Collaborative mechanisms and incentives: what works for achieving social, environmental and economic outcomes at large spatial scales

Rapid Evidence Assessment

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Executive Summary

Aims

The aim of this piece of work is to review evidence of which collaborative mechanisms and incentives 'work' in terms of achieving social, environmental and economic outcomes at large spatial scales. Specifically, it examines the extent and strength of all existing/available evidence with respect to:

- Social, environmental and economic 'effectiveness' (with reference to indicators linked to uptake/buy-in, environmental additionality, social impact, and value for money), with an emphasis on social effectiveness.
- A range of different mechanisms and policy instruments, including approaches centred on both collaboration and spatial coordination designed to achieve landscape-scale environmental benefits (including both those currently in operation and those which have operated previously).
- Financial incentives and/or different types of payment mechanisms (specific attention should be given to the use of reverse auctions and agglomeration bonuses as instruments to deliver large-scale environmental benefits and their effectiveness).
- Governance (top-down and bottom up approaches) including the 'effectiveness'/success of farmer groups with differing governance structures.

Methods

The Rapid Evidence Assessment (REA) methodology was used for this evidence review adapted from the Collaboration for Environmental Evidence Systematic Review Guidelines (Collins et al., 2015).

A *search strategy* was developed for each broad intervention type:

- Coordinated landscape scale approaches
- Payment mechanisms and incentives
- Collaborative agri-environment schemes
- Farmer-led approaches

Key words and search strings for each intervention type were identified and refined in an iterative process. Peer reviewed papers were identified using searches conducted in Web of Science and Google Scholar. Grey and unpublished literature was also identified from searches on websites of relevant specialist organisations as identified by the review team.

In the *screening stage* all retrieved articles were assessed for relevance using the inclusion/exclusion criteria which included: relevance to the REA aims, source origin (UK or international literature), source type, geographical limit, and publication date. A two-phase process was used to filter out non-relevant articles according to these criteria. This stage ensures that only the most relevant findings are taken to the evidence synthesis stage. Overall a total of 77 peer review articles and 39 grey literature reports were judged to have met the inclusion criteria. Records are provided for each intervention type in the relevant sections.

The *extraction phase* involved a critical appraisal in which scores were assigned to each piece of evidence according to relevance and robustness criteria. During the critical appraisal a number of factors were progressively identified within two categories *Determinants and Outcomes. Determinants* are key determining factors that affect the success of approaches. The majority of studies report on these factors, which affect the *process* of the intervention. *Outcomes* are key outcome factors that describe the impact and outputs (different approaches to and indicators for

assessing and describing the impact of an intervention are utilised in the evidence). Each piece of evidence was coded against these factors in the REA systematic map.

The final *narrative synthesis stage* reported here provides a description of the volume and characteristics of the evidence found by the review and discusses the adequacy of the overall evidence base to answer the primary REA question. This stage combines the scoring of relevance and robustness with a view to giving greater weight to higher scored pieces of evidence. Consensus among studies was used to complement the combined score.

Coordinated landscape scale approaches

Evidence was extracted and synthesised from 16 studies located through Web of Science and Google Scholar searches and 11 grey literature reports located through UK organisation website searches and expert suggestions. The evidence available reflects large variety in the aims, extent and partnerships deployed in large-scale conservation and lacks any systematic evaluation methodology or framework.

Determinants

Most determinants of success refer to objectives and design of projects, the ecological factors driving its design, sources of information, the institutions and practices of collaborative governance which include creating and sustaining partnerships, stakeholder relationships, arrangements (partnership design and process). There is less reference to the nature of governance structures (informal /formal) and the rules for decision making, and little attention to the role of AES.

Outcomes

Few studies provide evidence of outcomes. Much of the evidence for these is based on expert and stakeholder opinion, and reports levels of engagement with the community rather than specific quantifiable ecological/economic data.

Payment mechanisms and incentives

Evidence was extracted and synthesised from 27 studies located through Web of Science and Google Scholar searches and seven grey literature reports located through UK organisation website searches and expert suggestions. The majority of the peer reviewed papers come from economic studies and they are largely from experimental studies in non-UK contexts, usually assessing efficiency properties of a contract proposing an agglomeration bonus or auction. Recent use of reverse auctions in catchments applying new electronic tools now provide empirical evidence in UK, however these are relatively small scale.

Determinants

Auctions and agglomeration bonuses can be effective but adapting to address ecosystem services at the landscape scale is complex due to different spatial management requirements. Whilst auctions and agglomeration bonuses can be more successful than regular AES in terms of participation and cost effectiveness, this can be at the expense of environmental gains, and trade-offs are needed. Also lack of uptake and bidder behaviour can diminish these advantages. Auctions work best for interventions which involve clear, comparable outcomes. The limited use of the group supplements outside of agreements on common land, and the small number of studies, each with few respondents, makes it difficult to draw any firm conclusions about these.

Outcomes

Performance is largely judged on cost efficiency, and with limited attention paid to environmental, economic (to the farmer) or social benefits. There is some evidence that farmer social norms can be shifted. Recent use of reverse auctions in UK catchments have been promising, demonstrating the importance of adviser support in the bidding process.

Collaborative AES agreements (cAES)

Evidence was extracted and synthesised from 14 studies located through WOS and GS searches and five grey literature reports located through UK organisation website searches and expert suggestions. The evidence is not extensive. Studies are small with few farmers, and they tend to focus on case studies in small geographical areas across diverse landscapes. The research is largely qualitative and hypothetical, the number of actual studies of farmers' views and attitudes are low.

Determinants

A range of different forms of evidence point to similar conclusions. Farmers express willingness to participate and recognise that the landscape approach is important but the likelihood of farmers collaborating depends on the scheme design and contract arrangements. Farmer relations and autonomy are important, as are external support and facilitation.

Outcomes

Outcomes include some social benefits of feelings of belonging and collective efficacy. Studies of environmental gains are very limited.

Farmer-led landscape scale groups

Evidence was extracted and synthesised from 16 studies located through Web of Science and Google Scholar searches and 11 grey literature reports located through UK organisation website searches and expert suggestions. The volume of evidence is not extensive for this topic and the research is largely qualitative with small studies in specific contexts. There is an emphasis on farmer relations, governance, support and concerning the establishment and facilitation of groups; and behavioural, social capital aspects. Some evidence is presented for impacts such as learning and some limited evidence for environmental benefits. A recent CSFF evaluation provides comprehensive evidence drawing on 28 case studies

Determinants

Farmers who are members of a group, or who join CSFF groups, are motivated by interest in the environment. Evidence agrees that pre-existing networks, social capital, shared values and trust are important for engagement. Farmers appreciate scheme flexibility and involvement in design and some autonomy, which is widely reported for CSFF. Technical expertise *and* skilled facilitation are crucial.

Outcomes

All group members appreciate being part of a group and the social interactions that it provides, this in turn provides positive feedback to motivate behaviour. Improved knowledge exchange and learning in CSFF (supported by training and monitoring) are linked to improvements in social capital, including collaborative working, motivation, information sharing, awareness, ownership, ability and confidence in addressing environmental issues. Evidence of environmental gains is growing both from monitoring, wide scale analysis, and farmer observations and expectations.

Summary

Insights for ELMs can be derived from the Determinant and Outcome factors (Table A). These draw out the cross-cutting factors.

Table A: Lessons for ELMs

Determinant/Outcome factor/group of factors	**Lessons**
Farmer factors	• For tiers 2 and 3 build on existing interest in the environment by targeting farmers already in AES but be aware that acting on this motivation is contingent on approach design and delivery
Design: scheme, payment and partnerships	• Design of schemes and mechanisms influences participation, complexity is a barrier to uptake • Mechanisms need to adapt to deal with different and complex situations • Establish clear metrics for monitoring and evaluation programmes and for comparable outcomes for auctions
Relationship building • Farmer relations • Partnership creation and relationship building, and process	• Build on pre-existing networks and projects, and target, facilitate and support existing groups which already demonstrate some level of social capital
Inclusivity and involvement in design • Scheme design, farmers' involvement • Partnership creation and relationships	• Involve farmers in project or scheme design, and partners in coordinated approaches, in joint target and objective setting. Recognise that this may require a longer lead-in period before interventions can be delivered on the ground
Governance	• Farmers appreciate a sense of control but take time to establish groups and governance processes • Large-scale coordinated schemes face institutional challenges, dealing with these has associated costs
Support	• Facilitators are important but play different roles and accordingly need to have a number of attributes (expertise, skills, mediation).
Cost effectiveness	• Achieving cost effective delivery depends on the approach taken and context. A farmer-led approach does not automatically translate into cost savings overall
Social capital	• Fostering social and personal connections, and enabling learning and working together can be effective • Recognise the value of positive peer influences and the ability of interventions to shift social norms or nudge neighbouring farmers to participate
Learning	• Participation in farmer groups can increase learning and understanding of the environment.
Environmental gains	• Facilitation, monitoring and training in farmer groups (CSFF) can be effective in adding value beyond single AES

Contents

1. Introduction

The Environmental Land Management (ELM) scheme will provide public money to pay farmers and other land managers in England for the ecosystem services they deliver – providing a basis to achieve the goals set out in the 25 Year Environment Plan and the Agriculture Bill.

As well as steering environmental land management decisions at farm level, the Environmental Land Management Scheme will operate over much larger spatial scales, requiring management across land ownership boundaries. There is an increasing recognition that environmental management is more effective when carried out at the landscape rather than the field or farm scale, and that such approaches offer multiple benefits, not only for the environment. It is important therefore to consider how such 'landscape scale' approaches in ELMs can be supported.

There are a number of delivery approaches at the landscape scale with different methods of support and incentivisation that need to be examined. These can be broadly split into those that focus on spatial coordination of outcomes typically coordinated by a third party and those that take more collaborative approaches and are orientated towards being farmer-led.

A number of these landscape scale approaches are already being implemented in England utilising a range of governance ('top-down' or 'bottom-up') approaches, support and incentives to change land management practices. These include the landscape scale partnerships mediated by third parties designed to deliver environmental outcomes over large spatial scales[1], for example, those run by the major conservation NGOs e.g. the National Trust, the Royal Society for the Protection of Birds ("Futurescapes"), and the Wildlife Trusts ("Living Landscapes") (Adams et al. 2014). Publicly supported schemes operating at a coordinated landscape scale include the Countryside Stewardship Facilitation Fund' (CSFF) and 'Catchment Sensitive Farming' (CSF), while farmer-led 'Farm Clusters' (e.g. Marlborough Downs) are supported through CSFF and funding partnerships with third parties. Outside England there are also multiple examples of landscape scale initiatives e.g. Landcare in Australia and Germany (Wilson 2004; Prager and Vanclay 2010) and Environmental Cooperatives in the Netherlands (Franks, 2011).

In addition, many other initiatives (both agri-environmental schemes (AES) and non AES) have been implemented in the UK over a number of years. These are the subject of comprehensive literature reviews and case study analyses (Davis et al., 2004; Mills et al., 2008, 2011; Boulton et al., 2013; Jarrett et al., 2016; Nye, 2018); reflective analyses and summaries (Prager, 2015; Franks et al., 2016; Franks, 2019) and surveys (Wynne-Jones et al., 2019) and have provided insights into a range of farmer collaboration activities.

Collectively these experiences offer a range of evidence about how these approaches centred on collaboration 'work', which can inform ELMs.

The peer reviewed literature predominantly focuses on agri-environment schemes (AES), i.e. publicly funded financial compensation schemes for farmers who implement prescribed conservation measures. Studies have assessed UK farmers' willingness to participate in, or their favourability towards, collaborative AES and look at barriers to, and opportunities for, incentivising participation, including scheme design and support.

[1] It is increasingly recognised that ecological restoration demands conservation action beyond the borders of existing protected areas. This requires the coordination of land uses and management over a larger area, usually with a range of partners, which presents novel institutional challenges for conservation planners.

Less attention has been paid to governance arrangements initiated by actors outside the public domain (Runhaar and Polman, 2018). While some recent approaches have been evaluated, much of the evidence resides in the grey literature, or is still anecdotal. The extent of initiatives developed by NGO conservation organisations that seek to extend conservation management over larger areas of land has been reported (Adam et al., 2014), as has the breadth of farmer participation in non-AES, private, cross-farm boundary conservation schemes (such as schemes coordinated by Local Wildlife Trusts, Conservation Grazing Trusts and Organisations, and the Forestry Commission) and farmer-farmer collaborative schemes (such as the farmer-led Nature Improvement Areas) (Franks et al., 2016). However, little is reported about the effectiveness of these initiatives.

Overall, to date there has been relatively little rigorous and robust research evaluating and comparing the effectiveness of different landscape scale approaches. Nor has there been a thorough examination of the factors affecting the success of schemes in terms of the environmental and social additionality provided.

This review will examine the extent and strength of all existing/available evidence and contribute towards an assessment of *what works, where, when for whom, and in what context* to deliver additional and larger-scale environmental benefits. It will also consider how this learning could be used to inform the future ELM Scheme.

1.1 Aims and objectives

The aim of this piece of work is to review evidence of which collaborative mechanisms and incentives 'work' in terms of achieving social, environmental and economic outcomes at large spatial scales.

Specifically, it examines the extent and strength of all existing/available evidence with respect to:

- Social, environmental and economic 'effectiveness' (with reference to indicators linked to uptake/buy-in, environmental additionality, social impact, and value for money), with an emphasis on social effectiveness.
- A range of different mechanisms and policy instruments, including approaches centred on both collaboration and spatial coordination designed to achieve landscape-scale environmental benefits (including both those currently in operation and those which have operated previously).
- Financial incentives and/or different types of payment mechanisms (specific attention should be given to the use of reverse auctions and agglomeration bonuses as instruments to deliver large-scale environmental benefits and their effectiveness).
- Governance (top-down and bottom up approaches) including the 'effectiveness'/success of farmer groups with differing governance structures.

In doing this the review will identify:

- Key determining factors affecting the success of approaches, noting those that are cross-cutting and those that are specific to a particular approach.
- The approaches that are relevant to ELMs that can be used to inform decision making and thus would be useful to investigate further.
- Gaps in the evidence base pertaining to collaborative mechanisms and incentives. These will inform the primary research element of the project.

Using a Rapid Evidence Assessment (REA) methodology the review conducts a critical appraisal of the relevance and robustness of the evidence. The REA draws on both peer reviewed literature from both the UK and other developed countries where relevant, and grey literature which evidence and evaluate relevant approaches in the UK.

This narrative report is the outcome of the REA synthesis and is accompanied by databases documenting the search records and screening decisions for each intervention type, and the REA systematic map which documents the critical appraisal of the evidence.

2. Methods

2.1 Framework

Different typologies have been proposed for landscape scale or collective management (Uetake, 2013, 2014; Franks et al., 2017), however Boulton et al.'s (2013) distinction between collaborative and coordinated collective action, later advanced by Prager (2015), provides the most useful framework.

Collaborative approaches require land managers to meet and work with each other through a maintained dialogue. They are normally farmer-led (bottom-up) and require a 'shared vision'. For collaboratives that start as bottom-up initiatives, local and regional funding and administrative support tend to be important. *Coordinated* approaches are typically organised and orchestrated by a third party (Government/NGO) that bridges the group of farmers and the government. Although land managers still work towards the same objective, they tend to do so in isolation from each other. Coordinated activities are most common in projects with a primarily public benefit, such as large-scale conservation areas and catchments, and typically involve public-private partnership working.

Traditionally, AES have operated as top-down, coordinated approaches, as they are required to support the delivery of multiple (including public) benefits from agriculture (Prager, 2015). However, this has recently been challenged, as AES and other rural development measures are being increasingly utilised by bottom-up collaboratives. As such the boundary between collaboration and coordination can be "fuzzy", which gives rise to a coordination–collaboration spectrum, depicted as matrix, to allow different combinations of approach and governance to be accounted for (Prager, 2015).

This spectrum informs the framework for this review. Overlain on this are the support and payment mechanisms and incentives, which interact in different combinations to determine outcomes.

Regarding effectiveness, a number of measures of success and associated indicators have been used to assess effectiveness of coordinated and collaborative approaches and mechanisms, depending on the aims of research or evaluation. For example, comprehensive evaluation frameworks are developed for programmes such as CSFF (ADAS, 2018) and CSF (Environment Agency, 2019a,b), which include indictors of technical, social, and environmental effectiveness. Other approaches include assessing include effectiveness using multi criteria analysis (Mills et al., 2012; White et al.,2020); and more recently developing social indicators for AES (Mills et al., 2019). Indicators from these were used to inform the development of the key words in the preliminary stages of the REA, which were as follows:

- Social: indicators linked to participation, social capital, social learning, community impacts.
- Economic: indicators linked to transaction costs (for farmer), cost effectiveness and efficiency (assesses the performance of the intervention), rural economy.
- Environmental: indicators linked to habitat and species, water quality, soil quality, environmental additionality.

However, for the critical appraisal stage of the REA we did not use pre-defined indicators of effectiveness but used the REA to iteratively identify the main factors indicative of effectiveness in the evidence, where effectiveness refers to broad measures of success (see section 2.2.8). In doing this the review was guided by the overarching question: 'What collaborative mechanisms and incentives 'work' in terms of achieving social, environmental outcomes at large spatial scales?'

2.2 Rapid Evidence Assessment Methodology

The Rapid Evidence Assessment (REA) methodology was used for this evidence review due to its usefulness in 'the critical appraisal of the relevancy and robustness of the evidence base'. The REA methods used follow the Collaboration for Environmental Evidence Systematic Review Guidelines (Collins et al., 2015) and were carried out systematically and objectively by two project team members familiar with the material available.

The REA process is iterative and the review team worked closely in the development and use of key words, criteria for screening and scoring of relevance and robustness. Pilot tests were performed at each stage to validate and refine the methodology. Due to the largely qualitative nature of the evidence, it was necessary to adapt the REA methodology at some points as part of this iterative process.

2.2.1 Protocol

The first stage entailed drafting a protocol, which was shared with Defra for comment and approval. The protocol specifies the strategies and criteria for each stage of the REA. It also sets out the requirements for the collection of clear records throughout, in order to ensure transparency in reviewer decisions during the development of the search strategy, the screening and appraisal process. Preliminary key words and assessment criteria were drafted, as well as templates for the database and systematic map. This document was revisited and updated throughout the REA process.

PICO (Population, Intervention, Comparator, and Outcome)

The primary question of the REA is 'what collaborative mechanisms and incentives 'work' in terms of achieving social, environmental and economic outcomes at large spatial scales?'. This has the following components:

- Population: AES, conservation, nature improvement, natural capital, farmers.
- Intervention: Collaborative approaches, coordinated approaches; farmer-led approaches, incentives and payment mechanisms.
- Comparator: absence of intervention or individual AES agreements.
- Outcomes: Effectiveness (social, environmental and economic) according to a number of indicators.

2.2.3 Search strategy

Intervention type

A search was developed for each broad intervention type, guided by the framework (2.1) and the PICO:

- Coordinated landscape scale approaches
- Payment mechanisms and incentives
- Collaborative agri-environment schemes
- Farmer-led approaches

Keywords

Keywords were determined in an iterative process informed by the PICO, the REA aims and the research team's knowledge. A preliminary list of key words was collected and added to the draft protocol. In the pilot methodology different key words were tested for each intervention type in the

search strings. Through an iterative process some key words were retained and others removed on the basis of number, relevance and duplication of search results (judged on title) and research team's knowledge of the literature. Common synonyms were identified, no qualifiers were necessary. Table 1 lists all the key words selected for the REA. The italicised key words were removed as part of the iteration.

It was noted at this test stage that using key words for outcomes (Table 1) resulted in few relevant hits, and that when they were added to the research string (using AND) this considerably reduced the number of records in the search results. This is most likely due to, firstly, the limited evidence on impacts reported (few studies explicitly report on effectiveness, and where they do they use a number of 'measures of success', such as extent of participation in a scheme as a proxy). Secondly, in line with this, many papers report on process or 'what works' in terms of scheme or mechanism delivery and performance, partnership processes and governance. When searching without these key words, papers were identified that reported on effectiveness and impacts. It was decided therefore not to include these key words in the search strategy.

Comparator key words are intended to provide a reference case to capture additionality, which in this case would be 'minus' the intervention. During the test it was evident that it was not possible to express this in key words, but rather that any additionality would be captured in the search results from the main components: population and intervention.

Table 1: Keywords selected for the REA

Keywords related to the population*:* agri-environment, agriculture and environment, conservation, biodiversity, nature improvement area, space for nature, farmers, scheme *natural capital, ecosystem services*
Keywords related to the intervention*:* landscape scale; partnership; coordination; collaboration; collective; cooperation; coordination; payments; conservation auctions; collective auction; agglomeration bonuses; farmer-led; farmer cluster; bottom-up; farmer group; farmer network *Incentives, PES*
Keywords related to the comparator: *agri-environment schemes; additionality*
Keywords related to the outcomes: N/A *effectiveness, benefits, impact, uptake, buy-in, participation, engagement, social (impact, capital, leaning), knowledge, behaviour, attitude, environmental additionality efficiency, value for money. transaction costs)*

Search strings

Different key words were combined for each intervention type in the search strings. These combinations were tested iteratively and refined based on the number and relevance of search records. The intention was to find evidence particularly relevant to the intervention type and to avoid duplication. The final search strings are set out in Table 2.

Table 2: Final search strings used to identify relevant literature

Coordinated landscape scale approaches
(agri-environment OR conservation OR biodiversity) AND coordinat* AND approach AND (landscape scale OR partnership)
Payment and incentive mechanism
(agri-environment OR conservation OR biodiversity) AND farm* AND (landscape scale OR collaborat* OR collective OR cooperat*) AND (payments OR conservation auctions OR collective auction OR agglomeration bonuses)
Collaborative agri-environment schemes
(agri-environment OR conservation OR biodiversity) AND scheme AND farm* AND ("landscape scale" OR collabora* OR collective OR cooperat*)
Farmer-led approaches
(agri-environment OR conservation OR biodiversity OR "nature improvement area" OR "space for nature") AND (farmer-led OR "farmer cluster" OR bottom-up OR "farmer group" OR "farmer network") AND ("landscape scale" OR collaborat* OR collective OR cooperat*)

Wildcards (*) were used where accepted by databases/ search engines to pick up multiple word endings.

Evidence from studies of catchment scale approaches were identified through expert means to augment the records. These are particularly relevant for coordinated large-scale landscape approaches and payment mechanisms.

Sources and search locations

Peer reviewed papers were identified using searches conducted in Web of Science and Google Scholar. These are complementary and the research results did not overly duplicate each other. Web of Science is a more authoritative source for peer reviewed papers, while Google Scholar proved a good source in terms of results, identifying some grey literature as well as peer-reviewed titles. However, it is important to note that, whilst useful, Google Scholar searches are understood as an 'imperfect tool to perform systematic reviews' (see Piasecki et al., 2018).

Grey and unpublished literature was also identified from searches on websites of relevant specialist organisations as identified by the review team. These websites were searched manually by navigating through the site 'Publications' sections, if available, or by using any automated search facility with a number of key search terms. The websites of the following organisations were searched:

- Natural England Access to Evidence (AES and Catchment Sensitive Farming).
- Defra Science & Research Project repositories.
- Farmer clusters: Ernest Cook Trust, Wyevale Valley Farmers, Brompton Beck Flood Prevention Group, Ingleborough Cluster, 'Ryevitalise,' Martin Downs Cluster, Upper Wenssum Group.
- Large-scale Approaches: Prince's Trust, The Wildlife Trust's 'Living Landscapes'
- RSPB's 'Futurescapes,' England's Nature Improvement Areas', Heritage Lottery Fund's Landscape Partnership Schemes', Conservation Landscape Target Areas.
- Catchment approaches: West Country rivers Trust, Upper Thames Catchment, Wessex Water Poole harbour, Parrett and Taw catchment, Somerset levels.

2.2.4 Screening strategy

Inclusion and exclusion criteria

All Web of Science papers were screened. Due to large numbers of hits from Google Scholar only the first 10 pages were taken forward to the screening stage, except for the large-scale coordination intervention search, where the first 6 pages were taken forward for screening (due to the large number of irrelevant results beyond 6 pages and the relatively large number of grey literature documents from elsewhere selected for the critical appraisal).

Inclusion and exclusion criteria were derived based on the key words and other factors such as source (UK or international literature) and publication date. This stage ensures that only the most relevant findings are taken to the evidence synthesis stage. All retrieved articles were assessed for relevance using the following inclusion/exclusion criteria:

- Relevant to the intervention type being assessed and with reference to the PICO established for the study and the REA question and aims.
- Geographical reference: UK (Wales, Scotland, N. Ireland) and Ireland predominantly were included and other countries excluded. Exceptions were considered for European countries where effective approaches and mechanisms are reported (e.g. Environmental Cooperatives in Netherlands), and other developed world contexts where evidence is limited in UK and Europe (e.g. reverse auctions, agglomeration bonuses).
- Date restrictions: 2000-present (these were included at the search stage where possible).
- English language only.
- Reviews and secondary data, modelling studies included but theoretical, thought piece/viewpoints or conceptual studies excluded.

A two-phase process was used to filter out non-relevant articles according to these criteria.

The first phase screening included reading only the title or headline of the evidence found. The evidence sources were then marked as: clearly relevant, clearly not relevant or uncertain. If the evidence is found to be clearly relevant or uncertain at this first stage it was obtained in full.
The second phase screening involved reading the abstract or first paragraph (or full paper in some cases) of the clearly relevant or uncertain evidence to identify those that met the inclusion/exclusion criteria and would be used in the evidence extraction and synthesis phases. As well as the exclusion and inclusion criteria some evidence were excluded at this stage if it was better suited to another intervention type in the REA.

Following this screening, the Web of Science and Google Scholar results were combined and duplicates removed. At this stage peer reviewed papers and grey literature from expert sources or already known by the team as relevant to each intervention type were added.

Search results from organisational web sites were also screened using the same criteria. Those that passed the inclusion criteria were then examined at abstract/full text level by following the web links to retrieve the full document. Evidence referred to by expert sources was screened in the same way.

Search database

Searches were recorded for each intervention type. Decisions at each phase were recorded on a spreadsheet showing search terms, number of hits, number excluded/included and reasons, and number of pieces of evidence to be included in the critical appraisal. These spreadsheets are available separately.

Records are provided for each intervention type in the relevant sections below, but overall a total of 77 peer review articles and 39 grey literature reports were judged to have met the inclusion criteria. A schematic showing the numbers of records that were included and excluded at each stage of the REA is shown in Figure 1.

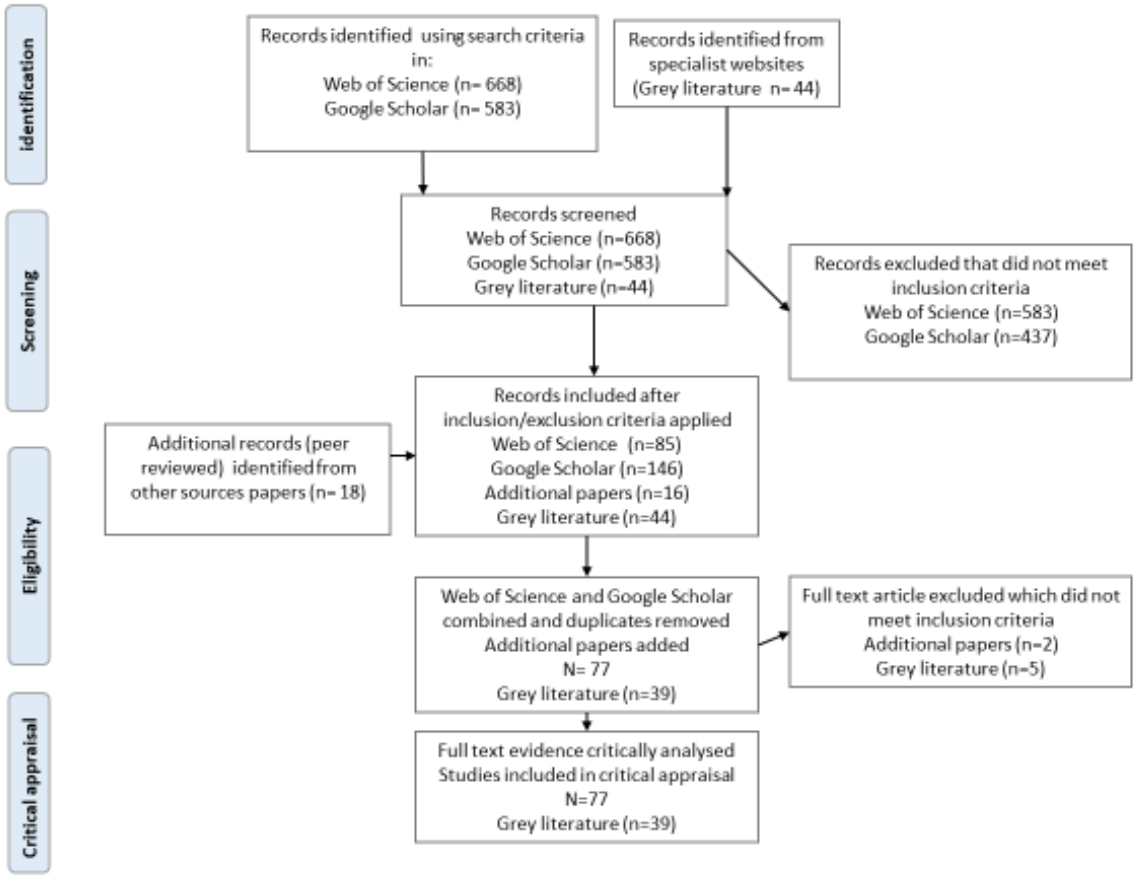

Figure 1: PRISMA flow diagram for REA

2.2.5 Strategy for extracting information and critical appraisal

A strategy for extracting evidence that relates to the main REA question was prepared, building on the database of included evidence. This entailed developing a template for information extraction (a systematic map). This ensured that the extraction was done in a way that was consistent for each piece of evidence. Again this was refined progressively through team discussion throughout the REA process.

Critical appraisal

In the critical appraisal stage the screened papers and reports were read and subjected to a full text analysis. As part of this analysis, each piece of evidence was evaluated to consider both the relevance of the evidence to the REA question, and the quality and robustness of the methodology utilised. Scores were assigned to each piece of evidence according to relevance and robustness of evidence. The criteria were devised with reference to the guidelines and adapted for the mostly qualitative evidence reviewed. The criteria were tested and developed iteratively within the review team to ensure a consistent approach (see Boxes 1 and 2).

Box 1: Relevance

Scoring and criteria for relevance

Each piece of evidence was ranked from 1-3 on the basis of the following (one single score was assigned):

- The relevance of the method used to the REA question
- The relevance of the evidence to the target subject/population of the REA
- The relevance of the outcome measured

An example for the topic 'Collaborative AES:

Score 3: A study about collaborative AES using relevant methods, where the outcomes or determinants of the success of an approach include for this intervention: participation, willingness to participate, attitudes to participation, barrier to participation, scheme design, contract design, social, environmental or economic benefits of participation (e.g. learning and awareness).

Score 2: A study about collaborative AES using relatively relevant methods, where outcomes or determinants assessed are useful but not directly related to success of the approach, or where the study is not about collaborative AES but outcomes assessed are directly relevant.

Score 1: A study not about collaborative AES (e.g. water catchment area or deer management), using non-relevant methods (e.g. modelling, theory), where outcomes or determinants assessed have limited relevance.

Box 2: Robustness

Category of type of evidence

A: Quantitative studies e.g. numbers participating before-after or matched to a control population; numbers of species monitored In a longitudinal survey.
B: Qualitative studies e.g. interviews, case studies to collect data on attitudes, behaviour, hypothetical studies to assess potential behaviour, behavioural intentions (e.g. theory of planned behaviour).
C: Modelling, experimental or laboratory based.
D: Economic studies e.g. cost-benefit, cost effectiveness studies.
E: Reviews e.g. literature reviews, summarises, desk based analysis, workshop and conference outputs.
F: Evaluation of projects and programmes including methods from A-E.

Scoring and criteria for robustness

Each piece of evidence is ranked from 1-3 on the basis of the following (one single score is assigned):

- The methodology used is clearly and transparently presented and peer reviewed.
- Numbers and types of farmers and/or stakeholders involved suit the studies research aims (n=.25).
- Sampling methods and analysis are reliable.
- Conclusions are backed up by well presented data and findings.

Score 3: Fulfils criteria and includes studies interviewing, surveying or consulting farmers and/or stakeholders where numbers and sampling method provide a largely representative rather than illustrative number (n= >25).
Score 2: Partially fulfils criteria (for example non peer reviewed study with reliable methodology); and/or includes hypothetical studies, choice experiments, modelled studies.

Score 1: Few criteria fulfilled and /or analysis from desk studies, interpretations, expert knowledge, or inferences from previous studies.

An example for the topic Collaborative AES:
Score 3: Peer reviewed paper with well described and executed methodology; if farmers are consulted then it consults > 25 farmers about actual behaviour.
Score 2: A study with some limitations in the methodology, such as limited numbers of respondents, or involves hypothetical studies or modelled studies of farmers' intentions or willingness.
Score 1: A study that describes or summarises outcomes from previous work based on a limited number of papers or reports.

A minimum quality appraisal level was set that defined those articles to be included and those of insufficient quality for use in any synthesis.

2.2.6 Determinants and outcomes

In the critical appraisal stage it was evident that not all studies explicitly addressed effectiveness, and those that did used a range of evaluation frameworks and methods, reporting a number of 'measures of success' (or indicators) to describe effectiveness. These were broadly categorised as process or impact-orientated, or *Determinants and Outcomes.* During the critical appraisal a number of factors were progressively identified within each of these categories and evidence was coded against these in the REA database (systematic map).

Starting with one intervention type, the results reported in each piece of evidence assessed were labelled according to their key characteristics (Factors). For example, 'farmer factors' influencing participation, or 'cost effectiveness' of the intervention. As the appraisal progressed these factors were refined down to those most commonly reported and listed together with their descriptor sub-factors. The factors were grouped into two categories of results being reported: *Determinants and Outcomes.* Through iteration and discussion in the review team this classification was used during the synthesis stage of the other three interventions and further added to and refined, since some factors are cross-cutting and some are specific or more relevant to a particular approach.

Determinants: These are key determining factors that affect the success of approaches. The majority of studies report on these factors, which affect the process of the intervention rather than the outcomes or outputs. This category includes factors that determine participation and process such as farmer factors, farmer relations (networks and social capital), scheme or intervention design, support and facilitation, and governance. For coordinated landscape scale approaches three additional factors referring to partnerships were added. Apart from quantitative surveys (which report metrics such as number of farmers participating), the 'metrics' used to describe the factors are largely qualitative. These were refined down to 10 main factors with a number of sub-factors (descriptors), as listed in Table 3.

Outcomes: These are key outcome factors that describe the success of approaches. Different approaches to assessing and describing the impact of an intervention are utilised in the evidence, from measurements, indicators developed as part of an evaluation framework or model, recommendations, inferences and claims, depending on the methodology used. Studies tend to measure shorter-term outputs and activities and infer longer-term outcomes (defined below[2]). However, we combine these

[2] Outcomes are longer term impacts of change that contribute to public goods, or end effects. Outputs can be: (1) functions (change in drivers) or (2) assets i.e. land, water, or other environmental features within a land

here and refer to them as outcomes (in line with the PICO), as they are often conflated in the results reported. A range of methods are reported including modelling, wildlife and water quality monitoring, attributed benefits from participation numbers and spatial scale, and qualitative social attributes. Economic factors include, for example, intervention performance (cost effectiveness); farmer income; and rural economy impacts. Social factors include, for example, learning (increased awareness and understanding of the environment impacts); enhanced social capital; and enhanced governance. Environmental factors include, for example, habitat and species; water and soil outputs. These were refined down to 6 main factors with a number of sub-factors (descriptors), as listed in Table 3.

Within each study, the results reported were assigned to a key category, factor and subfactors (where appropriate) on the systematic map. Where studies reported a range of results, these were all assigned to a factor.

The factors reflect the key characteristics or indicators being reported in the evidence reviewed. They also reflect to some extent the key assumptions about the causal links between them. A number of evaluations are based on a conceptual understanding that behavioural characteristics have an impact on environmental characteristics. For example, that participation in an AES or agreement holders' willingness to undertake environmental activities, will lead to environmental benefits.

When viewed together these two categories and their component factors provide a weight of evidence that allows us to judge the overall success of interventions.

2.2.7 Synthesis of the results

The final narrative synthesis stage, reported here, provides a description of the volume and characteristics of the evidence found by the review and discusses the adequacy of the overall evidence base to answer the primary REA question.

This stage combines the scoring of relevance and robustness with a view to giving greater weight to higher scored pieces of evidence. Consensus among studies was used to complement the combined score and to allow weight to be given to evidence which is reinforced by a number of studies. When taken together these (combined scoring and consensus) provided a weight of evidence that allowed us to judge the overall strength of evidence.

The stronger pieces of evidence are used in the synthesis, which is structured around the Determinants and Outcomes factors for each intervention.

This stage goes on to identify knowledge gaps and areas of interests for further research in the primary research phase of the project.

manager's control (White et al., 2020). Some evaluation frameworks describe activities as outputs on the assumption that an activity leads to an impact (Environment Agency, 2019a).

Table 3: Categorisation of determinants and outcomes

Determinants: Factors	Sub-factors
Farmer factors	Commitment to environment, attitude, motivation, perception
	Farmer prior experience
	Behaviour (e.g. bidder learning)
	Belief in benefits
Farmer relations	Farmer relations with government (trust)
	Farmer identity and independence
	Existing networks and relations
	Shared values
	Social capital
Scheme design and process	Flexibility
(design includes project and group; process includes mechanisms, contracts etc)	Eligibility
	Bureaucracy
	Financial reward
	Context specificity
	Spatial coordination
	Farmer involvement, inclusivity
	Sustaining engagement
	(non) demanding options
	Bidder behaviour
Transaction costs	Bureaucracy
	External support
Cost effectiveness	Scheme economic performance
	For farmer
	For government, agency
	Trade-offs
Support	Advice
	Facilitation
	Expertise
	Education and training
	External organisation support
	Intermediaries role
Governance	Self-governance
	Institutional challenges, context, co-management
	Trust
	Inclusivity
	Group size
	Autonomy, ownership, control
Partnership creation and relationships	Shared objectives and clarity of target area/issue; inclusivity
	Trust

	Identifying partners and clarity about roles
	Inclusivity
	Motivations and incentives
Partnership creation and process	Planning and timeframes
	Monitoring and evaluation
	Public engagement and communication
Partnership coordination and Support	Project coordination
	Governance, leadership
	Relevant expertise
	Financial resources and longevity
Outcomes: Factors	**Sub-factors**
Social capital	Social capital created/enhanced
	Collective efficacy
	Shifts social norms
Learning	Mutual/social learning
	Learning and awareness about the environment
	Efficacy, observed results
	Training and skills -farmers
Engagement	Participation in schemes (farmers) and projects (community)
	People and communities, public engagement, volunteers
	Training and skills -volunteers
Governance	Initiating institutional structures
	Extent and principles of collaboration
	Enhanced ownership, control
Environmental gains	Habitat and species
	Biodiversity connectivity
	Water quality and flood risk
	Soil quality
	Reduced pressure (e.g.destocking)
	Additionality
	Trade offs
	Collective efficacy
Economic benefit/disbenefit	Farm income
	Local multiplier effect
	Local employment
	Rural economy

3. Coordinated landscape scale approaches

3.1 Introduction

There is growing consensus among ecologists about the benefits of large-scale conservation. This entails coordination of land uses and management over large areas and often requires cooperation or partnership among state and nongovernmental conservation organisations, communities, and private landowners and managers (Adams et al., 2014).

The terms landscape scale and large-scale are used to denote this approach. "Landscape" scale can be defined as "action that covers a large spatial scale, usually addressing a range of ecosystem processes, conservation objectives and land uses" [Defra, 2011:18]). There are multiple terms used for 'large-scale': the term "large-scale conservation areas' (LSCA) proposed by Adams et al. (2016) is used here. There are many definitions concerning scale and the extent of geographical area that such initiatives cover is variable. In practice, initiatives often coalesce around areas of coherent landscape character, recognisable features of natural heritage (e.g. geological zones), hydrological areas (e.g. river catchments) or regional territories that stakeholders relate to. However, one comparative study (Eigenbrod et al., 2016:, 44) used at least 10km^2 (1,000ha) as a geographical criterion for these diverse initiatives; another set a minimum size as 5km^2 (500ha) (Adams et al., 2014). In their survey of 244 UK large-scale conservation projects, the mean area covered by the initiatives was 25,590ha; there were 83 projects over 10,000ha and 8 projects over 100,000ha (Adams et al., 2014, : 580).

Large-scale conservation often uses public-private partnerships to deliver landscape scale benefits. These require some element of co-management, where the processes of governance are shared among a group of stakeholders from government, private organisations, and civil society. This kind of mixed or plural approach has been characterised in terms of 'institutional blending' (Hodge and Adams, 2012). There are different modes in which partners work together; Hodge and Adams (2013) have identified various 'degrees of integration' from co-operation where participants remain as fully independent bodies, co-operatives where individual landholders form a separate organisation, and trusts where agents combine into a single independent body – effectively pooling property rights. Although considered to be predominantly top down, partnerships are increasingly characterised as involving a combination of 'top-down' and 'bottom-up' approaches to conservation issues.

Working at the landscape scale involves diverse actors, including, for example, non-governmental organisations, governmental organisations, farmers, the local community, academic researchers and contractors. To manage the institutional arrangements across diverse partners and large areas, initiatives are usually governed by a lead partner and through a project co-ordinator. The diversity of organisations and working arrangements can create challenges to the implementation of local management actions against the large-scale, often long-term aims, of initiatives. Delivering multiple objectives across organisations can create project dependencies between stakeholders; careful co-ordination and strategic planning is key to managing the scale of these projects. Partnership working is challenging, but when successful also offers added value in terms of shared expertise and resources delivering landscape scale outcomes – or additionality – that cannot be achieved by individual organisations, landowners or land managers.

In the UK, non-governmental environmental organisations have been integral to many large-scale conservation schemes; the Wildlife Trusts in their 'Living Landscapes' programme, The Royal Society for the Protection of Birds (RSPB) in their 'Futurescapes' programme, the National Trust in various Heritage Lottery Funded projects and Butterfly Conservation through butterfly and moth habitat restoration projects. The government's Nature Improvement Areas (NIA) programme has third sector involvement, as has the Heritage Lottery Fund. Many projects seek not just ecological outcomes, but

social and heritage benefits too. Many of the current projects are built around much older (and smaller) nature reserves, and the knowledge, logistics and local relationships built up over time (Adams et al., 2014).

Agri-environment contracts are a major source of funding for LSCAs awarded to landscape partners and the AES payments can play a key role in securing biodiversity targeted land management interventions by landowners (Hodge, 2014; Adams et al., 2016). Consequently a lot of the work in LSCA is concerned with supporting farmers getting into AES and then helping them to optimize their work within AES agreements (Adams et al., 2014). Some partnerships also use novel market based mechanisms to secure biodiversity, targeted payments by the state to landowners and market and biodiversity-friendly regulation.

Catchment scale management also takes a large-scale coordinated approach characterised by public participation, collaborative working with a focus on land-based resources, water quality and flood risk management. These can arise through specific government programmes (regulatory, statutory), institutions for integrated catchment management (Short, 2015), or more ad hoc or voluntary groupings (Cook et al., 2012). The Catchment Based Approach (CaBA) is an integrated catchment management initiative that Defra define as being able to offer a 'more locally focused decision making and action' framework to support 'improvements to the water environment and support river basin management planning as part of WFD activities (Defra, 2013). Integrated catchment management is the coordinated planning and management of a river catchment by a group of stakeholders operating under agreed terms of engagement (Cook et al., 2012). As with LSCA, they involve a wide range of interests and corresponding stakeholders and associated institutional and governance arrangements. Following a 2-year pilot phase, the CaBA was widely adopted across England with over 100 catchment partnerships formed in 93 catchments. CSF and Rivers Trusts movements deliver action through local participation, notably as farmer engagement, and advice, promoting uptake of AES and capital grants. Delivered in partnership with other catchment initiatives, agronomy firms and industry bodies, they also provide an effective way of linking up delivery at the catchment scale. Nature Based solutions (NBS) and Natural Flood Management (NFM) are catchment-based responses requiring integrated spatial management, with activity spread over a significant area. They require dialogue with local communities, landowners, land managers, and risk management officers and partnership formation (Short et al., 2019).

3.2 Search and screening record

The search and screening results after applying the exclusion and inclusion criteria are presented in Table 4. The detailed search and screening record (the search database) is attached as an excel spreadsheet.

Table 4: Search and screening results for LSCAs

	Results of Phase 1			Results of Phase 2 WOS and GS merged to remove duplicates:
	hits	not relevant	relevant or unclear	
Web of Science	152	122	30	Peer reviewed papers = 11 plus 5 additional papers =16
Google Scholar	60	28	32	
Additional papers from another source	N/A	N/A	7	
Grey Literature from other sources	N/A	N/A	19	16

As well as the exclusion and inclusion criteria, some evidence were excluded as they were better suited to one of the REA intervention types.

In addition to the these records which focus on conservation, three peer reviewed papers and three reports (grey literature) known to the research team were included as they concern coordinated catchment scale approaches in the UK with relevance to the REA question.

3.3 The Evidence - volume and characteristics

Evidence was extracted and synthesised from 16 studies located through WOS and GS searches (including 5 papers from another source), and 11 grey literature reports located through UK organisation website searches and expert suggestions.

3.3.1 Overall

- The evidence available reflects large variety in the aims, extent and partnerships deployed in large-scale conservation. There are messages about what works repeated across academic and grey literature, however these tend to be broad (e.g. the importance of co-ordination, of partnership working, building trust and involvement of local stakeholders) and based on expert opinion and experience. There are many factors shaping success and disentangling these in a standard way is not possible. This is not to say that evidence is unreliable, but rather that assessing factors such as governance and social dynamics, crucial to the success of large-scale conservation initiatives, is problematic. Generalising from case study approaches and small numbers of evaluation interviews needs to be done with caution given the variety of landscape scale conservation projects. Adams et al. (2016) concluded following a large survey that the large-scale conservation movement is in a relatively early stage in its development; that although it has potential and has had some success at the level of individual initiatives (Ellis et al., 2012), it has yet to deliver widespread, well-documented, and sustainable conservation outcomes. Since this conclusion, there have been few additions to the academic literature for the UK context.

- Given that most recommendations for 'what works' for large-scale conservation are similar across the various pieces of evidence, we can infer some reliability. However general recommendations and advice about what works may not be sufficiently detailed to help with the development of new initiatives (themselves place- and partnership-specific).

- Evidence (in the form of recommendations) is written for different audiences (e.g. policy makers, specific organisations, future partners, general public). For instance, National Trust (2017) reviews the Trusts' involvement in Heritage Lottery Fund (HLF) projects for the Trust and HLF; so findings are tailored to those organisational contexts.

- Evidence is polarised between: case-specific listing of outcomes from individual initiatives (e.g. quantitative data on extent of habitat restored, number of volunteer hours), and general principles about what works (e.g. general policy and practice notes).

- Clarke (2015: 25) notes that "The effectiveness of [landscape-scale] initiatives, in relation to both their nature conservation and their societal objectives is difficult to assess; the variety and dispersed nature of funded projects, delivered by multiple partners, together with 'noise' from other policy and funding initiatives makes evaluation methodologically problematic (and potentially costly)" (parenthesis in original). Adams et al. (2016) concur, concluding that "(t)here is no single model suited to supporting the creation of LSCAs activity".

3.3.2 Academic research into UK landscape scale conservation

- In terms of methods, academic research tends to be conducted through qualitative interviews, literature reviews and questionnaire surveys. Where interviews are used these are largely based on relatively small samples of scheme participants or project co-ordinators (Adams et al., 2016) and results are often supported with background information from websites. There is some survey work (Eigenbrod et al., 2016; Adams et al., 2014) covering UK landscape-scale initiatives. In the UK, some academic literature draws on research conducted in project evaluations in grey literature. Academic research scoring reflects the relevance and range of methods used (2-6). Those ranked 4-6 are referred to in the synthesis, those ranked 2 are limited in methods and/or too theoretical.

3.3.3 Academic research from outside the UK

- There are literature reviews without a systematic method stated (Doyle-Capitman et al., 2018, Powell, 2010, Brewer and Goodell, 2012) and literature reviews with systematic method stated (Heller and Zavaleta 2008; Blicharskaab et al., 2016). Some work provides general messages about partnership working being positive, engaging with stakeholders, meaningful participation (Blicharskaab et al., 2016), and alignment of partner interests as a key successful factor (Runhaar and Polman 2018). There is a constellation of methodologically robust studies focused on the BirdLife initiative in Sweden (Jofesson et al., 2017, 2018; Runhaar and Polman, 2018) and a forestry programme in Sweden (Eriksson et al., , 2018) which for example used 20 focus groups. There are other studies from Europe: France (Salliou et al., 2019) and Germany (Stoll-Kleemann and O'Riordan, 2002). The former, for example, analysed 30 interviews plus a further 173 interviews. Scoring shows a range of robustness but generally evidence from non-UK contexts is scored lower for relevance.

Grey literature (from the UK) falls into five types:

- Research including i) detailed accounts of case studies (Swales, 2009) and ii) survey and interviews (Eigenbrod et al., 2016).
- Evaluation of programmes (e.g. HLF, NIA, Butterfly Conservation) (Clarke et al., 2011; Collingwood Environmental Planning, 2015; Ellis et al., 2012; Harding and Spencer, 2017).
- Evaluation of individual initiatives (e.g. Living Wandle Landscape Partnership (Clarke and Anteric, 2017)).

- Summaries of workshops and conferences on landscape scale conservation (ThinkBig; Countryscape, 2015).

Grey literature is scored in the range 3-5, with 4 being most common. Those with larger scores reflect the scope of study and generally more robust methods while those with lower scores tend to include general recommendations and advice often organisation- or initiative- specific.

For the catchment based approaches there are a large number of evaluations (technical and behavioural) of Catchment Sensitive Farming (CSF) (for example, Environment Agency, 2019) and the Catchment Based Approach CaBA (for example, Cascade, 2015a,b). Those concerning assessments of partnership working and effectiveness of group/collaborative activities are most relevant to providing evidence for the coordinated approach reviewed here. Peer reviewed literature with a focus on group activity, governance and partnership working refers to water quality (Cook et al., 2012; Short et al., 2015), nature-based solutions (Short et al., 2019) and wider CSF benefits framed in terms of their contribution to maintaining and enhancing natural capital more widely (Vrain and Lovett, 2019).

3.4 Synthesis of findings

The database (systemic map) is attached with full details of the critical appraisal.

A range of different forms of evidence point to similar conclusions with regard to the following points about what works and why with respect to coordinated landscape scale approaches.

3.4.1 Determinants

Most determinants of success refer to objectives and design of projects, the ecological factors driving its design, sources of information, the institutions and practices of collaborative governance which include creating and sustaining partnerships, stakeholder relationships, arrangements (partnership design and process). There is less reference to the nature of governance structures (informal /formal) and the rules for decision making.

Partnership creation and relationships

Shared objectives and clarity of target area/issue

- A number of pieces of evidence stressed the need for partnerships to set clear, appropriate objectives that work towards a common vision (Collingwood Environmental Planning, 2015; Countryscape, 2015; Eingenbrod et al., 2016) Natural England, 2015). For example, Collingwood Environmental Planning (2015) note that the process of creating shared environmental visions for each Nature Improvement Area (NIA) was valuable for bringing partners together to agree priorities. Collective design and identifying 'common unknowns' may be helpful in this process (Berthet et al., 2016). For the CaBA a clear need for more joined up thinking at the local level to reduce overlap, duplication and single issue delivery by different institutions within the catchment was noted (Short et al., 2015).
- There are some reports that having a clearly defined area for the conservation effort is beneficial (Clarke et al., 2011; Collingwood Environmental Planning, 2015; Swales, 2009). Similarly, Powell (2010) notes that focusing on one issue can also be helpful. Where there is one overarching issue that needs to be addressed, the importance of this issue should be clearly articulated in order to motivate a range of stakeholders.

Trust

- Trust in coordinating organisations and between partners is crucial in creating and maintaining strong relationships. Empathy, listening, honesty and respect are all noted in the evidence as being important factors leading to effective partnerships (Eigenbrod et al., 2016; Stoll-Kleement and O'Riordan 2002; Natural England, 2015; Powell, 2010). Referring to the CaBA, Short et al (2015) notes the critical role of social capital which can enhance but also hinder inclusion where there is a lack of diversity and trust.
- There is some evidence that gaining sufficient trust and confidence from land managers can take a long time in the case of innovative management techniques (Ellis et al., 2011), although many projects are built around pre-existing initiatives (Adams et al., 2014). In voluntary sector catchment groups the nongovernmental role in brokering engagement and in partnership formation is key, because of local knowledge and the strengths of local networks (Cook et al., 2012). Public participation built on local relationships and local knowledge has been important in CaBA and Natural Flood Management (NFM() projects (Short et al., 2019).

Identifying partners and clarity about roles

- A common theme that emerged from the grey literature is that it is important to involve the right partners (both in terms of organisations and the individuals within those organisations) from the beginning and to be clear about everyone's roles (Countryscape, 2015; National Trust, 2017; Natural England, 2015). Countryscape (2015:3) advocate the inclusion of representatives from "those who live and work in the landscape, including businesses, the local community, the health sector, amongst others. This will ensure a multi-sectoral partnership that can consider many perspectives".
- Specific skills, knowledge and contacts within partner organisations, as well as wider organisational capacity, may be needed (National Trust, 2017; Natural England, 2015). Local volunteers can play a significant role in landscape scale conservation and their recruitment and training is an important component of most such projects (Ellis et al., 2011; Mackechnie et al., 2011).

Motivations and incentives

- Runhaar and Polman (2018) suggest that social learning from other farmers can be an important motivator for involvement in large-scale conservation groups. Based on evidence from five focus groups with people involved in meadow-bird conservation in the Netherlands, they found that farmers felt motivated by meeting peers and were proud to be part of the partnership. There is some evidence from Sweden (Jofesson et al., 2018) that the inclusion of voluntary, unsubsidised measures alongside subsidised measures can be useful for prompting intrinsic motivation, and thus commitment, among farmers.

Partnership creation and process

Planning and timeframes

- At least three pieces of evidence recommend early planning and ensuring sufficient start-up time (Countryscape, 2015; Clarke and Anteric, 2017; National Trust, 2017). Additional time may be needed to secure internal permissions and approvals within organisations. For instance, the National Trust (2017) notes that their projects have often underestimated the time required to develop work on communication and engagement.
- Clarke and Anteric (2017) suggest launching the biggest projects within an initiative early to help demonstrate achievement and momentum. Monitoring and evaluation approaches should also be planned from the beginning.
- There is strong consensus in the literature that projects need to be sufficiently long to enable strong relationships to be developed between partners, build up momentum and recognition, and allow for effective baseline data gathering (monitoring and evaluation) (e.g. Adams, 2016;

Collingwood Environmental Planning, 2015; Swales, 2009; Ellis et al., 2011; Eingenbrod et al., 2016). Brewer and Goodell (2012) stress that objectives also need to be thought about in the long-term in order to achieve multifunctional benefits that may take time to come to fruition. However, Adams (2016) cautions that land managers can become frustrated if decision-making is too slow and that long timeframes can conflict with other land management objectives/plans. Short-term funding timeframes can also be problematic for achieving long-term objectives (Natural England, 2015).

- Strategic planning need not restrict flexibility to respond to emerging opportunities throughout the project. The national Trust (2017) argues that systematic planning should be combined with "pragmatic responses to opportunities and local interests".

Monitoring and evaluation

- There is strong evidence that clear, well-planned monitoring and evaluation are crucial to successful projects (e.g. Clarke and Anteric, 2017; Clarke et al., 2011; Countryscape, 2015; Eigenbrod et al., 2016), both to measure the success of the project and to continue evaluating the relative benefits of large-scale approaches in general (Natural England, 2015).
- Good monitoring and evaluation is often resource-intensive both in terms of time and money. Mobilising community groups and volunteers to assist with monitoring can be effective (Collingwood Environmental Planning, 2015; Ellis et al., 2011; Mackechnie et al., 2011).
- Several sources stress the need to plan monitoring and evaluation from the start of a project (e.g. Clarke and Anteric, 2017; Collingwood Environmental Planning, 2015; Countryscape, 2015). Establishing good baseline data is important (Collingwood Environmental Planning, 2015; Natural England, 2015). This can require effective information and data sharing/gathering among multiple partners (England Biodiversity Group ThinkBIG, 2011).
- The design of monitoring and evaluation frameworks is important. Natural England (2015: 4) argue that "a balance is needed between national consistency and some local flexibility. Structured, repeated sampling is needed, not just happenstance records". Clarke et al., (2011: 21) suggest that (in the context of the HLF Landscape Partnership Programme) national programmes could ask individual projects to provide a "(biennial) 'snapshot' of achievement, possibly incorporating a set of standard data categories against which partnerships could collect data."
- A number of sources highlight issues with a lack of good quality and consistent spatial ecological data (Ellis et al., 2012; England Biodiversity Group ThinkBig, 2011; National Trust, 2017; Natural England, 2015). Such data (e.g. on target species and habitats) is essential for identifying project priorities and establishing current ecological conditions (a baseline) against which success can be measured. Relevant data may be disparately held, making information-sharing between partners essential (England Biodiversity Group Think Big, 2011). Where data does not exist, it may be necessary to undertake considerable preliminary work to gather it (Ellis et al., 2012).

Public engagement and communication

- There is agreement in the literature that effective communications to the public are particularly important for large-scale conservation projects, especially if they involve significant landscape or land-use change (Clarke and Anteric, 2007; Countryscape, 2015, Ellis et al., 2012). Natural England (2015: 22) suggest that insufficient engagement with people affected by large-scale initiatives in the past has led to "inaccurate and unnecessary perceptions of restrictive land designations or of productive land being 'wasted' or 'locked up'".
- Even where change is less extensive/obvious, engagement with the local community remains important. For instance, Ellis et al., (2012) report evidence from two local butterfly

conservation projects showing that such engagement helped to allay community fears and was beneficial in leading to new volunteers who assisted with recording and conserving butterflies and moths.

- Countryscape (2015) stress that it is important to help people understand why landscape-scale conservation is important. Key messages include i) financial benefits in terms of savings to national spending and contribution to the local economy; ii) health and wellbeing benefits; ecosystem service benefits from food, clean air etc.; iv) the cultural, historical and personal value of landscapes. Clarke and Anteric (2017) recommend using i) a good website from the start of the project, perhaps including an interactive map of the landscape; ii) a variety of social media; iii) regular newsletters to all project participants and volunteers.

Partnership coordination and support

Project coordination

- There is strong consensus in both the academic and grey literature that having a project coordinator or facilitator is essential to success in large-scale coordinated schemes (e.g. Countryscape, 2015; Eigenbrod et al., 2016; Ellis et al., 2011, 2012; Swales, 2009). The project coordinator could be an employee or volunteer (England Biodiversity Group ThinkBig, 2011), but should have relevant skills and expertise and build up essential long-term relationships with partners (Countryscape, 2015; England Biodiversity Group ThinkBig, 2011; Mackechnie, 2011). Many initiatives had a single "lead partner" that led decision making (Adams et al., 2014). Facilitation is key to engaging farmers and the community in the CaBA and CSF (Short et al., 2015; Environment Agency, 2019).

Governance

- The CaBA approach evaluation found that most catchment partnerships are successfully implementing key principles of collaborative working with transparent working and decision making (Cascade, 2015b), although Short et al (2015) suggest that CaBA face challenges in institutional design. Likewise, CSF delivery in partnership with other catchment initiatives, agronomy firms and industry bodies, is described as an effective way of linking up delivery at the catchment scale (Environment Agency, 2019a).
- However, for large landscape scale conservation partnerships, others to point to significant institutional challenges, and challenges in envisioning, incentivizing, and sustaining initiatives to alter land management practices (Adams et al., 2014). This was reported, for example, for the Weald Forest Ridge Landscape Partnership Scheme. Clear governance and decision making are needed (Eriksson et al., 2018), this is echoed for NFM as well (Short et al., 2019).
- The HLF review found that over time the capacity of organisations to conceive, develop and deliver projects grew enormously (Harding and Spencer, 2017).

Relevant expertise

- Ensuring sufficient and appropriate expertise within partnerships is important. Countryscape (2015) emphasise the need to have a core team but to also draw on external expertise and build capacity within the local community.
- The presence of a dedicated data manager to future-proof and archive data (Countryscape, 2015) and an experienced fundraiser (Eigenbrod et al., 2016), in addition to a project coordinator, is beneficial. Ellis et al., (2012: 8) also stress the need to ensure that contractors are experienced and well supported:

> "Since both traditional and innovative habitat management techniques may be utilised in landscape scale projects, experienced and sympathetic contractors with a good knowledge of land management for nature conservation are crucial. Errors by contractors can undermine relationships with landowners built up over many years.

It is therefore important that project officers meet contractors or landowners on site when work is underway, to ensure that it is carried out appropriately."

Financial resources and longevity

- Several sources stress that access to sufficient funding is essential (e.g. Adams, 2016; Natural England, 2015), for facilitation, coordination and communication as well as physical land management (Eigenbrod et al., 2016). Government grants can also facilitate added-value through initiating match-funding from non-public monies (Collingwood Environmental Planning, 2015). HLF increased funding to accommodate the financial difficulties of many public sector and voluntary organisations (Clarke et al., 2015).
- Natural England (2015) and the National Trust (2017) both argue that securing funding can be a resource-intensive and bureaucratic exercise in itself and the development phase of partnership projects should be sufficiently resourced (staff, time and money) to allow for this. Natural England (2015: 22) also highlight that,

  "Most projects face a huge challenge in trying to sustain momentum beyond their initial (usually short-term) funding and achieve a long-term legacy, caused by both problems in continuity of funding and the time it can take to achieve results on the ground."
- Reliance on AES payments are important to LSCAs, but there are limitations. Not all agri-environment agreements are targeted on local biodiversity objectives, which may or may not coincide with LSCA objectives. Also, the short-term voluntary agreements cannot be guaranteed to offer the particular incentives or continuity required for LSCAs (Adams, 2016). There is some evidence from Sweden (Jofesson et al., 2018) that the inclusion of voluntary, unsubsidised measures alongside subsidised measures can be useful for prompting intrinsic motivation, and thus commitment, among farmers.

3.4.2 Outcomes

Few studies provide evidence of outcomes. Collingwood Environmental Planning (2015) do provide a thorough discussion of a number of outcomes identified in their evaluation of Nature Improvement Areas (NIAs), though much of the evidence for these is based on expert and stakeholder opinion, rather than specific quantifiable ecological/economic data. Clarke *et al.* (2011) similarly present a long list of (primarily social) *outputs* from the Heritage Lottery Fund (HLF) Landscape Partnership programme. Adams et al. (2014) note from their survey that it was then too early to know the extent to which the approach can deliver long-term ecological change.

Learning

- The NIA outcomes cited include benefits for*: Enhanced knowledge and data* – Improved levels of knowledge were reported which it is hoped will help prioritise future interventions, particularly around habitat connectivity. *People and communities* - NIA work provided training for volunteers, contractors and students. By the end of year three 29,496 people had participated in educational visits. This led to better local understanding of the environment and accreditations and formal qualifications for some participants. Mobilising volunteers and improving access to the natural environmental is also thought to have improved physical fitness and mental health, although this was not measured. The Weald Forest Ridge Landscape Partnership Scheme reported considerable public learning benefit within the Scheme. The HLF review identified capacity building, improved skills and rigour in methods (evaluation), enhancing the ability of partners and projects to bring about conservation (Harding and Spencer, 2017).In a study of partnership BirdLife Netherlands the main (perceived) achievements include: a large contribution to awareness of and recognition for the important

role and efforts of farmers in meadow bird protection among citizens, politicians, policy-makers and companies in agri-food chains; but a modest contribution to improving conservation efforts by participating farmers; and a modest contribution to their knowledge about conservation of meadow birds, however this was due to farmers already being knowledgeable. A tension may exist between existing level of knowledge and motivation and learning gains. As noted earlier, there was evidence of social learning amongst farmers, farmers felt motivated by meeting peers and were proud to be part of the partnership (Runhaar and Polman, 2018).

Engagement

- Outputs from the Heritage Lottery Fund (HLF) Landscape Partnership programme (Clarke et al., 2011) include: *Community participation* – Large numbers of people involved in education and engagement activities; *Access* – open access areas and public rights of way created or improved (e.g. 484km footpaths); *Learning* – interpretation boards, leaflets, DVDs and community archives created; *Training and skills* – Training delivered to numerous volunteers, land managers, rural businesses and partnership staff; *Advice and support* – Production of advisory reports, management plans, project grants and advisory visits to landowners. *Farmer participation*-CSF-engaged farmers are more likely to have used or had dealings with Countryside Stewardship. The majority of farmers are very positive about their experiences of CSF and believe it is impacting water (Environment Agency, 2019b).

Environmental outcomes

- The NIA outcomes cited include benefits for: *Habitats and species* – Improvement to 13,664ha of existing habitat, restoration/creation of 4,625ha new habitat, and 225km of linear and boundary habitats, though actual outcomes/impacts are not yet known. However, stakeholder perceptions of these environmental benefits were high. For example, 88% of respondents to a survey felt that NIA had 'improved' or 'much improved' habitat quality and 87% 'improved' or 'much improved' habitat extent. *Ecosystem services* – enhancement of cultural, supporting and regulating services (and potential future enhancement to regulating and provisioning services) through improvement to habitats was reported, though the overall scale of benefits is not known.
- Outputs from the Heritage Lottery Fund (HLF) Landscape Partnership programme (Clarke et al., 2011) include: *Biodiversity* – habitat improvement, creation and restoration (e.g. 1900ha of priority grassland and health); *Built and archaeological* – Surveys, restoration and conservation of numerous sites, buildings and dry stone walls (e.g. 278 built heritage features conserved); *Artefacts and archives* – creation of or improvement to a number of exhibitions, catalogues and archives.
- Ellis et al. (2012) also provide evidence of environmental benefits from their case studies in the form of increases in numbers of occupied sites, the overall breeding area occupied, and improvements in connectivity. Improving habitat quality across a network of sites is seen as the critical success factor.
- Evidence from programmes from catchment scale approaches shows water quality improvements and reduced flood risks, as well as other natural capital benefits. CSF's significant progress in delivering its water quality objectives is linked to farmer engagement and advice, with evidence strongest for one to one advice, although group activities are noted as important for introducing farmers to CSF (Environment Agency, 2019). Respondents in the CaBA evaluation also agreed that on a range of aquatic environment and terrestrial environment improvements have been achieved. For one NFM intervention, delivered as part of a participatory local project, reduced average stage height and peak flow were recorded (Short et al., 2019)

Economic outcomes

- The NIA outcomes cited include benefits for *Local economy* – there was no specific monitoring of economic outputs, but benefits were thought to include supporting local businesses and enhancing attractiveness of the areas for visitors. The NIA partnerships directly employed an estimated 6.4 FTEs per NIA as well as providing employment for contractors. Additional resources of £15 million were utilised from non-public sources (excl. value of volunteer time).
- Outputs from the Heritage Lottery Fund (HLF) Landscape Partnership programme (Clarke *et al.*, 2011) were also assessed for: *Employment* in terms of number of jobs created or safeguarded (e.g. 93 internal FTE and 68 external FTE jobs created).

3.5 Knowledge gaps

- There is limited systematic assessment of economic, social, and environmental benefits; developing indicators and cost‐effective assessment of large-scale coordinated approaches for conservation.
- The gap between evidence in the form of case-specific listing of outcomes from individual initiatives and in the form of general principles about what works needs to be addressed.
- The dispersed nature of funded projects, delivered by multiple partners means that comparable evaluation methodologies are unavailable. Options for developing a common framework that can be applied to different contexts should be explored.
- A number of sources highlight issues with a lack of good quality and consistent spatial ecological data.
- Catchment based approaches have a longer period of establishment and evidence, and a more uniform approach making evaluation simpler, however the proposed causal link between group and partnership activities and improved water quality and flood risk needs further supporting evidence.
- The role of AES in these approaches needs further exploration, particularly the tension between the long-term objectives of large-scale initiatives and the shorter-term AES agreements, and the potential (mis)match of scale, targets and objectives.

4. Payment mechanisms and incentives

Payment options are available to incentivise spatial coordination such as auctions, agglomeration bonuses and group supplements. Governments and non-governmental agencies as well as the private sector can contract private landowners for the supply of environmental goods and ecological services. The challenge is to create institutional incentives for this ecological service provision that span property boundaries across landscapes and catchments.

4.1 Search and screening record

The search and screening results after applying the exclusion and inclusion criteria are presented in Table 5. The detailed search and screening record (the search database) is attached as an excel spreadsheet.

Table 5: Search and screening results for payment mechanisms and incentives

	Results of Phase 1			Results of Phase 2 WOS and GS merged to remove duplicates
	hits	not relevant	relevant or unclear	
Web of Science	137	123	14	Peer reviewed papers = 26 plus 1 additional papers =27
Google Scholar	201	145	56	
Additional papers from another source	N/A	N/A	1	
Grey Literature from other sources	N/A	N/A	9	7

The exclusion criteria were partially relaxed for this intervention to allow some key papers from USA and Australia to be included, and some empirical studies (Europe and Japan). This reflects the large amount of evidence from these countries in comparison to the UK. Those studies excluded are: summaries/reviews or conceptual papers with weak robustness levels or presenting no new evidence, or analysis; studies that are not relevant to the topic, or outside the geographical scope (e.g. Peru).

Evidence was extracted and synthesised from 27 studies located through Web of Science and Google Scholar searches (including 1 paper from another source). Seven grey literature reports were located through UK organisation website searches and expert suggestions.

4.2. Auctions

4.2.1 Introduction

In conservation auctions, farmers are asked to bid competitively for a limited number of conservation agreements. They induce farmers to reveal, through the bidding process, their compliance costs to the conservation agency and thus are of interest to policy-makers who experience information asymmetry. By favouring competition among farmers, this helps minimize the payments (Reeson et al., 2011; Taylor et al., 2004). A major consideration has been to reduce scheme payments by

establishing the most cost-effective delivery from the available bids. Auctions, as a complex incentive mechanism, involve a higher risk of failure than a simple fixed-rate payment (Latacz-Lohmann and Schilizzi, 2005). Auctions have been applied to a number of conservation activities but have mainly focused on delivering single objectives (often resource protection). A number of auction designs and payment formats are available: Discriminatory format; Reserve price strategy; Fixed budget Fixed target; Repeated auctions; Assessment metric (Latacz-Lohmann and Schilizzi, 2005; Schilizzi, 2017). Evidence is limited for collective bidding behaviours and outcomes. In this situation adjacent landholders can be encouraged to participate collectively in an auction so that bids with synergetic values are accepted together. In collective bidding, groups of farmers indicate the land area they are willing to manage according to certain conditions, and the payment they require to do so. Funders then select the bids that provide conservation services at the least cost

4.2.2 The Evidence - volume and characteristics

The majority of the peer reviewed papers come from economic studies and are characterised by a focus on designs for conservation contracts for individual farms rather than collective auctions, which are not very common. Special attention has been devoted to implementing spatially connected auctions which give greater weight to bids which are adjacent to each other (Reeson et al. 2011). The methodology applied is largely experimental using laboratory-based approaches (game playing), simulation models, sometimes using realistic landscapes (Taylor et al., 2004; Calel., 2012; Bamiere et al., 2013; Elliott et al., 2015; Schilizzi, 2017). Some studies compare mechanisms or report on combinations like auctions with payment by results (e.g. Klimek et al., 2008). Not many studies actually present measurements, such as transaction costs (Latacz-Lohmann and Schilizzi, 2005). For experimental research, relatively minor details in the design of auctions and other market institutions can have a major impact on performance, suggesting that there are multiple combinations of factors and variations of outcomes, which complicate any consensus about the evidence (Reeson et al., 2011).

There are two key review papers from economic research. Latacz-Lohmann and Schilizzi (2005) provided a comprehensive review of the literature on conservation contract design and the use of auctions in agri-environmental policy and natural resource management. As well as reviewing case studies, this focused on the theory and practice of auction and contract design in the field of economic research. At this time the authors cautioned that care needs to be taken in interpreting figures from different studies because they are based on different counterfactual fixed payment rates, and cannot be compared to each other. They concluded that it was too early to make a robust assessment of the cost effectiveness of auctions in agri-environmental management. Although the body of evidence has grown since then, an updated review of laboratory research on conservation auctions by Schilizzi (2017) (described as almost exhaustive given the relative youth of the experimental literature in this area) reports advances in understanding but also points to the limitations of experimental work.

In addition to these reviews, others have reviewed the main developments in the literature on incentive-based policy mechanisms more generally (de Vries et al., 2016; Mills et al., 2012; Kuhfuss et al., 2019; White et al., 2020), and potential approaches for UK (Chaplin, 2011).

Evidence from real cases until recently have predominantly come from non UK settings such as the Conservation Reserve Program in the United States and the Bush Tender in Australia, with one Challenge Fund in Scotland (reviewed by Latacz-Lohmann and Schilizzi, 2005). Recent use of reverse auctions in catchments applying new electronic tools now provide empirical evidence in UK (WRT and EA, 2020; UEA and WRT, 2013) however these are relatively small scale and there is limited evidence about how effective a nationwide scheme would be (White et al., 2020).

Higher robustness scores were assigned to evidence where fieldwork was undertaken as opposed to experimental modelling, conceptualisation or reviews. Robustness of most papers has been ranked 2, not due to the individual paper's methodology but to their experimental, simulation approach. Robustness of UK case studies is average (2) due to the small numbers of farmers involved or surveyed.

With respect to the relevancy (including context, method used and outcomes measured) to the REA question, most papers tend to assess auction format and performance in economic terms, rather than environmental outcomes. That is, they contribute to understanding what works rather than the effectiveness in terms of outcomes. Schilizzi (2017) distinguishes evidence as intermediate outcomes, which refer to bidder participation and bidding behaviour; and final outcomes, which mainly refer to auction performance (several criteria). The relevance of the evidence from non-UK settings, often referring to natural resource management in general, and focusing on individual contracts, is relatively low for the REA question. Furthermore, individual auctions are intended to engender competition not cooperation between farmers. However, there are some insights into auction design, bidder characteristics and behaviours that are pertinent to collective approaches and achieving environmental outcomes (Klimek et al., 2008; Bamiere et al., 2013; Ulber et al., 2011). Higher relevance was assigned to collective auctions and group contracts, as opposed to individual auctions.

Very few studies look at effectiveness of collective auctions as an intervention to achieve collaborative behaviour and associated social or environmental impacts with exceptions of those that assess spatial characteristics of the conserved area and biodiversity (Bamierre et al., 2013; Ulber et al., 2011).

4.2.3 Synthesis of findings

The database (systemic map) is attached with full details of the critical appraisal.

Determinants

Farmer factors

- Bidder characteristics are a key focus of study. Although largely from Schilizzi's (2017) overview of experimental approaches, the suggestion is that making information available to bidders about the metric used for ranking bids influences outcomes, as farmers express environmental preferences (bird species for example). On this basis bidders can be selected and segregated, or mixed, according to their environmental preferences but this is not yet a reliable process.
- Bidding motivations for the Fowey auction in UK were split into broad categories: 1. consideration of other farmers, although not all shaped by the desire to make it competitive against other farmers, as some wanted to ensure some fair distribution of funds. 2. consideration of relative contribution - how the cost of the capital item should be divided up between the farmer and South West Water.

Farmer relations (Farmer involvement)

- Evidence is limited for collective bidding behaviours and outcomes. However allowing neighbouring landholders to submit joint bids, researchers agree, builds on local knowledge and enable landholders to decide among themselves how best to share effort and payments among their members, thereby helping any conservation agency with the funding decision (Latacz-Lohmann and Schilizzi, 2005; Prager et al., 2012). There is consensus that collective auctions can increase cost-effectiveness if well designed, improve farmers' engagement in the design of agri-envionmental project, and improve understanding of ecological processes (Kuhfuss et al., 2019).

- Bidding mechanisms that allow individuals to decide both the technology they will use for pollution abatement and the quantity, for example, were found to be efficient (Taylor et al., 2004), while communication between bidders is known to influence auction outcomes (Schilizzi, 2017).
- Issues of trust arise when one landowner's reward is contingent upon his neighbour's behaviour (Goldman et al., 2007). An experimental study on collective behaviour investigated a group contract for nutrient reduction, which tied the payments of individual farmers to the collective performance of the entire group in a small sub watershed (Taylor et al., 2004). A neighbourhood or nudge effect is supported elsewhere (Kuhfuss et al., 2014, 2016).
- Pre-existing farmer relations and institutional context can influence auction outcomes. A social experiment of a conservation auction, conducted in rice irrigation in Japan, provides empirical evidence that where there are already formal and informal organisations (farmer groups) managing resources, this can reduce auction transaction costs (Takeda et al., 2015). In line with this, some studies note that a certain conservation behaviour and consciousness can be fostered at the site under study before a conservation auction is conducted (Latacz-Lohmann and Schilizzi, 2005) and that prerequisite steps are needed before designing a scheme to encourage collaborative provision of ecosystem services, which front-loads participation within programme design and builds trust and co-operation (Prager et al., 2015).

Design and process (promoting coordination and auction format)

- The reverse auction approach may struggle to coordinate delivery of land use change, given that each participant in the auction process is competing against the others for the available funding. According to White et al. (2020), although the studies show that coordination of landowner behaviour can be "steered" in the laboratory, there has been less focus on spatial coordination of landowner participation in order to improve delivery of biodiversity and ecosystem services across land in actual conservation auction schemes. This is because implementing auctions with explicit spatial coordination is challenging. A number of studies exist but evidence of success appears to be mixed or show the complexity of each situation.
- It is agreed that adapting auctions to address ecosystem services at the landscape scale requires an auction mechanism that can promote coordination while maintaining competition. Evidence agrees that multiple-round auctions, where farmers bid repeatedly over several rounds before submitting their final bid, are needed to achieve this spatial coordination of bids. Provided the bid assessment process places a positive value on connectivity, bids which co-ordinate will have a greater chance of success (Latacz-Lohmann and Schilizzi, 2005; Reeson et al., 2011. Elliott et al., 2015).
- However, evidence from a number of sources suggests that coordination and collusion often come together. As already noted in a range of evidence, multi-rounds may offer greater potential for collusion by bidders and thus reduce the cost-effectiveness (Klimek et al., 2008; Reeson et al., 2011; Takeda et al., 2015). The challenge in the domain of spatial conservation auctions is to reduce intensified rent-seeking by participants at strategic locations on the landscape. For example, not revealing in advance the numbers of rounds prevents rent-seeking behaviours from those farmers. Trade-offs between promoting coordination over multiple rounds and minimising collusion and learned strategic behaviour have to be considered (Reeson et al., 2011). Information increases competition and improves cost efficiency of the auction but needs to be managed (Elliott et al., 2015).
- Adapting auctions to address ecosystem services at the landscape scale requires a method for ranking the bids made by landholders, a metric to measure and compare the level of ES provided by alternative bids, such as spatial weighting. Evidence concerning metrics is more limited. Studies suggest that where there are landscape-scale objectives such as habitat connectivity, the ecological metrics required to prioritise proposed conservation projects become more complex (Hanley et al., 2012; Mills et al., 2012). The Fowey trial in the UK found

that the auction lacked precision in the definition of the items, which made it considerably more difficult to make accurate assessments of the relative merits of different bids. This limits the ability of the auction administrator to quantify and value the benefits of different bids in order to choose the most cost-effective solutions. White et al. (2020) concur that the challenge for reverse auctions lies in the ability to effectively compare the benefits of different bids and whether they are able to accurately assess the difference in the quality of outcomes. This can limit their application to specific areas where this can be measured.

- The bundling of ecosystem services and biodiversity conservation, whereby bidders offer multiple environmental goods for a single price, is also seen as a design issue (de Vries and Hanley, 2016).
- Auctions may struggle to find the right structure for incentivising complex, risky outcomes, although there may be specific areas where they could be applied, such as in habitat creation projects using the Defra Metric 2.0 to measure the outcomes delivered.
- Other design issues relate to the level of design complexity and the transaction costs of auctions (increasing complexity can deter participation) (de Vries and Hanley, 2016). The use of online trading tools in the UK (Tamar trial and Poole Harbour) has attracted land managers who had previously not engaged in agri-environment activity (half of participants in Tamar trial), as they are less bureaucratic (EnTrade, 2018; Hackett, 2019). However, advisers' support was essential. If run autonomously, WRT felt that it would fail to see similar levels of success. For those running the auction, the tool was not seen as stand-alone, as the majority of negotiation happened post-auction.
- For both Fowey and Tamar auctions, it was agreed that it would work better if used for a smaller number of discrete/clear interventions.

Cost effectiveness

- A range of different forms of evidence point to similar conclusions with regard to performance, with studies agreeing that auctions in agri-environmental management (single-round auctions) are more cost-effective than standard first-come first-served flat rate payment schemes (Latacz-Lohmann and Schilizzi, 2005; Reeson et al., 2011; Bamiere et al., 2013; Elliott et al.2015; de Vries and Hanley, 2016; White et al., 2020). However they also agree that this depends on securing a sufficient level of uptake to develop a competitive marketplace. Where there are few bidders, the payment rates are likely to be higher and the cost-effectiveness of the approach limited.
- Studies also agree that bidder behaviour can diminish these advantages. Schilizzi and Latacz-Lohmann (2005) refer to the 'unanimity' in the empirical literature and experimental research concerning bidder learning, which is seen to pose a substantial threat to the efficiency of multiple-round conservation auctions (Reeeson et al., 2007; Bamiere et al., 2013; Klimek et al., 2008).
- In the Fowey auction, compared to an adviser-supported PES mechanism, auction-based PES mechanisms are the preferred option for distributing funds when the benefits of investments can be estimated reasonably accurately without site-specific knowledge. Auctions also have a considerable advantage in that they scale-up with relatively little additional cost. As such, an auction might be preferred for large-scale schemes, particularly where there is little detailed local knowledge of a region through which farms can be effectively targeted.

Outcomes

Environmental outcomes – trade-offs

- Evidence from a pilot regional scale case study in Germany found higher farmer participation in auctions compared to numbers for existing AES contracts. The authors suggest this demonstrates that an appropriately designed payment scheme can support farming systems that are managed for vascular plant diversity in managed grasslands in addition to the production of market goods (Klimek et al., 2008).
- The evidence from economic modelling for targeted habitat or regional scale approaches shows that, whilst auctions can be more successful in terms of participation and cost effectiveness than regular AES, this can be at the expense of environmental gains, and trade-offs are needed. Bamiere et al. (2013) compared three incentive-based policy instruments (a subsidy per hectare of reserve, an auction, and an agglomeration malus (i.e. a reduction of the payment) for cost-effective habitat conservation on agricultural lands, where the desired spatial pattern of the reserve was a random mosaic. They found the auction scheme was most cost-efficient but that the costlier agglomeration malus allows a better spatial pattern than both other instruments. Similarly, in a regionally-scaled conservation procurement auction in the EU, an incentive-based PES scheme proved to be highly effective in enhancing arable plant diversity on participating fields but bid prices submitted substantially exceeded individual farmers' opportunity costs and had limited cost-effectiveness (Ulber et al., 2011).
- White et al.'s (2020) MCRA analysis concludes that flexible and cost-effective solutions that work best for interventions involve clear, comparable outcomes. This could be useful in reducing negative externalities, as well as potentially encouraging landscape level changes such as incentivising significant areas of habitat creation at low cost. However, it is less likely to be useful when there are complex combinations of outcomes to be compared and evaluated in the auction process.

4.3 Group supplements

4.3.1 Introduction

A group supplement takes the form of an additional payment within an agri-environment scheme (AES) to cover the costs incurred by agreement holders working together to co-ordinate action across more than one holding. It can be applied to a series of individual agreements to require co-operation between the individual agreement holders over specific aspects of delivery. There is limited experience in UK. As part of the Environmental Stewardship Scheme's (ESS) introduced in 2005, the Higher-Level Stewardship (HLS) allowed farmers to select the HR8 option "Supplement for Group Applications". This option was designed to protect resources that typically cover more than one land manager's domain. For example, inter-tidal flood management, wetland management and landscapes with extensive archaeological or historic features. HR8 in 2010 comprised 2% of all HLS agreements, although the proportionate area is greater (~11%) because the supplement is strongly associated with agreements on large, mainly upland, commons (Chaplin, 2011). The supplement UX1 "Moorland Commons and Shared Grazing Requirements" was also introduced under the Uplands Entry Level Stewardship (UELS) and used in association with agreements on upland common land. Other situations where the group supplement has been used include for co-ordinating the management of fragmented non-contiguous sites (often small SSSIs), and for raising water levels to create wetland habitats (Chapman, 2011).

4.3.2 The Evidence - volume and characteristics

Given the narrow range of experiences in the UK, evidence of effectiveness is limited to lessons learned for incentivising Higher-Level Stewardship (HLS) option HR8 (Franks and Emery, 2013) and experiences with UELS (Mills et al., 2008, 2012). The limited use of the supplement outside of agreements on common land, the small geographical scale of existing examples (mostly linked to upland areas, although Franks and Emery (2013) included lowland respondents) and the small number of studies, each with few respondents, makes it difficult to draw any firm conclusions. Most evidence reports research understanding uptake rather than assessing outcomes.

4.3.3 Synthesis of findings

Determinants

Farmer factors

- Farmer prior experience is important. HR8 option was more likely to be agreed when the ESS agreement replaced a previous AES agreement (Franks and Emery, 2013).

Farmer relations

- Many agreements were agreed between farmer members of existing groups (Franks and Emery, 2013).

Design and process

- A large degree of flexibility in contracts is needed to successfully address the wide range of site-specific contractual problems encountered (Franks and Emery, 2013).

Transaction costs

- The costs can be variable but high for some (Mills et al., 2012).
- The number of stakeholders and their range of interests, rather than the land area covered by the agreement, were the major determinants of transaction costs on large-area agreements (Franks and Emery, 2013).

Support

- Most of the HR8 agreements reviewed were initiated by an outside agency. There is some consensus that initial negotiation of a group supplement requires a degree of facilitation, and this is a cost that is borne upfront with no guarantee of success (Mills et al., 2012; Franks and Emery, 2013).
- Securing an agreement is time-consuming (and often un-rewarded) (Mills et al., 2008). For UELS, the path of least resistance was sometimes taken in order to secure agreements and it is suggested that stronger guidance from agencies and Defra is needed (Mill et al., 2008).

Outcomes

Social capital

- The process of negotiating both group agreements and a series of agreements to which a group supplement is applied can result in improved social cohesion or a reinvigorated traditional management structures (Mills et al., 2008).

4.4 Agglomeration payments

4.4.1 Introduction

A bonus payment with a spatial element is known as an agglomeration bonus. A bonus is paid on top of a standard payment for managing land in a biodiversity-enhancing manner if the managed patches are arranged in a specific spatial configuration, typically adjacent neighbours' land (Parkhurst et al., 2002; Parkhurst and Shogren, 2007). An agglomeration malus is an instrument which accounts for the spatial issue and consists of a subsidy per hectare of reserve completed with a malus (i.e. a reduction of the payment) when the additional reserve site is adjacent to another reserve site (Bamiere et al., 2013). The agglomeration bonus idea requires co-operation among landowners (Parkhurst et al., 2002; Parkhurst and Shogren, 2007). Drescher et al. (2010) distinguishes agglomeration payments, in which payments are made only if a certain level of spatial connectivity in the land where conservation actions are applied is reached, as separate from a top-up to other AES payments.

4.4.2 The Evidence - volume and characteristics

Evidence is largely from laboratory experimental studies of the coordination problem for USA contexts, usually assessing efficiency properties of a contract proposing an agglomeration bonus (Parkhurst et al., 2002; Parkhurst and Shogren, 2007; Banerjee et al., 2012), while in one case study participation is the theme (Kuhfuss et al. 2014, 2016). The context covers mainly conservation but herbicide use and soil re-wetting of organic soils are also represented (Kuhfuss et al., 2014, 2016; Ferre et al., 2018).

The behaviour of land-users in the cooperation process has been investigated mostly by applying experimental games. These consider different design aspects of the agglomeration bonus from a purely theoretical or hypothetical perspective. Cost effectiveness studies draw on the economics literature on the spatial allocation of conservation activities. Drechsler et al. (2010, 2017) applied a conceptual model to a real-world case study on the conservation of the Large Blue butterfly in Germany. Goldman et al. (2007) contributes with some conceptual ideas about expanding on the agglomeration bonus, in addition to other ideas for offering different rewards for different levels of cooperation (options based on scale and on social familiarity and trust). One qualitative study (described as preliminary and indicative) looks at what is referred to as 'the only case of agglomeration bonus in use', the Swiss network bonus scheme (Kramer and Wätzold, 2018).

With respect to the relevancy, most studies tend to assess performance in efficiency and economic terms, rather than environmental outcomes, so relevance is limited to determinants of how bonuses work. Evidence from non-UK settings is relevant and scored 2. Robustness of most peer reviewed sources has been ranked 2, not due to the individual paper's methodology but to their experimental approach.

4.4.3 Synthesis of findings

Determinants

Farmer relations

- A range of evidence agrees that trust and familiarity are important. For the agglomeration payment to work, landowners needed to co-ordinate with each other about side payments and their actions (Goldman et al., 2007; Dreschler et al., 2010).

- The extent of the transaction costs will depend on factors such as the local tradition of co-operation between landowners (Dreschler et al., 2010). For collaborative schemes to work, it is important that farmers are able to choose their collaborators. Schemes which require participants to work with specific neighbours on the basis of geographic criteria can be problematic due to issues of trust (Mills et al., 2012).
- The evidence seems to concur that communication and learning is important for coordination. Providing information on the behaviour of neighbouring land-owners is beneficial for coordination (Kramer and Wätzold 2018; Banerjee et al., 2012).
- These studies also found that farmers observe each other and learn from each other's behaviour. Experimental evidence concurs that while no-bonus mechanisms consistently create fragmented habitat, with the bonus players coordinate actions and achieve a targeted habitat reserve and this can be enhanced when pre-play communication is introduced (Parkhurst et al., 2002).
- For policy, fostering market transparency by revealing landowners' land management actions is likely to improve the environmental outcome in terms of higher conservation benefits generated from spatial connectivity and spatial spill-overs (Parkhurst and Shogren, 2007; Banerjee et al., 2012, 2014).

Design and process

- Performance is judged in terms of dealing with the coordination problem. The key conclusion from studies investigating behaviour of land-users in the cooperation process (using experimental games) is that achieving desired patterns of land use from private land owner decisions is a coordination problem (Parkhurst et al., 2002; Parkhurst and Shogren, 2007; Banerjee et al., 2014; Bamiere et al., 2013). Accordingly, the focus has been on agglomeration bonus performance: namely, complexity of coordination pattern, possibility of communication and experience (Parkhurst et al., 2002; Parkhurst and Shogren, 2007).
- Concerning the agreement, evidence seems to agree that size, habitat type and complexity of agreement are important factors determining success. In laboratory experiments, the bonus mechanism was successful in prompting participants to co-ordinate their actions for a number of simple spatial configurations (a corridor style habitat or a single core habitat style), although in more complex and realistic co-ordination experiments the bonus mechanism proved less effective (Parkhurst and Shogren, 2007). Banerjee et al.'s (2012, 2014) experiments suggest a significant difference in patterns of coordination (and underlying behaviour) in two landscapes, with efficient coordination being harder in bigger networks relative to smaller ones.
- In line with this, Drechsler et al. (2010) found that an agglomeration payment is always better than a homogeneous payment in terms of budget efficiency, but that the approach works best for small conservation budgets and possibly for single species. Drechsler et al. (2017) point to difficulties of designing cost-effective heterogeneous payments for some conservation problems. With respect to their butterfly study, the (added) benefit of a meadow – and so the cost-effective compensation payment for that meadow – depends on the presence and the locations of other meadows with promoted mowing regimes in the region, which are not known a priori to the conservation energy.

Cost effectiveness and trade-offs (also relevant to outcomes)

- Evidence indicates that trade-offs have to be made to achieve environmental gains. Dreschler et al. (2010) showed that an agglomeration bonus leads to higher ecological benefits but it can also lead to higher costs. It may be necessary to include costly patches to achieve a desired spatial configuration. This is supported by Krämer and Wätzold (2018) who found that the network bonus approach is more costly, but that more ecologically valuable areas are included

in comparison to a hypothetical situation where the additional money spent on network payments were used for a general increase of payments for ecological compensation areas.

- In one study, the agglomeration malus did better than an auction mechanism for achieving the required spatial pattern for environmental outcomes but was more costly (Bamiere et al., 2013). As noted above, information disparity across landowners about conservation costs affects the extent of the transaction costs. Communication between neighbours can produce the ecologically desirable outcomes, but may also imply a lower level of cost-effectiveness (Drechsler et al., 2010).
- However, in a computerised framed experiment with respect to re-wetting organic soils, Ferre et al. (2018) found that a constant agglomeration payment scheme, aligned with initial highest opportunity costs of farmers, was more environmentally-effective and also more cost-effective than a variable payment that follows the dynamic evolution of opportunity costs.
- Two modelling studies looked at impact on farmer income of spatial coordination. Cong et al. (2014) found that coordinated management of pollination at the landscape scale increased the profit of each farm involved compared to the uncoordinated management solution. A follow up study applying the model to a realistic landscape found that, if landscape scale management improves the collective benefits, some farmers lose by collaborating (Bareille et al., 2020).

Outcomes

Social capital

- There is some evidence that social norms can be shifted. The establishment of a network project seems to provide the possibility to initiate a process where farmers learn from their neighbours and join the network project (Krämer and Wätzold, 2018), while a collective bonus can also encourage the emergence of a new social norm or peer pressure influencing winegrowers' behaviour towards pro-environmental practices (Kuhfuss et al., 2016).

Learning

- Joint development of a target plan and selection process (target and index species) increased the awareness of farmers about the value of biodiversity and provided the possibility of a mutual learning process about conservation measures, and to gauge their success. This leads to a kind of crowding-in effect of intrinsic motivation (Krämer and Wätzold, 2018).

Environmental outcomes

- In terms of ecological effectiveness, increases in the size of the contracted areas has been achieved in practice with bonus payments (Krämer and Wätzold, 2018) and choice experiments (Kuhfuss et al., 2016). The additional areas included were of high ecological quality and integrated in a coherent network of areas to conserve target species. Overall, the quality of conservation areas that already existed prior to the network bonus was improved.
- Well-designed spatial configurations of the meadows with promoted mowing regimes may (using conceptual analysis) lead to ecological benefits (for the Large Blue butterfly), which are 50% higher than benefits from average configurations.

4.5 Payments and incentives - Knowledge gaps

- For auctions, although cooperation between neighbouring landowners directly increases spatial coordination, the majority of studies typically assume that bids from landowners are

independent. Future research needs to more thoroughly address the issue of spatial coordination and incorporate the potential synergies across landowners.

- Auction experimental studies typically constrain the conditions - institutional, cultural or otherwise - in which the auctions are to be implemented, and leave behaviours unconstrained. Understanding the context and behavioural responses of potential participants, such as bidder characteristics and their environmental preferences (including whether they would be willing to carry out the management at a net cost to themselves anyway), with real case studies is a clear gap.
- Much of the evidence derived from economic disciplines is largely experimental and theoretical. More empirical studies are needed to build on the work from experimental laboratories and simulations.
- Issues of trust and communication between farmers are important but little research has been undertaken in real life settings.
- Performance is largely judged on cost efficiency, and with limited attention paid to environmental, economic (to the farmer) or social benefits.
- Studies that have looked at incentives with respect to habitat targeting and coordination need expansion, as many reveal that trade-offs are needed between environmental gains and transaction costs.

5. Collaborative AES agreements (cAES)

5.1 Introduction

The principal publicly-funded instrument currently used to maintain and improve biodiversity, landscape quality and diversity in the countryside is AES. AES agreements range from the current situation of relying on as many individual agreements as possible to add up to a level of landscape protection, through to more proactive – and likely more complex and expensive – options whereby farmers coordinate joint agreements (cAES) and use single environmental management agreements for multiple farm units (Franks and Emery, 2013). However, only a small number of agreements have given neighbouring farmers the opportunity to formally work together to deliver a landscape-scale oriented agreement. Collective agreements are available within ES but are predominantly used for facilitating commons agreements. Collaborative landscape scale management were options (UX1) in Upland ELS (a compulsory management tool for instances where farmers jointly manage stock on common land), and HR8 in HLS, which offered a per hectare supplement for 'group action'. More recently for Countryside Stewardship (CS) Mid-Tier, there are two incentives to encourage farmers to participate in collaborative landscape-scale: a Facilitation Fund which pays for a facilitator; and a Farmer Group incentive; reports concerning this are covered in the Farmer-led section but referred to here.

5.2 Search and screening record

The search and screening results after applying the exclusion and inclusion criteria are presented in Table 6. The detailed search and screening record (the search database) is attached as an excel spreadsheet.

Table 6: Search and screening record for cAES

	Results of Phase 1			Results of Phase 2 WOS and GS merged to remove duplicates
	hits	not relevant	relevant or unclear	
Web of Science	258	223	35	Peer reviewed papers = 13 plus 1 additional paper =14
Google Scholar	201	168	33	
Additional papers from another source	N/A	N/A	1	
Grey Literature from other sources	N/A	N/A	5	5

As well as the exclusion and inclusion criteria, some evidence were excluded as they were better suited to one of the REA intervention types.

5.3 The Evidence - volume and characteristics

Evidence was extracted and synthesised from 14 studies located through Web of Science and Google Scholar searches (including 1 paper from another source) and five grey literature reports located through UK organisation website searches and expert suggestions.

The evidence to date addresses challenges and the potential of cAES, and assesses UK farmers' willingness to participate in, or their favourability towards, collaborative AES. This includes barriers to, and opportunities for, incentivising participation, including scheme design and support. They include predominantly academic papers; reports including literature reviews and case study analysis (Davis et al., 2004; Mills et al., 2008, 2011; Nye, 2018); reviews (Jarrett et al., 2016); reflective analyses and summaries (Prager, 2015; Franks, 2019); and a CSFF evaluation (ADAS, 2018). Studies aim to understand participation in existing schemes, like HR8 and CSFF, and in hypothetical schemes. Relatively few farmers were involved in each study, and they tend to focus on case studies in small geographical areas across diverse landscapes. The research is largely qualitative. These studies are not extensive and rarely actually monitor effects on the environment, with the exception of Dutton et al. (2008). This is supported by reports that acknowledge that evidence for wildlife benefits is limited and that more monitoring and evaluation of landscape-scale impacts of AES, individual and collaborative, is required (Jarratt et al., 2016; Franks, 2019; Natural England, 2018). Prager (2015) analyses European experiences and has been included as a summary reference.

The number of actual studies of farmers' views and attitudes are low, as noted in previous reviews. Most research looks at farmers' favourability towards cAES with hypothetical options (Emery and Franks 2012; Riley, 2018) or in other contexts choice experiments (Austin et al., 2014), and modelling to predict the likelihood of farmers joining an AES (Dutton et al., 2008). Qualitative approaches predominate using farmer and other stakeholder interview methods. Some studies apply the Theory of Reasoned Action/Planned Behaviour methodology, with Likert scales looking for factors that might predict intention to join a scheme (Mackenzie et al., 2013; Dutton et al., 2008). Others use in-depth interviews (Riley et al., 2018) and close case study analysis (Mill et al., 2008, 2011) taking a social-cultural approach. Studies tend to include farmers already holding individual agreements or an interest in conservation, where farmers are disposed toward schemes and have supportive networks (Riley 2018; Franks 2016), although exceptions are the case study analysis of Emery and Franks (2012) and McKenzie et al. (2013) who include both AES participants and non-participants. Reviews and case study analysis (Davis et al., 2014; Mills et al., 2008; Jarrett et al., 2016) cover a range of case studies not all cAES.

Evidence with most relevance (which is about cAES) and robustness comes from academic papers where a number of farmers (>30) were interviewed (and/or combined with consultation) (Emery and Franks, 2012; McKenzie et al., 2013; Franks 2016; Riley et al., 2018). However, three complementary papers use the same set of data. Emery and Franks (2012) report analysis of interviews with 32 farmers in three case studies in the UK asking about willingness to participate and looking for predictive factors. McKenzie et al. (2013) draw on the same interviews and add analysis of a UK wide online farmer consultation, while Franks et al. (2016) analyse the same online consultation looking at design features which would positively and negatively influence their decision to participate in a cross-holding AES.

Franks (2019) analyses are ranked high on relevance but mid-range for robustness a due their review nature. Evidence from case studies analysis (Davis et al., 2004; Mills et al., 2008) which includes a range of collective approaches scores slightly lower on relevance to cAES as these reviews cover a number of non cAES initiatives. Reviews summarising findings of UK-based collective action schemes

(Franks 2019; Prager, 2015), while highly relevant, scored lower on robustness as they not produce new data. Franks (2019) identifies components of AES which have the potential to deliver landscape-scale activities and Prager (2015) provides a case study based analysis and synthesis. Their suggestions and recommendations are based on interpretation from wider literature on individual AES participation and general Defra surveys. Both highlight context specificity and suggest that the attitudes and views of non-UK farmers may not form an especially reliable basis upon which to design innovative cross-farm AES for the UK. Two studies provide insights into farmer perceptions of collaboration more widely (Austin et al, 2014; Sutherland et al., 2012) (deer management and organic farming receptively), but their relevance is low.

5.4 Synthesis of findings

The database (systemic map) is attached with full details of the critical appraisal.

Although the majority of farmers studied would at least consider participating in landscape-scale AES, and tend to refer to and acknowledge the potential environmental benefits that collective participation in AES would bring (Franks et al., 2016; Emery and Franks 2012; McKenzie et al., 2013), this finding is from hypothetical studies. Uptake of the two options UX1 and HR8 has been extremely low, whereas CSFF has been more promising (ADAS, 2018). A range of different forms of evidence point to similar conclusions with regard to the following points about willingness, and barriers, to participation. The following key determinants are used to explain land holders' likely participation and engagement in cAES.

5.4.1 Determinants

Farmer factors

- Farmers express willingness to participate and recognise that the landscape approach is important but detail of any proposed scheme is key (Emery and Franks, 2012; Riley et al., 2018; Franks, 2019). Prior experience of AES determines willingness to engage (Austin et al., 2014, Emery and Franks, 2012).
- Farmers' commitment to the environment and belief in the effectiveness of cAES is important, as is their need to be told about potential benefits (Emery and Franks, 2012; Franks 2016).

Farmer relations

- Farmers prefer to work independently with a cultural imperative for independence (Davies et al., 2004; Emery and Franks, 2012; Franks and Emery, 2013; Riley et al., 2018).
- There are concerns about trust between members; the diversity of stakeholders' interests; the enforceability of contracts; possible personal disagreements; and others reneging on aspects of collective agreements (Emery and Franks 2012, Mills et al., 2011; Franks et al., 2016).
- There are concerns about different opinions on conservation (Franks and Emery, 2013). Farmers' general lack of communication about their conservation activities means they find it difficult to assess the conservation efforts of their neighbours (Riley et al., 2018).
- Interpersonal relationships, particularly the issues of trust, rapport and mutual respect are highlighted as important for a cAES to work, as are shared values and beliefs by individual farmers (Davis et al., 2004; Franks, 2011).
- Collective agreements are most likely to work in situations where individuals are well-known to each other or are part of some pre existing local informal social network or organisation (Davies et al., 2004, Mills et al., 2011; Franks and Emery 2013). However, relations are complex and need to be understood as multiple, issue-specific, and temporal. Functional farmer

relations such as shared machinery are not always indicative of participation in cAES (Riley et al., 2018).

- Group governance and effective leadership with committed key individuals has been shown to be important for sustaining collective arrangements (Davis et al., 2004; Mills et al., 2011). Taking account of farming cultures, socio-cultural buy-in and dialogue is important, but also building trust with the institutions facilitating governance processes (Emery and Franks, 2012).

Scheme design and process

- Farmers need adequate financial compensation to participate (Davies et al., 2004; Emery and Franks, 2012; Franks and Emery, 2013).
- The likelihood of farmers collaborating depends on the scheme design and contract arrangements. For applications there are barriers imposed by the rules, terms and conditions attached to cAES application process, its competitiveness, voluntary or compulsory, the options available and how individual farmer's AES payments are made (Davies et al., 2004; Franks and Emery, 2013; Mills et al., 2011; Franks, 2019). Simple options (e.g. maintaining existing hedgerows) are viewed more favourably than extensive or cooperatively demanding land management options (e.g. large-scale habitat creation) (Franks and Emery, 2012; McKenzie et al., 2013; Austin et al., 2014).
- A degree of flexibility in scheme rules, including farmers in developing scheme design, locally targeted and clearly defined aims, and demonstrable benefits that can be monitored as a record of success are all important (Austin et al., 2014; Emery and Franks, 2012; Franks, 2016).
- Success is reliant on development of business and social confidence, on the simultaneous upholding of environmental and production-related values, and on the cAES contributing to the viability of the farm business (Emery and Franks, 2012; Davis et al., 2004; Mills et al., 2011).

Transaction costs

- The number of stakeholders and their range of interests are the major determinants of transaction costs. The availability of finance to help meet the costs of submitting and or managing a collective application is important (Franks, 2019). Mills et al. (2011) agree that costs depend on the capacity and maturity of the group, with higher initial costs for group schemes compared to individual agreements, and lower costs later in the schemes with less government administration due to significantly fewer individual agreement negotiations.
- Coordinated (third party) and negotiated arrangements are preferred but can involve higher initial costs setting up for farmers (Franks, 2016), or for external agencies (although supporting farmers reduces their transaction costs) (Dutton et al., 2008).

Support

- Farmers wish to work with external agencies who understand farming systems and the objectives, needs and priorities of the individual farm business (Davis et al., 2004). They do not trust some government schemes, particularly when they see it as intrusive or bureaucratic (Austin et al., 2014; Mills et al., 2011). Intermediaries/facilitators need to increase the flow of information between farmers, and in particular should understand the detailed historical contexts under which these farming patterns have evolved (Riley et al., 2018).
- Farmers need support from external advisers and facilitators to arrange meetings, lead group development and coordinate the submission of paperwork (Davies et al., 2004; Dutton et al., 2008; Emery and Franks, 2012; Franks and Emery, 2013; Mills et al., 2011).
- Barriers can emerge when there is uncertainty about environmental benefits arising from AES in general, and from landscape scale collective action in particular. Demonstrating and communicating benefits are recommended (Davies et al., 2004; Mills et al., 2011; Austin et al., 2014).

Governance

- Leventon et al. (2017) consider the governance system more widely in terms of barriers to collaboration which create actor fragmentation. Drawing on empirical findings in Germany and Sweden, they argue that 'actor fragmentation' is reinforced by the Common Agricultural Policy (CAP) in three ways: (1) through targeting individual farmers; (2) by creating confusion around coordination roles for increasing numbers of actors; and (3) by failing to engage with barriers to collaboration among farmers. See also Farmer-led section. This resonates with Riley's (2018) observation of a general shift towards individual motivations being promoted.

5.4.2 Outcomes

Few studies provide evidence of outcomes.

Social capital

- Social benefits from collaborative approaches are described qualitatively in terms of enhanced social capital, "a feeling of belonging", collective efficacy and social learning (Nye, 2018; Mills et al., 2008, 2011).

Environmental outcomes

- Environmental gains (water voles and brown hares) were monitored by Dutton et al. (2008). A foraging study review suggests bats, large mammals and some pollinator species will likely benefit from large-scale agri-environment options, while the majority of birds and smaller mammals may be adequately served by the current AES system, but this is not linked to cAES (Mckenzie et al., 2013). In other studies, farmers' observations and beliefs in habitat and environmental gains in Ireland Moor and CSFF respectively (Mills et al., 2008; Nye, 2018) are not supported with evidence.

5.5 Knowledge gaps

- Barriers to uptake are well understood and are similar to those experienced with individual AES in many cases. Knowledge gaps exist in the scope of research (limited numbers and regions) and the depth of qualitative assessment.

- More comprehensive studies of larger cohorts of farmers are needed including AES non participants to confirm suggestions that introducing landscape-scale activities in AES would have farmers' support. Specifically, the link between details of any proposed scheme and potential uptake needs further exploration.

- The absence of evidence to support claims and suggestions of environmental and natural resources benefits needs addressing. As farmers are incentivised by such evidence or demonstration of effectiveness, this would contribute to uptake.

6. Farmer-led landscape scale groups

6.1 Introduction

Farmer-led groups in this section are characterised by active engagement methods and involve farmer-farmer dialogue and exchange of information, as opposed to passive co-operation groups which are initiated and coordinated by third party interactions (Franks, 2019). They include genuinely farmer- initiated and -led groups and facilitated groups.

Landscape-scale farmer groups or farm clusters are described as bottom-up, farmer-led groups of individuals who, facilitated by an environmental adviser, coordinate their efforts to conserve nature and deliver public goods across their holdings. The farm cluster concept – whereby farm conservation is progressed by neighbouring farmers working together in a group – was initially developed by the Game and Wildlife Conservation Trust (GWCT) in association with Natural England (the inception of clusters was the farmer-led Marlborough Downs Space for Nature initiative in 2012). Most clusters are supported by Countryside Stewardship Scheme Facilitation Fund (CSFF), a competitive fund provided by Natural England which seeks to support 'people and organisations that bring farmers, foresters and other land managers together to improve the local natural environment at a landscape scale'. The CSFF gives particular preference to people and organisations employing more 'active' engagement methods, demonstrating 'partnership and a collective approach across holdings' (Natural England, 2017). Others are privately funded, for example in the South Downs National Park one farm cluster is supported by Portsmouth Water, or self-funded by farmer groups. CSFF has been running for three years and has some 98 groups.

There are many examples of bottom-up farmer groups (i.e. not supported by AES) across the farming and rural community. These groups take different forms and have tended to look for local and regional funding and administrative support. Two extensive reviews in Scotland (Boulton et al., 2013; Davis et al., 2004) concluded that, although there are a large number of bottom-up collaborative initiatives which deliver private benefit to land managers (for example producer groups, machinery rings, discussion groups), there are very few examples of bottom-up initiatives designed to deliver public benefits. A recent UK survey assessing the extent of collaboration showed preferences for informal forms of collaboration markedly outweighed those for formal collaboration (Wynne Jones et al., 2019). Other collaborative models include farmer-led innovation networks (such as Innovative Farmers, AHDB Monitor farms, and operational groups across Europe), which have been widely supported and facilitated to different extents by partnerships, levy and RDP funds in recognition that peer-peer learning is important for farmers in achieving sustainable and productive agriculture.

There are examples from other countries of farmer-led groups seeking environmental outcomes, such as the German Landcare (Prager and Vanclay, 2010). Most prominent are the Dutch Environmental Co-operatives - local organisations of farmers and often non-farmers who work in close collaboration with each other and with local, regional and national agencies to integrate nature management into farming practices. They represent a model of bottom-up, locally orientated voluntary membership group (self-help) but there is no equivalent in the UK. These local environmental cooperatives are of interest for their institutional structures, which have been developed to support collective action towards agri-environmental goals and are often mentioned as good examples of self-governance (van Dijk et al., 2015).

This section also refers to governance with respect to farmer groups and more widely in the context of cAES and landscape scale management.

6.2 Search and screening record

The search and screening results after applying the exclusion and inclusion criteria are presented in Table 7. The detailed search and screening record (the search database) is attached as an excel spreadsheet.

Table 7: Search and screening record for farmer-led landscape scale groups

	Results of Phase 1			Results of Phase 2 WOS and GS merged to remove duplicates
	hits	not relevant	relevant or unclear	
Web of Science	121	115	6	Peer reviewed papers = 7 plus 9 additional papers = 16
Google Scholar	121	96	25	
Additional papers from another source	9	N/A	9	
Grey Literature from other sources	N/A	N/A	11	11

As well as the exclusion and inclusion criteria some evidence were excluded as they were better suited to one of the REA intervention types.

6.3 The Evidence - volume and characteristics

Evidence was extracted and synthesised from 16 studies located through Web of Science and Google Scholar searches (including 9 papers from another source) and 11 grey literature reports located through UK organisation website searches and expert suggestions.

The volume of evidence is not extensive for this topic and the research is largely qualitative. Evidence was extracted from three main sources. First, evidence from evaluation reports of CSFF (Phase 1 and 2) (ADAS, 2018; Jones et al., 2020) and from selected CSFF (Nye, 2018; Fresnay, 2017; Cumulus, 2013; Manning, 2017). Second, case study analysis and evaluation of Pontbren farmers in Wales (three pieces of evidence) (Mills et al., 2009; WRO, 2013; Woodland Trust, 2013), supported by peer reviewed papers (Mills et al., 2001; Wynne Jones, 2017), the latter theoretical. The third source comprises peer reviewed papers concerning Environmental Cooperatives in the Netherlands. This is included as it represents a body of relevant peer reviewed literature, although the same data is used (Franks and Gloin 2007a,b; Franks, 2011) and van Djik et al. (2015).

Relatively few farmers were involved in each study, which tend to focus on case studies in small geographical areas and specific contexts. There is an emphasis on farmer relations, governance, support and concerning the establishment and facilitation of groups; and behavioural, social capital aspects. Some evidence is presented for impacts such as learning and some limited evidence for environmental benefits. The recent CSFF evaluation provides comprehensive evidence about the value of facilitation and social benefits drawing on 28 case studies (Jones et al., 2020).

The three sources of evidence, whilst scoring high on relevance, score mainly medium (2) for robustness due to the small numbers of respondents, and case study analysis of the same groups in Pontbren and in the ECs. Other supporting evidence include a study from Italy (included due to its

relevance) where famers have been involved in scheme design (Toderi et al., 2017), and a survey and case study analysis of collaborative initiatives capturing informal modes of mutual aid and resource sharing in general in the UK (Wynne Jones et al., 2019). These are robust but of medium relevance. As such all evidence has a combined rating of 5 but for different reasons.

6.4 Synthesis of findings

The database (systemic map) is attached with full details of the critical appraisal.

A range of different forms of evidence point to similar conclusions with regard to the following points about what works and why with respect to farmer-led groups at landscape scale. Whilst the evidence is drawn from different contexts, for example the unique situation of Pontbren farmers, and the EC which represent institutional arrangements specific to the Netherlands, the studies do show some complementarity and reinforcement in findings. The term 'groups' is used here to refer to both farmer-led and facilitated groups.

6.4.1 Determinants

Farmer factors

- Farmers who are members of a group, or who join CSFF groups, are motivated by interest in the environment, as evidenced in all Pontbren studies and all CSFF evaluations. Farmers tend to prioritise biodiversity over natural resources. For example, for the Marlborough Downs the most popular topics for further information were habitat management and downland species (Fresnay, 2017). For EC, farmer intentions were linked to different social factors showing that social pressure, self-identity and facilitation by the EC relate to the intention of farmers for the protection of meadow birds, while attitude and perceived personal ability to participate are associated with the intention of farmers to participate in ditch bank management (van Dijk et al., 2015). A study of 28 case studies found that a large proportion of AES were already in place at CSFF group formation, reflecting the pre-existing interest in conservation (Jones et al., 2020). The bottom-up / evolved impetus for Deer Management Groups stems from considerable private interest in deer management (Boulton et al., 2013).
- Studies of Pontbren farmers all agree that key individuals with the skills and determination to move the group forward are important. They initially invested much of their own time and resources in making the group a success.

Farmer relations

- Evidence agrees that pre-existing networks, social capital, shared values and trust are important for engagement and predispose farmers to work together and learn from each other (Franks 2011; Mills et al., 2008; WRO, 2013; Manning, 2017; Boulton et al., 2013). For EC this is depicted as a shared cultural readiness to adopt or comply with AES, based on collective working which can be supported by appropriate governance structures (Franks and Gloin 2007a,b). Prager et al. (2012) and Prager (2015) also point towards social capital development and 'genuine participation' across multiple levels, including 'front-loading' stakeholder participation in the design of measures as a basis for more durable decisions, based on cooperation and trust built through the process. Evidence from a UK survey where social factors were perceived as the most important enabler for collaborative working in all contexts support this (Wynne Jones et al., 2019). In a catchment study, Southern et al. (2011) found that leading farmers and advisers in demonstrating successful implementation of cross-boundary working encouraged and reassured others of how it can work in practice. This shows the influence of reputation in agriculture (e.g. in the context of 'good farming').

- Although farmer collaboration is underpinned by a strong sense of mutual interdependence (Wynne Jones et al., 2019), this does not always equate to social capital. Some authors 'unpack' social capital. Riley et al. (2018) see farmers engaging across boundaries as more ad hoc and not necessarily associated with building human, social and cultural capitals while Wynne Jones (2017) examines farmers' changing sense of self in this context.

Scheme design and process

- With respect to non-AES grants, farmer groups appreciate the flexibility and autonomy afforded to them, as in Pontbren. This is aligned to their desire for independence and their frustrations with administrative and regulatory burdens (Mills et al., 2011; WRO, 2013; Boulton et al., 2013). Flexibility in design is also rated highly for CSFF in Dartmoor Farming Futures (DFF) (Cumulus, 2013; Manning, 2017).
- Aligned to this appreciation of flexibility is the value of farmers' involvement in design, which is widely reported for CSFF. This is supported by Toderi et al. (2017) who agree that the farmers' role in designing their own measures favours the flow of local knowledge and can create site-specific AES with a landscape dimension. Studies agree that involvement needs to be from the beginning and continued throughout the project. It also needs to be extended to other stakeholders (Manning, 2017; Toderi et al., 2017).
- The importance of inclusiveness and the need to engage with all rights holders was noted for DFF. However there are also issues of exclusivity, for farmers who did not join DFF, they remarked that they did not know about it or have no time to be involved (Cumulus, 2013; Manning, 2017). Pontbren farmers are a small kinship group with small exclusive membership, which has not expanded.
- In a desk study, applying a framework based on key characteristics from an assessment of previous AES to CSFF, Franks (2019) identifies several design revisions which could widen the appeal of FF: reducing the restriction on the number of farmers and the area of farmed land necessary to form a Farmer Group; better targeting of collective action incentives; making non-refundable payments to help facilitators bring farmer groups together; offering varying and longer duration agreements; providing farmers with additional non-financial incentives; and increasing compensation payments, perhaps on the basis that collective actions are likely to increase environmental benefits.

Transaction costs

- There is agreement in studies of EC that collective contracts can reduce transaction costs for farmers and benefit the government by lowering public transaction costs. For farmers, EC helps by countering the 'hold-up', 'assurance' and 'incomplete contract' problems (Franks, 2011; Franks and Glooin, 2007a). Franks (2011) sees government cost of compensation (e.g. to support and help buy in extra advice) as justified, arguing that ECs are cost and ecologically effective and increase participation rates as well as frame decisions in ways that shift attitudes, values and aspirations among members. However, Mills et al. (2011) point out that costs depend on the capacity and maturity of the group, and that there are higher initial costs if group schemes rather than individual agreements have to be negotiated. Mills et al. (2012) note that bottom-up groups are more cost effective,e as costly monitoring and enforcement are not needed when farmers are committed.

Support

- Farmer-led groups, who follow the Pontbren model, need access to the services of skilled facilitators and technical advisers who understand the objectives of the farm business and environmental needs and can provide the group with ideas and advice on securing funding and steer them through bureaucratic hurdles (Mills et al., 2011; WRO, 2007; Woodland Trust, 2013). For the Deer Management Groups this only requires a relatively small amount of

support and facilitation to help utilise an existing and motivated network of land managers (Boulton et al., 2013). For CSFF, training plays an important role as noted below.

- The role of ECs in supporting and increasing participation rates was noted. EC do this by providing trusted and clear information about choices, carefully explaining scheme options and their farm management implications, and offering to co-ordinate submissions. In this way, they are able to impose a degree of peer pressure and influence and change farmers' attitudes.
- Drawing on 28 case studies, Jones et al. (2020) concluded that facilitation is shown to be critical to CSFF groups in organising and maintaining the momentum of the group, involving the whole group in decision making, building trusted relationships and shared responsibility and linking to other organisations. Technical expertise and skilled facilitation is pointed out as important, as well as an understanding of both the farm business and environmental objectives.

Governance

- Although governance arrangements differ, there is coherence in the evidence from all studies that farmers appreciate a sense of control over and ownership of projects, and in finding their own solutions within the group. Instilling autonomy and enabling groups of farmers to determine the allocation of costs and activities amongst themselves is also important (Prager, 2015). Facilitation can enhance this (Jones et al., 2020).
- The establishment of a collaborative group takes time (10 years) (Mill et al., 2008). Group leadership is important. In the Forest areas of DFF, collective management enabled leadership to emerge (Manning, 2017). For EC it is difficult to identify people with the experience and reputation needed to gain the support of members and the local and national organisations.
- Co-management governance arrangements can bring about a change in roles with a shift from the passive role of farmers from 'implementors of AEMs' to the active role of 'AEM designers', while external agencies became supporters of the participatory process. Trust and engagement are important when transferring responsibility in groups.
- EC represent a new type of flexible institution between the state and agriculture that step away from centrally imposed, generic policy measures, towards the increased use of farmer-based solutions to deliver environmental improvements. EC have a role in co-ordinating joint submissions, managing scheme payments and monitoring progress towards achieving environmental output targets (Franks and Gloin, 2007b). In terms of initiating groups, the EC model understands that the emphasis must be on farmers and other rural dwellers taking the initiative and forming community of interest groups. The Ministry then assists EC to overcome key hurdles (such as start-up costs). The EC constitutions are seen to help embed similar values among members and so help develop groups characterised by fair-mindedness and trustworthiness (Franks, 2011).
- Nye (2018) distinguishes three modes of governance in 9 farmer groups studied (private and CSFF): Farmer-led (small, facilitator facilitates rather than manages); Farmer-led with a board (larger groups but bottom-up with broader stakeholders); Organisation-led (larger group with an agenda already in place). Different pathways to, and interpretation of, 'bottom-up' were described.
- Concerning governance more generally, while moving governance tasks to farmers' groups implies self-governance by the group with respect to a number of tasks, Westerink et al. (2015) show (in a study in the Netherlands) that government is still responsible for setting goals and evaluating effectiveness; and the bureaucracy this introduces restricts uptake. In another study, in 4 out of 5 European collaborative AES case studies, farmer groups became involved in the performance of more governance tasks over time but in all cases a professional(ised) organisation (governmental organisation or a group of farmers) was

responsible for spatial coordination, possibly due to the complexities inherent to a landscape approach (Westerink et al., 2017).

6.4.2 Outcomes

Social capital

- For CSFF members, they appreciate being part of a group and the social interactions that it provides (Fresnay, 2017; Manning, 2017). The mutually supportive culture provided by group membership is highly valued by individuals (Mills et al., 2011). Wynne Jones et al. (2019) agree that social outcomes arising from collaboration provide important feedback back into farmers' motivations to undertake activities. Farmers also appreciate an enhanced public image as reported for EC and CSFF (Franks, 2011; Jones et al., 2020).
- Improved knowledge exchange and learning in CSFF are linked to improvements in social capital, including collaborative working, motivation, information sharing, awareness, ownership, ability and confidence in addressing environmental issues, social interaction and trust (Jones et al., 2020). Social/personal connections, learning and working together towards environmental outcomes were noted as dependent on the existence of the Facilitation Fund (Jones et al., 2020).

Learning

- The evidence concurs that participants in groups find it a positive learning experience. Participating commoners in DFF feel that they have a greater awareness of the key habitats, species and other environmental features on their common (Manning, 2017; Cumulus, 2013). In line with this, the Marlborough Down study found that gaining knowledge and contributing to improve the natural and farm environment were the two most highly appreciated aspects. Where members see directly the results of their actions, this is rewarding and increases their knowledge about the farm environment, which is an incentive to continue with project (Fresnay, 2017). The recent CSFF evaluation also reports greater confidence of land managers, both in understanding environmental value of habitats/features and in their ability to deliver appropriate management (Jones et al., 2020). Reviews of Pontbren farmers agree that farmers have learnt a lot from the project, and their attitudes and behaviour have changed in some areas (particularly in relation to stocking densities and their understanding of catchment hydrology) but not necessarily their fundamental values and behaviours (WRO, 2013). The farmers appreciate their collective efficacy (Mills et al., 2011).
- Learning is supported by training, which is highlighted as beneficial for CSFF (Manning, 2017). Training has enabled group members to learn skills to be able to manage different habitats and allowed for members to share best practice, ideas etc. (Jones et al., 2020). For DFF, commoners' training and monitoring were highlighted as impactful, with a greater increase in understanding of the connections between their management decisions and the desired environmental outcomes in the Forest pilot area compared to the Haytor/Bagtor area. This was attributed to self-monitoring in the former area, whereas in the latter there is no biological SSSI and monitoring is largely undertaken by third party bodies, with little direct involvement from the commoners.

Environmental outcomes

- Evidence of environmental benefits, although not reported in many of the studies reviewed, is inferred. For the DFF evaluations, although no evidence is presented, there are indications that environmental improvements will be achieved. Both commoners and stakeholders were positive about the ability of DFF to deliver the full range of environmental benefits as set out in the outcomes for each area of common. There was a general consensus that the greatest

environmental impacts would arise in relation to food production, management of natural habitats and biodiversity, fire prevention and management of archaeological sites (Manning, 2017). Commoners and stakeholders agree that they expected the environmental benefits under the DFF approach would be higher under DFF than under ESA or HLS alone. They attributed this to improved understanding and ownership and the wider range of environmental services being delivered, amongst other things (Manning, 2017). Similarly with the Marlborough Down group biodiversity is seen as a success; farmers referred to the Farmland Bird Programme, which has shown increasing bird populations in the area (Fresnay, 2017).

- Facilitation is seen as important in achieving environmental (and other objectives) and added value. A high level comparison of agreement level option uptake in and out of CSFF groups indicated that option richness and option diversity were significantly greater in facilitated agreements This suggested that facilitated agreements were more complex (Jones et al., 2020). With respect to spatial coherence of options for biodiversity, results indicate an overall positive contribution of the CSFF with potential to improve connectivity for some specific species groups such as pollinators, granivorous birds and waders (Jones et al., 2020). For alignment of options which mitigate water quality issues and flood risk, the outputs vary but demonstrate some positive alignment of AES options with areas of higher risk for water quality and flooding.
- For EC, improved environment is inferred (as there is no counterfactual) by uptake and speed of processing and quality of submissions and farmer participation. It is agreed that outputs need to be observable, measurable and directly correlated with environmental goods. Farmers need to trust those tasked with making these measurements, and EC have played a key role in underpinning this trust (Franks, 2011; Franks and Gloin, 2007a,b).
- For Pontbren farmers, biodiversity and hydrological benefits have been monitored and demonstrated, and these were attributed to the significant numbers of native broadleaf trees planted, length of hedgerow regenerated and new ponds created (WRO, 2013; Woodland Trust, 2013).

Economic outcomes

- There are is no strong evidence provided about farmer economic benefits of participation in these groups. Farmers reported no economic benefits or disadvantages to joining DFF (Manning, 2017). From a different perspective, Pontbren studies agree that it is possible to work with farmers' production priorities and that destocking occurred with benefits to hydrology and environment but no loss to income.
- Both Pontbren and EC participants discussed the economic benefits and additional income streams, which for EC farmers increased business profitability for the farmers involved (Franks, 2011). Pontbren farmers were also able to leverage resources, diversification opportunities, and funding through the group's enhanced lobbying power.
- Mills et al. (2011) also noted the multiplier effect of Pontbren in which a lot of the project funding has gone to local contractors and suppliers.

6.5 Knowledge gaps

- Knowledge gaps exist in the scope of research (limited numbers of studies and small cases) for genuinely farmer-led groups. These limitations reflect the small number of farmer-initiated groups that are concerned with the public goods and environmental outcomes in the UK. Evidence to date still appears to come largely from Pontbren, which is context specific.
- With respect to facilitated groups, as the CSFF programme develops more data will be available to monitor benefits. Based on a comprehensive evaluation framework, this will provide rigorous evidence both for social and environmental indicators.

- The nature of the relationship between certain determinants (governance, support) and outcomes (social and environmental) needs to be further explored.
- Whilst determinants of participation in groups have been explored, less attention has been paid to non-participation in such groups.

7. Summary of findings

The REA set out to review the strength of evidence for which collaborative mechanisms and incentives 'work' in terms of achieving social, environmental outcomes at large spatial scales. This was done for each of four intervention types reported in sections 3-6. This section draws out the commonalities in terms of the volume and characteristics and strength of the evidence.

7.1 The Evidence - volume and characteristics

The main types of evidence available are: Peer reviewed papers and grey literature evaluation and research reports. Studies draw on social science and economics methods and include: literature reviews, qualitative studies (case studies and interviews) with some quantitative surveys**.** Peer reviewed papers also include, hypothetical studies, simulation and modelling, and cross case analysis combined with theoretical development. Where reported, quantitative techniques are used for monitoring and evaluating environmental change.

The evidence characteristics reflect the different bodies of literature that have developed for each intervention type. It also reflects the different stages of establishment of the interventions.

For Coordinated large-scale conservation interventions there is a range of evidence including a small number of peer reviewed papers from UK and European contexts and a larger number of research and evaluations reports which tend to generalise from case study approaches and small numbers of evaluation interviews. This reflects the fragmented nature of these approaches and their relatively recent implementation compared for example to the comprehensive evaluations of the longer established CFS farming approaches.

For Payments and incentives, the majority of the peer reviewed papers come from economic studies with the methodology applied being largely experimental involving simulation and modelling. Given the narrow range and small-scale nature of experiences in UK with auctions, group supplements and bonus payments, evidence is still limited to evaluations of small-scale initiatives (grey literature). Most studies tend to assess determinants, performance in efficiency and economic terms, rather than environmental or other outcomes. This evidence is commensurate with the fact that these payment interventions are new or untested in UK contexts.

For both Collaborative AES and Farmer-led interventions, the volume of evidence is not extensive. The research is largely qualitative with some quantitative surveys. Relatively few farmers are involved in each study, and they tend to focus on case studies in small geographical areas across diverse landscapes. The number of actual studies of participation are low. Overall there is an emphasis on determinants. For cAES these are factors affecting farmer participation while for Farmer-led, these are process factors such as farmer relations, governance, support and the establishment and facilitation of groups, and behavioural, social capital aspects. Environmental, economic and social outcomes are not commonly reported. The evidence reflects the fact that cAES has been a topic of interest since early 2000s, while CSFF farmer-led evidence is relatively recent.

7.2 The strength of evidence

The strength of evidence is assessed using three components: relevance scoring, robustness scoring and consensus.

Relevance scoring in general are in the range 2-3 in terms of answering the main REA question due to earlier screening which removed non-relevant evidence. Studies with only marginal relevance to the REA question and supporting studies from non-UK contexts were scored low (1).

Robustness scores tend to be around the mid-range (2). Maximum scores (3) were rarely given as qualitative methods commonly used small sample sizes or content specific case studies, or (together with economic methods) included hypothetical or modelling approaches. No evidence in the grey literature was scored above 2 dues to absence of peer review.

Combined scores range from 2-6, with most in the range 4-5. This allowed a hierarchy of evidence so that most weight was given in the synthesis to higher scores. Consensus among studies was used to complement the combined score and to allow weight to be given where there was a supporting body of evidence.

When taken together these (combined scoring and consensus) provide a weight of evidence that allowed us to judge the overall strength of evidence. This was used to derive the factors and direct the synthesis.

7.3 Synthesis of findings – what the evidence indicates

In the synthesis we explored what the evidence indicates about effectiveness for each intervention type.

Two categories, *Determinants* and *Outcomes* and their component factors, which were most commonly reported in the evidence, were identified iteratively. These reflect the key characteristics or indicators being reported in the evidence reviewed. When viewed together these factors provide a weight of evidence that allows us to judge the overall success of interventions. These are detailed for each intervention in sections 3-6.

These factors can provide insights into how 'joined-up' approaches can be supported or incentivised in the ELM Scheme. This section provides a summary of key determining factors affecting the success of the interventions reviewed, as well as the main outcomes reported. Cross-cutting factors as well as those that are specific to particular approaches are identified.

7.3.1 Determinants

Determinants have been grouped where there are cross cutting factors.

Farmer factors

- Factors such as farmers' positive attitudes towards the environment, and scheme design (favouring less-demanding options and objecting to bureaucratic processes), already known to be important in individual AES participation, are equally relevant to cAES. For farmer-led and cAES interventions, a pre-existing interest in conservation or participation in a scheme predisposes farmers to join collaborative schemes and groups such as CSFF. This is also demonstrated for CSF. For all intervention types (except payments and incentives) there is evidence that demonstrable benefits persuade farmers to participate.
- Farmers appear to express willingness to participate in cAES and recognise that the landscape approach is important but the detail of any proposed collaborative arrangement is key. For example, the rules, terms and conditions attached to a cAES application process, its competitiveness, voluntary or compulsory, and the options available and the flexibility interact with motivations and influence decisions about participation. Some evidence suggest that farmers prefer coordinated third party arrangements if they provide support, as this lowers their transaction costs.

- Farmers are described as culturally disposed to working independently, and it is argued that the context of 'actor fragmentation' and a shift towards individualism reinforces this. There is evidence of farmers entering multiple collaborative arrangements, although this is not always indicative of engagement in collaborative approaches.

Lessons for ELMs: For tiers 2 and 3 build on existing interest in the environment by targeting farmers already in AES but be aware that acting on this motivation is contingent on approach design and delivery.

Design - scheme, payment and partnerships

Factors relevant to design and delivery of schemes, payments mechanisms and the creation and delivery of partnerships are cross cutting:

- As with single AES, scheme design (the application process in terms of eligibility, the rules, terms and conditions, its competitiveness), the options available, the nature of the contract, and how it is delivered are all important issues. This also applies to other instruments.
- Online trading tools for auctions have attracted land managers who had previously not engaged in agri-environment activity (e.g. half of participants in Tamar trial) as they are less bureaucratic, however adviser support was essential.
- Evidence for different payment mechanisms shows the complexity of each situation. The bidding process in auctions is particularly challenging and those delivering auctions may struggle to find the right structure for incentivsing different, particularly complex, environmental management. Also, payment mechanisms need clear, comparable outcomes. For auctions the challenge lies in the ability to effectively compare the benefits of different bids. This can limit their application to specific areas where these can be measured (see trade-offs)
- Coordinated landscape approaches need to allow for clear target setting and effective baseline data gathering and for establishing clear monitoring and evaluation programmes from the beginning.

Lesson for ELMs:

Design of schemes and mechanisms influences participation, complexity is a barrier to uptake

Mechanisms need to adapt to deal with different and complex situations

Establish clear metrics for monitoring and evaluation programmes and for comparable outcomes for auctions

Relationship building

The following factors concern relationship building and are cross cutting across all interventions:

Farmer relations

- Pre-existing networks are important for engagement and predispose farmers to work together, this has been shown for farmer-led initiatives, cAES and for payment mechanisms. Collective agreements are more likely to work in situations where individuals are well-known to each other or are part of some pre-existing organisation. Trust is an important determinant of success in all intervention types. This has been demonstrated for payment mechanisms where familiarity is important. In auctions, issues of trust arise when one landowner's reward

is contingent upon his neighbour's behaviour, while for agglomeration payments to work, land-owners needed to co-ordinate with each other about side payments.
- Shared values and trust (social capital) for cAES and farmer-led approaches has been shown to be important in motivating and enhancing collaboration. Equally absence of social capital can be a barrier to collaboration.
- Voluntary groups (e.g. catchment groups, Deer Management Group) and non-AES farmer groups value their autonomy but may offer an entry point for new schemes.

Partnership creation and relationship building, and process

- Coordinated landscape approaches require investment in relationship building. Here as with other interventions, trust in coordinating organisations and between partners is crucial in creating and maintaining strong relationships but takes time. Building on local knowledge and existing relationships and networks can be effective. Engaging stakeholders and partners from the beginning of the project is important.

Lessons for ELMs:

Build on pre-existing networks and projects and target, facilitate and support existing groups which already demonstrate some level of social capital. Where these conditions do not exist there may be a need for pre-engagement activities to begin to build trusted relationships.

Inclusivity and involvement in design

The following factors concern inclusivity, this is a cross cutting factor across all interventions:

Scheme design - farmers' involvement

- The value of farmers' involvement in project or scheme design is widely reported for farmer-led approaches and for cAES. Involving famers and other stakeholders from the beginning is important. Participation in objectives setting and planning has been shown to lead to greater commitment and understanding, as evidenced for CSFF. For agglomeration bonuses the joint development of a target plan and selection process (target and index species) increased the awareness of farmers about the value of biodiversity and provided the possibility of a mutual learning process about conservation measures. For cAES, locally targeted and clearly defined aims are important and demonstrable benefits that can be monitored as a record of success are all important. For cAES and farmer-led approaches a degree of flexibility in scheme rules is highly valued.

Partnership creation and relationships

- Collective design is valued in coordinated landscape approaches and partnerships able to jointly set out clear, appropriate objectives that work towards a common vision have a better chance of success.

Lesson for ELMs:

Involve farmers in project or scheme design and partners in coordinated approaches in joint target and objective setting. Recognise that this may require a longer lead-in period before interventions can be delivered on the ground.

Governance

Governance is a cross cutting factor across all interventions, although each intervention type has a particular approach or challenge:

- Although governance arrangements differ, there is coherence in the evidence from all studies that when farmers engage in farmer-led projects they appreciate a sense of control over and ownership. Non-AES farmer groups in particular value the flexibility and autonomy afforded to them. Farmer-led groups take time to establish, and finding a suitable leader is important. Group governance and effective leadership with committed key individuals has been shown to be important for sustaining collective arrangements.
- Clear governance, transparent working and decision making are needed in large-scale coordinated schemes but there are institutional challenges associated with managing large partnerships. There is a strong consensus that having a project coordinator is essential to success in large-scale coordinated schemes.

Lesson for ELMs:

Farmers appreciate a sense of control but take time to establish groups and governance processes.

Large-scale coordinated schemes face institutional challenges. There are costs associated with addressing these.

Support

- All interventions benefit from facilitation. For cAES, farmers need support from external advisers and facilitators to arrange meetings, lead group development and coordinate the submission of paperwork. Farmer-led groups need access to the services of skilled facilitators and technical advisers. Facilitation is shown to be critical to CSFF groups in organising and maintaining the momentum of the group, involving the whole group in decision making, building trusted relationships and shared responsibility and linking to other organisations. Technical expertise and skilled facilitation are important as well as an understanding of both the farm business and environmental objectives.
- Facilitation is also key in the functioning of coordinated approaches and crucial to engaging farmers and the community in catchment approaches such as CaBA and CSF.
- Equally for payment mechanisms, facilitation and support are important in the initial delivery and recruitment stage. Early negotiations of group supplement require a degree of facilitation, while adviser support was essential to complement the online trading tools in the UK (Tamar trial and Poole Harbour).

Lesson for ELMs:

Facilitators are important but play different roles and accordingly need to have a number of attributes (expertise, skills, mediation). It would be beneficial to bring groups of facilitators together to share common experiences, best practice, challenges etc. They know a lot about 'what works'.

Cost effectiveness

- A body of evidence concurs that both auctions and agglomeration payments are more cost-effective than standard first-come first served flat rate payment schemes, however, there are caveats. The former needs sufficient uptake, while the latter approach works best for small

conservation budgets and possibly for single species. This suggests a one size fits all approach is inappropriate.

- For farmer-led approaches like EC in the Netherlands there is agreement that collective contracts can both reduce transaction costs for farmers and benefit the government by lowering public transaction costs. For coordinated (third party) and negotiated arrangements the cost depends on the level of support offered to the farmer, more support reduces farmer transaction costs but increases costs for external agencies.

Lesson for ELMs: Achieving cost effective delivery depends on approach taken and context. A farmer-led approach does not automatically translate into cost savings overall.

7.3.2 Outcomes

Social capital

- For some intervention types the process of bringing people together for negotiation can bring about social benefits. In one example, the process of negotiating both group agreements and a series of agreements to which a group supplement is applied resulted in improved social cohesion or a reinvigorated traditional management structure.
- For cAES and farmer-led approaches the mutually supportive culture (a feeling of belonging) provided by group membership is highly valued by individuals and provides a sense of collective efficacy, leading to positive feedback.
- Social and personal connections, learning and working together towards environmental outcomes can be fostered by AES, as evidenced for CSFF.
- There is some evidence from coordinated approaches and agglomeration bonuses that social norms can be shifted, that farmers learn from their neighbours resulting in a 'neighbourhood nudge effect'. Using leading farmers as demonstrators in catchments has proved effective way of utilising this peer pressure.

Lesson for ELMs:

Fostering social and personal connections, and enable learning and working together can be effective

Recognise the value of positive peer influences and the ability of interventions to shift social norms or nudge neighbouring farmers to participate

Learning

- Involvement in farmer-led groups such as CSFF and EC can be a positive learning experience, increasing awareness and understanding of the environment. This is enhanced when farmers are involved in scheme/project design, monitoring and training. The expectation of environmental benefits is greater under the CSFF compared to other schemes and this is attributed this to involvement and improved understanding.

Lesson for ELMs: Participation in farmer groups can increase understanding of the environment

Environmental gains

- CSF's significant progress in delivering its water quality objectives is linked to strong farmer engagement and advice. Evidence from surveys show that participating farmers are very

positive about their experiences and believe their activities are impacting water quality. Taken together these suggest a strong causal link.

- Indications are that for CSFF groups, option richness and option diversity are greater in facilitated agreements than single AES ones, also that facilitated agreements were more complex, with the potential to improve connectivity for some specific species groups. There is a direct link drawn between these indications and the learning, monitoring and training of the CSFF.

Lesson for ELMs: Facilitation, monitoring and training in farmer groups (CSFF) can be effective in adding value beyond single AES

7.3.3 Trade-offs

The REA revealed some interesting trade-offs and balances in these factors which may have some bearing on ELMs delivery.

With respect to governance it is noted that while farmers value autonomy and can carry out some form of self-governance effectively, often the state still needs to be responsible for setting goals and evaluating effectiveness which introduces bureaucracy. There is balance to be drawn between offering farmers ownership, which can enhance uptake, while maintaining some degree of control which itself may restrict uptake (Westerink et al., 2015).

In line with this it, is argued that for coordinated approaches strategic planning need not restrict flexibility to respond to emerging opportunities throughout the project. The National Trust (2017) argues that systematic planning should be combined with "pragmatic responses to opportunities and local interests". Equally in the design of monitoring and evaluation frameworks Natural England (2015, p.4) argue that "a balance is needed between national consistency and some local flexibility".

Scheme and payment mechanism design and delivery needs to find the right structure for incentivising different spatial coordination, avoiding complex application processes. Simplifying processes can make demands on other supporting services, for example, when auctions are delivered using online tools they are popular but farmers required additional support from advisers.

A further tension was highlighted by Runhaar and Polman (2018) with respect to the extent of learning achieved by participating in Birdlife, a coordinated approach. They note that these approaches attract highly motivated and knowledgeable farmers but that because of this there is only a modest contribution to their knowledge about conservation from participating, compared to other farmers. This raises a question about who to target and recruit.

For auctions, it is agreed that adapting auctions to address ecosystem services at the landscape scale requires an auction mechanism which can promote coordination while maintaining competition. Trade-offs between promoting coordination over multiple rounds and minimising collusion and learned strategic behaviour have to be considered (Reeson et al.2011). Information increases competition and improves cost efficiency of the auction but needs to be managed (Elliott et al., 2015).

Evidence for both auctions and agglomeration bonus indicates that whilst they can be more successful in terms of participation and cost effectiveness than regular AES, this can be at the expense of environmental gains, and trade-offs are needed where specific spatial patterns are required. Also agglomeration bonus leads to higher ecological benefits but it can also lead to higher costs (Dreschler et al., 2010). Context is also important for auctions, they might be preferred for large-scale schemes,

particularly where there is little detailed local knowledge of a region through which farms can be effectively targeted.

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Appendix 1 Glossary

Bottom-up approach- Impetus comes from and is maintained by land managers who communicate with each other and organise themselves (Boulton et al., 2013).

Catchment based approach (CaBA) is an integrated catchment management initiative defined as being able to offer a 'more locally focused decision making and action' framework to support 'improvements to the water environment and support river basin management planning as part of WFD activities (Defra, 2013).

Collaborative approach - Land managers need to engage with each other for the project to deliver its desired outcomes. They meet, work together and maintain a dialogue. Collaboration usually refers to a bottom-up approach where land managers communicate with each other and organise themselves (Boulton et al., 2013, Prager, 2015).

Collaborative management refers to the collaboration among land managers who are involved in actually carrying out management activities on-the-ground.

Collaborative governance refers to the involvement of governmental and non-governmental actors in the processes and structures of decision making and management at the scheme level.

Collective action —a set of actions taken by a group of farmers, often in conjunction with other people and organisations, acting together in order to tackle local agri-environmental issues (Uetake, 2013).

Co-ordination -land managers working towards the same objective but in isolation. Joint working between participants is not necessary for the project to deliver its desired outcomes. External facilitation is a common feature of this approach. Co-ordination usually describes a top-down hierarchical management approach where land managers are organised and directed by a third party (a project officer for example) (Boulton et al., 2013; Prager, 2015).

Landscape-scale- refers to action that covers a large spatial scale, usually addressing a range of ecosystem processes, conservation objectives and land use (Defra, 2011). In most cases some or all of the following characteristics are identified (Chaplin, 2011):

- A planned/co-ordinated approach across multiple property boundaries in a defined spatial area;
- An approach that addresses multiple objectives;
- A clear understanding of the amounts and spatial configuration of the different types of land management practice required in the area to achieve objectives;
- An approach that optimises delivery of quantified objectives

Nature Based Solutions (NBS) The EC (2015) defines NBS to societal challenges as solutions that are inspired and supported by nature, which are cost‐effective, simultaneously provide environmental, social and economic benefits and help build resilience (Short et al., 2019).

Natural Capital - the elements of nature that directly or indirectly produce value to people, including ecosystems, species, freshwater, land, minerals, the air and oceans, as well as natural processes and functions (Natural Capital Committee, 2014).

Natural Flood Management (NFM)- refers to the utilisation or restoration of 'natural' land cover and channel–floodplain features within catchments (i.e., the actual interventions) to increase the time to peak and reduce the height of the flood wave downstream and is therefore a subset of NBS. (Short et al., 2019).

Social capital – "Features of social organization such as networks, norms, and social trust that facilitate coordination and cooperation for mutual benefit"' (Putnam 1995, p. 67)]. Also defined as networks together with shared norms, values and understandings that facilitate co-operation within or among groups.

Social learning - a change in understanding that goes beyond the individual, to become situated within wider social units or communities of practice through social interactions between actors within social networks (Reed et al., 2009).

Top-down Initiated by a Government Agency, NGO or by a Government funded adviser to deliver public policy (Boulton et al., 2013).

Transaction costs -encompass the initial outlay in time and money which a farmer must expend to join a scheme. They also apply to the body implementing an AES, and can be related to actions such as informing landowners about the AES, which represents a major communications and marketing task (Dutton et al., 2008).

Appendix 2 REA databases and systematic map

REA files

The REA files can be found in a folder at this link:

https://connectglosac-my.sharepoint.com/:f:/g/personal/s2104665_glos_ac_uk/EhrhqnZ34-hNgqxSay7F7WABEY8XQNfUnDluv02q_aOtRA?e=SNxjpx

These include the following

Database files

Four excel sheets record the search and screening results for each intervention type.

Systematic map files

This map records the appraisal for each piece of evidence evaluated including the relevance and robustness scoring, and the Determinants and Outcomes coding.

Two files are available in the folder:

- Systematic map: Large-scale coordinated
- Systematic map: cAES, payments, farmer-led