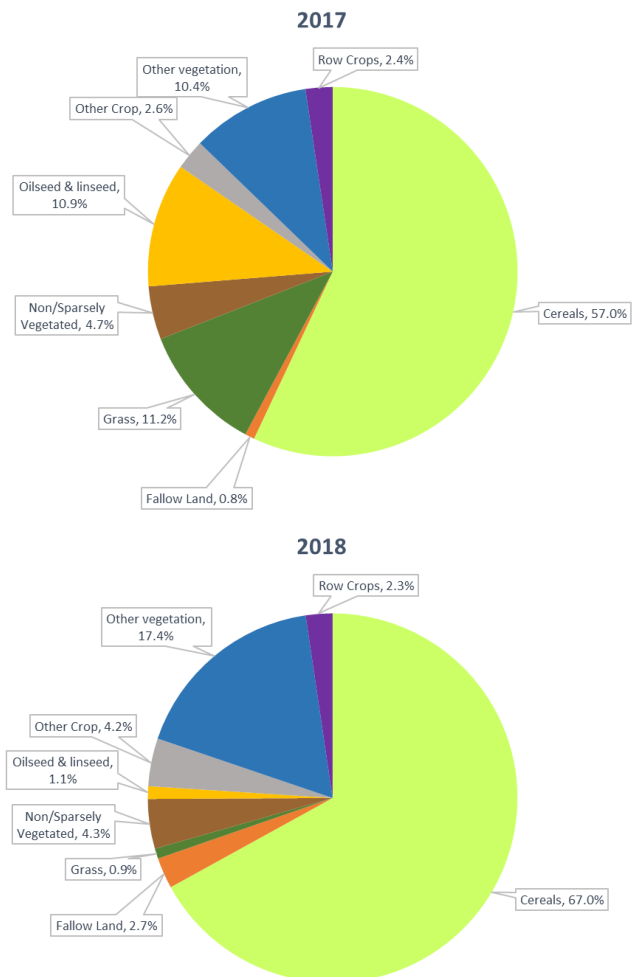
Crop type replacing reversion loss

2.31 The CROME crop type replacing arable reversion loss was evaluated to understand the nature of AR loss. This analysis was conducted for whole parcel options in the year in which loss was first detected. The distribution of aggregated land uses for 2017 and 2018 is shown in Figure 2-5. In both cases, Cereals are a key replacing crop, with more Cereals found in 2018 (67%) than 2017 (57%). Oilseed & Linseed is also well represented in 2017 with 11% of the total area compared to 1.1% in 2018. In these cases, we can clearly see that arable reversion has not been retained, and the grower has reverted to arable cultivation.

2.32 In 2017 grassland also forms a notable replacing class (10%), which seems counterintuitive as these parcels have all been classified as having lost AR. However, the rules used in this study for identifying AR loss compared the area of AR eligible CROME codes against the area of ES options, with

loss being flagged if the CROME codes were less than 80% of the option area. This has meant that many parcels flagged as having lost AR may still be partially covered by grassland, and that we may be seeing evidence of partial rather than complete reversion loss in 2017.

Figure 2.5: Area of aggregated crop class replacing whole-parcel arable reversion lost in 2017



Conclusions

2.33 The results of the spatial analysis show that a narrow majority of arable reversion options have been classified as retained – with 56.3% of parcels assigned to AR classes C or D and a substantial number of parcels (43.7%) losing arable reversion after the scheme ends. Looking at the year of loss, the majority is lost in 2017 (72.2%) which furthermore paints a picture of immediate loss of arable reversion following the end of scheme.

2.34 There were clear differences in arable reversion loss and retention across the different ES options, with HD2, HK13 and

HK14 showing higher rates of retention than other options. The highest rates of loss were found for HD7, HJ3, and HK17. The economic implications of these differences between options, and the subsequent impacts on environmental assets, will be considered in more detail in later chapters.

2.35 Looking at the distribution of arable reversion across different ALC grades, we found a slightly higher rates of retention on Grade 1 land, but given the small number of parcels in this class it is difficult to draw strong conclusions.

2.36 Considering the Agricultural Landscape Types, we saw that retention was slightly higher for South East Mixed, Western Mixed and Upland; all classes where dairy and sheep farming are noted as being prevalent.

Limitations / caveats

2.37 The analysis methodology has been designed to provide a robust basis for spatial analysis of patterns of arable reversion loss and retention. However, given the inherent differences between the available data sets, there are implications for the accuracy of this analysis:

- Spatial information on the location of arable reversion within parcels was not available digitally. While comparison of relative areas is a good indication of loss and reversion, for sub-parcel options in particular this will introduce error.
- ESA and CSS spreadsheets had very few matches with the RLR database, possibly due to changes in the RLR ID between scheme dates. This has greatly reduced the number of parcels available for evaluation.
- The 0.4 ha resolution of CROME data means that field parcels are not always well represented, especially for smaller fields where parcel edges lead to greater chances of misclassification.
- In the analysis of patterns of loss and retention there are a number of categories with small, and therefore unrepresentative, numbers of parcels. As this is a true representation of the number of parcels in each category the results have been included for completeness, but care must be taken when evaluating the results for these underrepresented categories.

Chapter 3

Impacts of arable reversion on ecosystem services

This chapter explores how arable reversion options impact on ecosystem services

Headline findings

3.1 The main headline findings from the analysis set out in this chapter reveal:

- Arable reversion options have a positive impact on a variety of ecosystem services.
- Ecosystem services which benefit the most include climate regulation, cultural heritage, biodiversity, erosion regulation, water regulation and landscape.
- Trends in arable reversion option uptake vary significantly across the different Agricultural Landscape Types (ALTs).
- This has knock on impacts for the delivery of ecosystem services, e.g. arable reversion has a greater relative impact on cultural heritage in the lowland ALTs and a greater relative impact on erosion regulation in the upland ALTs).

Background to this analysis

3.2 This element of the study involved researching the likely impacts of arable reversion options on ecosystem services. In common with the rest of this research, only arable reversion options within Environmental Stewardship (ES) have been considered (see Table 1.1). As many ES agreements have now expired, this enables an analysis of the impact of options retained since the cessation of the agreement (as well as ecosystem services which have been lost).

3.3 The initial stages of this research involved a literature review to identify the likely impacts of arable reversion on ecosystem services. Key sources of information included the Natural England Ecosystem Services Transfer Toolkit, the ES Handbooks, the Natural England Technical Information Note on Arable Reversion, as well as a variety of academic papers. The main sources are included as footnotes within the rationale for each ecosystem service.

3.4 Table 3.1 below contains details on the ecosystem services used for this analysis. It also includes information on ecosystem services which have been excluded.

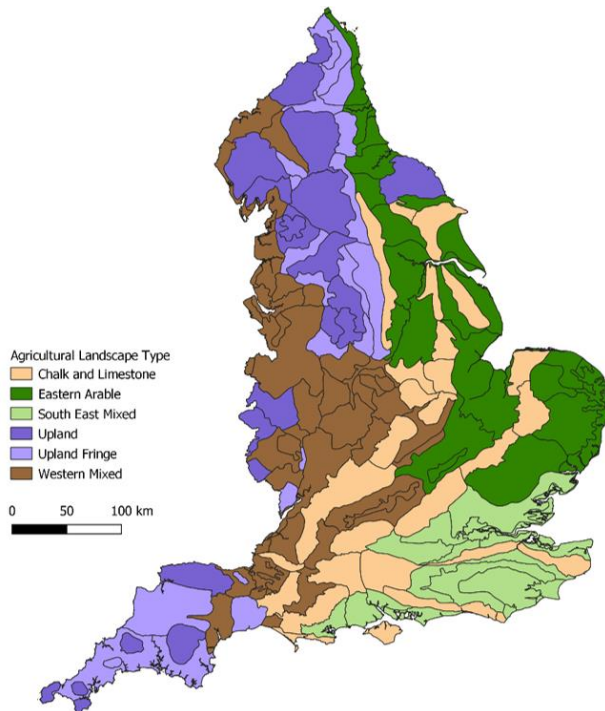
Table 3.1: Ecosystem services used in this study⁵

Service	Description
Provisioning services	
Food	The provision of crops and livestock through agricultural practices used directly or indirectly for human consumption and wild foods derived from habitats, such as berries, nuts, fungi and honey.
Fibre	The provision of fibres used in construction, furnishings, clothes, paper and card etc including timber and coppice products, wool, livestock hides, and fibre crops.
Genetic resources	The genes and genetic information used for animal and plant breeding focusing specifically on the rare genetic stock of rare breeds (cattle, sheep and ponies) and rare crops (old orchard species). Genes associated with rare species of wild plants and animals are excluded as these are covered separately under biodiversity.
Fresh water	The freshwater provided by ecosystems.
Regulating services	
Air quality	The role of woody plants, trees and other vegetation in filtering particulate matter out of the atmosphere as a contribution to air quality.
Climate regulation	Mitigation of climate change through carbon storage and sequestration by ecosystems, also taking account of changes in the output of other greenhouse gases.
Water regulation	The influences of changes in land cover and changes in water storage potential on the timing and magnitude of run-off, flooding, aquifer recharge, and water table levels.
Erosion control	The prevention or reduction of soil erosion.
Water purification/waste treatment	Reducing the quantity of pollutants (organic and inorganic wastes, fertilisers and pesticides) reaching surface and ground waters.
Disease regulation	Affecting the abundance of human pathogens and altering the abundance of disease vectors, such as mosquitoes and midges. The focus is solely on human health.
Pollination	Changes affecting the distribution, abundance and effectiveness of pollinators.
Cultural services	
Cultural heritage values	The conservation of sites and landscapes of historical importance,
Landscape	The combination of natural, cultural and perceptual influences which create a distinct character within a given area.
Biodiversity	
Biodiversity	Biodiversity is a measure of variation of the biotic environment at the genetic, species, and ecosystem levels. It is a key part of the natural capital which delivers many of the ecosystem services, however the conservation of biodiversity for its own sake is also considered as a separate and discrete service.
Ecosystem services which have not been considered as part of this study	
Service	Description
Fuel	The provision of biological materials as a source of energy including both biomass (wood, straw and other biological materials) and biofuels derived from bioenergy crops.
Natural hazard regulation.	Prevention of landslides and coastal erosion associated with wind, wave and coastal flooding. Arable reversion is unlikely to have a significant impact on this ecosystem service and has not been considered as part of this study.
Pest regulation	Affecting the prevalence of pests (plants and animals) and diseases relating to crops and livestock and wildlife habitats and species. Arable reversion is unlikely to have a marked impact on this ecosystem service.

⁵ Taken from the research study: *Provision of Ecosystem Services Through the Environmental Stewardship Scheme*. Defra, March 2009.

3.5 Some of the analysis within this chapter is presented by Agricultural Landscape Type (ALT), to provide further distinction according to the different types of agricultural landscape found across England. A map of the ALTs is provided below for reference (Figure 3.1).

Figure 3.1: Map showing the distribution of Agricultural Landscape Types across England



Developing 'ecosystem service profiles'

3.6 The findings of the literature review were used to develop a simple profile of the likely impacts of the grassland created through arable reversion options on each of the ecosystem services. The main focus is the contribution of the options to ecosystem services after arable reversion has been undertaken (i.e. when the grassland has been established), rather than the impact of arable land on ecosystem services prior to reversion (e.g. arable land is likely to make a positive contribution to the provision of food).

3.7 Each option has been assigned a 'negligible', 'low', 'medium' or 'high' indicator rating for each ecosystem service, reflecting the likely impact on ecosystem services of the grassland created through arable reversion. This is based on the likely effect of the grassland created in isolation, rather than comparing the magnitude of change from the arable land reverted to grassland. It is also important to note that complex interrelationships and trade-offs between the different ecosystem services that have the potential to be delivered through arable reversion is not within the scope of this analysis. Therefore the findings presented in this chapter should be interpreted as a high level indication of the delivery

of ecosystem services by arable reversion options, which could be subject to specific and detailed research.

3.8 The rationale for the allocation of indicator ratings against the ecosystem services is as follows set out below.

Food

3.9 All options are classed as 'medium' for the provision of food, as grassland may be used for the grazing of animals which produce meat or milk. Note that an assumption of the analysis is that all options are rated as 'high' for the provision of food *before* arable reversion (i.e. through the cultivation of food crops), although this analysis is not directly comparing ecosystem services before and after arable reversion.

Fibre

3.10 All options are assigned 'low' indicator ratings, even though reverted grassland may be used to graze sheep for the production of wool (the 'low' rating reflects the generally low market value of wool as a product in the UK).

Genetic resources

3.11 The genetic resources ecosystem service refers to the diversity of agricultural animal breeds and crops (wild species are considered under 'biodiversity'). All options are rated as 'negligible', as the introduction of rare breeds/species on the land (i.e. the use of rare breeds of livestock to graze) is a possibility but is not outlined in the prescriptions for any of the options. It is also not possible to assume that grassland created through arable reversion will contain rare plant species that could contribute to the delivery of this ecosystem service.

Fresh water

3.12 The Resource Protection options HJ3 and HJ4 are given 'high' indicator ratings, as the scheme prescriptions state that they should be located in areas where run-off is an issue, thus protecting fresh water supplies. HK13/HK14 are assigned to 'medium', as the creation of these wet grassland habitats will help with the filtration and provision of fresh water. All other options are classified as having 'low' indicator ratings as some contribution to this ecosystem service may occur indirectly, but it is not a key objective of the option.

Air quality

3.13 All options are given 'low' indicator ratings against this ecosystem service. There is evidence that arable reversion will have a positive impact on air quality in cases where ammonia-based fertilisers are used which release nitrogen

into the air⁶. However, if the reverted field is used for the grazing of cattle this improvement may be offset by production of ammonia from livestock. Other emissions from livestock (e.g. methane) can impact negatively on air quality. Since options ED2, HD2, OD2 and OHD2 do not specify low stocking levels of reduced levels of fertiliser in the scheme prescriptions, these options are given 'negligible' indicator ratings for air quality.

Climate regulation

3.14 All options are given 'high' indicator ratings for climate regulation. There is extensive evidence that arable reversion has a positive impact on carbon storage – as restored grassland and pasture store more carbon than arable land⁷. The research mostly focuses on CO₂ and N₂O emissions⁸. On the other hand, the introduction of livestock on formerly arable land could lead to increased levels of methane emissions, particularly at higher stocking densities⁶.

Water regulation

3.15 HJ3 and HJ4 are given 'high' indicator ratings as the prescriptions for these options state they should be placed in land parcels identified as being at risk of soil erosion/run-off. HK13 and HK14 are also classified as 'high', as the wet grassland created – likely including areas of standing water – will make a strong contribution to water regulation (through holding water back from entering the watercourse). The remaining options have 'low' indicator ratings, as there is likely to be some positive contribution despite the options not being specifically targeted for water regulation purposes⁹.

Erosion regulation

3.16 Similar to the above, options HJ3 and HJ4 are given 'high' indicator ratings as the prescription for these options states they should be placed in land parcels identified as being at risk of soil erosion/run-off. All other options are given 'medium' indicator ratings as grass cover will help to improve the stability of the soil structure, although these options are not specifically targeted at areas at risk of erosion¹⁰. Another example is arable reversion targeted to benefit archaeological features. The resultant management almost always also benefits erosion regulation, though this relationship cannot be assumed therefore has not been accounted for in this analysis.

Water purification/waste treatment

3.17 Most options for this ecosystem service are assigned 'medium' indicator ratings, as the cessation of arable agriculture should result in a positive impact on water purification due to reduction in pesticides/fertilisers on the land which could pollute water, although this will depend on the stocking density of the grassland¹¹. Zero/restricted inputs of nitrogen fertilisers and organic manures will reduce the risk of nitrate leaching. ED2/HD2/OD2/OHD2 are given 'low' ratings as the prescription for these options does not state the exclusion or reduction of fertilisers.

Pollination

3.18 The effect of arable reversion on the abundance of wildflowers (food provision for pollinators) will depend on how the arable land was managed before reversion. Since most reversion options prescribe no or low amounts of fertiliser, the effect on wild plant diversity is likely to be positive¹². Options for the benefit of biodiversity (HK13, HK14, HK17 and HK8) are given 'medium' indicator ratings, as efforts to increase biodiversity are likely to have a positive effect on the diversity of plants, while the rest of the options have 'low' ratings. It should be noted that the prescriptions for these options do not specially target pollinators, so there is some uncertainty with this assumption.

Cultural heritage values

3.19 Options ED2, HD2, OD2, OHD2 and HD7 are assigned 'high' indicator ratings as the options will be located where archaeological features are present. Option HK17 is allocated a 'medium' indicator rating, as this option may be co-located with other archaeological options, or be targeted to deliver biodiversity outcomes. All other options have 'low' indicator ratings, as any preservation of archaeological features will be coincidental.

Biodiversity

3.20 HK13, HK14, HK17 and HK8 are given 'high' indicator ratings, as the main objective of the options is to improve biodiversity. All other options are 'medium'. While biodiversity is not a primary objective of these options, evidence notes that the introduction of pasture can lead to improved biodiversity in areas with arable production¹³. It is also important to recognise that biodiversity is not always considered as an ecosystem service in its own right. However, as it is comprised of the

⁶ Air Pollution from Agriculture. Air Quality Expert Group, 2018.

⁷ Carbon storage by habitat: Review of the evidence of the impacts of management decisions and condition of carbon stores and sources. Natural England, 2012.

⁸ Natural England Ecosystem Services Transfer Toolkit, 2014.

⁹ Natural England Commissioned Report NECR102: Ecosystem services from Environmental Stewardship that benefit agricultural production. 2012.

¹⁰ Natural England Commissioned Report NECR102: Ecosystem services from Environmental Stewardship that benefit agricultural production. 2012.

¹¹ Diffuse nitrate pollution from agriculture – strategies for reducing nitrate leaching. ADAS, 2007

¹² England Farmland Report. Plantlife, 2013.

¹³ Natural England Technical Information Note TIN066 - Arable reversion to species rich grassland: site selection and choice of methods. 2010.

different natural capital assets which deliver many ecosystem services, the conservation of biodiversity for its own sake is considered as a separate and discrete service for the purposes of this evaluation. This also reflects that biodiversity is one of the desired outcomes of ES, and as such is one of the key themes used across this research to analyse the impacts of arable reversion.

Landscape character

3.21 As with biodiversity, landscape character is not always considered an ecosystem service in its own right. More often, it is seen as the combination of various natural capital assets and the services they provide in a geographic area. ‘Landscape’ is also often used as an overarching framework to analyse and present information on ecosystem services – such as the National Character Area (NCA) profiles. However, the conservation and enhancement of landscape character is one of the objectives of ES. For these reasons it was felt important to include landscape character as an ecosystem service in this analysis.

3.22 Arable reversion can help to strengthen landscape character¹⁴. For example, it can contribute to pastoral or mixed farmland landscapes, and provide diversity in predominantly arable landscapes (where targeted appropriately, as previous research has found). Landscape character and distinctive ‘sense of place’ are important cultural services and have suffered degradation in many areas.

3.23 For this analysis, we have assumed that all arable reversion options will contribute to the mixed pastoral and arable character of the landscape. Some may have a greater impact than others which will depend on the placement of the option and the specific landscape that the option is located within. Previous research¹⁵ has highlighted the ability of arable reversion options to benefit and enhance the landscape by restoring and recreating key landscape characteristics (see photographic example at Figure 3.2).

Ecosystem services analysis

3.24 Table 3.2 shows the simple numeric ‘scoring’ assigned to each of the indicator ratings, which has been used to provide some high-level analysis of delivery throughout this chapter. Table 3.3 over the page shows the complete ecosystem service profile for each of the 11 options considered by this research.

Table 3.2: Indicator ratings

Indicator rating classification (applied to ES options to give an indication of potential ecosystem service delivery)	Numeric rating used in high-level analysis
High	3
Medium	2
Low	1
Negligible effect	0

Figure 3.2: This example of co-located options HK13 and HD2 introduces diverse land cover into an otherwise homogenous arable landscape



¹⁴ Natural England Technical Information Note TIN066 - Arable reversion to species rich grassland: site selection and choice of methods. 2010.

¹⁵ Monitoring the effects of Environmental Stewardship on Landscape Character and Quality (June 2013). Prepared by LUC in association with Julie Martin Associates, Countryside, Fabis Consulting, and Professor Carys Swanwick.

Table 3.3: Indicator profiles of ecosystem services for each option following arable reversion

Option code	Option name	Ecosystem service													
		Provisioning				Regulating							Cultural		
		Food	Fibre	Genetic resources	Fresh water	Air quality	Climate regulation	Water regulation	Erosion regulation	Water purification/waste treatment	Disease regulation	Pollination	Cultural heritage values	Biodiversity	Landscape character
ED2	Take archaeological features out of cultivation (Historic environment)	2	1	0	1	0	3	1	2	1	0	1	3	2	2
HD2	Take archaeological features out of cultivation (Historic environment)	2	1	0	1	0	3	1	2	1	0	1	3	2	2
HD7	Arable reversion by natural regeneration (Historic environment)	2	1	0	1	1	3	1	2	2	0	1	3	2	2
HJ3	Reversion to unfertilised grassland to prevent erosion/run-off (Resource protection)	2	1	0	3	1	3	3	3	2	0	1	1	2	2
HJ4	Reversion to low input grassland to prevent erosion/run-off (Resource protection)	2	1	0	3	1	3	3	3	2	0	1	1	2	2
HK13	Creation of wet grassland for breeding waders (Biodiversity)	2	1	0	2	1	3	3	2	2	0	2	1	3	2
HK14	Creation of wet grassland for wintering waders and wildfowl (Biodiversity)	2	1	0	2	1	3	3	2	2	0	2	1	3	2
HK17	Creation of grassland for target features (Biodiversity/Resource Protection/Historic Environment)	2	1	0	1	1	3	1	2	2	0	2	2	3	2
HK8	Creation of species-rich, semi-natural grassland (Biodiversity)	2	1	0	1	1	3	1	2	2	0	2	1	3	2
OD2	Take archaeological features out of cultivation (Historic environment)	2	1	0	1	0	3	1	2	1	0	1	3	2	2
OHD2	Take archaeological features out of cultivation (Historic environment)	2	1	0	1	0	3	1	2	1	0	1	3	2	2

Applying the profiles to the data

3.25 To apply the profiles to the data, the total area of each option was calculated. Based on the data used to inform the spatial analysis element of this study (see **Chapter 2**), the total area was calculated for all reversion options and arable reversion options that have been retained. The left-hand chart at Figure 3.3 below shows the area of all the reversion options (and whether they were single option or co-located with other options) and the total area of the retained reversion options (on the right).

3.26 To calculate the relative effect of each option on each ecosystem service, the total area (hectares) of each option is multiplied according to the indicator rating as defined in Table 3.3. For example, HK13: Creation of wet grassland for breeding waders is assigned a 'medium' ('2') indicator rating for the provision of fresh water. This option covered 731.2 hectares in total. The indicative 'relative impact' of HK13 on the provision of fresh water is therefore calculated as 1,462.4 (x 2 the option coverage).

3.27 As shown in Figure 3.3 below, HK17 has the highest area coverage for both all reversion options and retained reversion options only. Coverage of ED2, OD2 and OHD2

were very low so these options have been excluded from some of the detailed analyses.

Overall results

3.28 Figure 3.4 on the next page shows the relative impact 'scores' calculated for each ecosystem service, using the uptake data (area coverage) for all options. Figure 3.5 that follows shows just the relative impacts of the retained arable reversion options on the ecosystem services. Care needs to be taken when interpreting these graphs, due to the methodology followed and assumptions made (as discussed previously). Due to the high amount of uptake of option HK17, this option has greatest relative impact on all ecosystem services. Option HD2 also has a high relative impact on cultural heritage values, while option HK8 has a high relative impact on biodiversity. The ranking of options is similar when considering all uptake and only retained uptake. However, when considering retained grassland, some options witnessed greater levels of decline (loss of arable reversion) than others. For example, the loss of HK17 options led to a 47.1% decrease in the amount of grassland remaining, whereas the loss of HK8 options led to a 34.1%. The delivery of ecosystem services by these options is assumed to have reduced as a result.

Figure 3.3: Total area of all reversion options and retained reversion options



Figure 3.4: Relative impact of option on ecosystem services - all uptake (see previous Figure 3.3 and Table 3.3 for the indicator ratings and uptake areas used in the calculation of 'Relative Impact')

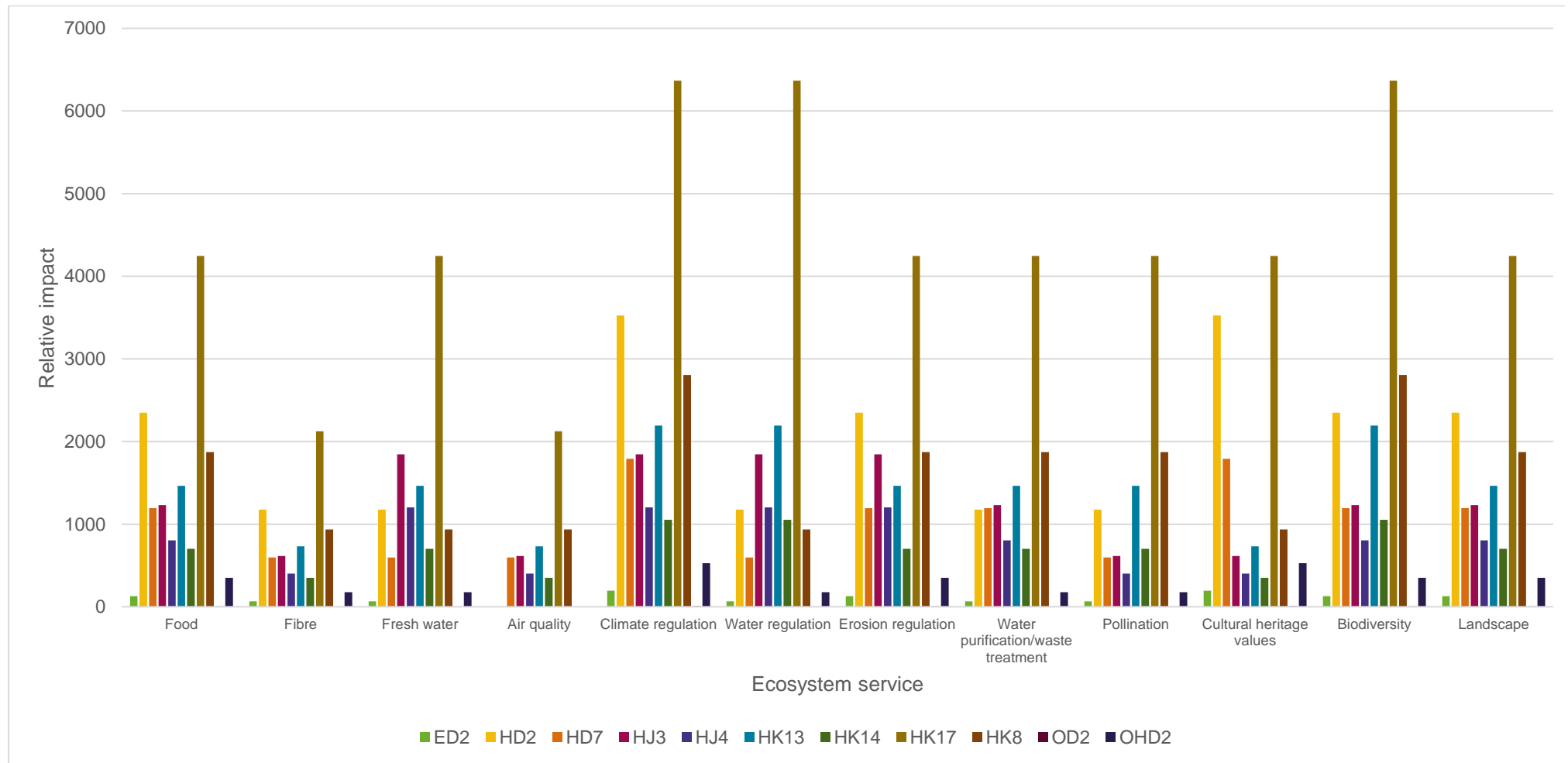
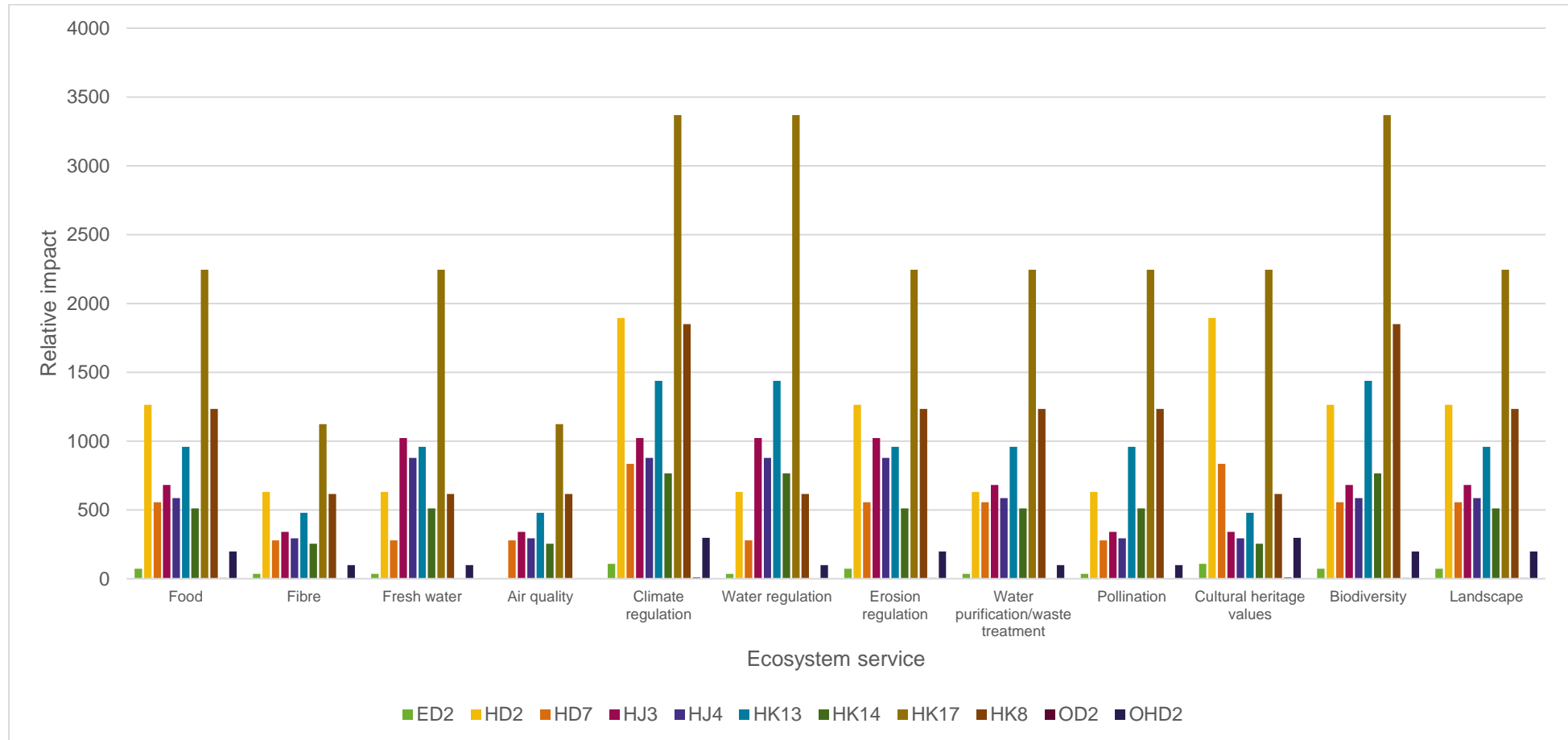


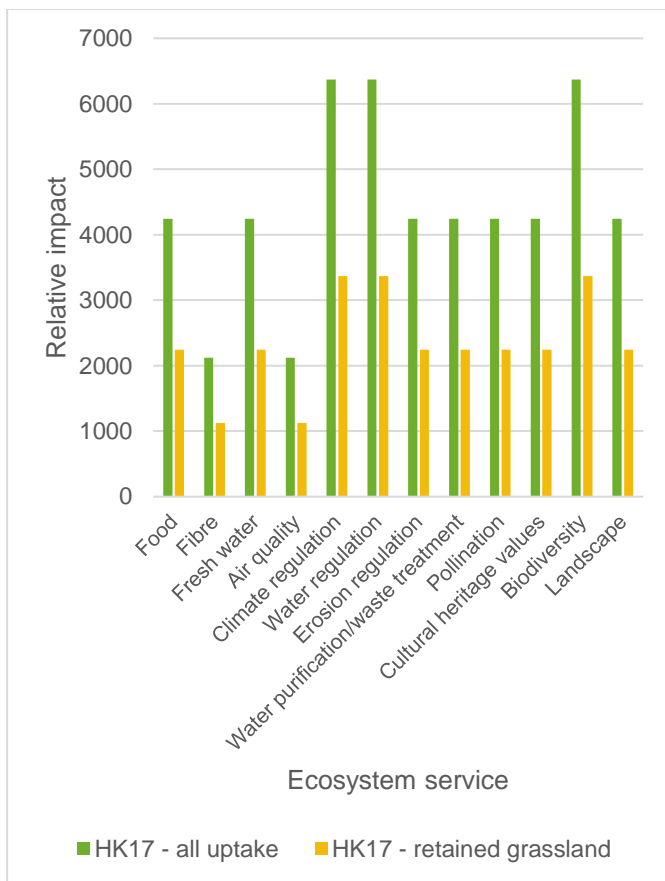
Figure 3.5: Relative impact of options on ecosystem services - retained grassland following agreement end (see previous Figure 3.3 and Table 3.3 for the indicator ratings and uptake areas used in the calculation of 'Relative Impact')



Results by arable reversion option

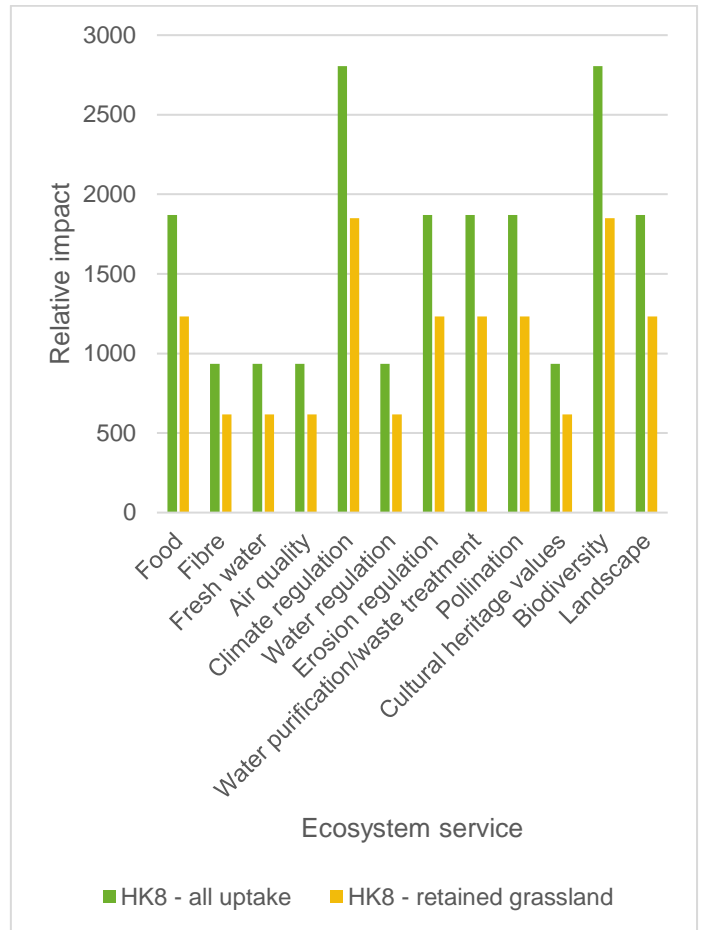
3.29 It is also possible to directly compare the relative impact of each arable reversion option between all recorded uptake and the retained uptake. Figure 3.6 compares the impacts of all HK17 uptake versus the impacts of the retained HK17 grassland. As noted previously, the expiry of ES agreements with land under HK17 has resulted in a 47.1% decline in the area of grassland retained. Therefore this loss is assumed to have a consequential impact on the delivery of ecosystem services, as shown in Figure 3.6.

Figure 3.6: Impacts of option HK17 on ecosystem services



3.30 Figure 3.7 similarly compares the impact of all HK8 uptake and the impacts of the retained HK8 grasslands. Following the expiry of ES agreements, a 34.1% decrease in the area of grassland was seen. As noted in the ALT analysis later in this chapter, uptake of this option is concentrated in the Chalk and Limestone Mixed, Eastern Arable and Western Mixed ALTs. Retention levels of the grassland were also higher in these ALTs.

Figure 3.7: Impacts of option HK8 on ecosystem services



3.31 It is also interesting to note different outcomes for similar options (e.g. HJ3 [Figure 3.8] and HJ4 [Figure 3.9]). Proportionally, HJ3 has seen greater losses (a reduction of 44.7%) than HJ4 (reduced by 27%) following the expiry of ES agreements. The prescription for HJ3 does not allow the use of fertilisers or organic manures, while the prescription for HJ4 allows low input fertiliser. This could indicate that there may be an economic or practical reason why landowners/managers are more reluctant to continue the management of no input areas following the cessation of ES payments.

Figure 3.8: Impacts of option HJ3 on ecosystem services

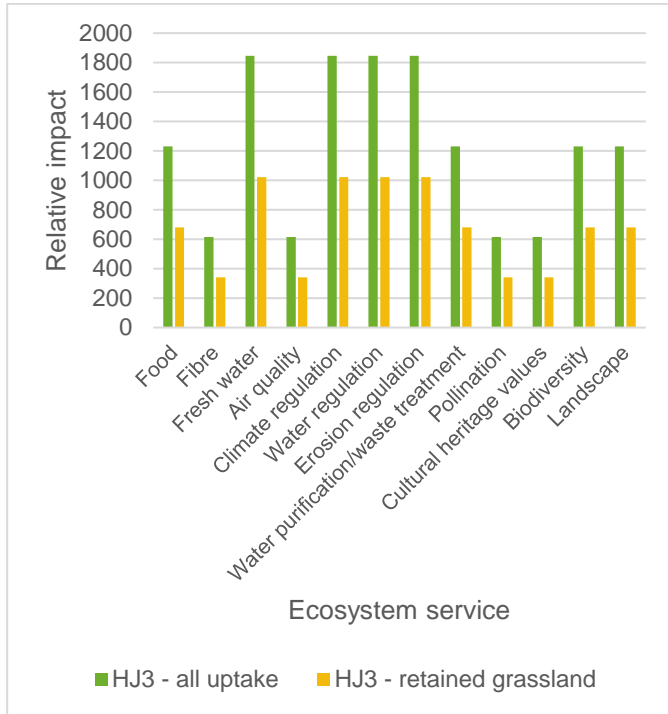
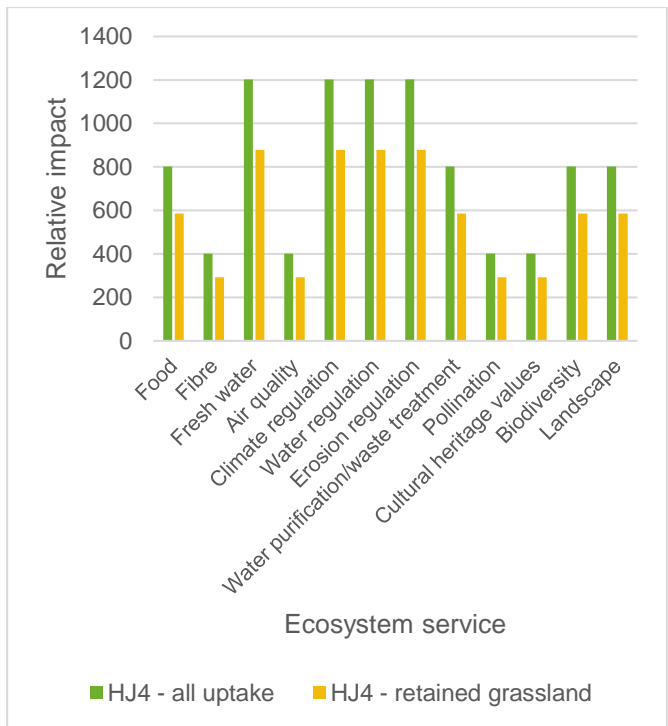


Figure 3.9: Impacts of option HJ4 on ecosystem services

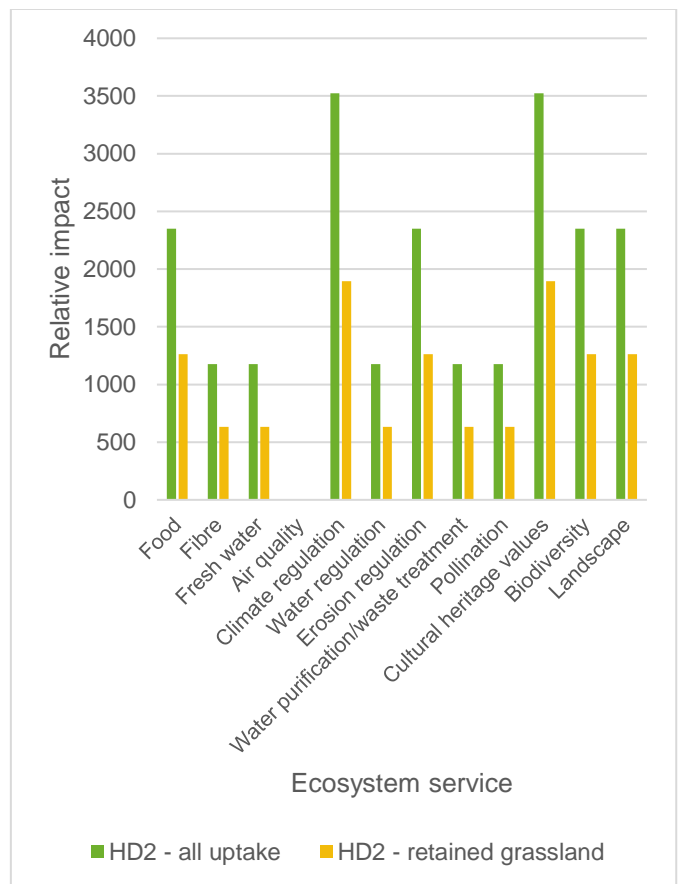


3.32 Figure 3.10 shows the relative impact of option HD2 on ecosystem services. As noted in paragraph 3.28, this is one of the more abundant arable reversion options which therefore

has a high relative impact on the cultural heritage values ecosystem service when considering both all uptake and retained uptake only.

3.33 The amount of retained grassland declined by 46.3% following the expiry of ES Agreements. Levels of decline were similar across all ALTs except Upland Fringe (where there was only a 9.5% decline) and South East Mixed (where uptake declined by 86.5%), however the small amount of uptake in the Upland Fringe/Upland ALTs means caution should be taken when interpreting these results.

Figure 3.10: Impacts of option HD2 on ecosystem services

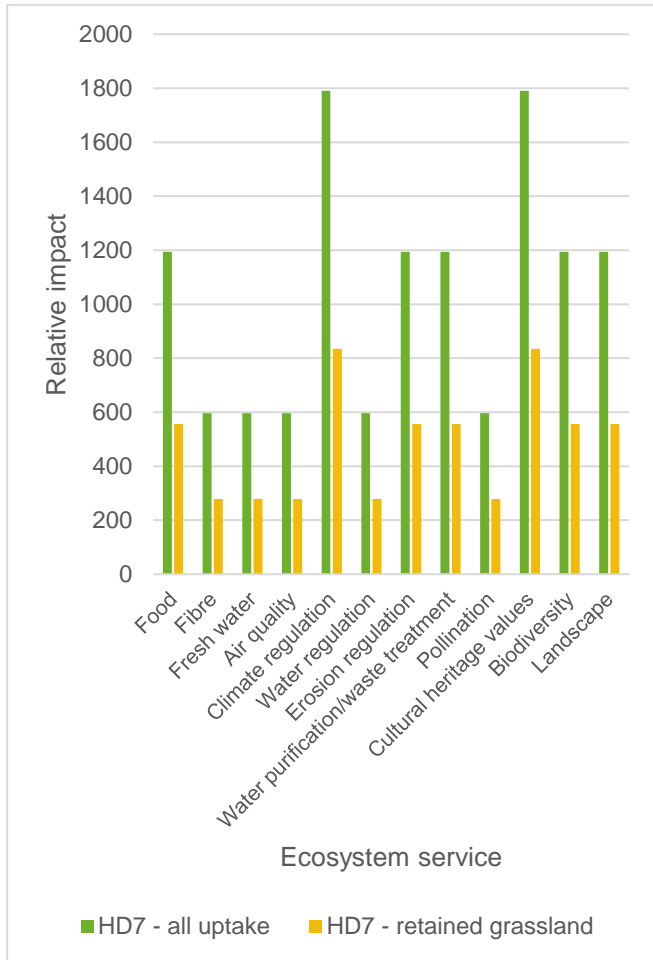


3.34 Overall, retention levels of grassland established under HD7 (Figure 3.11) were low, with a 53.4% decline in the area of grassland remaining following the end of ES Agreements. This resulted in a significant decline in the provision of ecosystem services.

3.35 The prescription for this option states that it is targeted at the most vulnerable features within arable or grass ley situation. This makes the high levels of decline concerning given the potential adverse impacts of cultivation on these features. As well as a significant decline in the provision of cultural heritage values (or indeed potential irreversible loss if

features are ploughed up), this option can also help to protect soils from erosion and reduce diffuse pollution, leading to a decline of the provision of erosion regulation and water purification services.

Figure 3.11: Impacts of option HD7 on ecosystem services



3.36 Generally, retention levels of grassland created under HK13 (Figure 3.12) and HK14 (Figure 3.13) were high compared to other arable reversion options. This may reflect that the initial effort to implement these options can be extensive. Also, the prescription for these options states that these options would normally only be suitable for locations that undergo flooding by freshwater in a non-tidal situation and which have been identified in Environment Agency flood management strategies. Therefore, so while some productivity of the land may have been lost, landowners may be keen to retain the grasslands for the other benefits that they provide such as flood management.

Figure 3.12: Impacts of option HK13 on ecosystem services

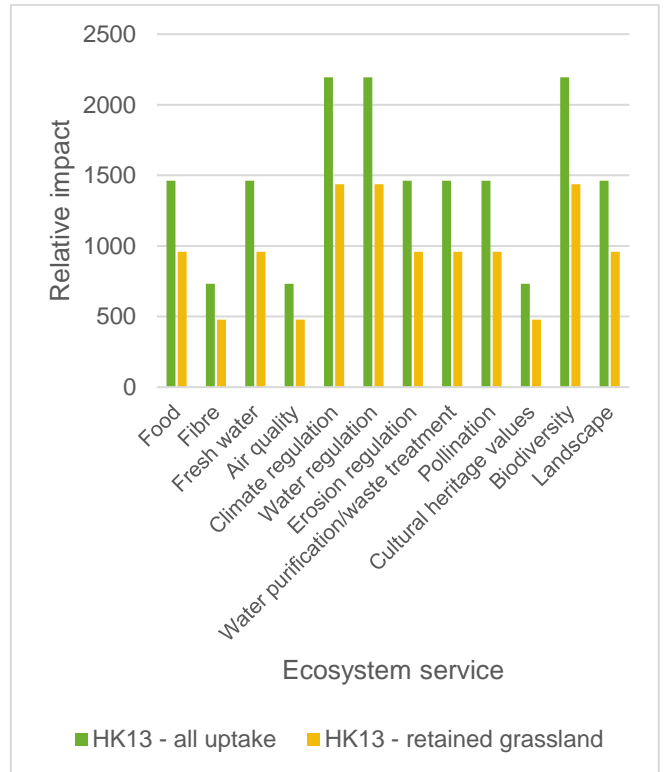
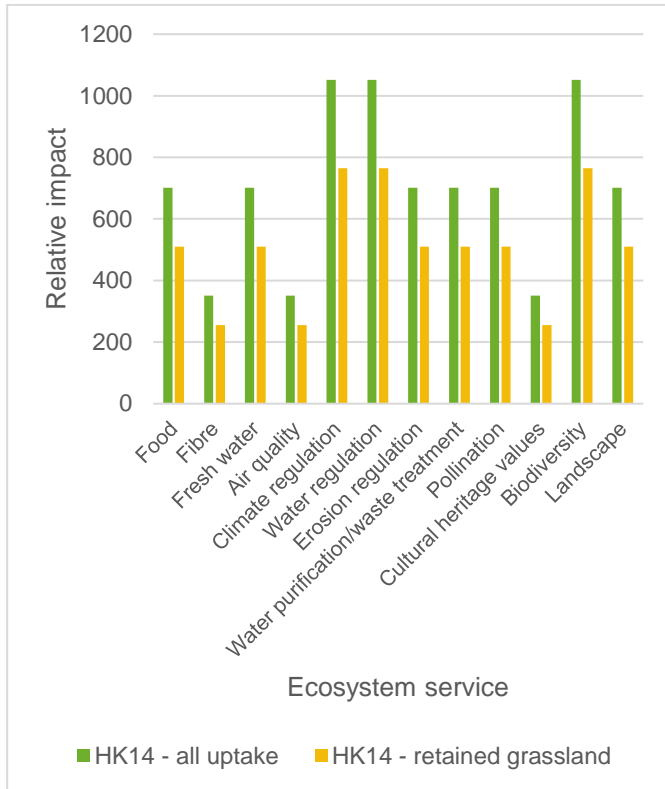


Figure 3.13: Impacts of option HK14 on ecosystem services



Results by Agricultural Landscape Type (ALT)

3.37 Arable reversion options are not distributed evenly throughout the six ALTs (see Figure 3.1 and Appendix A of the ESL’s full report, as cited in Chapter 2). Most of the options are located within the Chalk and Limestone Mixed (ALT 1) and Eastern Arable (ALT 2) ALTs. Since arable is the primary land use in these ALTs, this is an unsurprising finding. The frequency of arable reversion options in the Upland Fringe (ALT 5) and Upland (ALT 6) ALTs is lower, as agricultural land within these ALTs is primarily grassland.

3.38 Uptake of habitat creation options (HK13, HK14, HK17 and HK8) within the Upland Fringe and Upland ALT was low compared to other ALTs. The reason behind this is likely to be that semi-natural habitats within the Upland Fringe/Upland landscapes are less likely to have ever been lost to arable use, therefore equivalent ‘maintenance’ or ‘restoration’ options are often more appropriate.

3.39 Similarly, the options to take archaeological features out of cultivation (ED2, HD2, OD2, OHD2 and HD7) are less frequent in the Upland Fringe and Upland ALTs as arable land

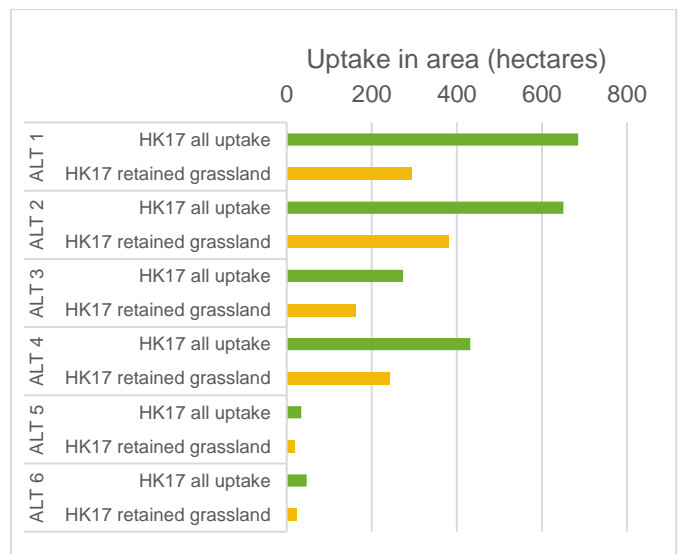
use is uncommon and archaeological features are unlikely to be impacted by cultivation.

3.40 However, options to prevent erosion/run-off (HJ3/HJ4) are more common in the Upland Fringe/Upland ALTs. Erosion and run-off risk are increased by factors including the slope of land and soil types. As land in these ALTs is typically more sloping than much of the rest of the country, it is to be expected that these options are more commonly targeted in these locations.

3.41 The charts (Figures 3.14 to 3.21) on the following pages illustrate the level of total uptake and retained grassland of selected arable reversion options within each ALT¹⁶.

3.42 Figure 3.14 shows that uptake of option HK17 is concentrated in the Chalk and Limestone Mixed (ALT 1) and Eastern Arable (ALT 2) ALTs, with high levels of uptake in the Western Mixed ALT (ALT 4). There is very little uptake of this option in the Upland Fringe (Alt 5 and Upland (ALT 6) ALTs. The retention of grassland created under HK17 has declined by around 50%. It declined by 57% in ALT 1 and 42% within ALT 2, though levels of retention are highest in these ALTs.

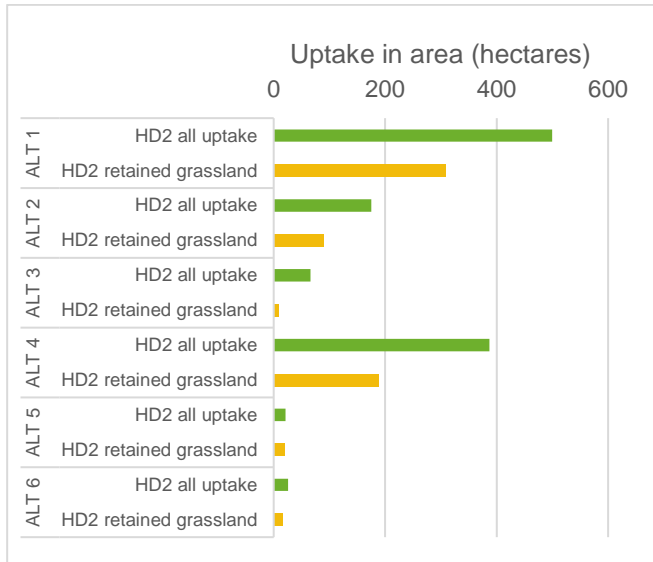
Figure 3.14: Total uptake and retained grassland of option HK17 by ALT



3.43 Uptake of option HD2 is most frequent in the Chalk and Limestone Mixed (ALT 1), Eastern Arable (ALT 2) and Western Mixed (ALT 4) ALTs as shown in Figure 3.15. When considering retained grassland, ALT 1 has the highest level, witnessing a lower rate of decline than ALT 4.

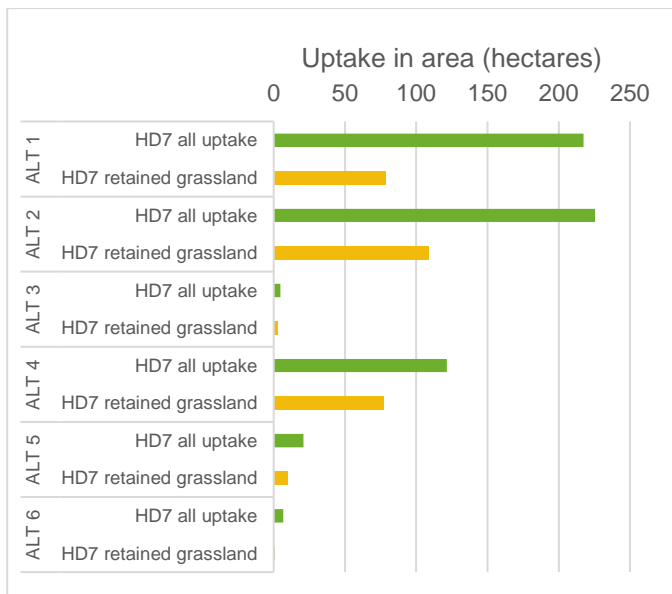
¹⁶ Based on option area.

Figure 3.15: Total uptake and retained grassland of option HD2 by ALT



3.44 Figure 3.16 shows the distribution of option HD7 is concentrated in the Chalk and Limestone Mixed (ALT 1), Eastern Arable (ALT 2) and Western Mixed (ALT 4) ALTs. As noted in paragraph 3.35, retention levels were relatively low, declining by between 36.4% and 91%.

Figure 3.16: Total uptake and retained grassland of option HD7 by ALT



3.45 Uptake of option HJ3 (Figure 3.17) is concentrated in ALT 2: Eastern Arable and ALT 4: Western Mixed. Uptake of option HJ3 is also good within the Chalk and Limestone Mixed (ALT 1), and Upland ALTs (ALT 6), although retention levels

vary across the ALTs. Loss of the grassland was greatest in ALT 2: Eastern Arable.

3.46 Levels of uptake for option HJ4 (Figure 3.18) were relatively low in all ALTs excepting Chalk and Limestone Mixed (ALT 1) and Western Mixed (ALT 4). Within most ALTs, retention levels of the grassland were relatively high.

Figure 3.17: Total uptake and retained grassland of option HJ3 by ALT

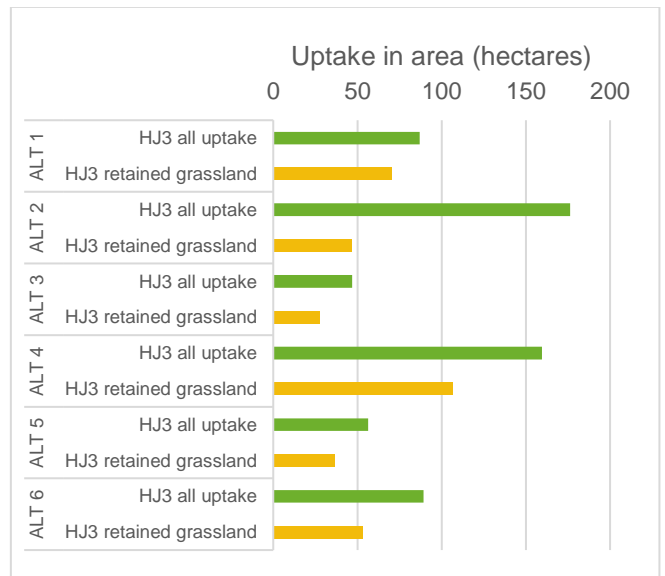
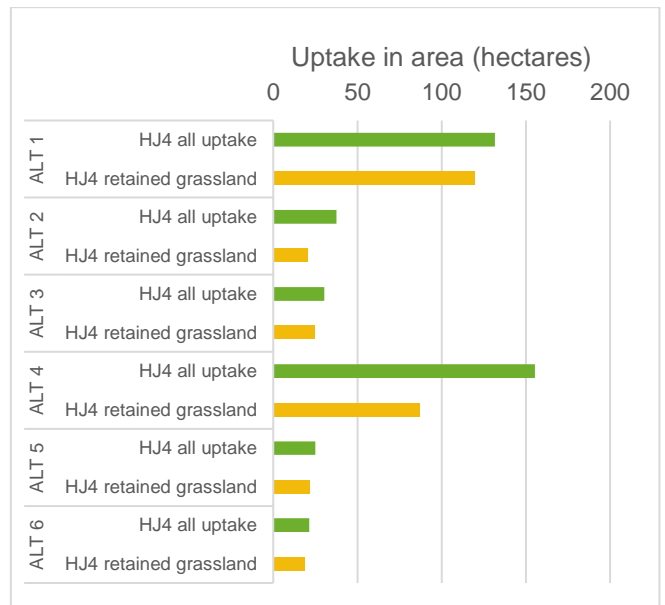


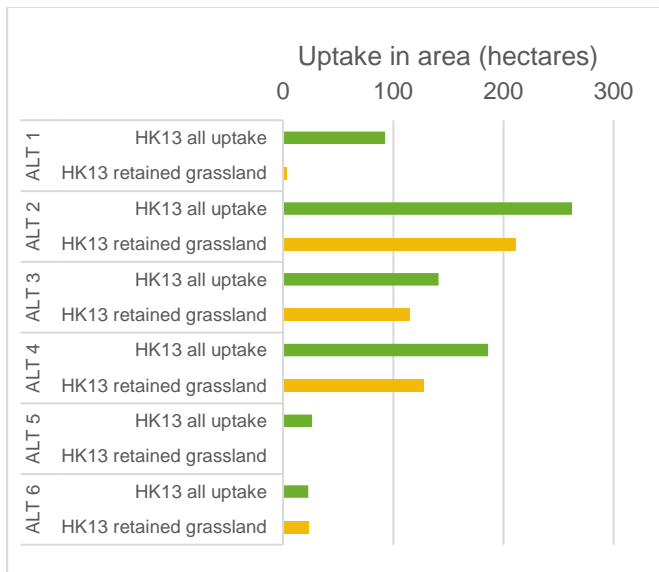
Figure 3.18: Total uptake and retained grassland of HJ4 by ALT



3.47 Figure 3.19 shows the uptake of option HK13 by ALT. Most uptake of this option is within the Eastern Arable (ALT 2), South East Mixed (Wooded) (ALT 3) and Western Mixed (ALT

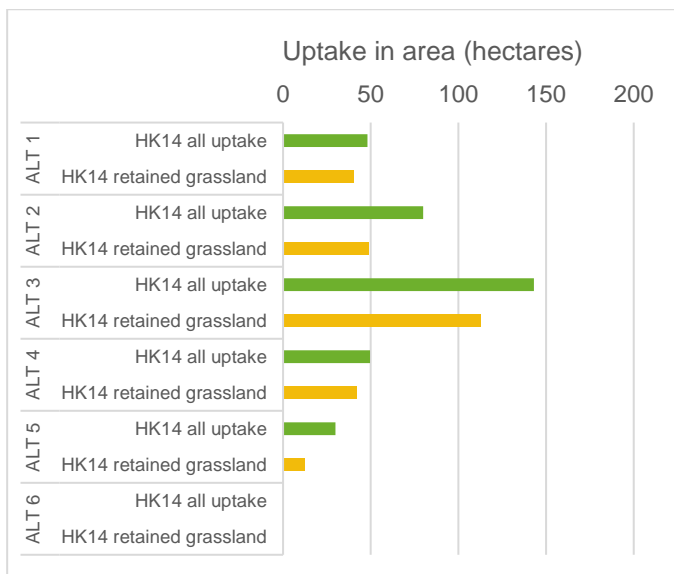
4) ALTs. Retention levels are generally good, excepting within ALT 1 where almost all grassland has been lost. There is very little uptake of option HK13 in the Upland Fringe (ALT 5) and Upland (ALT 6) ALTs, since equivalent 'maintain' or 'restore' options are more likely to be used in upland areas with less arable land and more intact areas of semi-natural habitat.

Figure 3.19: Total uptake and retained grassland of HK13 by ALT



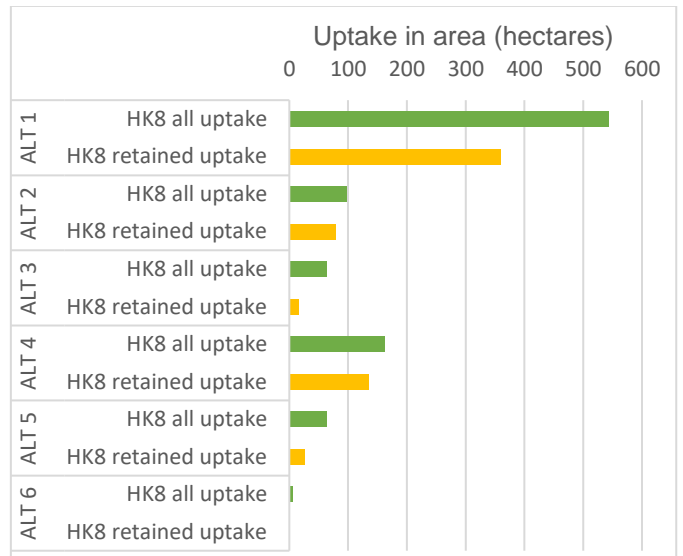
3.48 Figure 3.20 shows that the area uptake of option HK14 was greatest in ALT 3: South East Mixed (Wooded). Retention levels of grassland under this option were generally good, except for ALT 5: Upland Fringe where the area decreased by 60%. There was no uptake of this option in ALT 6: Upland.

Figure 3.20: Total uptake and retained grassland of HK14 by ALT



3.49 Figure 3.21 illustrates that the vast majority of uptake for option HK8 is located within ALT 1: Chalk and Limestone Mixed. Levels of retained grassland were generally good across the ALTs, with the exception of ALT 3: South East Mixed (Wooded), which saw a 75% decline.

Figure 3.21: Total uptake and retained grassland of HK8 by ALT



Contribution of arable reversion to ecosystem services by ALT

3.50 The figures at the end of the chapter show the relative impact of the arable reversion options (total uptake area and retained area) on the various ecosystem services for each ALT. As previously mentioned, most uptake of arable reversion options is located within the Chalk and Limestone Mixed (ALT 1) and Eastern Arable (ALT 2) ALTs, which are characterised by swathes of arable cultivation.

3.51 There is less uptake of arable reversion in the Upland Fringe (ALT 5) and Upland (ALT 6) ALTs, as discussed previously, resulting in arable reversion options having less impact on ecosystem services. However, the appropriate implementation of certain options (e.g. resource protection options for the prevention of run-off) on the uplands may well have cascading impacts which will positively impact on other ALTs.

3.52 Figure 3.22 shows the contribution of arable reversion options to ecosystem services within the Chalk and Limestone Mixed ALT (ALT 1). As this ALT contains the highest frequency and area coverage of arable reversion options, relative impacts on ecosystem services are also greater. Options which make the highest relative contribution are HK17, HK8, HJ4, HD2 and HD7.

3.53 The contribution of arable reversion options to ecosystem services within the Eastern Arable ALT (ALT 2) (Figure 3.23) is also relatively high due to the abundance of options located within this ALT. Options HK17, HD7, HD2 and HK13 make the greatest relative contribution to ecosystem services within this ALT.

3.54 Compared to ALT 1: Chalk and Limestone Mixed and ALT 2: Eastern Arable, impact of arable reversion options on ecosystem services within ALT 3: South East Mixed (Wooded) (Figure 3.24) is significantly reduced, primarily due to less uptake. However, the overall trends are similar to those noted in ALTs 1 and 2. Option HK17 makes the greatest relative contribution to the provision of ecosystem services, followed by option HK13 and HK14.

3.55 ALT 4: Western Mixed (Figure 3.25) has a high area coverage of arable reversion options, resulting in high levels of relative impact on ecosystem services. There is good uptake of a diverse range of arable reversion options within this ALT with option HD2, HJ3, HJ4, HK13, HK17 and HK8 all making significant contributions to the provision of ecosystem services within this ALT.

3.56 ALT 5: Upland Fringe (Figure 3.26) has significantly lower levels of uptake of arable reversion options, resulting in lower levels of impact on ecosystem services. Options HJ3, HK8, HK17 and HK14 are having the greatest relative impact on ecosystem services within this ALT.

3.57 In ALT 6: Upland (Figure 3.27), HJ3 has the greatest relative impact on most ecosystem services, due to the frequency and high area coverage of this option within the uplands. As noted in paragraph 3.41, this option is targeted at areas at risk of erosion and run-off. The relative impact of arable reversion options on biodiversity and cultural heritage is reduced compared to other ALTs. Options within these themes are less likely to be targeted within this ALT as cultural heritage features and semi-natural habitats are less likely to have been impacted by arable farming in upland landscapes.

Conclusions

3.58 Grassland created via arable reversion options makes a positive contribution to many ecosystem services, although the loss of the grassland has been significant and is likely to have reduced the magnitude of these positive impacts since the expiry of some ES Agreements. In the case of cultural heritage options, there is a danger that irreversible damage or loss has occurred on land no longer under option – i.e. through archaeological features being ploughed up or damaged by being put back into production.

3.59 All arable reversion options have the potential to have a high level of impact on climate regulation, although the magnitude of this effect is dependent on several factors which

may amplify or reduce the effect, including the stocking levels on reverted grassland. Other ecosystem services where arable reversion had high relative impacts include cultural heritage, biodiversity, erosion regulation, water regulation and landscape character.

3.60 The majority of arable reversion options are located within the Chalk and Limestone Mixed (ALT 1) and Eastern Arable (ALT 2) ALTs, which are characterised by frequent areas of arable land. It is noted that reversion of land back to arable will likely lead to an increase in food provision.

3.61 The impact of arable reversion options on ecosystem services varies across the six ALTs, due to differences in levels of uptake and a preference for certain types of arable reversion options within different ALTs. For example, options relating to the historic environment and biodiversity tend to dominate in the lowland ALTs, while options relating to resource protection are more frequent within upland and upland fringe ALTs. The variations in option uptake across the ALTs result in different ecosystem services seeing the most benefit. Options tend to have a higher relative impact on cultural heritage in the lowland ALTs, and a higher relative impact on erosion regulation in the upland ALTs.

3.62 Limitations of the analysis include the data used to underpin this study (see also Chapter 2) and general assumptions made in assigning simple indicator ratings to the options. The lack of digital data has limited the depth of the analysis, as it has not been possible to assess how the specific location of an option in the landscape may impact on the contribution to ecosystem services.

3.63 Nevertheless, the analysis indicates that arable reversion options can positively benefit various ecosystem services, particularly where the grassland is retained beyond the lifetime of a single agreement. Ecosystem services should therefore be a key consideration when choosing and siting similar reversion options as part of any future AES, to maximise the multi-functional benefits that these options can provide.

Figure 3.22: Relative impact of arable reversion options and retained grassland on ecosystem services in ALT 1

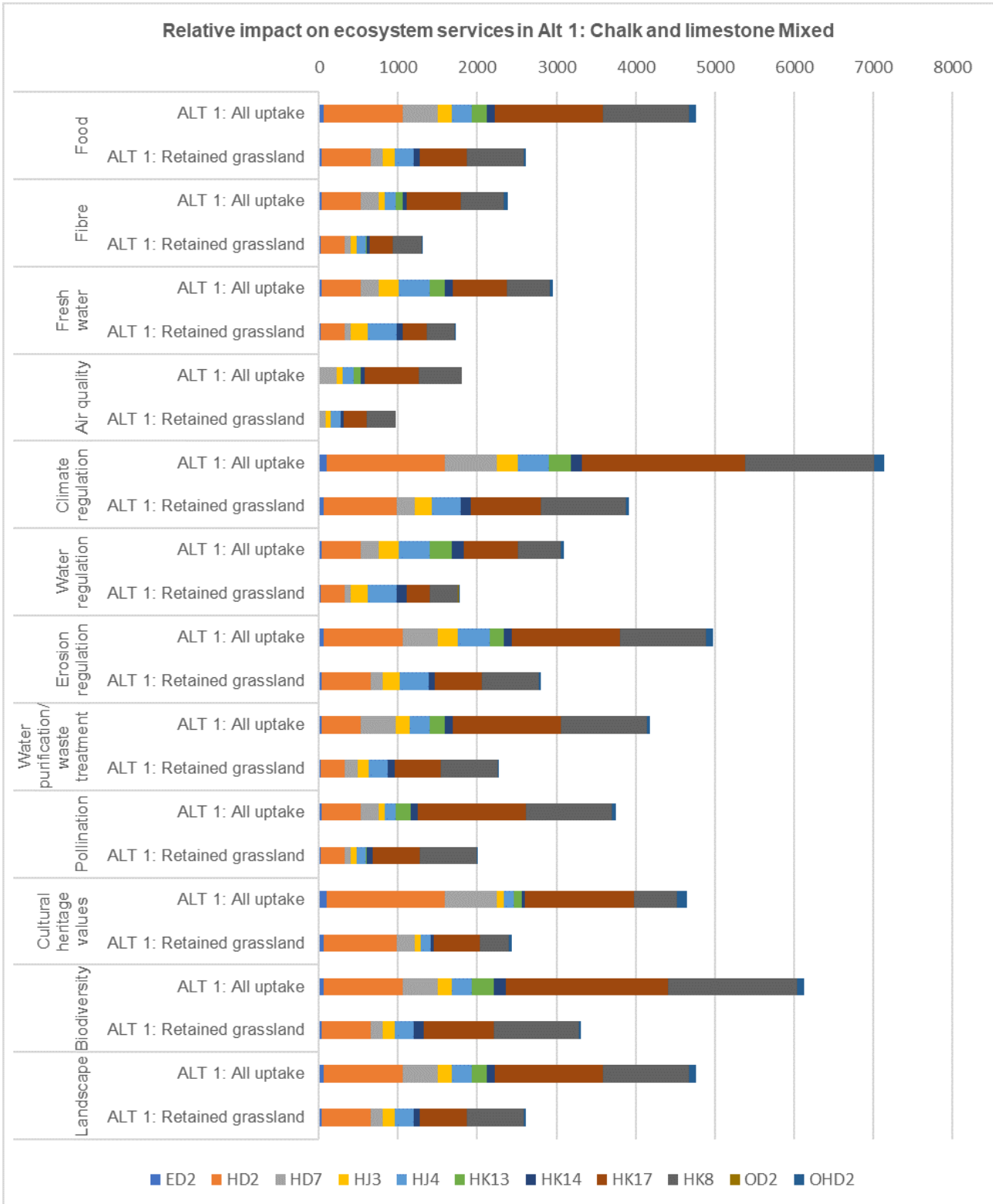


Figure 3.23: Relative impact of arable reversion options and retained grassland on ecosystem services in ALT 2

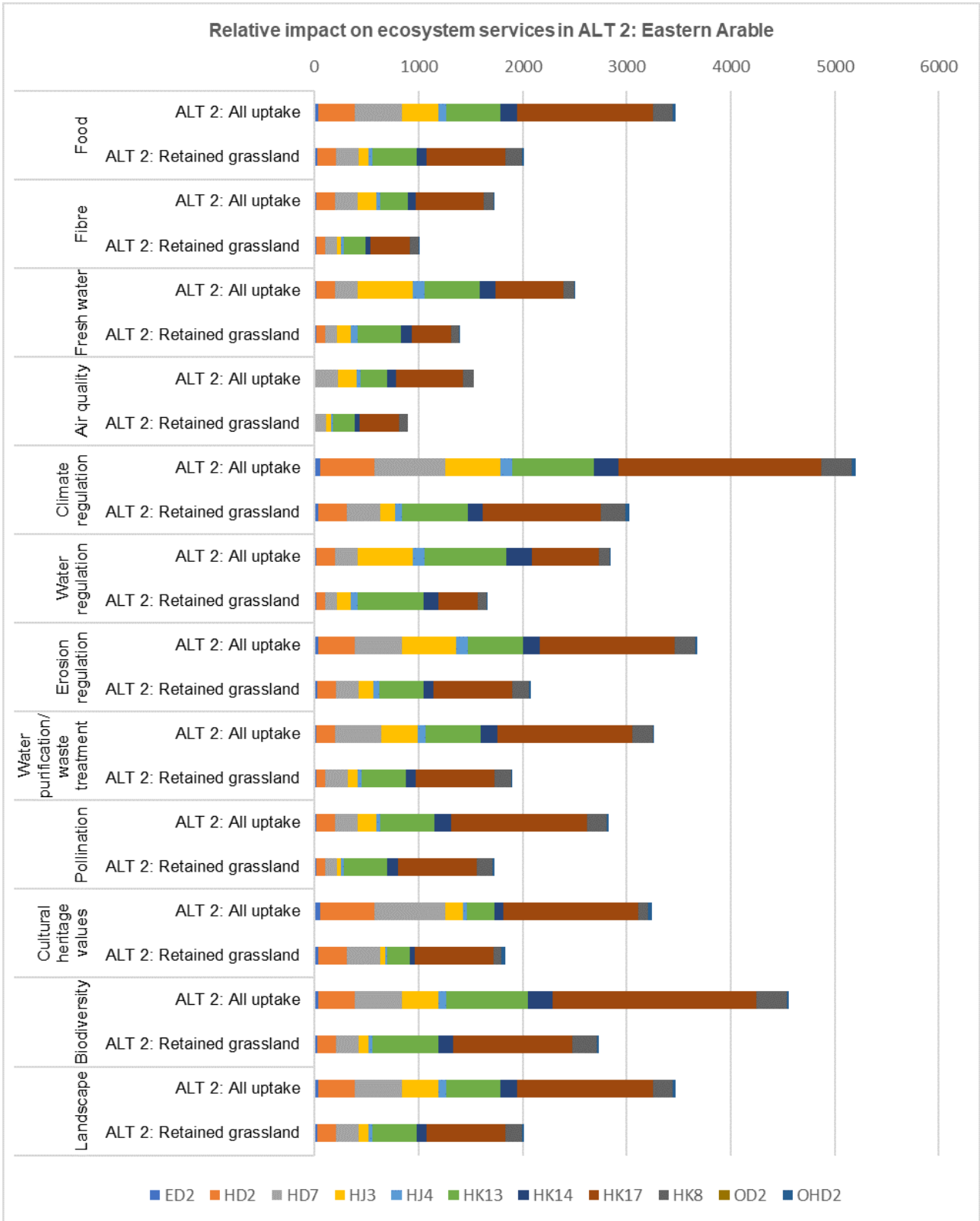


Figure 3.24: Relative impact of arable reversion options and retained grassland on ecosystem services in ALT 3

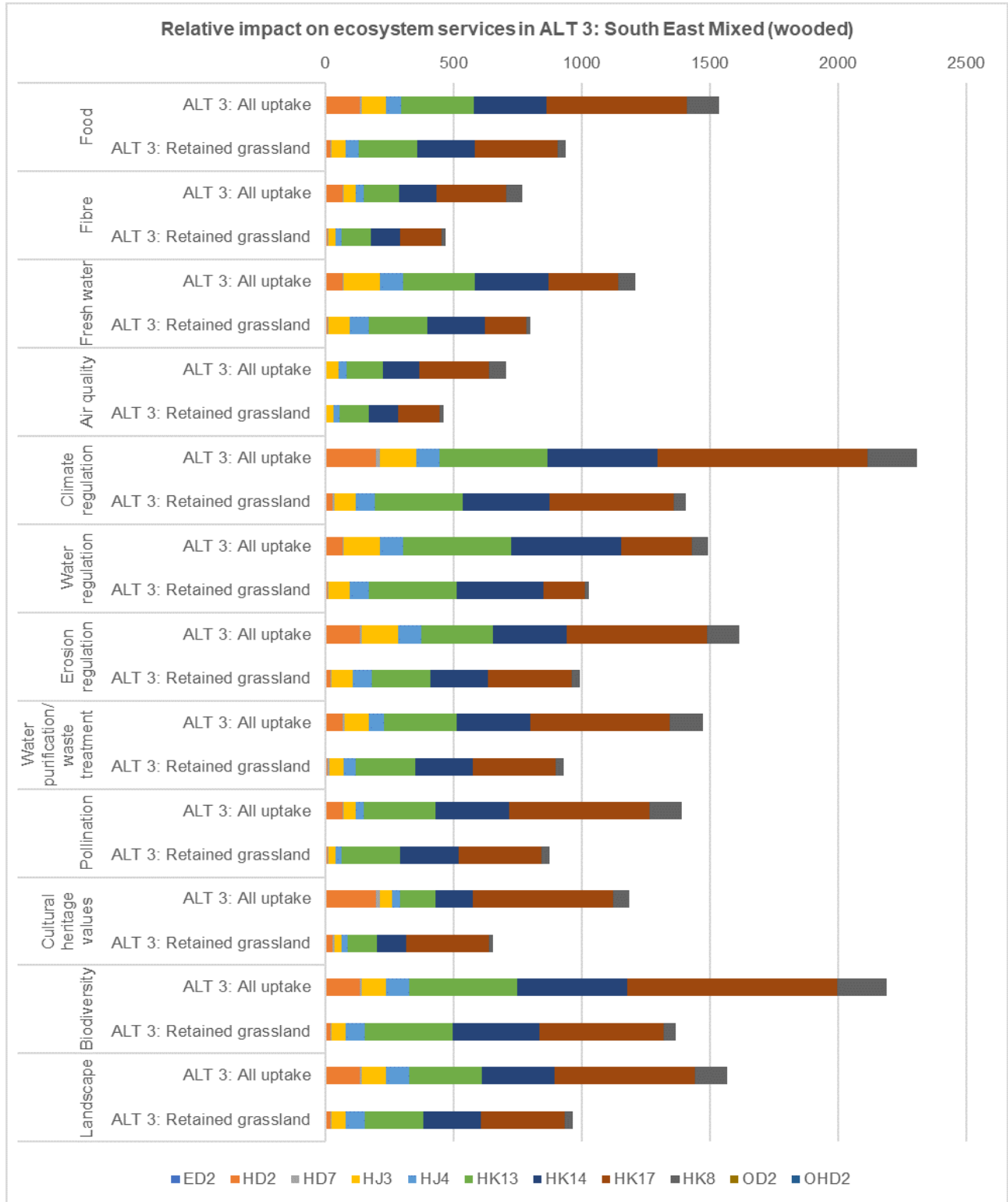


Figure 3.25: Relative impact of arable reversion options and retained grassland on ecosystem services in ALT 4

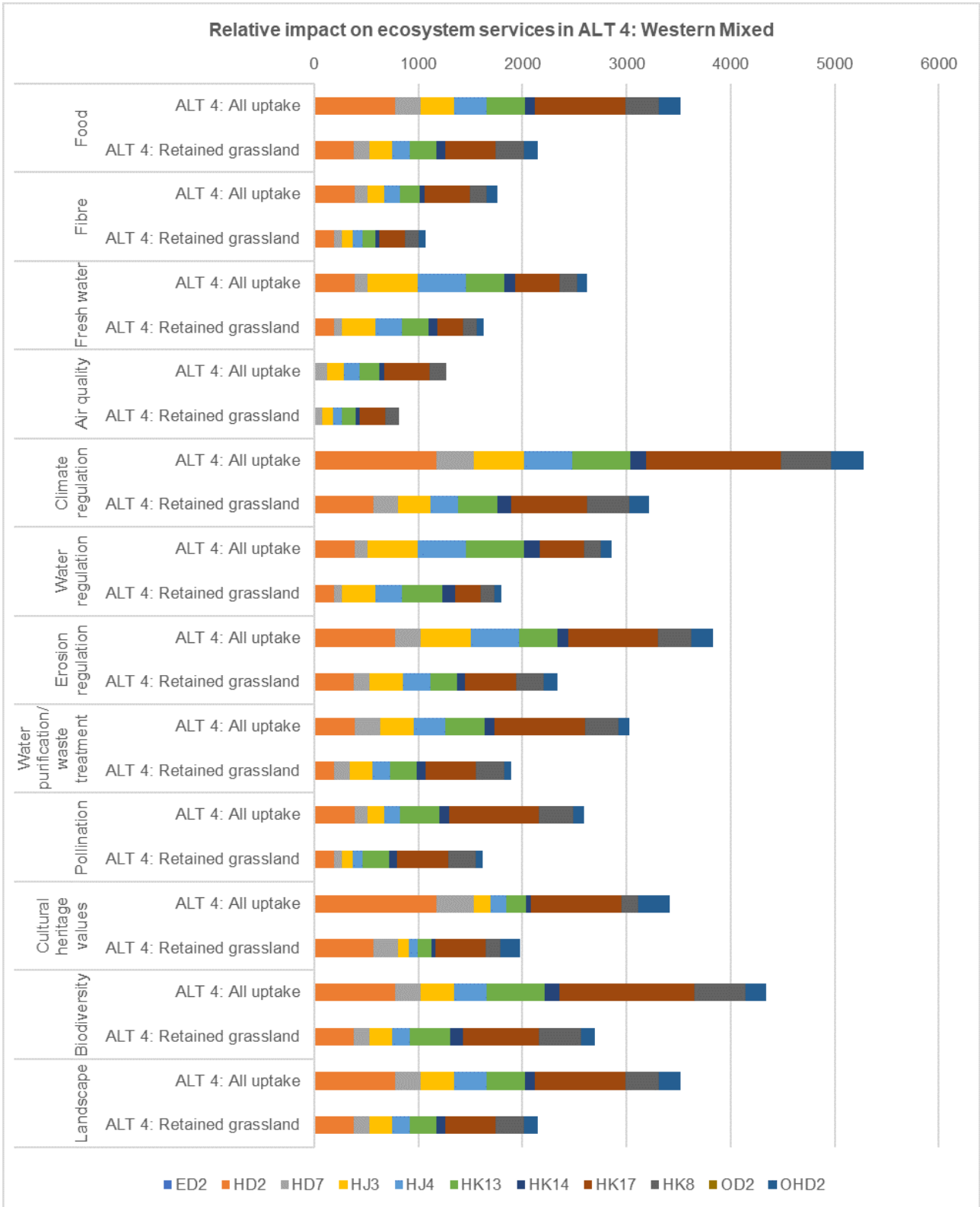


Figure 3.26: Relative impact of arable reversion options and retained grassland on ecosystem services in ALT 5

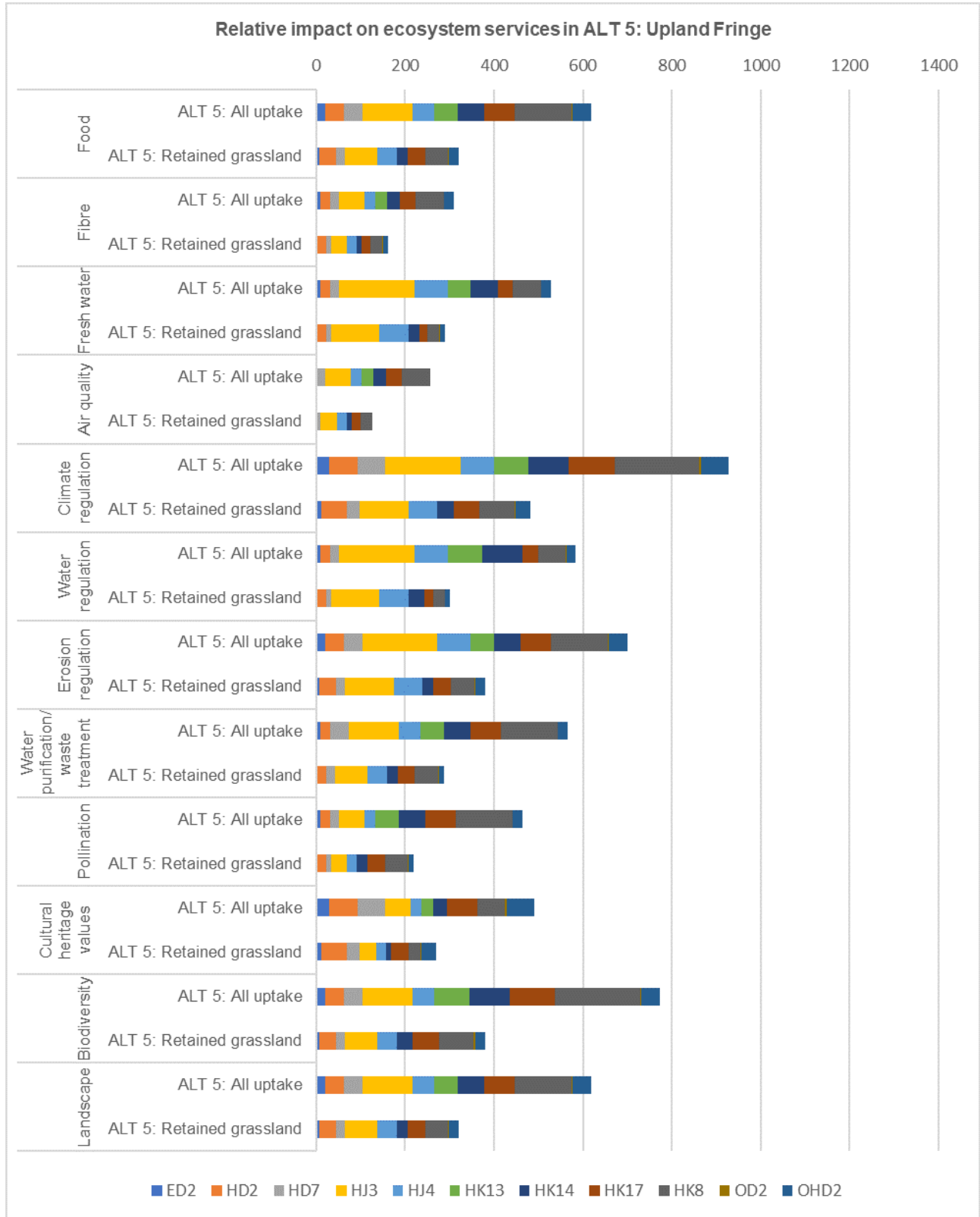
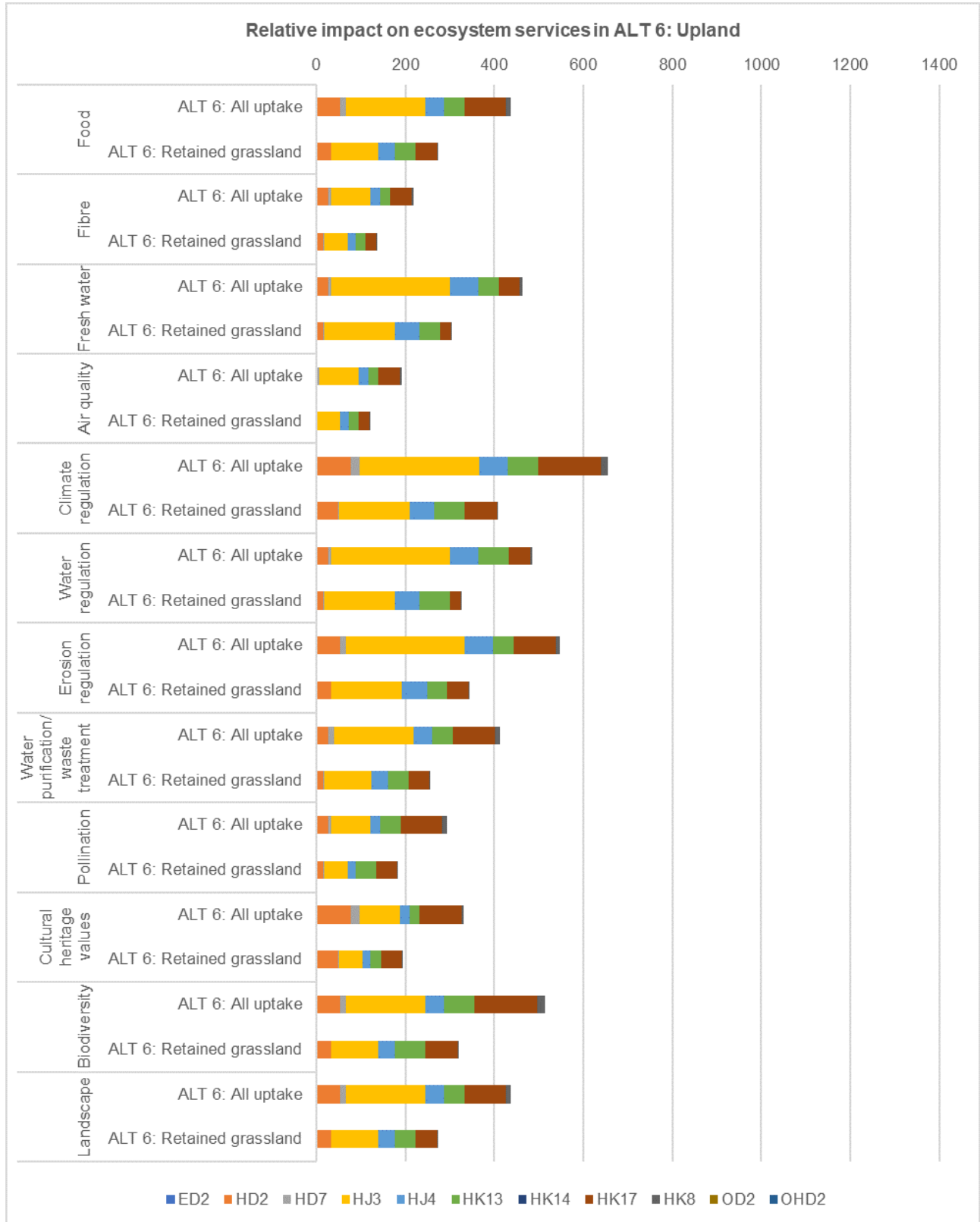


Figure 3.27: Relative impact of arable reversion options and retained grassland on ecosystem services in ALT 6



Chapter 4

Survey of land managers and agreement holders

This summarises the survey of agreement holders which explored the impacts of arable reversion and reasons behind its retention and loss

Headline findings

4.1 The headline findings from this survey, based on interviews with 107 agreement holders with AR options, are as follows:

- Just under half of those interviewed had been in an AES agreement before the ES agreement with arable reversion (AR) options.
- According to the respondents, large parts of the grassland reverted from arable (65%) remain.
- In total, 64 respondents (60%) stated that they had retained all of the grassland established under ES.
- Two thirds of the sample had Biodiversity-themed AR options, a third had Resource Protection options, and a further third had options aimed at achieving gains for the Historic Environment.
- Two fifths (38%) indicated that landscape character was a factor in them choosing AR options
- AR options were found to be very effective in meeting their objectives; establishing a sward and fitting with the farming system.
- Advice in the build-up and at the start of the agreement was widespread (88%) but less common on long-term management (46%)
- Those with Historic Environment-themed agreements were the least likely to receive advice on the implementation of the option(s) at the start or when their agreement ended.
- Those with no previous experience of AES were also more likely not to have a follow-on AES agreement.

4.2 Appendix A contains a list of the questions asked through telephone interview, and Appendix B presents the responses against each question.

Background to the survey

4.3 Over a one-month period at the end of 2019 and the beginning of 2020, telephone surveys were undertaken with 107 farmers and land managers who previously had Environmental Stewardship agreements containing arable reversion options. The aim of the interviews was to establish what has happened since their agreements ended, and the influences behind those decisions.

4.4 The agreements were chosen from those analysed through the spatial data task undertaken by ESL (as summarised in Chapter 2). This identified 1,474 parcels which were part of ES agreements containing arable reversion that were due to expire after October 2016. These parcels equated to 422 agreement holders, which constituted the sample for the telephone interviews (with contact details requested from Defra/Natural England). Of these 422 agreement holders, corresponding data from ESL's analysis was held for 397 – and this became the focus for the survey. At the end of the process, all but one of the interviewees was able to link back to holdings analysed as part of ESL's work.

4.5 Contact was made/attempted with 354 agreement holders, with 30% (107) taking part in an interview. The interview team made at least three attempts to contact each of the 354 before moving onto the next contact. In 66 cases the agreement holder declined to participate in the survey. This was for a variety of reasons, including being in a new scheme and focusing on that, due to personal circumstances (e.g. family bereavement) or were simply not interested. In some cases the land had changed hands or the owner had retired from farming. In only a few cases was the reason due to frustrations with the scheme or another issue concerning the farm.

4.6 A breakdown showing the response rate / reasons for not participating is shown in Table 4-1 below.

Table 4.1: Response rate for the telephone interviews

Type of response	No.	%
Interview Completed	107	30
Declined	64	19
Retired from farming	7	1
Awaiting answer	22	6
No answer	99	30
Details incorrect/absent	52	15
Total	354	100

Background statistics about the sample

Interviewees

4.7 Of the 107 agreement holders 69% (74 respondents) were the principal farmer and 17% were a business partner (18 respondents), suggesting that the survey was undertaken with the key people involved in the farm business. Only four farm managers and five agents were interviewed.

Tenure and farm characteristics

4.8 The tenure of the sample was mostly owned, with 51% (54) 'wholly owned'; 29% 'mix of owned and rented', and 17% 'wholly rented'.

4.9 Most farms were categorised as 'large', with 77% in the '100ha or more' category. The mean farm size was 240 ha and the median 160 ha. Indeed, 32 respondents (30%) had holdings of over 250 ha. Table 4-2 shows this survey compared with Defra statistics¹⁷ and other AES surveys¹⁸.

¹⁷ Defra (2019) *Agriculture in the UK 2018*, Produced by: Defra, DAERA, WG and SG [Accessed 19/03/20]

¹⁸ Boatman N, Short C, Elliott J, Cao Y, Gaskell P, Hallam C, Laybourn C, Breyer J and Jones Net al 2014 (2015) *Assessing the impact of advice and support on the outcomes of Higher Level Stewardship agreements*, report for Natural England by the Fera Consortium. Fera: York.

Short C, Lewis N, Reed M, James R and Jones N (2018) *Initial Evaluation of the implementation of Countryside Stewardship in England in 2015/16: Applicant and Non-Applicant survey, Final Objective 1 Report*, to Natural England by the Fera Consortium. Countryside and Community Research Institute: Gloucester.

Table 4.2: Comparison of farm size with Defra categories and previous AES surveys

	Sample (2020)		England June 2017*		Previous Studies	
	Number	Percent	Number (000)	Percent	2014 (n=99)**	2017 (n=403)***
<20ha	1	0.9%	42	39.9%	15.2%	9.2%
20 to <50ha	10	9.3%	21	19.5%	15.2%	14.1%
50 to <100ha	14	13.1%	18	16.9%	16.2%	16.6%
100ha & over	82	76.6%	25	23.7%	53.5%	60.1%
Total	107	100%	106	100%	100%	100%
Mean area (ha)	239.7		87		221.3	324.8

Sources: *Defra et al (2019), ** Boatman et al (2014) *** Short et al (2017).

4.10 The table shows that against the Defra statistics for main holdings, the AR survey was not very representative, with far fewer holdings of under 20 ha. In reality, these will be horticultural and housed pig and poultry units that are unlikely to enter into arable reversion. A better match is found with two recent AES surveys (cited above) where the average holding size is much closer to the Defra average. The 2014 survey was with HLS agreement holders and the 2017 with a range of interviewees who had either entered Countryside Stewardship or had considered doing so.

4.11 Farm size is also an important factor in the type of AR agreement, with the historic environment the least likely AR option to be found on smaller farms. Analysis of these agreements shows only one agreement of a holding of under 100 ha, with a third over 250 ha.

4.12 In terms of farm type, 45% of the sample described themselves as 'mainly arable' with a further 28% as 'mixed' farms (mostly a mix of arable and livestock). 15% were lowland beef and sheep and only 4% 'mainly dairy'. Table 4-3 compares these figures with the two other surveys. It should be noted in the 2014 survey there was no 'mixed' category.

Table 4.3: Comparing the description of farm type with other surveys

Which best describes your farm type?	Percentages		
	2020 n=107	2017 n=415	2014 n=102
Mainly arable	44.9%	25.5%	25.5%
Mainly dairy	3.7%	9.2%	2.0%
Upland beef & sheep	1.9%	17.3%	20.6%
Lowland beef & sheep	15.0%	14.2%	20.6%
Mixed	28.0%	21.2%	n/a
Other	6.5%	12.5%	28.4%
Total	100	100	100

Sources: * Short et al (2017), **Boatman et al (2014)

4.13 As one might expect, the proportion of 'mainly arable' is higher in this survey (2020), compared to the other surveys which contained responses from across HLS agreement holders (Boatman et al 2014) and CS applicants (Short et al 2017). Respondents were also asked about the proportion of the business income that came from agricultural enterprises (including AES and BPS income). For 38% of respondents

(41), this represented all of their income with a further 42% (45) saying that 'most of it' came from the farm. Therefore, 80% of the sample were whole or mostly dependant on the farm for their business income. This is very much in line with previous surveys.

Attitudes to conservation

4.14 Respondents were asked a series of four statements about the relationship between farming and conservation. These same statements were asked in a 2014 survey of HLS agreement holders and the intention was to compare

responses. Table 4-4 shows the percentage of each response according to a four-point scale where 'strongly agree' was recoded as 1 and 'strongly disagree' as 4. The closer the mean score is to 1 the stronger the agreement with the statement. The 2014 responses are shown in red.

Table 4.4: Attitudes towards the relationship between farming and conservation (2014 in red) (% of responses)

Attitudes to conservation	Strongly Agree (%)	Agree (%)	Disagree (%)	Strongly Disagree (%)	Mean Score
Conservation should be an integral part of agricultural activity	53.3 46	43.9 53	2.8 1	0 0	1.5 1.6
Conservation activity is detrimental to efficient agricultural activity	0 3	14 20	61.7 60	24.3 17	3.1 2.9
Farmers should take on more responsibility for the environment	23.4 18.4	57.9 53	16.8 25.5	1.9 3.1	1.97 2.1
Agri-environment schemes are the most effective way to make farmers take an interest in conservation	16.8 22.2	71 65.7	12.1 12.1	0 0	1.95 1.9

4.15 When comparing this survey with the figures in red from the 2014 HLS survey, the first impression is that the responses are very closely matched, both across the categories and in the average score for each response. The slight variation is that while participants in this new survey are just as positive – with 97% believing that conservation should be an integral part of agriculture, and 86% disagreeing that conservation is detrimental to efficient agricultural activity. However, these are not significant differences according to Chi Squared, and might easily be explained as being part of a wider trend of increased environmental awareness amongst farmers in the six years between the two surveys.

Area covered by arable reversion options and previous experience of AES

Area coverage of arable reversion options

4.16 All but one of the 107 agreement holdings subject to interview were able to be cross referenced with NE data on AR options and number of parcels and sub-parcels involved. The summary data shows that the 106 agreements had a total of 352 field parcels with AR options with an average of 3.3 AR field parcels. Just under a quarter of agreements (24%), had only one AR parcel with a similar proportion having two AR parcels. Indeed, 75% of respondents had four or fewer field parcels with AR options. The largest number in a single agreement was 12, with another having 10 and three holdings with nine AR parcels. The mean area covering AR options on all holdings was 10.9 ha (on field parcels with a mean coverage of 16.5 ha).

4.17 It should be noted that the parcel figure above is made up of both whole parcel and sub-parcel data, so the 'parcel' figure is a combination of both. There was not time within a telephone interview to separate these out, but it can be safely assumed that 'fields' are larger than 'parcels' (although sometimes they may refer to the same area). The discussion in the interviews related to all AR areas and not individual parcels or AR options. However, early in the questionnaire we asked the interviewees if the area listed in the NE database and the options were correct – this being confirmed in the majority of cases. In the few cases where there was a discrepancy, the changes were clarified and the agreement holders' perspective on total AR area and options was used as the basis for the interview.

4.18 Looking at the total data, the mean area of the parcels was 27.3 hectares across the 106 respondents. The smallest was 1.54 ha and the largest 172.46 ha. It is within these parcels that the AR options were placed. The mean area of AR per agreement was 15.2 ha, suggesting that the average proportion of AR land compared to total parcel area is 67.3%. All of the respondents were asked if the option(s) were whole or part field. In 51 cases (48%) they were all whole field and in only 23 cases (22%) they were part field. In a third of cases (31%) they were a combination. However, the trend towards whole field options explains the average proportion figure being two-thirds of the field parcel.

4.19 To give an idea of the size range of the AR options in the field parcels, Table 4-5 shows the field parcel sizes containing AR against the total area of AR options within them.

Table 4.5: Field and AR parcels by size (NE data for 106 respondents)

	Field Parcel		AR Parcel	
	N	Percent	N	Percent
0 to <5ha	14	13.2	29	27.4
5 to <10ha	16	15.1	21	19.8
10 to <25ha	34	32.1	34	32.1
25 to <50ha	24	22.6	16	15.1
50ha & over	18	17.0	6	5.7
Total	106	100	106	100

4.20 As would be expected, the field parcels are larger with almost 40% 35 ha or greater. This compares to 21% for the area of AR options. Over a quarter of the AR options total less than 5 ha compared to only 13% of the field area.

Nature of ES agreements

4.21 All of the 107 respondents were asked which ES scheme the AR options were delivered under. In 101 cases (94%) the options were under Higher Level Stewardship (HLS) with only six cases for Entry Level Stewardship (6%). As far as it was possible to link the total sample population to an ES scheme, 358 (90%) of the 400 were HLS and 42 Organic HLS. As a result, it is not possible to determine any differences in attitude towards or retention of AR between ELS and HLS agreement holders with AR options. Analysis around the organic AR options is also likely to be limited.

Previous AES experience

4.22 Respondents were also asked if they were in an AES agreement before they entered the ES agreement containing the AR options. Just under half (50 respondents (47%)) said that they had been in previous AES agreements. Therefore

for 53% of the sample the ES agreement, including the AR options, was the first AES agreement that they had been involved in. Those who had been in a previous scheme were asked which one it was. The most frequent was the ‘classic’ CSS (34), followed by those joining from a previous ES agreement (9 via HLS and 6 ELS) and four from ESA. Given the even split of this variable it does provide a useful means of analysis for this report, but there is no meaningful variation in these descriptive statistics regarding farm size, farm type or the number of arable reversion parcels that the agreements contain. Nor was there any variation in attitudes towards conservation and agriculture between those who had been in AES before and those who had not.

Ease of understanding and implementation

4.23 As a supplementary question, the respondents were asked if the AR elements of the ES agreement were complex to understand and to implement. Similar questions have been asked in previous surveys and the intention was to see if there were any variations. The results are shown in Table 4-6 below.

Table 4.6: Understanding and Implementation of AR agreement

	2020		2017*	2014**	
	Difficulty of UNDERSTANDING grassland options	Difficulty of IMPLEMENTING grassland options	How complex your CS agreement is to DELIVER? n=263	How complex do you feel your HLS agreement is to UNDERSTAND n=101	How complex do you feel your HLS agreement is to IMPLEMENT n=100
Very complex	8.4	8.4	12.2	13.9	9
Complex but manageable	28	27.1	47.9	52.5	58
Very manageable	63.6	64.5	39.9	33.7	33

Sources: * Short et al (2017), **Boatman et al (2014)

4.24 The table shows that just under two-thirds of the respondents to the survey mostly found the AR options both straightforward to understand and implement. In the 2017 survey (Short et al, 2017), of those who had just joined CS, nearly half felt the agreement was ‘complex but manageable’. These were at the very start of the agreement so this is perhaps not a fair comparison. The AR response was much closer to the HLS survey in 2014 (Boatman et al), whose respondents were well advanced in their agreements. Similarly, they found the HLS agreement ‘complex but manageable’ to understand (52.5%) and to implement (58%). So, it would seem that that AR respondents were more confident in implementing AR-related options. Possibly this is because the agreement has now been completed and to some extent they have moved on. Nevertheless, it is encouraging that the majority of respondents look confidently back on the AR options within their agreements in terms of implementation and understanding

4.25 Further analysis revealed that there was no variation in either understanding or implementation according to whether the respondent had been in an agri-environment scheme before or not. One might expect those for whom this was their first AES agreement to be more concerned about the AR option(s), due to the higher level of intervention of the reversion element compared to other ES options (such as managing existing hedges or grassland), but this appears not to be the case. However, the survey is reflective, asking respondents to look back over a decade ago. One or two respondents in this survey commented that they were nervous at the start and were not sure if it would work out.

4.26 Therefore, it is possible to deduce that the areas of AR are small, especially given the size of the holdings involved. However, both new agreements holders and those with AES experience stated that, on reflection, the AR options were ‘very manageable’ in terms of understanding and implementation.

Arable reversion options and types of activity

Options and themes

4.27 Across the 106 interviews with corresponding data on their agreements, there were 162 options, giving an average of 1.53 AR options per agreement. Only three agreements had any specific organic options so further analysis of this strand was not possible. The most popular AR option in the survey was HK17: Creation of grassland for target features, which was included in 42% of agreements, followed by HK8: Creation of species-rich, semi-natural grassland (27%) and HD2: Take archaeological features out of cultivation (25%). The full breakdown is shown in Table 4-7 below.

Table 4.7: Breakdown of AR options by theme

Option	No.
ED2 Take archaeological features out of cultivation	6
HD2 Take archaeological features out of cultivation	27
HD7 Arable reversion by natural regeneration	19
HJ3 Reversion to unfertilised grassland to prevent erosion/run-off	12
HJ4-Reversion to low input grassland to prevent erosion/run-off	5
HK13-Creation of wet grassland for breeding waders	11
HK14-Creation of wet grassland for wintering waders and wildfowl	5
HK17-Creation of grassland for target features	45
HK8-Creation of species-rich, semi-natural grassland	29
OD2-Take archaeological features out of cultivation	0
OHD2-Take archaeological features out of cultivation	3
	TOTAL: 162

Colour coding:

Historic Environment options

Resource Protection options

Biodiversity options

Organic (historic environment) options

4.28 In the 107 responses there were 53 with historic environment options across 51 (48%) respondents. There were also 19 resource protection options across 17 (16%). The largest group were those with biodiversity options, totalling 90 across 74 (69%) respondents. In total, the 107 agreements had 1.31 themes per agreement (141 in total). There was not enough time, nor would it have been effective, to relate specific parcels to a theme during the telephone interview. The overlap between themes and even within options is apparent when looking at HK17, which is classified as a biodiversity options but can also relate to the historic environment and landscape character themes. Likewise, HD7 is recorded as an HE option but during the interviews was referred to as a resource protection option. As is shown later, landscape character is an overarching theme of AR agreements.

4.29 Those with HK17, were asked what the target feature(s) that were specified as being connected with this option. Of the 45 responses, 19 specifically mentioned birds and 18 wild flowers or species-rich grassland. Butterflies were mentioned occasionally (4) along with hare (6) and pollinators (5).

Heritage features were also mentioned on three occasions (ridge and furrow, a battlefield and 'archaeology under the ground') alongside biodiversity reasons.

4.30 The split into the three themes enabled some further analysis on the parcel size, in order to see if there was a difference between AR agreements with historic environment options compared to resource protection and biodiversity options. The process for this was to look at each agreement that occurred in that theme. The breakdown is shown in Table 4-8 below.

4.31 Table 4-8 shows that field parcel areas were similar across all three themes (37.3-29.9 ha). The total area of AR is largest for historic environment (17.0 ha) but all are broadly similar with the resource protection theme smallest at 16.5 ha. The proportion of percentage of parcel area in AR reveals the first difference with a mean of 71.6% of parcel area under biodiversity compared to 54% for resource protection and 59.6% for historic environment. This is also true when it

comes to the % of the total farm size, with 12.3% under biodiversity AR options compared to only 7.5% for resource protection and 8.9% for historic environment. As mentioned above, this is likely to be explained by historic environment options being applied to specific sites/features/assets and resource protection focusing on areas of high risk. Biodiversity options tend to be more widely assigned across a field or multiple fields on a farm – reflecting the distribution of target habitats.

4.32 Overall the analysis shows a trend towards historic environment and resource protection options covering small areas within parcels compared to biodiversity. This would make sense when considering the implementation of these options to specific heritage assets or parts of a parcel in proximity to a watercourse, for example.

Table 4.8: Mean coverage of field parcel according to AR theme

Variables	Whole sample n=107	Mean values – according to Theme		
		Historic Environment	Resource Protection	Biodiversity
Mean total area of parcels - ha	27.3	35.1	37.3	29.9
Mean total area of AR - ha	15.2	16.7	16.5	17.0
Mean % of parcel area in AR	62.3	59.6	54.7	71.6
Mean number of field parcels	3.3	3.4	4.4	3.5
Mean parcel area as % of total farm	10.8	8.9	7.5	12.3
Mean AR area as % of total farm	16.5	15.5	14.6	18.4

Perceptions and motivations related to landscape character

4.33 Landscape character is an overarching theme that is not explicit to specific AR options, but its enhancement is often an additional outcome of AR implementation (particularly in landscapes where grassland is a key characteristic). This is explored further in Chapter 5. All 107 respondents were asked if landscape character was a factor in their decision to take up the AR options. In total, 42 (39%) agreed that it was part of their decision compared to 57% (61 respondents) who said it was not (and four providing no response).

4.34 Looking more closely at those who did indicate landscape character was a factor, they were asked if other options were selected for landscape reasons. In response, a wide range of options were listed covering much of those on offer under ES. In total, 30 responses were provided, 71% of those who indicated landscape character was a reason for choosing AR options. There were multiple mentions of popular ES options for hedge management and field margins suggesting there was no clear trend but a perception amongst agreement holders that many ES options would enhance landscape character alongside AR options. The most popular were boundary features such as hedges (10 responses) and field margins (8 responses). Five respondents believed that all of their options were landscape-related and a further five said they were targeted to wetland features.

4.35 For those who indicated that landscape reasons were behind their decision to take up the AR options, the following were some example responses:

- *“All options had landscape factors as key to the agreement”.*
- *“All [options are] linked [to landscape character], with 8ha of grassland reverted to species-rich grassland”.*
- *“Hedges, margins and many other options [are relevant to landscape character]. We care deeply about the landscape, with Grade 3 land that we want to manage for the environment”.*
- *“[Examples are] restoring hedgerows and planting new hedgerows and trees”.*
- *“[Examples are] wildfowl options for waders, some archaeological features with minimal till, field boundaries and protected trees”.*

Other motivations for choosing AR options

4.36 Those who did not indicate that landscape character was a factor (61 respondents) were asked what their reasons were for taking up AR options. Almost all of them (58) covered

more than one AR theme or perspective. The findings are presented in Table 4-9 below.

Table 4.9: Reasons for choosing AR options

Reason	Number	%
Landscape	42	39
Land not viable for farming	10	9
Financial/economic	12	11
Historic/archaeology	15	14
Environmental or biodiversity	14	13
Fits farming system	13	12
Getting into ES agreement	6	6
Soil or resource protection	4	4
Unspecified non-landscape reason	4	4
No reason given	4	4

4.37 There were a range of reasons offered by interviewees, and they often overlapped. In 14 cases there was mention of a historic or archaeological feature – and in at least three cases this was not known of prior to the ES agreement. In 13 cases environmental or biodiversity reasons were given. Interestingly, issues of soil management or resource protection were only stated by four respondents. The land not being good for arable production (9%) and economic reasons (11%) were frequent. ‘Fitting with farming system’, such as using the AR options to continue an agreed change in the farming system, was mentioned in 13 cases. Only a small number of interviewees said that AR options were used to ensure that they ‘got into the scheme’.

4.38 For those who indicated that other reasons were behind the decision to take up AR options the following were illustrative statements:

- *“Archaeological features as identified in preparation for the HLS [agreement]. Didn’t know they were there”.*
- *“For economic reasons (for the payment); fitted in with farming system. Used the unfertilized grassland to rear young cattle. Arable land was not very productive, so scheme payments made it worthwhile switching to grazing”.*
- *“For easier management of the farm – it took some hilly bits and difficult corners out. The areas were reasonably unproductive so it made financial sense”.*

- *“For wildlife, to encourage birds...”*
- *“Mainly for the payment, but the field had suffered from bad run-off after heavy rain and was quite stony”.*
- *“[It] made financial sense to do so. They were going to pay me to take the land out of arable. I’m not against looking after the environment just as long as the costs are covered. I didn’t go into the new CS because the payment would have been halved”.*

4.39 The quotes reveal some interesting aspects. First, that in some cases the archaeology was not known by the agreement holder before the HLS agreement was being developed. Second, that while the finances made sense for it was a challenge to ensure they continued once other options were considered. Less challenged were those who saw the AR option as part of a progression for the farm as a whole and made sure it fitted with the farming system.

4.40 In summary, this section (from para 4.27) has shown that biodiversity options are found in nearly two-thirds of AR agreements with HK17 the most popular option. Half of agreements have historic environment AR options and less than a fifth resource protection AR options. Nearly 40% of agreement holders felt landscaper character was behind their choice of AR options whilst for others it was a financial or strategic opportunity to adjust the farming system. Further discussion on farmer motivations is provided in Chapter 5.

Advice and support for the agreement holder

At the start of the agreement

4.41 All of the respondents were asked if they received advice while considering the inclusion of AR options in their agreements. Given that this was about 16 years ago, it is surprising that only 4 of the 107 respondents could not remember. Overwhelmingly, 92 (86%) indicated that they did receive advice. There is some variation amongst the themes, with 97% of those with resource protection options taking advice, 91% for those with biodiversity options, and 73% for historic environment options. There was little variation between those who had been in previous AES (66%) and those who had not (72%) receiving advice.

Table 4.11: Receipt of advice at the end of ES scheme by AR theme

	All responses	Historic Environment	Resource Protection	Biodiversity
Yes	69.2	60.8	70.6	75.7
No	30.8	39.2	29.4	24.3

4.42 Those receiving advice were then asked who offered the advice. In most cases, it was an NE officer (including Catchment Sensitive Farming officers) (64%), with a third (34%) having received advice from a conservation NGO and 28% from their own adviser. In total, about two thirds (68%) had one source of advice and 32% had two sources. One interesting variation that occurred here is that those who were new to AES agreements were more than twice as likely to receive advice from their own adviser (32%) compared to 14% of those with AES experience. Other sources of advice were the same (NE officer or NGO adviser), suggesting that new applicants sought additional advice alongside the NE or NGO advisers. For those who had been in AES before, the main sources of advice were NE and NGO advisers, rather than their own adviser.

4.43 In terms of what the advice was for, the responses are summarised in the table below. The table shows that almost all of those receiving advice had some assistance with the selection of AR option(s) (88%), as well as where to place it (60%). Nearly half were advised on long-term management (46%) and 41% on sward creation. Again, there was no variation between those who had been in previous AES and those who had not.

Table 4.10: Type of advice offered to AR agreement holders by adviser

Advice focus	%
Assist with option selection	88.2
Assist with option placement	60.2
Advice on sward creation	40.9
Advice on long-term management	46.2
Other	11.8

At the end of the agreement

4.44 The respondents were also asked if they received any advice when the agreement came to an end. Of the 107 respondents, 74 (69%) said that they did receive advice. Table 4-11 below shows the variations when this response is analysed against the three AR themes.

4.45 The table shows that those with biodiversity themes to their AR options (76%) were the most likely to receive advice when the ES agreement ended compared to 71% for resource protection and only 61% for historic environment. Therefore, this continues and seems to accentuate the trend of those who received advice at the start of their ES agreements. It may be possible that advisers feel Biodiversity options require more advice as they need to be assessed and tweaked, whereas with historic environment agreements it is a case of continuing to protect the features. For those who were new to AES, they were slightly more likely to receive advice (72%) at the end, compared to 66% of those who had previous experience of AES.

4.46 The key to understanding this is what the agreement holders thought of the advice they received. An assessment was made of the comments supplied by those respondents who had received advice by theme, considering whether or not they had been in an AES scheme before. Table 4-12 below provides a summary of whether the agreement holder reported finding the advice as being positive, neutral or negative in terms of helping future actions.

Table 4.12: Assessment of comments from those receiving advice at the end of the agreement

	Historic Environment	Resource Protection	Biodiversity
Positive	5	2	19
Neutral	10	8	19
Negative	13	2	17

Advice on migration to Countryside Stewardship

4.47 Biodiversity was the only theme where the positive responses were greater than the negative. The main reason for this was a stronger link between AR options under ES and Higher Tier options in CS. In this sense the agreement holders had a stronger sense of a link between the two schemes. For the resource protection themed agreement holders, a number mentioned that there was not a strong link between ES and CS. In some cases they were not in a priority area, while in others the only option was to move to low input management of permanent pasture options, which were not particularly popular due to the lower payment rates. Few seemed to be eligible for Higher Tier and specific habitat options. The most common negative comment from those within the historic environment theme was that there was no specific archaeological option in CS that would cover the AR options they had under ES. It is likely that this is the key factor in fewer Historic Environment themed agreement holders recalling any advice they received at the end of the

agreement. The fate of this land will be considered in the following section.

4.48 As an illustrative quote the one below summed up the thoughts of a few with negative experiences of advice at the end of their agreement. This was often undertaken by an NE project officer who had not been to the farm before and therefore had no knowledge of the agreement:

“Spoke to NE, and someone came out to visit the farm. They were most unsuitable and they were not interested in furthering the work. They considered it a 'waste of time'. Not encouraged to go into another scheme. Have since spoken to a CSFO [Catchment Sensitive Farming Officer] who was much more positive, and we are now considering CS”.

4.49 Not all such comments had a positive ending but it reinforces the point about ES and CS being different schemes with different priorities. It also shows that the more targeted approach of CS had an impact on AR agreement holders, some of whom felt they were no longer in the right place or offering the right type of management for CS. However, it is clear that for a number of respondents the process of moving from ES with AR options to CS was quite straightforward.

Perceived effectiveness of AR options

4.50 The respondents were also asked to rate the effectiveness of the AR options on a five-point scale with 1 being 'very ineffective' and 5 being 'very effective' for three criteria:

1. the effectiveness of the option in meeting its objectives;
2. the effectiveness of establishing a grass sward; and
3. the fit with their farming system.

4.51 The results are set out in Table 4-13 on the next page. The table shows that in the most cases, the AR options were seen to be at the 'very effective' end of the scale. Because of the high scores, there is little difference between the three AR themes or previous experience of AES. Overall, this is a very encouraging finding, with over three quarters of AR agreement holders finding the options to be effective at meeting their objectives, establishing a grass sward and fitting in with the farming system. There were no variations according to the level of previous AES experience.

Table 4.13: Effectiveness of AR options according to three criteria

	How effective 1= very ineffective 5= very effective					Mean
	1	2	3	4	5	
Meeting objectives of the option	4.7	2.8	5.6	30.8	56.1	4.31
Establishing an effective grass sward	1.9	3.7	16.8	31.8	45.8	4.16
Fitting with the farming system	0.9	3.7	12.1	30.8	52.3	4.3

4.52 All of the respondents were also asked what would have happened to the land that was under AR in ES if this option had not been available. In total, 85 respondents (79%) said that it would have been managed outside of AES under conventional agricultural systems. Only a few would have entered all of this land (10%) or some of this land (10%) into a different ES option.

4.53 The agreement holders were also asked how important the outcome of the AR options were to them, that is to say, the intended outcomes as specified in the ES agreement. For 46 respondents (43%), the outcomes were ‘very important’ and for 49 (46%), they were important. Therefore, for the vast majority of the sample, the outcomes of the agreement were at least ‘important’, which is very encouraging. Again, there was no variation according to the three AR themes or whether the respondents had previous AES experience.

Management following the end of the ES agreement

4.54 It is worth reiterating here that the sample included in this survey all had ES agreements with AR options that were expected to expire in 2016, although a few ended early. At this point the only option would have been to move to a CS agreement. When the interviews took place, the research team did not know what had happened to the land previously under [ES] AR options. ESL’s research (Chapter 2) had made an estimation using satellite data and associated algorithms. Therefore, as well as finding out what might have happened from the respondents themselves, the analysis of this and associated questions also provided an opportunity to test the accuracy of the previous data analysis.

4.55 The question offered to the respondents was ‘What has happened since you left ES/ or no longer have the grassland creation options?’. There were four options available covering different permutations and the response are shown in Table 4-14. The focus here is on the quantitative responses to this question and the areas of land involved. Chapter 5 explores the motivations and attitudes of the respondents in terms of the areas retained or lost.

Table 4.14: What has happened since the ES agreement ended?

What has happened since ES agreement ended?	Frequency	Percent
In AES and continuing with AR options on same parcel of land	19	17.8
In AES but now have different options	55	51.4
Applying for AES	2	1.9
No longer in an AES scheme (since agreement with grassland creation options ended)	31	29
Total	107	100

4.56 The table shows that 19 respondents (18%) felt that their new CS agreement continued the AR options on the same parcel(s) of land. In reality, this is not likely to be the case (as is discussed later), as the land is no longer arable by virtue of previous reversion – but, in their minds, there is continuity of the AR option. In these 19 cases we can be sure that 100% of the AR parcel(s) have been retained as grassland. In addition, it seems fair to assume that the same management is taking place through the new CS agreement.

4.57 The main difference between the two schemes is the payment rate (see Table 4.15 on the next page), with CS’s GS13 offering £90/ha, which is substantially less than the previous AR options under ES. GS6 is management of species-rich grassland, which offers £182/ha and GS9 is management of grassland for breeding waders, which offers £264/ha. Both of these options (the most frequently cited by respondents as covering AR grassland) are closer to ES payment rates and would suggest that the management has been very successful. However, they are clearly not AR options, due to their application to converted grassland (now well established after over ten years).

4.58 The largest group (55 respondents), making up just over half the sample (51%), are also now in CS but replied saying that they had a different option(s) on the AR field parcel(s). In these cases, it cannot be assumed that 100% of the AR

parcels remain as grassland or that the same management is undertaken. Both retention and management will be assessed below along with identifying which CS options they are signed up to.

Table 4.15: ES and CS payment rates by option

Option code	Option	Rate per hectare (points /£)
Entry Level Stewardship/Organic Entry Level Stewardship		
ED2	Take out of cultivation archaeological features currently on rotational / cultivated land	460 pts
OD2	Take out of cultivation archaeological features currently on rotational / cultivated land	600 pts
Higher Level Stewardship		
HD2	Take out of cultivation archaeological features currently on cultivated land	£460
HD7	Arable reversion by natural regeneration	£500
HJ3	Arable reversion to unfertilised grassland to prevent erosion or run-off	£280
HJ4	Arable reversion to grassland with low fertiliser input to prevent erosion or run-off	£210
HK13	Creation of wet grassland for breeding waders	£355
HK14	Creation of wet grassland for wintering waders and wildfowl	£285
HK17	Creation of grassland for target features	£210
HK8	Creation of species-rich, seminatural grassland	£280
OHD2	Take out of cultivation archaeological features that are currently on rotational land	£600
Countryside Stewardship (for agreements starting 1.1.21)		
GS6	Management of species-rich grassland	£182
GS7	Restoration towards species-rich grassland	£145
GS9	Management of wet grassland for breeding waders	£264
GS10	Management of wet grassland for wintering waders and wildfowl	£157
GS13	Management of grassland for target features	£90
HS2	Take archaeological features out of cultivation	£425

4.59 A further two respondents are in the process of applying to CS, suggesting that there has been a gap between the AES agreements. The final group of 31 respondents (29%), are no longer in AES; in most cases since ES ceased in 2016. For both of these groups the twin issues of what proportion, if any, of the AR options remain and the current management were supplementary questions. Both are dealt with later in this section.

4.60 In terms of the overall response of those who have progressed into a CS agreement, there was an interesting variation amongst those with no previous experience of AES, (42% no longer in AES), compared to 14% of those who had AES experience. One possible explanation is the gap in payments between the AR options under ES and potential CS options for managing grassland, which respondents with no previous AES experience considered unacceptable. In this respect they have not brought into the sense of long-term change using the payments to adjust their farming system to incorporate the new areas of grassland. Those with AES experience might be more accustomed to such thinking and the changes between schemes and therefore anticipated this at the start. Further analysis of the reasons underlying this are picked up in Chapter 5.

Levels of retention as grassland or conversion back to arable

4.61 For the 55 who entered into a new AES agreement but with a different option, 51% had all of the former AR option parcels under grassland and only 6% had been taken all of it back into arable cropping. Where the respondent indicated a return to arable, they were asked what the rotation is. In 44% of cases this rotation includes grassland and in 36% of cases it is in continuous arable. There is no way of checking, but presumably these changes in land use would need to be in line with the permanent pasture coding under BPS.

4.62 Amongst those who had not moved into CS (31 respondents), 52% (16) retained all of the grassland created under AR options and 26% (8 respondents) had none left with all converted back to arable cropping. A smaller proportion (23%) (7 respondents) retained some grassland but returned other parcels to arable rotation. The motivations and reasoning behind these responses are explored in more depth in Chapter 5.

4.63 All of the respondents were asked to indicate what proportion of the grassland that was under AR options now remains. It should be stressed this is the farmer/land manager's assessment of the proportion remaining and no verification has been undertaken. It was also not possible to determine which of the options remained due to the time constraints of the telephone interviews – therefore it was considered as a total (unverified) figure.

4.64 Out of the total sample of 107, the results indicate that about 65% of the AR grassland remains. Breaking this down also becomes very interesting, as together with the 19 respondents now in CS with all of the AR option grassland retained, a further 45 with other AES options or outside of AES have also retained 100% of the grassland. This gives a group of 64 respondents (60%) who have retained the area of grassland originally established under ES. Only 13 respondents indicated that none of the grassland created under AR remained. A further 22 respondents removed more than half of the grassland created. In Chapter 5, a new combined variable is outlined that integrates the retention of AR parcels and the associated management.

Costs of management for retained grassland

4.65 The 75 respondents who retained at least some of the grassland were asked how the costs of this management were covered. For almost half (49%), this was through CS, while the rest (48%), it was absorbed by the farm business. In only two cases were the costs covered by another source.

How could arable reversion options be improved?

4.66 While the proportion of those retaining grassland appear high (60%) all respondents were asked to identify factors that would improve AR options in AES schemes with two questions at the end of the questionnaire. The first asked 'Based on your experience, if you could change and/or improve anything about the AR options what would it be?'. All 107 respondents provided an answer.

4.67 Looking at the three AR themes, the response from those with Resource Protection options showed that flexibility on weed control and dates (4) and payments being too low in the follow-on offer (3) were of concern. The issue of follow-on payments was felt to be relevant as species-rich grassland is unlikely to develop in 10 years. There was also mention (2) of the permanent pasture regulation – meaning that respondents in this group ploughed up the pasture rather than risk it being registered as such. For four respondents the scheme worked well.

4.68 There was a similar range of comments for the Historic Environment – themed agreements. In total 12 agreement holders said that the agreement worked well and a further 4 had no comment to make. However, of those 12 7 said that the ES agreement did not continue as there was no suitable follow-on option. The need to graze or cut according to local conditions (6) was not always seen as helpful and some respondents didn't like the natural regeneration approach (4) to more formal interventions. Some concerns were made about the poor quality of the grassland (3) and inability to tackle weeds. However, there was a sense of frustration that

the historic environment was a clear theme under ES but not under CS. This type of inconsistency was mentioned by 10 in this group, typified by these two quotes:

- *"[There needs to be] more joined up thinking in transition from ES to CS. Involve farmers in designing the options. NE staff do not always understand what works".*
- *"Don't cut payments when creating new schemes".*

4.69 The largest group were those with Biodiversity-themed agreements and these were the most content group – with eight suggesting no major changes. However, some (10) wanted more flexibility and had struggled with weeds.

- *"Make [the option(s)] less prescriptive - allow for more farmer input concerning grazing management. Would like to modify for the benefit of biodiversity, but don't have an adviser to work with at present".*
- *"More flexibility in option prescriptions. Farmers have a lot of local knowledge about which field operations work best on establishing and maintaining species-rich grassland. NE should be more flexible and work with farmers and take account of their knowledge. Not everything can be found in a book. I have over 25 years' experience in working with options and a lifetime's experience of managing the farmland with all its quirks and peculiarities."*

4.70 Respondents suggested the following areas to refine the AR options:

- More flexibility;
- A faster process to allow weeds and pest to be tackled;
- Consistent advice and support across all parts of the scheme, especially at the start and end of agreements; and
- A clear strategy of how to link with the next scheme or policy initiative,

4.71 For some, the scheme worked well and enabled the farm business to change its approach.

4.72 A second question was 'Do you have any other comments you would like to make about your AR options and the AES scheme and related processes?' Here there was quite a strong sense of the need for consistency between schemes, as well as over-zealous inspections with some respondents being fined (even though an NE officer felt this was unfair). Issues of paperwork and flexibility arose again

with five of the Resource Protection-themed group mentioning this:

- *“More flexibility concerning dates and cutting times etc. This is changing due to climate change and needs to be considered. Farmers need the flexibility to be able to make decisions concerning this and associated issues. It is also too short of a time period (five years) for grassland creation - and also businesses would want a greater period of commitment [following the] application process...” (this quote reflects the views of quite a few respondents):*
- *“Would go into a scheme now if they were simple to administer with NE. We considered going into another scheme after ES but faced having to send in hundreds of pictures of the farm, and it wasn't feasible. It needs to be practical and easy for both NE and the farmers”.*

4.73 Within the Historic Environment - themed respondents there was a similar frustration about CS and the need to reduce paperwork and an overly-complex application process. The need for advice was also made several times (6), which is interesting as this group received notably less advice at the start and at the end than the other two themes (as discussed in section 4.40 onwards). There was also the suggestions by two respondents that new techniques, such as min-till or no-till, would enable some cropping to occur on areas under this theme as the soil disturbance was reduced.

- *“Need to have continuity in advisors. There has been so much change over at NE that the advisors don't get to know the agreements they are dealing with”.*
- *“Need to keep advisors. NE has lost too many”.*

4.74 A very similar set of comments were received from those in the Biodiversity-themed agreements with a scene that NE appears less interested if you are in the Mid-Tier, compared to the AR options. This is likely to be a result of Mid-Tier being a farmer-led process with little NE adviser input but this suggests that applicants would still value receiving advice or find the online advice inadequate.

4.75 Further analysis of the key themes explored through the farmer/land manager interviews is provided in the next chapter.

Chapter 5

Implementation of arable reversion through Environmental Stewardship

This chapter considers a number of research areas to understand the nature and impacts of arable reversion delivered through ES.

5.1 This chapter takes a more focused look at the research findings under a number of themes. Case studies are included at the end of the chapter to illustrate some interesting examples of the application of arable reversion options – and what the situation is now in relation to the grassland created.

Headline findings

5.2 The following summarises the key findings from this chapter:

Farmer motivations

- Those reporting a direct transition to CS had been the most successful in creating areas assessed as 'high value' under the AR options attracting higher paying CS options.
- Perceptions of a lack of a clear route from ES AR options into CS was the main reason for not continuing. This is most pronounced for Historic Environment and Resource Protection themed agreements

Levels of arable reversion retention

- Just over two-fifths (42%) retained all of the AR option land and are managing this under a different option but with the same or appropriate management.
- Just under one fifth (18%) have retained all of the AR option grassland but are managing it under different regime outside of the AES schemes.

Levels of expenditure according to retention / loss trends

- Over half of AES arable reversion payments relate to grassland that has been retained at the end of the agreement period. This varies between options
- The pattern of AES arable reversion payments does not appear to correspond exactly to the pattern of ecosystem service delivery, though exact comparison is difficult.

Farmer/land manager motivations

5.3 In the previous chapter the analysis of respondents to the survey showed that approximately 65% of the grassland created under the AR options in ES agreements remained at the end of 2019/beginning of 2020. This section explores the reasoning behind this and the attitudes and motivations of the agreement holders concerned.

Decisions to continue with AES

5.4 First, we look at the critical issue of whether to continue keeping the land previously in ES under a new AES – namely Countryside Stewardship (CS). The previous chapter revealed that 19 agreement holders (18%) considered that they had a seamless transition into a follow-on CS agreement that covered all the AR option parcels.

5.5 All of these respondents were asked ‘*What were the reasons for the areas of AR being retained?*’. Of the 19, five specifically mentioned biodiversity or the environment, as illustrated by these two quotes:

- *“Lots of orchids - very rare in the area. Want to keep them. A university comes and visits”.*
- *“Because it’s so important for biodiversity - especially butterflies – and our livestock”.*

5.6 The latter quote makes the link between the AR options, the environment and the farming system. A further five also make this link to the farming system, some quite dramatically so, illustrated by the following comments:

- *“Have been in schemes for a very long time. Business is structured around this, and the payments are crucial, but we want to pass the farm on to our children in a better state. It is very important to look after it”.*
- *“Change in way we farmed - we went organic”.*
- *“[Grassland] already established so transferred over. It was the easiest thing to do and worked best with current management as the sections of land were field corners and hilly sections which were difficult to grow crops on”.*

5.7 The last quote mentions poorer land that is largely unsuitable for arable production, something a further three respondents also highlighted. Only two mentioned financial factors – the first in terms of the AR field being part of a package (i.e. the wider CS agreement), and the second also mentioning their interest in the environment and ‘*preserving the countryside*’.

5.8 There was only one mildly negative comment, regarding the length of the new CS agreement:

- *“[I] wanted to continue the work down previously. But [you] need more than the 5 years in the current agreement.”*

5.9 So, apart from the comment about the duration of the CS agreement, these 19 respondents were content to continue with AES and did so for a variety of farming, environmental and personal reasons.

Decisions not to continue with AES

5.10 At the other end of the spectrum were the 31 (29%) respondents who have not transferred into CS. Of the 31, 27 offered a response to the question ‘*What was the thinking behind the change in land management when the AR options ended?*’.

5.11 Not surprisingly, a frequent response was that the land had returned to arable, this was mentioned in six cases:

- *“Now arable land, can’t afford to keep it as grassland” [now they are no longer in a scheme].*
- *“All AR options have gone as large bits of land have returned to cropping. If there had been a scheme to go into [we] would have considered this”.*

5.12 The latter quote refers to the lack of a follow-on scheme. This was an issue raised by six of the respondents. The clear implications here is that these agreement holders did not feel that they were involved in long-term change involving a shift to grassland. A key factor seems to be the drop in payments from one scheme to the next combined with the perception that they are not linked. These quotes illustrate the key concerns about the follow-on to ES:

- *“Had no advice when left ES, basically NE said best option Mid Tier and much reduced payments. Not worth considering so now not in any scheme and field in farm’s normal rotation. Will be back in grass for 5/6 years but currently in arable”.*
- *“A new CS [option] would have paid half the money, so was not financially viable, so went back into the arable rotation”.*

5.13 Several of these mentioned the lack of follow-on advice and the gap between Mid Tier options and those experienced under ES for these parcels.

5.14 The reasons were not always negative, however. For some the management remained the same even though the land was outside an AES agreement:

- “[It] fitted in with the suckler beef herd, have small area of arable but the old AR fields are now in grassland. In AES elsewhere on the farm and [in Higher Tier] manage grassland for the wild flowers”.
- “Both fields are still grassland and cut for hay. It is good grass and less wildflowers so makes better hay and now sell all for horses”.

5.15 The overwhelming response in this group related to the lack of a clear follow-on AES scheme that linked to the AR parcels and the need to seek financial return through arable cropping. Where this worked well, as in the quotes above, the farming system has adjusted to incorporate the new areas of grassland.

5.16 The role of landlords was a factor in two cases, either requesting that some land stays in grassland or taking the land back in hand for sheep grazing. In one further case the land was taken for development. Numbers were too small to make any judgement, but land tenure is a factor that needs to be considered when developing AR options, given their longer-term perspective.

5.17 In the 13 cases where all of the AR options were lost, the respondents were asked ‘What was the reason for all of the AR options being lost?’ The responses reflect those above with a pressure for income and for the land to be productive. Mention was made of CS only being able to offer half the money that ES did for AR options. No one specifically mentioned changing policy or uncertainty regarding the Common Agricultural Policy, but it is likely that would have been in their minds. One respondent mentioned the AR option producing ‘the wrong sort of grass’, so it was ploughed up and a different seed mix planted as temporary pasture. It is noted that guidance on AR seed mixes changed during the lifetime of ES but there is no way of assessing if this is a factor in this case.

5.18 Respondents who returned some of the AR parcels to arable were also asked about the rotation. In most cases this included winter wheat (11) and maize (6), including in five cases where there were historic environment options. In seven of the 33 cases mention is made of grass – e.g. as a single year in a rotation of four years, or of five years’ grass and five of arable cropping.

Previous involvement in AES

5.19 One of the major differences highlighted in the previous chapter concerned the low proportion of respondents who had been in a previous AES agreement (14%) before choosing AR options through ES. This was compared to 42% who entered ES for the first time.

5.20 It is interesting to note that 11 of the 19 who transferred all of their AR option land into CS had previous AES experience. On the other hand, only three had returned all of the AR option parcels to arable. Of the 50 in this group, 32 (64%) had retained all of the grassland. This is the same proportion as the sample as a whole, meaning that they were not more likely to keep the AR parcels in grassland, just more likely to do so within an AES agreement. The reasons for retaining the grassland were variable. There were mentions of fitting the farming system; retiring so taking things easier; poor agricultural land and presence of features such as tumuli and wildlife species. There was only one mention of payments being positive (Higher Tier) and another that was less positive about CS but still remained in the scheme due to him being a “committed environmentalist”. This example is explored further in the first historic environment case study included later in this chapter.

5.21 The group which had no previous experience of AES include 10 of the 13 holdings which had lost all of the grassland created under ES. The reasons are clearly economic with this specifically mentioned in seven cases, with the others citing the lack of advice or absence of a follow-on scheme.

5.22 For those who kept some of the grassland, the reasons seemed less positive, as these quotes illustrate:

- “Kept 10 of the 25 hectares as forced to in order to be able to plough up the other bits. [There was an] archaeological area in one field and one of 9 ha was to remain as grass. [The land] had been arable for centuries and reverting to grassland was a good idea at the time – but not if we couldn't get out”.
- “It was the poorer land”.
- “Unable to take them out of grassland without penalties. We have other business ventures due to large events such as Brexit”.
- “Needed [to retain the grassland] for the environmental focus area”.

5.23 The sense here is of a more difficult decision and a need to consider the farming system and the economics of the farm in question. The lack of a clear link between the AR option under ES and the options and support within CS, notably Mid Tier, were a factor.

Situations where arable reversion has persisted

5.24 The core to this section is the development of a new variable that combines the responses to a number of questions. From previous analysis we know that 64% of the

AR options, in terms of land area, have been retained. We also know that 60% of respondents kept all of their AR land under option. What we are less clear about is the management of these areas of grassland, and how they are fitting into the farming system. This analysis provides a sense of whether keeping the grassland is a permanent change or temporary, and whether the future management will continue that undertaken with the AR options under ES.

5.25 Four categories have been created for this new variable:

1. All AR grassland retained on the same parcels with the same management under different AES option
 - Respondents in AES where options cover all previous AR areas
2. AR grassland retained with different management
 - Respondents who retained all AR areas but these are now outside AES and/or management has changed
3. AR grassland partly retained
 - Respondents who kept less than 100% of the grassland created under AR (but at least 25%)
4. AR grassland mostly or all lost
 - Respondents who kept less than 25% of the AR option area.

5.26 The initial results are presented in Table 5.1 below.

Table 5.1: Frequency of combined retention and management categories

Category	Frequency	Percent
All retained - same management	45	42.1
All retained - different management	19	17.8
Partly retained	21	19.6
Mostly or wholly lost	22	20.6
Total	107	100.0

1 – All grassland retained with the same management

5.27 45 (42%) of respondents had retained all of the AR option parcels as grassland and now undertake the same management as they had under the ES scheme. This includes the 19 who felt that the new AES agreement was rolling over from the ES scheme and a further 26 respondents who are also under an AES agreement that covers all of the AR option parcels. The decision to include those under new

AES agreements assumes that any new agreement would be considered by NE and the prescriptions for the former AR parcels would reflect and build on the previous management.

2 – All grassland retained with different management

5.28 The second category of ‘all retained under different management’ includes 19 (18%) of the sample, and covers those incidences where new AES options cover only some of the former AR areas, or if there is no AES agreement but the grassland has been retained. The comments made about management were assessed to ensure that this was an accurate assessment. The combined total is the 60% of the sample that retained the AR grassland but broken down based on its current management.

5.29 The ‘different management’ to that under AR options in the second ‘all retained’ category is taken from text responses. The responses show that the AR parcels have been reseeded (2), cut for forage (4), managed more intensively with inputs (2), not kept to-date in AES (1) and grazed more intensively (2). Some of the changes are minor compared to the management under AR options but others more significant – as these quotes illustrate:

- *“Only difference is that I can cut it earlier (before July 15) if I want to and this makes better hay. Still no fertilizer and graze with some sheep after the hay cut and later in the year”.*
- *“Reseeded it, field now cut three times a year. Changed from arable to lowland beef so farm all grass now”.*

3 – Grassland partly retained

5.30 For the group that have partly retained the AR parcels as grassland, where there is a CS scheme it is assumed that the management is the same. This is the case in five situations. In six cases (outside AES) the grassland management is clearly different but broadly in line with environmental management. In 11 cases it is clearly more intensive with more inputs and a different timing for field operations. These quotes are indicative of the responses and highlight some of the changes that occurred when the ES scheme ended.

- *“Kept the field with the orchards and now goes as greening land. It was just topped but now bale some of the grass. Still no inputs.”*
- *“The new CS did not have suitable grassland management options. So even though we were losing income by keeping most of the grassland, we wanted to continue to take the nutrients out of the system on the poor land. We did not want to lose all*

we had achieved in ten years. Part of the field under the archaeology option went back into the arable rotation (not the part over the archaeology). This was the compromise. Some of the timings of operations is different.”

3 – Most or all grassland lost

5.31 For those in this group that retained some grassland, these included areas added to new schemes or with heritage designations (3), and therefore the assumption is that they are managed in the same way. In two cases the AR parcel was reseeded to meet the requirements of other AES options; one because the respondent did not think the resource protection option was the right one; and the other changing the grassland to a wild bird seed mix. However, over half of this group had no AR parcels left as grassland, and the rest manage it differently, including as part of a rotation, which just happened to be grass when they were interviewed.

Table 5.2: Categories of retention / management by farm size

Farm Size Retention & management	<100ha		100<150ha		150<250ha		250ha & over		Total	
	n	%	n	%	n	%	n	%	n	%
All AR retained & same management	11	24	7	16	10	22	17	38	45	100
All AR retained & different management	7	37	6	32	3	16	3	16	19	100
AR grassland partly retained	5	24	3	14	4	19	9	43	21	100
Mostly or wholly not retained	2	9	9	41	8	36	3	14	22	100
Total	25	23	25	23	25	23	32	30	107	100

5.33 The numbers are too small for statistical analysis but the table shows a clear trend towards larger farms retaining the AR parcels and the same management. Looking at the comments there are farms who report ‘taking a hit’ with lower payments on the AR option areas but this is part of a larger agreement so this may be offset by other options elsewhere. Larger farms are also likely to have greater flexibility and be able to spare some land for environmental enhancement purposes or link this to other enterprises. Farm size is an existing trend within AES generally. The two categories covering some loss of AR grassland show that small and large farms can fall into this category, reflecting situations where

Levels of retention according to farm characteristics

Farm type and size

5.32 The findings above were checked against the background characteristics of the sample to see if there were any trends that might help explain why respondents kept their AR grassland and retained the same management. There was no trend according to farm type, partly because arable was so dominant in this category, but there was according to farm size. The trend was that larger farms, notably those over 250ha, were more likely to be able to retain the AR grassland with the same management. It is likely that a combination of factors such as increased flexibility, financial security and a greater understanding of AES schemes contributed to their increased likelihood of retention. The figures are shown in Table 5.2 below.

there is both a lack of flexibility and farm economics or a sense that it ‘was not working’ as one agreement holder put it.

Farm tenure

5.34 There is also a variation in trends according to land tenure, although the numbers are small. Farmers were less likely to retain the AR grassland if they were wholly renting the holding. Only seven of the 45 respondents in the ‘All retained and same management’ category were from wholly rented holdings. This compares with six out of 22 respondents in the ‘Mostly or wholly not retained’ category. These quotes illustrate some of the reasoning:

- *“Wouldn’t want to convert back. Small fields not particularly productive.”*
- *“All back into arable as no follow-on scheme offered or thought to be available”.*
- *“Didn’t want 40 acre block to be permanent pasture, [there was] very little interest from NE to pursue it. It was mainly in areas with public footpaths and bridleways, NE said too much footfall for grassland in this area to be a benefit to the environment”.*

Previous experience of AES

5.35 In terms of previous AES experience, those that retained the land were slightly more likely to have been in a scheme before; 51% (23) for those who retained with the same management and 58% (11) for those who have changed the management. However, the differences are not as pronounced as you might expect – so are therefore not illustrative of this group. The number of AR parcels is interesting, but the analysis is hampered a little by small numbers. However, it seems that there is a trend towards those with larger numbers of AR parcels not retaining these areas. This is presented in Table 5-3 below.

Table 5.3: Retention and management of former AR parcels

No. of AR parcels	1-2		3-5		>5		Total	
	n	%	n	%	n	%	n	%
	All AR retained & same management	23	51	16	36	6	13	45
All AR retained & different management	9	50	9	50	0	-	19	100
Partly retained & variable management	7	33	8	38	6	29	21	100
Mostly or wholly not retained	11	50	6	27	5	23	22	100
Total	50	47	39	37	17	16	107	100

5.36 While it is difficult to draw too many conclusions from the smaller AR parcel categories, it would seem that those agreements with more than five AR parcels are less likely to retain them or retain the same management. Of the 17

respondents in this category, 11 fall into the ‘partly retain’ or ‘mostly not retain’ categories. This might suggest that larger numbers of AR parcels increase the likelihood that they are not kept and maintained as grassland. This might be because the agreement was over ambitious or the farm business is not able to maintain the new areas of grassland from an economic perspective.

5.37 Looking at the size of these holdings, all but two fell within the over 250ha category and the other two in the 150-250ha category, so these are large holdings. There was no clear pattern in terms of previous AES experience with equal numbers having been in previous schemes (five) compared to six who had not. The areas concerned were large in all cases (over 20 ha) so perhaps it is not surprising that not all of this was retained.

Analysis by theme (option outcome priority)

5.38 There are some interesting trends when considering the groupings of the AR options into the three themes (Historic Environment, Resource Protection and Biodiversity). These are shown in Table 5-4 below.

Table 5.4: Retention and management of former AR parcels by theme

AR theme	Historic Env't		Resource Protection		Biodiversity		Total	
	n	%	n	%	n	%	n	%
All AR retained & same mgmt	11	22	6	35	38	51	45	42
All AR retained & different mgmt	9	18	4	24	11	15	19	18
Partly retained & variable mgmt	13	25	3	17	13	18	21	20
Mostly or wholly not retained	18	35	4	24	12	16	22	21
Total	51	100	17	100	74	100	107	100

5.39 The table shows that for those with Historic Environment AR options, they were less likely to retain the grassland (22%) compared to the whole sample (42%); and more likely to ‘mostly or wholly not retain’ it (35%). This mirrors results from previous sections where Historic Environment agreements

appear less inclined to continue agreements. In terms of retention, the Resource Protection agreements sit in the middle with 35% retained under the same management and 25% retained under different management. Turning to Biodiversity, there is a significant number of parcels where all grassland has been retained under the same management, reflecting the number that transferred over to a new AES scheme. The numbers are high enough for a Chi-squared test to indicate this difference is significant. The reasons for this are not clear but it might be that those in HE feel less engaged as there are no changes to appreciate, unlike the Biodiversity or RP options.

Retention and advice at the end of the agreement

5.40 Thirty-seven of the 45 (82%) who retained all AR grassland under the same management received advice at the end of their agreement. This compares to just over half of the 'All retained and different management' and the 'Mostly or wholly not retained' categories. This suggests that there is a link between the receipt of advice at the end of the ES agreement and the retention of the AR grassland under the same management. Grassland created under Biodiversity options is also most likely to be secured into a new scheme with the same management.

ES option expenditure according to levels of arable reversion retention and loss

5.41 Table 5-5 on the next page shows patterns of arable retention and loss in relation to the total amount of financial support over the ten year lifetime of an agreement. It is based on ES option rates and the area covered by parcels that were retained, possibly retained, probably lost and lost (as calculated by ESL and summarised in Chapter 2). This provides an impression of the extent to which public expenditure has produced lasting benefits and that for which benefits were confined to the lifetime of the agreement.

5.42 Figure 5.1 shows the pattern of AES payments according to the category of retention or loss, breaking the information down by option. Figure 5.2 shows the same data presented by option, broken down further by the category of retention or loss.

5.43 The analysis shows that around 45% of total expenditure on arable reversion options relates to parcels that were retained as grassland at the end of the option period. If those parcels where grassland is 'possibly' retained are included, the proportion rises to around 57% of total expenditure, totalling just under £13 million. Parcels where grassland was lost or probably lost at the end of the option period account for around 43% of expenditure, totalling just under £10 million.

5.44 The proportion of expenditure on retained parcels was highest for:

- HJ4: Arable reversion to grassland with low fertiliser input to prevent erosion or run-off – 67% retained, 5.7% possibly retained
- HK14: Creation of wet grassland for wintering waders and wildfowl - 63% retained, 10% possibly retained
- HK13: Creation of wet grassland for breeding waders – 53% retained, 13% possibly retained
- HK8: Creation of species-rich, seminatural grassland – 50% retained, 15% possibly retained.

Table 5.5: Total ES option payments over 10 years, by retention category

Option code	Option	Lost	Probably Lost	Possibly retained	Retained	Total
ED2 ¹⁹	Take out of cultivation archaeological features currently on rotational / cultivated land	£3,266	£5,277	£5,195	£5,609	£19,346
HD2	Take out of cultivation archaeological features currently on cultivated land	£1,440,798	£1,059,808	£541,006	£2,363,190	£5,404,802
HD7	Arable reversion by natural regeneration	£898,365	£694,520	£312,210	£1,079,140	£2,984,235
HJ3	Arable reversion to unfertilised grassland to prevent erosion or run-off	£516,986	£251,874	£169,288	£784,176	£1,722,325
HJ4	Arable reversion to grassland with low fertiliser input to prevent erosion or run-off	£218,583	£9,135	£48,069	£566,370	£842,157
HK13	Creation of wet grassland for breeding waders	£700,674	£194,487	£ 326,202	£1,374,322	£2,595,685
HK14	Creation of wet grassland for wintering waders and wildfowl	£244,664	£27,189	£96,245	£630,297	£998,395
HK17	Creation of grassland for target features	£1,421,994	£ 677,878	£659,959	£1,697,957	£4,457,788
HK8	Creation of species-rich, seminatural grassland	£520,999	£371,902	£397,096	£1,328,620	£2,618,616
OD2	Take out of cultivation archaeological features currently on rotational / cultivated land	N/A	N/A	N/A	£815	£815
OHD2	Take out of cultivation archaeological features that are currently on rotational land	£423,720	£34,200	£173,160	£422,160	£1,053,240
TOTAL (£)		£6,390,049	£3,326,269	£2,728,429	£10,252,656	£22,697,403
TOTAL (%)		28.2	14.7	12.0	45.2	100

¹⁹ For point-based ELS options ED2 and OD2, we applied a notional amount of £30/ha (consistent with ELS payments) to feed into this analysis.

Figure 5.1: Total AES payments over 10 years, by retention category

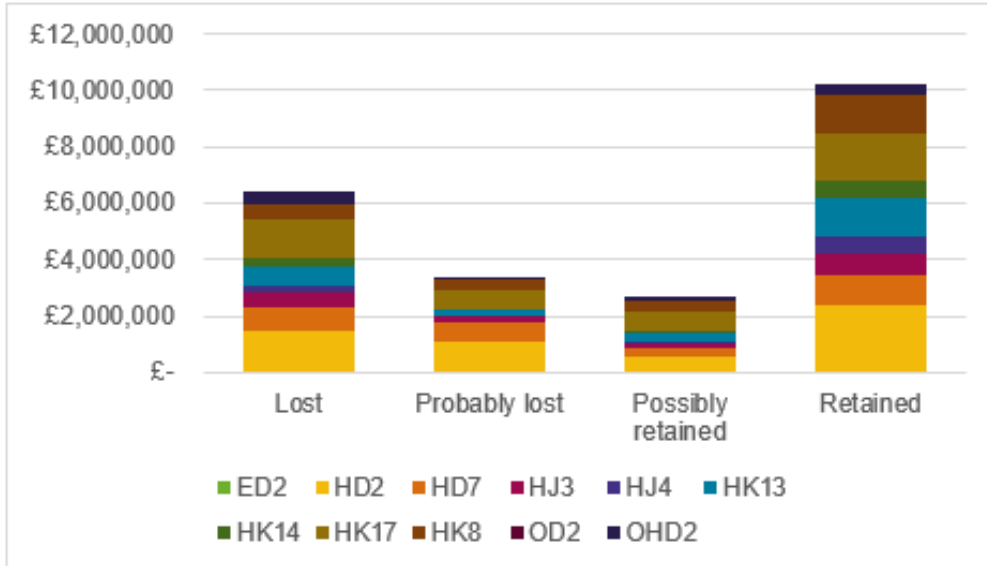


Figure 5.2: Total AES payments over 10 years, by option

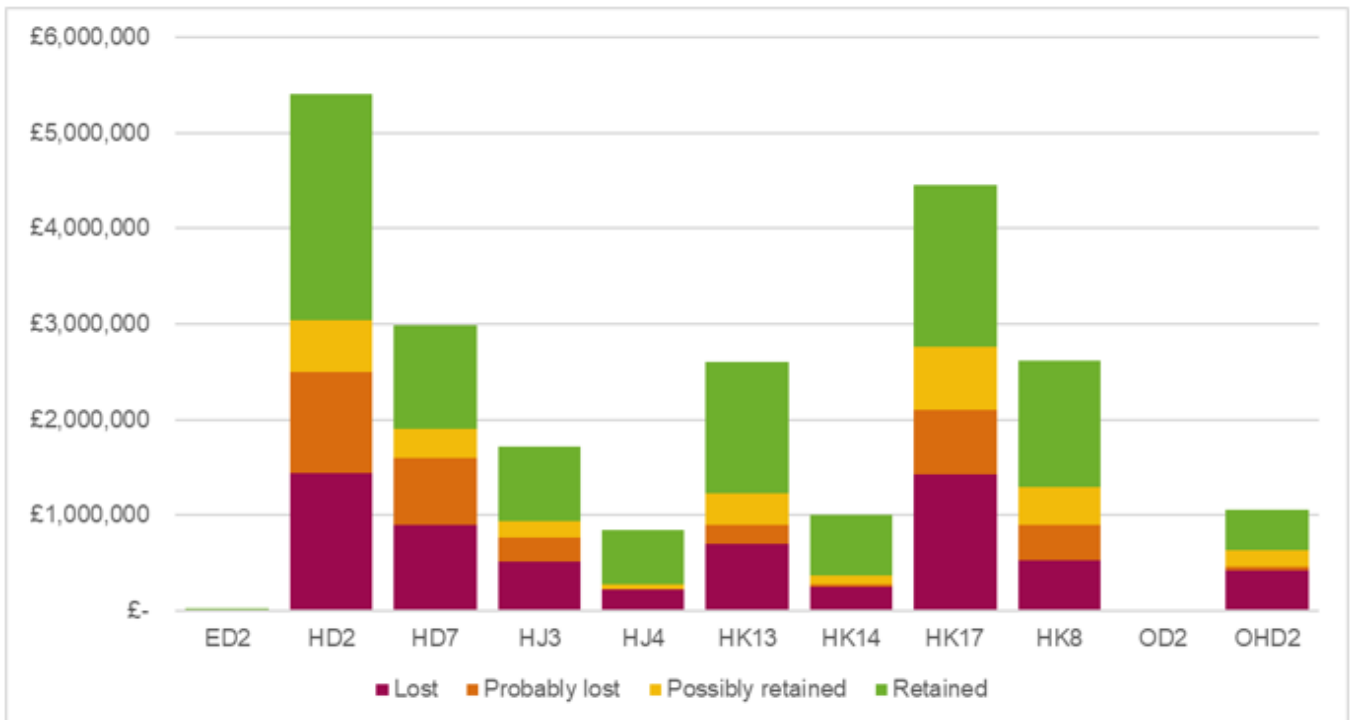
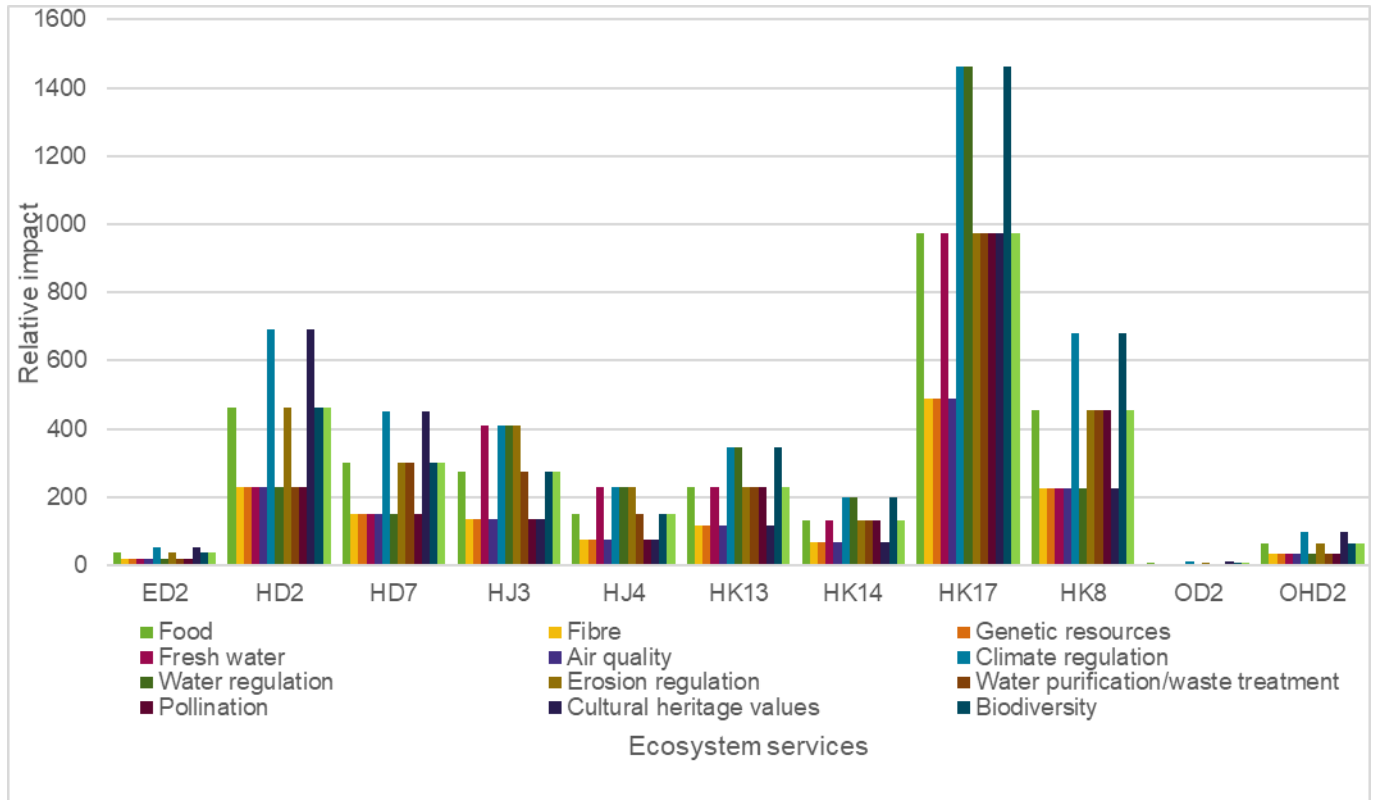


Figure 5.3: Ecosystem services provided by AES options (see chapter 4 for more detail)



5.45 Figure 5.3 above represents analysis from Chapter 4, showing the relative contribution of arable reversion options to the delivery of ecosystem services. This takes account of the number of times each option was taken up, but not the area to which it applied. Comparison with Figure 5.2 shows that total AES payments do not always correspond to this analysis, with the results reflecting the differing spatial take-up of options, as well as their varying contribution to ecosystem services. For example, the analysis of AES payments indicates that option HD2 accounts for the largest share of expenditure, while the ecosystem service analysis suggested more modest contributions across most categories. HK17, which previous analysis suggests delivers the largest ecosystem services is the option with the second largest expenditure, though the proportion retained as grassland is lower than average.

5.46 This analysis suggests that AR options will differ in their benefits for ecosystem services, popularity of uptake and long-term retention.

Case studies of arable reversion and impacts on natural capital / environmental assets

5.47 The following section presents a number of case studies highlighted from the farmer surveys, helping to illustrate how the application of arable reversion has been achieved in practice – and how this is perceived to have brought benefits to natural capital assets. It explores the different motivations for undertaking arable reversion from the different farmers' perspectives, and what has happened since the scheme ended.

5.48 These case studies are presented under the following key themes:

- Conserving and enhancing landscape character
- Protecting and managing the historic environment
- The restoration of grassland habitats
- Resource protection and soil health

5.49 Wherever possible we have highlighted examples from different Agricultural Landscape Types (ALTs) and National Character Areas (NCAs) across England.

Conserving and enhancing landscape character

5.50 The conservation and enhancement of landscape character is one of the objectives of AES (including ES), often achieved through the implementation of options designed primarily for other outcomes (e.g. biodiversity). Recent research for Natural England²⁰ found that 67% of land under ES options was 'conserving' landscape character, 21% was going further in 'enhancing' the key characteristics of the landscape, and 11% was maintaining current landscape character.

5.51 Similarly, even though the arable reversion options concerned by this study are primarily aimed at achieving gains for biodiversity, the historic environment and resource protection, 39% of farmers interviewed cited landscape character as a reason for being part of the scheme. The following provides two contrasting examples of farmers' experiences of arable reversion under ES, both citing landscape character as a reason for being involved in the scheme.

Arable farm in NCA 146: Vale of Taunton and Quantock Fringes

5.52 This case study is a 150 ha mainly arable farm in the Vale of Taunton, Somerset, within the Western Mixed ALT. The farmer put one parcel of land (covering 12ha) under ES option HJ4: Reversion to low input grassland to prevent erosion/run-off. On the floodplain of the River Tone, the grassland creation was for the overall purpose of resource protection. The area in question was previously cropped for wheat, maize and short-term grassland. Following the end of the agreement, the land has been put under CS option and retained as grassland – grazed by livestock – with no fertiliser inputs.

5.53 The farmer cited the following landscape improvements on his land as a result of being in AES – orchard planting, the planting of a new avenue of trees in parkland, and the restoration of other parkland features such as bridges.

Mainly arable farm in NCA 76: North West Norfolk

5.54 This is a large 200 ha mainly arable farm in North West Norfolk, within the Chalk and Limestone Mixed ALT. The farmer (owner of the land) entered five parcels into arable reversion options under ES, covering some 34 ha. The options chosen were all felt to have landscape aspects as key to the agreement; with one parcel under HK17: Creation of grassland for target features, another under ED2: Take archaeological features out of cultivation in combination with HK8: Creation of species-rich, semi-natural grassland, two fields covered by HK8 only, and a further parcel under HD7: Arable reversion by natural regeneration in combination with HK8.

5.55 Unfortunately, the farmer felt that the options made very little impact in terms of desired outcomes, also resulting in the fields being smaller and awkward to farm. Following the end of the ES agreement, NE was unable to dovetail the agreement into a new one. Due to this uncertainty, the land was put back into arable cultivation for business reasons. A fine was issued following the end of the agreement due to some non-compliances, which the farmer felt was extremely unfair and did not recognise his "effort and passion". He explained feeling trapped and "punished by the system". This negative experience has led to him not wanting to work with NE or RPA again.

²⁰ LUC and Rural Focus Ltd (2016) Monitoring the contribution that Environmental Stewardship is making to the maintenance and

enhancement of landscape character and quality: Report of the Rapid Survey 2014-16.

Protecting and managing the historic environment

Mixed farm in NCA 116: Berkshire and Marlborough Downs

5.56 One of the farmers interviewed for this study rented a 200-hectare farm on a historic estate in West Berkshire. Situated within NCA 116: Berkshire and Marlborough Downs, this is a mixed agricultural landscape with land classified as Grade 2 or 3. The arable reversion options implemented under the ES agreement covered four parcels of land (totalling 29 ha), with a focus on delivering benefits for the historic environment. The farmer explained that his overall motivation for entering into the agreement was to return the land “to how it was in the 18th century”. He went on to explain that it was formerly a dairy farm, converted to a mixed enterprise (with a beef store herd) 15 years ago.

5.57 Nearing retirement with no family succession, his aim through the ES options was to restore the mixed parkland landscape before finishing farming. The farmer went on to say that the fields concerned were too wet for arable cultivation, which also suited reversion to grassland from a commercial perspective.

5.58 Figure 5-4 shows an Ordnance Survey map of the area in the late 19th century, against recent aerial photography showing the location of the ES options. The recent imagery shows that all the parcels are now grassland, and the overall landscape (and parkland features within it) is strongly reminiscent of the scene from over 100 years ago, as depicted in the historic map.

5.59 The holding is now under CS but not all of the parcels were able to be transferred over. The farmer commented that he is maintaining the land as grassland, but feels the standard of management is now lower than it was under ES. Although he feels that he has taken on the “financial burden” of keeping the land as grass (stating that he would be better off ploughing it up), he now considers himself a “committed environmentalist” since stopping dairy farming. He feels that he has achieved his wish to make the land more reminiscent of the 18th century parkland (also planting many parkland trees). In addition, benefits to biodiversity have been witnessed through lapwings and brown hares seen on the new grassland.

Figure 5.4: Estate farm in West Berkshire – comparing the Ordnance Survey map of the area in the late 19th century with recent imagery showing the location of ES options – now all shown to be grassland.



Arable farm in NCA 76: North West Norfolk

5.60 This example is a rented 120 ha arable farm in Norfolk, within the Chalk and Limestone ALT. Six parcels of land, collectively covering 51ha, were all covered by the same option – HD7: Arable reversion by natural regeneration. The parcels were selected to include a large Roman villa (nationally designated as a Scheduled Monument) and surrounding fields, shown in Figure 5.5 below. The villa is one of a rare group of seven villas along a stretch of the Icknield Way in Norfolk.

Figure 5.5: Location of HD7 options in relation to a nationally designated Roman villa



Copyright: Bing Maps.

5.61 The farmer explained that natural reversion wasn't very successful on the Scheduled Monument, and was therefore told by their agent to do some seeding, which was much more effective and covered the site. Historic England placed restrictions on ploughing on the Roman Villa (3 ha to 3 inches depth), with the agreement holder told to graze the land with sheep. The farmer felt that this was a mistake from a biodiversity perspective, as the sheep seemed to scare away the lapwings that had started to appear. He also thought that leaving the grass to grow would have been better for the environment.

5.62 The Scheduled Monument remains as grassland under CS but is not currently grazed, with some areas planted (shallow) with a wild bird seed mix. For financial reasons all other land previously under HD7 has gone back into arable rotation.

The restoration of grassland habitats**Arable farm in NCA 119: North Downs**

5.63 The first case study in this theme focuses on a mainly arable, rented farm located on the North Downs, within the Chalk and Limestone ALT. There are a few pockets of 'Good quality semi-improved grassland' as defined in the Priority Habitats Inventory in the local area, though not immediately adjacent to the case study farm. The parcels in question lie around 4.5 km from a chalk grassland SSSI and SAC hosting a rich invertebrate community. This farmer was motivated by financial and environmental drivers, expressing a desire to enhance the environment and preserve the countryside. They had taken up option HK17: Creation of grassland for target features across half of an 8ha field. The other half of the field, together with a larger, neighbouring parcel, had been included in HD2: Take archaeological features out of cultivation. Option HK17 was used to create flower-rich grassland on poor soil, with the aim of supporting pollinators and invertebrates and maintaining soil quality.

5.64 The farmer also mentioned delivering additional landscape benefits through hedgerow planting, the introduction of fallow, wild plants and flowers, and flower rich margins to fields. The switch to grassland represented a complete change from previous arable cultivation on the parcel in question. The intended grassland outcomes were very important to the farmer and when the ES option agreement came to an end, they retained the grassland under another option. The grassland was considered both financially and environmentally beneficial to the farm.

Mixed farm in 110: Chilterns

5.65 This case study focuses on a mixed, owner occupied farm located in the Chilterns, within the Chalk and Limestone ALT. The local area includes a significant number of blocks of 'Lower Calcareous Grassland' and 'Good quality semi-improved grassland' as defined in the Priority Habitats Inventory, several of which are designated as SSSI. Some of these parcels adjoin the farm. For this farmer, the switch from arable to grassland made practical sense. They had the necessary equipment already and the land was of relatively low fertility and therefore well suited to creating species-rich grassland.

5.66 Option HK8: Creation of species-rich, semi-natural grassland was used across parts of a number of field parcels. The farmer was partly motivated by a deep concern for the landscape and a desire to manage for the environment. He had been in three agri-environment schemes over the past 25 years and has gained very good advice from a knowledgeable farm adviser over that period. The establishment of species-rich grassland has been very successful with a wide range of

species now present. At the end of the option period, the grassland was retained and is now managed under Countryside Stewardship. The farmer commented that agri-environment schemes could benefit from land managers' local knowledge about the quirks and peculiarities of their land and the best ways of achieving desired outcomes.

Arable farm in NCA 87: East Anglian Chalk

5.67 A further case study focuses on a large, mainly arable farm, comprising a mix of owner occupied and rented land in Cambridgeshire. It is located within the East Anglian Chalk NCA and the Chalk and Limestone ALT. The local area includes a number of areas of 'Lower Calcareous Grassland' and a few 'Lowland Meadows' as defined in the Priority Habitats Inventory. Here the farmer used three options across several field parcels (HK17: Creation of grassland for target features, HK8: Creation of species-rich, semi-natural grassland and HD7: Arable reversion by natural regeneration). The parcels lie close to an area of heathland which is designated as SSSI which is in unfavourable (recovering) condition.

5.68 In part this was a practical response to awkward fields at the end of the farm, but it also provided an opportunity to create grassland of a similar character to adjoining areas of heathland. There were some practical challenges in establishing the grassland, with the farmer having to adapt equipment to undertake the drilling process. Now established, the grassland is grazed by sheep with no other inputs. At the end of the ES agreement, the land was retained in grassland because it suits the farm system. It is now under a CS option, contributing both to the diversification of the farm's income and providing environmental benefits.

Beef and sheep farm in NCA 32: Lancashire and Amounderness Plain

5.69 The fourth case study for this theme focuses on a medium sized, lowland beef and sheep farm, comprising a mix of owner occupied and rented land. The farm is located on the Lancashire and Amounderness Plain, within the Western Mixed Agricultural Landscape Type. The local area includes a number of parcels of 'Coastal and Floodplain Grazing Marsh' and 'Lowland Meadows' as defined in the Priority Habitats Inventory, though none adjoin the farm. The parcels lie around 3km from an extensive wetland SSSI.

5.70 The farmer used two options to establish grassland - HK13: Creation of wet grassland for breeding waders and HD7: Arable reversion by natural regeneration. The latter was particularly focused on World War II archaeological remains found within the parcel. The field had been wet before being brought into agricultural use and aim was to encourage lapwing back onto the farm.

5.71 At the end of the ES agreement, the land came out of agri-environment schemes altogether since there were no suitable Countryside Stewardship options. The land previously under HK13 is now used for temporary grass and cereals while the land under HD7 was rented and is no longer under the farmer's control. The farmer commented that the Countryside Stewardship mid-tier is not sufficient financially attractive and that there should have been more 'joined up thinking' during the transition from ES to CS. Echoing the thoughts of others, he felt that farmers should be more involved in designing options, arguing that they usually know what works best on their land.

Resource protection and soil health

Beef and sheep farm in NCA 3: Cheviot Fringe

5.72 This case study focuses on a 100ha owner occupied mixed farm located in the Upland Fringe ALT. The farmer put four parcels adjacent to a river into ES options HJ3: Reversion to unfertilized grassland to prevent erosion/run-off and HD7: Arable reversion by natural regeneration. The decision was initially made on financial grounds, but difficulties in working these fields meant that it was a practical solution too. The fields had historically been grassland and did not crop well.

5.73 The fields remain under grass and are managed under Countryside Stewardship. The farmer noted that when the grassland was established, they used a specialist grass seed mix which proved unpalatable to the sheep. They noted that this turned out to be a waste of seed (even though it was covered by the AES payments) and that it is important to ensure that the grass is liked by livestock.

Mixed farm in NCA 62: Cheshire Sandstone Ridge

5.74 The third case study focuses on a medium sized, mixed farm comprising a mix of owned and rented land. It is located in the Western Mixed ALT on the Cheshire Sandstone Ridge. The farmer put around 4 ha of a field near a watercourse into option HJ3: Reversion to unfertilized grassland to prevent erosion/run-off. The switch to grassland provided financial benefits and fitted with the farming system, allowing the farmer to use unfertilised grassland to rear young cattle.

5.75 The field had not been very productive when in arable cultivation, so it made financial and practical sense to switch to grazing. The commercial nature of the decision is probably reflected in the decision not to retain the grassland at the end of the option period. Some of the land has been re-seeded as grassland, some of the more productive land has been put back to arable, and a further amount kept as grassland but fertilised. This continues to fit with the farm system but achieves better higher stocking densities and improved grazing outputs, particularly as the fertility was previously declining.

Mixed farm in NCA 151: South Devon

5.76 The final case study in this theme focuses on a medium sized, owner occupied, mixed farm in South Devon – within the Upland Fringe ALT. The farmer put parts of five fields into ES option HD7: Arable reversion by natural regeneration. The land has not been retained under grass, in part because the farmer was concerned that if they had not ploughed it up they might have been forced to retain it as permanent pasture (under possible new rules). Taking the land out of grassland therefore offered the farmer comfort that they could make a decision about whether to go back into an agri-environment scheme later.

5.77 Looking forward, it is likely that some steeper areas currently in cropping will be put back to grass to reduce erosion risk. Others will be put down to grass as part of the rotation.

Beef and sheep farm in NCA 3: Cheviot Fringe

5.78 This case study covers a small, owner-occupied farm specialising in lowland beef and sheep, within the Upland Fringe ALT. The farmer put a parcel of land into Environmental Stewardship under option HK8: Creation of species-rich, semi-natural grassland with the aim of restoring soils. The grassland has been retained following the expiration of the ES agreement, and is now under a different CS option. The farmer noted that they wanted to continue the work achieved previously but needed more than five years within the current CS agreement. In part this reflects the extended period for grassland establishment but also the complexity of the application process and the burden this places on the business.

5.79 The farmer argued that options should be more flexible about prescription dates for activities such as cutting, reflecting the influence of climate change and the need to make decisions according to prevailing conditions. Finally, they underlined the importance of Natural England staff having good knowledge of farming and the issues that are likely to be raised when they meet with farmers.

Chapter 6

Recommendations

This chapter sets out the recommendations arising from this research, set out under a number of themes

6.1 At the start of each chapter is a summary of the headline findings from the research. This final chapter considers these and puts forward a series of recommendations for designing and implementing arable reversion options through AES.

Recommendations

Data and evidence

- A major source of uncertainty in this project was the lack of information regarding the exact location of arable reversion options within parcels. As almost 40% of the parcels evaluated contained sub-parcel options, lacking precise information on the location of options within parcels was a significant limitation. We understand that information on the location of options within parcels is available in pdf records; **digitisation of option records into a spatial format such as a geodatabase would allow for direct monitoring of the options through remote sensing (e.g. using aerial photography or satellite imagery) or by comparison against the CROME data.**
- Spreadsheets for the 'classic schemes' (ESA and CSS) have very few matches with the RLR database, possibly due to changes in the RLR ID between scheme dates. This has greatly reduced the number of parcels available for evaluation. **If the RLR parcel database recorded changes to IDs over time it would be possible to more accurately link these options over the lifetime of consecutive schemes.**
- The 0.4 ha resolution, and hexagonal tessellation, of CROME data means that field parcels are not always well represented. This is particularly the case for smaller fields where parcel edges lead to greater chances of misclassification. **The CROME map would be more suitable for analysis if it reflected parcel boundaries and also identified the areas of crop within each parcel, allowing mixed crop parcels to be**

represented. This would be achievable using the RLR parcel database and a within-season segmentation of cropped areas as the basis for an annual crop map.

Advice and support

- The evidence from the agreement holder survey shows that **investment in advice and support at the start and end of AR agreements represents good value for money**. Where this takes place there is a greater likelihood that farmers and land managers remain in AES and that AR option areas are managed to the same or appropriate specifications following reversion to grassland. This includes issues concerning paperwork and an acknowledgement that local conditions will impact delivery of these options.
- The role of the NE project officer was confirmed as important and the **issue of continuity** shown to be relevant. Previous studies have shown the need for **pre and post agreement visits and engagement**. There is a role of peer-to-peer learning and knowledge exchange and farm visits regarding options like AR where the levels of intervention are high increasing the opportunity for knowledge exchange.
- For those applicants who have been in AES before there is a greater empathy with the overall approach – and what happens when one scheme ends and another begins. **Greater input is needed for first-time AES agreement holders after the scheme ends to discuss potential next steps**. This could help more AR option land to be retained and the former agreement holders remain in AES. The historic environment themes group were the least likely to receive advice, they were also the group who mentioned its importance the most in terms of scheme changes.

Fit with farming system and placement of AR options

- When discussing AR options with potential applicants **the fit of the option with the farming system** is important as AR options are best considered as long-term ‘game changer’ options. Where the agreement holder acknowledges the fit is good the AR option is seen to sustain or influence changes across the whole farm.
- Where AR options are less compatible with current farming practices (e.g. no livestock or isolated from other grassland) they can become frustrating and the likelihood of them being retained reduces. This seems particularly evident under Historic Environment options, perhaps because there is little visible change over the

length of the agreement compared to biodiversity or resource protection.

Number of AR parcels and farm size

- The evidence from this research suggests that those with more than five AR parcels are less likely to retain them once the scheme ends. This suggests that since AR options are complex and require high levels of intervention **careful consideration should be given to agreements with more than 5 AR parcels (e.g. where AR supports wider changes to farming system or as part of a plan for landscape-scale changes)**.
- Farm size is also a factor, with larger holdings seemingly able to absorb the longer-term changes that AR options bring. **Farm size should therefore be a factor in considering such interventions in the future**.

Transition to new AES agreements and suggestions for future scheme design

- This research has found that AR options have a role to play in landscape-scale projects. **The maximisation of the ecosystem services delivered by arable reversion should be considered in future AES scheme design and in the targeting of AR options**.
- The lack of a clear follow-on route from ES to CS, especially for Historic Environment and Resource Protection themed options, was a clear frustration to agreement holders and an issue that impacted the likely retention of the grassland under AR options. **AR options are high cost ‘game changers’ with corresponding high levels of intervention, as a result they would benefit from an approach that goes beyond 10 years standard duration of an AES agreement**. Agreement holders need to be aware that the AR options are buying long term change and this might require some transition payments as one agreement ends and another begins.
- **A clear route into subsequent AES options once the grassland is established** would maximise the ecosystem services and environmental outcomes being retained. NE advisers should be clear on the specific needs of grassland created through AR, with **clear signposting to relevant options available to AR land** (also clearly set out in in scheme handbooks).
- The most frequent change requested in AR options was for **more flexibility**, for example in dates for cutting and the management of weeds.
- Those agreement holders who didn’t retain the AR options often regretted having to take them back into arable production. For them it was an economic

decision as the potential options were too limiting. **A perceived lack of understanding within NE and the RPA** led some to say that they would not be applying in future, as the case study shows.

understanding among agreement holders about what the options are trying to achieve and provide a basis for continuing into future schemes.

Future research and development of AR options in future schemes

- It was only mentioned by two respondents, but the use of minimum or no tillage practices could be considered in future schemes under the historic environment AR options as a way of maintaining arable production but ensuring no damage to archaeological features.
- Clearly some agreement holders were more successful than others in establishing a grassland sward. The presence of orchids and over 20 species per metre squared what could be done. Given this breadth it might be worth examining the potential of an outcomes based approach for the AR options, especially given the range of ecosystem services and public goods that they can provide. This could allow greater flexibility in how AR parcels are managed, and provide space for agreement holders to bring their own knowledge and understanding of management techniques to create the desired outcomes.
- The AR options represent one of the few AES interventions that cover cultural heritage and, therefore deserve special attention. In some cases, where the agreement has not been continued, it is possible that irreversible damage has taken place (e.g. features lost / damaged through cultivation practices). The highest risk for such areas comes at the end of the agreement, when the next steps are considered. Future schemes that include cultural heritage options need to focus on the transition between schemes – and the length of agreements becomes more important in order to reduce avoidable loss of features.
- Resource protection options are a key part of CS with the inclusion of water quality. Therefore, the expansion of options available under this theme would indicate that arable reversion for resource protection reasons is now more widespread.
- Biodiversity has always been a key theme within AES and the AR options. Although these bring high value for the agreement holder, they need to be feasible and achievable. Where schemes have not continued there will be a potential loss of habitat connectivity in the landscape. Different options might therefore be considered, such as a more towards a results based payment approach where the agreement holder is rewarded for the biodiversity achieved on the AR option parcels. This would help develop knowledge and

Final note on study limitations

6.2 It is important to interpret the findings of this study in light of the limitations presented by the underlying data, and assumptions made in the related analyses (see further detail on the spatial data limitations at the end of Chapter 2).

6.3 A number of necessary assumptions were also made in assessing the ecosystem services delivered by arable reversion grasslands, as noted in Chapter 3.

Appendix A

Telephone questionnaire

This appendix contains the questionnaire used to interview farmers / land managers about arable reversion

LM0485: Assessment of Retention of Arable Reversion / Grassland Creation

Telephone Questionnaire

Sample No (UID):

Interviewer Name:

Interviewee Name:

Interviewee Position with respect of AES agreement:

Time start:

Time finish:

Introduction

Interviewer: When you phone the interviewee check that they have received a letter outlining the research. Early in the call clarify that the purpose of this research is to assess the factors that influenced the decisions behind the grassland creation options on their holding. Ask them:

Can I confirm if you had arable reversion options as part of your ES agreement? There is a list of the options in the letter from Natural England.

If No or not sure – end the call.

If yes, explain the reason for the research.

Give a brief reminder that:

- *The research is aimed at gaining a better understanding of the motivations and thinking of agreement holders who have had grassland creation options in previous AES agreements.*
- *The interview is in 4 parts: - First, details of the farm business and the interviewee's recent experience with ES, Subsequent sections look at the decision behind retaining or losing the grassland creation options and post-option management options.*
- Indicate to the agreement holder that you would like to record the interview for the purposes of providing a clear record for use of quotes and partial transcribing. Reassure them that it helps make sure that important points that come up during the interview are not missed but is not used in any other way. *Ask them if they are happy for the interview to be recorded.*
- *The interviews usually take about 20 mins to complete. Suggested timings are given for each section.*

Privacy statement: to be read out before start of the interview

- *The survey is confidential and no details will be released to third parties.*
- *The project complies with Data Protection Legislation. Data will be stored in a database on the University of Gloucestershire's secure computer network and will only be available in its original form to the research team for purposes relating to this project.*
- *Data that we collect is anonymised and will not be reported at an individual level. You can read a full statement <http://www.ccri.ac.uk/data-protection/>*

Section 1 You and your farm (5 mins)

- Background aspects to the holding like tenure and structure
- Factors influencing decision making in the future

Land tenure and Enterprises

1. What is the total area of the holding/farm
Is this acres or hectares? (Circle/select)
2. Is the land that you farm...
 - Wholly owned
 - Mix of owned & rented
 - Wholly rented
 - Contract farm
 - Other
2. Which best describes your farm type? (Read all and ask them to choose one)

Mainly arable / mainly dairy / upland beef & sheep / lowland beef & sheep / pigs / poultry / horticulture / mixed / other
3. Approximately how much of your business income derives from the agricultural enterprises (including AES payments) on the farm?
(If business income not known 'unknown', for holdings with non-business focus (e.g. Wildlife Trust) enter 'Not Applicable')

All of it / most of it / about half / less than half / very little / none
Unknown / Not applicable
4. According to NE records you had ha of grassland creation options, is this correct?
 - a. Yes / No / Don't know
 - i. If **no**, please clarify?
 - b. Under which scheme was this?
 - i. Environmental Stewardship Higher Level
 - ii. Environmental Stewardship Entry Level
 - iii. Other (please specify)

5. According to the NE database the option code was (*pre-enter which ones on NE database*)

		NE DATA	Interviewee	
ED2	Take archaeological features out of cultivation			
HD2	Take archaeological features out of cultivation			
HD7	Arable reversion by natural regeneration			
HJ3	Reversion to unfertilised grassland to prevent erosion/run-off			
HJ4	Reversion to low input grassland to prevent erosion/run-off			
HK13	Creation of wet grassland for breeding waders			
HK14	Creation of wet grassland for wintering waders and wildfowl			
HK17	Creation of grassland for target features			Target features:
HK8	Creation of species-rich, semi-natural grassland			
OD2	Take archaeological features out of cultivation			
OHD2	Take archaeological features out of cultivation			

6. Which suggests the grassland creation was for (*tick one*)

Historic environment	
Resource protection	
Biodiversity	

Is that correct?

Yes ... No ... Don't know ...

If No, what were the options for?

7. Were you in any AES agreements before you selected the grassland creation options?

Yes ... No ...

a. If yes, which schemes have you been part of?

(*Drop down box to contain list of: previous ES HLS/ ES ELS / ES UELS / ESA / old CSS / Wildlife Enhancement Scheme / other scheme (please specify)*)

Section 2 Background to Grassland creation options (4 mins)

- Background to selecting these options
- How well they operated during the agreement

8. Please indicate how much you agree or disagree with each of the following 4 statements are concerning the nature of the relationship between environmental management and agriculture. For each I need to record one of four options.

a. Conservation should be an integral part of agricultural activity	Strongly Agree / Agree / Disagree / Strongly Disagree.
b. Conservation activity is detrimental to efficient agricultural activity	S A / A / D / SD
c. Farmers should take on more responsibility for the environment	S A / A / D / SD
d. Agri-environment schemes are the most effective way to make farmers take an interest in conservation	S A / A / D / SD

9. How complex do you feel your grassland creation options were to?

- a. Understand (Very complex, Complex but manageable, Very manageable)
- b. Implement (Very complex, Complex but manageable, Very manageable)

10. Was landscape character or enhancement a contributing factor in your decision to take up option(s) for grassland creation?

Yes ... No ... Don't know ...

If Yes:

- a. Have you taken up other options for landscape reasons? Yes ... No ... Don't Know
(if Yes, which options - e.g. field boundary management, woodland)

If No:

- a. What were your reasons to take up the grassland creation option?

Section 3 Advice and support received (5 mins)

11. Did you receive advice whilst considering and securing your grassland creation options?

Yes ... No ... Don't know ...

If Yes, who gave you advice? *(select any sources from which advice received)*

- NE officer, including Catchment Sensitive Farming officer
- Conservation NGO advisor,
- Own agricultural advisor,
- Other farmers
- HEFER or Historic England.
- other source (please specify)

If Yes, what was the advice about? *(select all that apply)*

- Assist with option selection
- assist with option placement
- advice on sward creation
- advice on long-term management
- Other...

12. How would the land entered into grassland creation options have been managed in absence of this ES option?

- Maintained under previous AES options but not grassland creation
- All land entered under different AES option
- Some of land under different AES option
- Managed under conventional agricultural system outside of AES

13. How effective do you feel the grassland creation option was concerning: *(chose a number between 1-5 where 1=very ineffective – 5= very effective)*

	1 -	2	3	4	5 +
Meeting objectives of the option					
Establishing an effective grass sward					
Fitting with the farming system					

14. Was the option whole or part field?

- a. Whole field ...
- b. Part field ...
- c. Don't know

15. How did this impact on management decisions for that field? *(prompt – looking for what changed in terms of the land management activity)*

16. How important are the intended grassland creation outcomes to you?

Very important / important/ unimportant

17. Did you receive any advice when your ES agreement ended as to what you should do next regarding your grassland creation options?

Yes ... No N/A ...

If yes, what was this advice?

Section 4 Post AES management of grassland creation options (5 mins)

- What has happened since the ES agreement has ended?
- What attitudes and motivation underpin the current situation?

18. What has happened since you left ES / or no longer have the grassland creation options?

- In AES and continuing with grassland creation options on same parcel of land ... Go to Q21
- In AES but now have different options. Please provide details of options
- Applying for AES. Please give details of proposed options
- No longer in scheme (since agreement with grassland creation options ended) ...
- Other (please specify)

19. What land management activity now occurs on the land that used to have grassland creation options?

Left as grassland	all	some	none
Returned to arable cropping	all	some	none
Different management	all	some	none

If arable cropping, what is the rotation now:

What was the thinking behind the change in land management when the arable reversion options ended? Open response

20. **Approximately** what proportion of the ES grassland creation option area remains?

a. Note % to nearest 5% 5-100% **Go to Q21**, **0% Go to Q25**

For all cases where some/all of the original grassland creation area is retained:

21. **What were the reasons** for the areas of grassland creation areas being retained?

Open response

22. What were the reason for the areas of grassland creation areas being lost?

Open response (**ONLY FOR THOSE <100%**)

23. Where grassland creation area retained, is this area managed in the same way as it was under the ES? Yes ... No ... DK ...

a. If no, what are the key differences?

24. Where grassland creation area retained, how is the cost of any management covered:

- a. Different AES option (Specify)
- b. Absorbed by the farm business
- c. Secured from another source

For all cases where none of the original grassland creation area is retained:

25. What were the reason for ALL the areas of grassland creation areas being lost?

Open response

Final questions:

26. Based on your experiences, if you could change and or improve anything about the grassland creation options you had, what would it be?

27. Do you have any other comments you would like to make about your grassland creation options and the AES scheme and related processes

Yes / No

That is the end of the interview but before closing the interview do you have any other comments that you think are relevant? **Thank you very much for taking part in this survey. Your contribution has been very helpful and should help towards improving the scheme over the next few years. Your assistance is therefore much appreciated.**

Record time interview close

Appendix B

Analysis of questionnaire results

This appendix contains a summary of the responses to the survey questions (analysed in further detail in Chapter 4)

Interviewee Type			
		Frequency	Percent
Valid	Principal farmer	74	69.2
	Farm manager	4	3.7
	Partner	18	16.8
	Agent	5	4.7
	Other	6	5.6
	Total	107	100

Groupings of Farm Size			
		Frequency	Percent
Valid	<20ha	1	0.9
	20 to <50ha	10	9.3
	50 to <100ha	14	13.1
	100ha & over	82	76.6
	Total	107	100

Is the land that you farm...			
		Frequency	Percent
Valid	Wholly owned	54	50.5
	Mix of owned & rented	31	29
	Wholly rented	18	16.8
	Other	4	3.7
	Total	107	100

Which best describes your farm type?			
		Frequency	Percent
Valid	Mainly arable	48	44.9
	mainly dairy	4	3.7
	upland beef & sheep	2	1.9
	lowland beef & sheep	16	15
	mixed	30	28
	Other	7	6.5
	Total	107	100

Business income from agriculture			
		Frequency	Percent
Valid	All of it	41	38.3
	most of it	45	42.1
	about half	5	4.7
	less than half	7	6.5
	very little	5	4.7
	None	1	0.9
	Not applicable	3	2.8
	Total	107	100

Statistics - Parcel Area					
		Total area of parcels - NE Data	Total area of AR Grassland - NE Data	% of Total Parcel(s) area that are in AR Grassland agreement	% of Total Parcel(s) area that are in AR Grassland agreement - LIMIT MAX100
N	Valid	106	106	106	106
	Missing	1	1	1	1
Mean		27.3008	15.2015	67.347	67.2754
Median		17.535	10.945	83.7591	83.7591
Std. Deviation		27.69729	14.95109	34.00662	33.93567
Minimum		1.54	0.35	1.81	1.81
Maximum		172.46	78.18	102.34	100
Percentiles	25	8.785	4.6025	37.1466	37.1466
	50	17.535	10.945	83.7591	83.7591
	75	35.86	20.2975	99.1735	99.1735

Ranges of Parcels - using NE Data			
		Frequency	Percent
Valid	0 to <5ha	14	13.1
	5 to <10ha	16	15
	10 to <25ha	34	31.8
	25 to <50ha	24	22.4
	50ha & over	18	16.8
	Total	106	99.1
Missing	System	1	0.9
Total		107	100

Ranges of AR - Using NE Data			
		Frequency	Percent
Valid	0 to <5ha	29	27.1
	5 to <10ha	21	19.6
	10 to <25ha	34	31.8
	25 to <50ha	16	15
	50ha & over	6	5.6
	Total	106	99.1
Missing	System	1	0.9
Total		107	100

Resource Protection as Theme			
		Frequency	Percent
Valid	No	74	69.2
	Yes	33	30.8
	Total	107	100

Historic Environment as Theme			
		Frequency	Percent
Valid	No	90	84.1
	Yes	17	15.9
	Total	107	100

Biodiversity as Theme			
		Frequency	Percent
Valid	No	33	30.8
	Yes	74	69.2
	Total	107	100

Historic Environment				
Statistics				
		Total area of parcels - NE Data	Total area of Grassland - NE Data	% of Total Parcel(s) area that are in HLS Grassland agreement - AMENDED TO LIMIT MAX100
N	Valid	51	51	51
	Missing	0	0	0
Mean		35.1386	17.532	59.6014
Median		28.41	13.65	59.8779
Std. Deviation		31.39234	16.27733	33.99056
Minimum		1.68	0.56	5.31
Maximum		172.46	78.18	100

Resource Protection				
Statistics				
		Total area of parcels - NE Data	Total area of Grassland - NE Data	% of Total Parcel(s) area that are in HLS Grassland agreement - AMENDED TO LIMIT MAX100
N	Valid	17	17	17
	Missing	0	0	0
Mean		37.3771	16.5071	54.7006
Median		28.46	13.65	48.6878
Std. Deviation		32.61846	38.78997	13.28074
Minimum		2.46	2.46	0.35
Maximum		172.46	172.46	47.34

Biodiversity				
Statistics				
		Total area of parcels - NE Data	Total area of Grassland - NE Data	% of Total Parcel(s) area that are in HLS Grassland agreement - AMENDED TO LIMIT MAX100
N	Valid	73	73	73
	Missing	1	1	1
Mean		29.8537	16.9539	71.6074
Median		17.48	12.06	86.6667
Std. Deviation		31.39198	15.87479	31.08606
Minimum		1.54	1.08	4.23
Maximum		172.46	78.18	100

Historic Environment				
Statistics				
		Number of field parcels - NE Data	Grassland in HLS as % of TOTAL Farm	Parcel areas as % of TOTAL Farm
N	Valid	51	51	51
	Missing	0	0	0
Mean		3.67	8.9414	15.5308
Median		3	7.035	12.8236
Minimum		1	2.251	8.77525
Maximum		10	1	0.38

Resource Protection				
Statistics				
		Number of field parcels - NE Data	Grassland in HLS as % of TOTAL Farm	Parcel areas as % of TOTAL Farm
N	Valid	17	17	17
	Missing	0	0	0
Mean		4	7.5119	14.6019
Median		4	7.28	16.33
Minimum		1	2.574	5.64133
Maximum		9	1	0.05

Biodiversity				
Statistics				
		Number of field parcels - NE Data	Grassland in HLS as % of TOTAL Farm	Parcel areas as % of TOTAL Farm
N	Valid	73	73	73
	Missing	1	1	1
Mean		3.51	12.3044	18.4397
Median		3	7.89	12.7856
Minimum		1	0.38	0.82
Maximum		12	100	100

1=STRONGLY AGREE (2.5 = NEUTRAL)	2020 n = 107				
	Strongly Agree	Agree	Disagree	Strongly Disagree	Mean Score
Conservation should be an integral part of agricultural activity	53.3	43.9	2.8	0	1.5
Conservation activity is detrimental to efficient agricultural activity	0	14	61.7	24.3	3.1
Farmers should take on more responsibility for the environment	23.4	57.9	16.8	1.9	1.97
Agri-environment schemes are the most effective way to make farmers take an interest in conservation	16.8	71	12.1	0	1.95

Did you receive advice whilst considering and securing your grassland creation options?			
		Frequency	Percent
Valid	Yes	92	86
	No	11	10.3
	Don't know	4	3.7

Did you receive advice whilst considering and securing your grassland creation options? - %				
	All responses	Historic Environment	Resource Protection	Biodiversity
Yes	86.9	73.5	97	90.5
No	10.3	23.5	3	5.4
Don't know	2.8	2.9	0	4.1

How would the land entered into grassland creation options have been managed in absence of this ES option?			
		Frequency	Percent
Valid	All land entered under different AES option	11	10.3
	Some of land under different AES option	11	10.3
	Managed under conventional agricultural system outside of AES	85	79.4
	Total	107	100

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Advice focus	%
Assist with option selection	88.2
Assist with option placement	60.2
Advice on sward creation	40.9
Advice on long-term management	46.2
Other	11.8

Advice source	%
NE officer, including Catchment Sensitive Farming officer	64.5
Conservation NGO advisor,	34.4
Own agricultural advisor,	28
Other	5.4

Was the option whole or part field?			
		Frequency	Percent
Valid	Whole field	51	47.7
	Part field	23	21.5
	Combination of Whole & part	33	30.8
	Total	107	100

How important are the intended grassland creation outcomes to you?			
		Frequency	Percent
Valid	Very important	46	43
	Important	49	45.8
	Unimportant	12	11.2
	Total	107	100

Did you receive any advice when your ES agreement ended as to what you should do next regarding your grassland creation options?			
		Frequency	Percent
Valid	Yes	74	69.2
	No	33	30.8
	Total	107	100

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ALL RESPONSES						
How effective 1= very ineffective 5= very effective						
	1	2	3	4	5	Mean
Meeting objectives of the option	4.7	2.8	5.6	30.8	56.1	4.31
Establishing an effective grass sward	1.9	3.7	16.8	31.8	45.8	4.16
Fitting with the farming system	0.9	3.7	12.1	30.8	52.3	4.3

Q19 How effective...				
How effective 1= very ineffective 5= very effective				
	All responses	Historic Environment	Resource Protection	Biodiversity
Meeting objectives of the option	4.3	4.2	4	4.4
Establishing an effective grass sward	4.2	4.2	4.2	4.2
Fitting with the farming system	4.3	4.2	4.3	4.4

Q23 Advice - end of ES				
Did you receive any advice when your ES agreement ended as to what you should do next regarding your grassland creation options? - %				
	All responses	Historic Environment	Resource Protection	Biodiversity
Yes	69.2	58.8	66.7	75.7
No	30.8	41.2	33.3	24.3

Q24 What has happened since you left ES / or no longer have the grassland creation options?			
		Frequency	Percent
Valid	In AES and continuing with grassland creation options on same parcel of land	19	17.8
	In AES but now have different options	55	51.4
	Applying for AES	2	1.9
	No longer in scheme (since agreement with grassland creation options ended)	31	29
	Total	107	100

Q24.b.i Where grassland creation area retained, is this area managed in the same way as it was under the ES?			
		Frequency	Percent
Valid	Yes	19	100
Total		19	100

Q24.b.i.b Where grassland creation area retained, how is the cost of any management covered? Q24_b_i_b_i			
		Frequency	Percent
Valid	Different AES option	19	100

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Approximately what proportion of the ES grassland creation option area remains? - %			
		Frequency	Percent
Valid	0	13	14.8
	5	2	2.3
	15	4	4.5
	20	3	3.4
	25	2	2.3
	30	4	4.5
	35	1	1.1
	40	1	1.1
	45	1	1.1
	50	4	4.5
	60	1	1.1
	65	2	2.3
	80	1	1.1
	85	2	2.3
	90	1	1.1
	95	1	1.1
	100	45	51.1
	Total	88	100

Where grassland creation area retained, how is the cost of any management covered? 24_g_v_a			
		Frequency	Percent
Valid	Different AES option	37	49.3
	Absorbed by the farm business	36	48
	Secured from another source	2	2.7
	Total	75	100

What land management activity now occurs on the land that used to have grassland creation options?			
% - n=55	Left as Grassland	Returned to arable cropping	Different management
All	50.9	5.5	7.3
Some	43.6	36.4	25.5
None	5.5	58.2	67.3

What land management activity now occurs on the land that used to have grassland creation options?			
% - n=2	Left as Grassland	Returned to arable cropping	Different management
All	50	50	0
Some	0	0	0
None	50	50	100

What land management activity now occurs on the land that used to have grassland creation options?			
% - n=31	Left as Grassland	Returned to arable cropping	Different management
All	51.6	25.8	9.7
Some	22.6	22.6	0
None	25.8	51.6	90.3

Groupings of Farm Size			
		Frequency	Percent
Valid	<20ha	1	0.9
	20 to <50ha	10	9.3
	50 to <100ha	14	13.1
	100ha & over	82	76.6
	Total	107	100

Groupings of Farm Size 2			
		Frequency	Percent
Valid	<100ha	25	23.4
	100 to <150ha	25	23.4
	150 to <250ha	25	23.4
	250ha & over	32	29.9
	Total	107	100

			Groupings of Farm Size 2				Total
			<100ha	100 to <150ha	150 to <250ha	250ha & over	
Historic Environment as Theme	No	Count	22	9	9	16	56
		% within Historic Environment as Theme	39.28%	16.07%	16.07%	28.57%	100.00%
		% of Total	20.60%	8.40%	8.40%	15.00%	52.30%

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		Adjusted Residual	4.1	-1.9	-1.9	-0.3	
	Yes	Count	3	16	16	16	51
		% within Historic Environment as Theme	5.88%	31.37%	31.37%	31.37%	100.00%
		% of Total	2.80%	15.00%	15.00%	15.00%	47.70%
		Adjusted Residual	-4.1	1.9	1.9	0.3	
Total		Count	25	25	25	32	107
		% within Historic Environment as Theme	23.40%	23.40%	23.40%	29.90%	100.00%
		% of Total	22	9	9	16	56

			Groupings of Farm Size 2				Total
			<100ha	100 to <150ha	150 to <250ha	250ha & over	
Resource Protection as Theme	No	Count	23	23	17	27	90
		% within Resource Protection as Theme	25.56%	25.56%	18.89%	30.00%	100.00%
		% of Total	21.50%	21.50%	15.90%	25.20%	84.10%
		Adjusted Residual	1.2	1.2	-2.5	0	
	Yes	Count	2	2	8	5	17
		% within Resource Protection as Theme	11.76%	11.76%	47.06%	29.41%	100.00%
		% of Total	1.90%	1.90%	7.50%	4.70%	15.90%
		Adjusted Residual	-1.2	-1.2	2.5	0	
Total		Count	25	25	25	32	107
		% of Total	23.40%	23.40%	23.40%	29.90%	100.00%

			Groupings of Farm Size 2				Total
			<100ha	100 to <150ha	150 to <250ha	250ha & over	
Biodiversity as Theme	No	Count	4	9	12	8	33
		% within Biodiversity as Theme	12.10%	27.30%	36.40%	24.20%	100.00%
		% of Total	3.70%	8.40%	11.20%	7.50%	30.80%
		Adjusted Residual	-1.8	0.6	2.1	-0.9	
	Yes	Count	21	16	13	24	74
		% within Biodiversity as Theme	28.40%	21.60%	17.60%	32.40%	100.00%
		% of Total	19.60%	15.00%	12.10%	22.40%	69.20%
		Adjusted Residual	1.8	-0.6	-2.1	0.9	

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			Groupings of Farm Size 2				Total
Total		Count	25	25	25	32	107
		% of Total	23.40%	23.40%	23.40%	29.90%	100.00%

		Did you receive advice whilst considering and securing your grassland creation options?			Total
			Yes	No	
Historic Environment as Theme	No	Count	51	2	53
		% within Did you receive advice whilst considering and securing your grassland creation options?	96.20%	3.80%	100.00%
		% of Total	49.50%	1.90%	51.50%
		Adjusted Residual	2.3	-2.3	
	Yes	Count	41	9	50
		% within Did you receive advice whilst considering and securing your grassland creation options?	82.00%	18.00%	100.00%
		% of Total	39.80%	8.70%	48.50%
		Adjusted Residual	-2.3	2.3	
Total		Count	92	11	103
		% of Total	89.30%	10.70%	100.00%

		Did you receive advice whilst considering and securing your grassland creation options?			Total
			Yes	No	
Resource Protection as Theme	No	Count	76	10	86
		% within Did you receive advice whilst considering and securing your grassland creation options?	88.40%	11.60%	100.00%
		% of Total	73.80%	9.70%	83.50%
		Adjusted Residual	-0.7	0.7	
	Yes	Count	16	1	17
		% within Did you receive advice whilst considering and securing your grassland creation options?	94.10%	5.90%	100.00%
		% of Total	15.50%	1.00%	16.50%
		Adjusted Residual	0.7	-0.7	
Total		Count	92	11	103
		% of Total	89.30%	10.70%	100.00%

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		Did you receive advice whilst considering and securing your grassland creation options?			Total
			Yes	No	
Biodiversity as Theme	No	Count	25	7	32
		% within Did you receive advice whilst considering and securing your grassland creation options?	27.20%	63.60 %	31.10%
		% of Total	24.30%	6.80%	31.10%
		Adjusted Residual	-2.5	2.5	
	Yes	Count	67	4	71
		% within Did you receive advice whilst considering and securing your grassland creation options?	72.80%	36.40 %	68.90%
		% of Total	65.00%	3.90%	68.90%
		Adjusted Residual	2.5	-2.5	
Total		Count	92	11	103
		% within Did you receive advice whilst considering and securing your grassland creation options?	100.00%	100.00 %	100.00%
		% of Total	89.30%	10.70 %	100.00%