

The 'Payment for Ecosystem Services' approach - relevance to climate change

*Laure Kuhfuss, Mike Rivington and Michaela Roberts, James Hutton Institute;
August, 2018*

Defining 'Payments for Ecosystem Services'

The term 'Payment for Ecosystem Services' is used to describe financial incentives to land-managers to maintain or improve ecosystems above and beyond what is required by regulatory compliance. It might also be described as one way of providing public money for public goods.

Ecosystem services are those not bought and sold – they are currently outside the normal economy. This approach has evolved in response to the failure of the market to maintain healthy and functioning ecosystems. Payment for these services is defined here as **any scheme or agreement where the individuals who benefit from Ecosystem Services offer a payment to land managers in exchange for the provision of these services**

The term ecosystem services (ES) covers the goods and services we derive from nature¹. These services are commonly grouped into four categories:

- Provisioning: production of food, fibre and making available water.
- Regulating: climate control via the carbon cycle, hazard reduction.
- Supporting: water and nutrient cycles, soil formation, primary production.
- Cultural: recreational, cultural heritage and aesthetic experience benefits.

Key to Payment for Ecosystem Services schemes is that they are voluntary, and actions are above and beyond regulatory compliance, and can be either

- **Inputs based**, contributing to the costs of actions in the expectation these will result in ecosystem service maintenance or enhancement, or;
- **Outcomes (Results) based**, where land managers are paid on achieving objectives.

Key findings

Scale: 'Payment for Ecosystem Services' schemes cover multiple ecosystems, land uses and geographical scales. With relevance to climate change, peatlands (e.g. Peatland Code) and woodland (e.g. Woodland Carbon Code) are often targeted due to their potential for carbon sequestration or reducing emissions.

¹ Other similar terms have also been used, for example Natural Capital, which can be defined as the world's stocks of natural assets which include geology, soil, air, water and all living things. In other words, the mix of ecosystems that provides Ecosystem Services. Natural capital accounting refers to the process of calculating stocks and flows of natural resources and Ecosystem Services. See [Natural Capital Coalition](https://naturalcapitalcoalition.org/natural-capital/)
<https://naturalcapitalcoalition.org/natural-capital/>

Focus: Single objective schemes can target their efforts to achieving a well-defined objective, but also run the risk of failing to account for negative side effects (externalities) on other ecosystem services. With all schemes there will thus be trade-offs between benefits and dis-benefits. For providers the administrative load and time commitment may be the determining factor in deciding on participation.

Targeting:

- Localised schemes may have greater potential for improved trust and transparency and associated communication of benefits to prospective participants.
- National schemes (Woodland and Peatland Codes) have high spatial extent, whereas targeted schemes (e.g. Pumlumon Project) have possibly better up-take but lower spatial extent.
- Adaptation to climate change requires more locally tailored schemes because they tend to be more context dependent, particularly for the ES provider side (land managers).

Timing of return on investments and payments: Input based payments tend to be upfront (woodland grant) whereas output based are either spread or one-off over the longer term if desired outcomes are achieved. It is important that climate change focussed schemes have longevity to maintain the required management actions and to avoid the risks of perverse outcomes (e.g. changes in land use that result in increased emissions).

Cost covering: There are uncertainties with different sources of funding (e.g. taxes, donations, carbon markets), whether political uncertainty of future public budgets, financial uncertainty of prices in carbon markets, and uncertainty on long-term sustainability of donations from private parties. Questions also arise, depending on whether payment is tied to activity or outcome.

Requirements for monitoring: Schemes for climate change mitigation have long timeframes; evaluation of success may not be viable (e.g. in terms of carbon sequestered) until long after initial participation by providers or estimated average or modelled values are used.

Conclusions

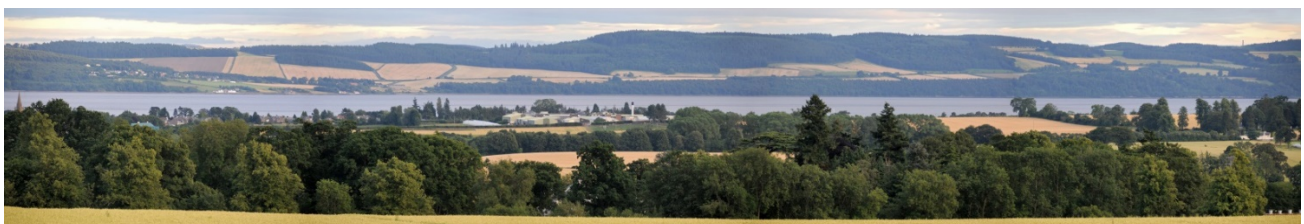
'Payment for Ecosystem Services' schemes have been developed in a broad range of areas that seek to support good environmental management. Common to all the schemes is that they take a voluntary approach to offering financial incentives to land-managers for actions that maintain or enhance services that are not routinely bought and sold or provided through regulation.

The characteristics of different 'Payment for Ecosystem Services' schemes vary considerably. For the purposes of meeting climate change needs, 'Payment for Ecosystem Services' has substantial potential but with several key issues:

- The degree to which participation by actors, particularly providers can be facilitated.
- The type of scheme (inputs or outcomes based), the structural arrangement for the relationships between actors and how well it fits with the objectives.
- How well the scheme balances the need for supply of other ecosystem services (and biodiversity).

Contacts: for further information from the authors, please contact;

Mike Rivington, The James Hutton Institute. Mike.rivington@hutton.ac.uk



Contents

Defining 'Payments for Ecosystem Services'	1
Key findings	1
Conclusions	2
Introduction	4
General approach	4
From Ecosystem Services.....	4
... To Payments for Ecosystem Services	5
PES definition(s)	6
How are 'Payment for Ecosystem Services' most frequently defined?	6
"PES-Like" schemes	8
PES and carbon offsetting	9
PES schemes for climate change in practice: 9 case studies.....	10
Their objectives.....	10
Their context.....	12
Who is involved.....	12
Types of PES contractual arrangements with ES providers	13
Lessons from the 9 case studies.....	14
Differences and issues in participation and up-take of schemes	14
Strengths and weaknesses of schemes for climate change	15
Conclusion and recommendations	18
Appendix A. Case Studies	20
1. Peatland Code UK	21
2. Woodland Carbon Code, UK.....	22
3. Agri-Environment and Climate Scheme, SRDP, UK.....	23
4. Scottish Water Drinking Water Protection Scheme	24
5. Forestry Grant Scheme, SRDP	25
6. Scottish Farm Carbon	26
7. Pumlumon Project, Wales.....	27
8. MoorFutures, Germany.....	28
9. Conservation Reserve Program US	29
Appendix B. Glossary	30
Appendix C: References	32
Appendix D: Further web based information	33

Introduction

The purpose of this report is to explore the Payment for Ecosystem Services (PES) approach, the types of schemes used and how they are variously defined, structured and implemented. The evolution of PES has been *ad hoc* hence the risk of confusion about what it means and covers. This report considers clarity and consistency in the language used, the range of objectives for PES, how it is defined and how it operates, as there are important distinctions between different types of schemes and what they seek to achieve. The aim is to provide a common set of definitions and principles encompassing that range, whilst also pointing out the differences in approaches. There is need to understand these definitions and principles when designing schemes to achieve the desired outcomes. The context is in terms of how PES relate to climate change mitigation and adaptation.

In a **broad definition**, PES offers financial incentives to land-managers to provide Ecosystem Services (ES – see definition below) that are not routinely provided by standard markets (i.e. services that are not brought and sold, Arriagada and Perrings 2009) or from regulatory compliance requirements. The 'financial incentives' covers a range of types and is expanded on later.

Currently, PES have been implemented for the provision of four main ES:

- water provisioning
- carbon sequestration
- landscape amenity and
- biodiversity conservation (Arriagada and Perrings 2009).

In this report we critically assess nine PES case studies focusing on a range of ES, including carbon sequestration (climate change mitigation) and where several have adaptation benefits (e.g. flood mitigation etc.). These nine case studies represent different forms of PES that illustrate the variations in definition, structure and implementation.

The first section presents the general approach of PES, from the definition of ES to the need for PES. The second section defines and provides an overview of the types of tools that are considered PES in the literature. Thirdly we describe and critically assess the nine case studies, before providing a conclusion and general recommendations. We provide as appendices a 1 page summary of each of the nine case studies that are or could potentially be applied to climate change mitigation and adaptation as well as a glossary of commonly used terms.

General approach

From Ecosystem Services...

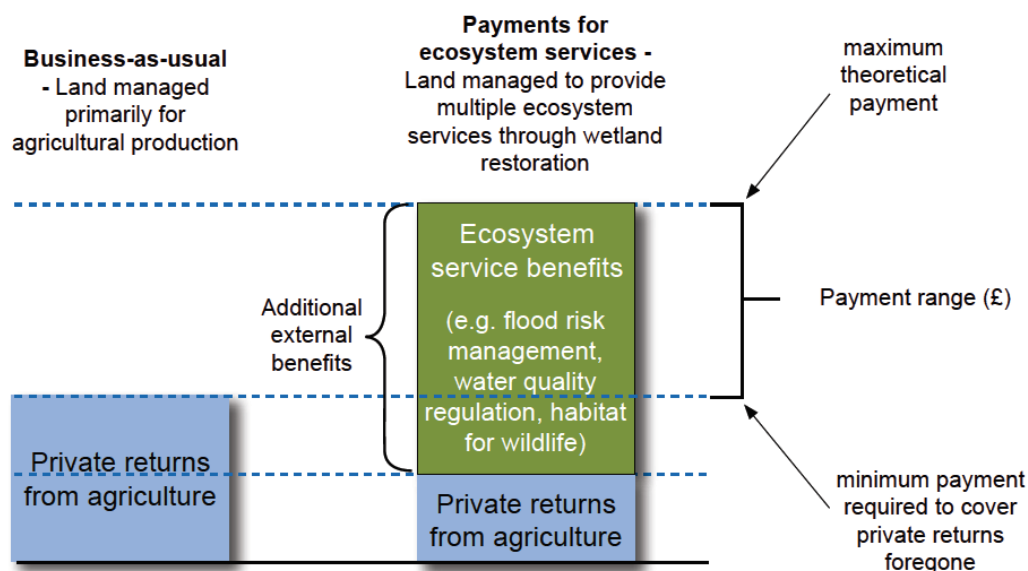
The term Ecosystem Services (ES) is applied to encompass the goods and services we derive from Nature. They are commonly grouped into four categories:

- Provisioning: production of food, fibre and making available water.
- Regulating: climate control via the carbon cycle, hazard reduction.
- Supporting: water and nutrient cycles, soil formation, primary production.
- Cultural: recreational, cultural heritage and aesthetic experience benefits.

The [UK National Ecosystem Assessment](#) describes ES as “the benefits provided by ecosystems that contribute to making human life both possible and worth living”. Unsurprisingly there is debate amongst scientists, practitioners and policy makers as to the definition of ES, and how they can be quantified and accounted for. The [Millennium Ecosystem Assessment](#) placed human wellbeing as the central focus for the ES concept, whilst recognising that ecosystems also have intrinsic value. For the purposes of this report in respect of PES, we emphasise that ecosystems need to be functional (i.e. be in good 'health', see [O'Brien 2016](#)) in order to supply goods and services. Hence there is need for ecosystem functionality (e.g. ability of soils to grow crops due to microbial biodiversity underpinning

The 'Payment for Ecosystem Services' approach - relevance to climate change

nutrient cycles) to be supported by human activity when drivers (including negative human activity) may reduce ES capacity, or where there is a need for additional management to achieve desired goals



(e.g. attaining a certain water quality level). Biodiversity is not an ES in its own right, but is essential in enabling ecosystem functionality; hence many PES schemes seek to support biodiversity protection or enhancement.

Note: other similar terms to ES have also been used, for example Natural Capital, which can be defined as the world's stocks of natural assets which include geology, soil, air, water and all living things. In other words, the mix of ecosystems that provides ES. Natural capital accounting refers to the process of calculating stocks and flows of natural resources and ES. For further information see [Natural Capital Coalition](#) (web link in Appendix G).

... To Payments for Ecosystem Services

A long standing argument has been made that climate change is a worse case example of market failure (Stern 2006), as ecosystem degradation (and hence the services they provide) is considered external to economic activity (e.g. the cost of degradation and its repair is not included in the economic activity). The implication is that the market cannot directly provide the protection or restoration of ecosystems without intervention from the government, NGOs or other stakeholders.

PES schemes are examples of attempts to develop new forms of market and non-market interventions. The idea is that if some people benefit from ES, they should be willing to pay money for their provision when these are threatened, typically when there is an environmental issue.

Therefore, a **very broad definition** of PES schemes is that of “any scheme or agreement where the individuals who benefit from Ecosystem Services offer a payment to land managers in exchange of the provision of these Ecosystem Services”.

The implementation of PES schemes makes sense in situations (in ideal scenarios) where the ES benefits are larger than the cost of providing these ES. Figure 1 below shows that, in these situations, implementing a PES scheme would lead to a win-win situation, where society as a whole is better off, benefiting from an increased production of public goods in the form of ES, while the land managers are (more than) compensated for the cost. Figure 1. Example of the Payment for Ecosystem Services concept using wetland restoration (from: Defra 2013, p. 18),

The beneficiaries (those that benefit from the supply of ES secured through a PES scheme) are better off when the scheme is implemented, due to the additional external benefits they receive (e.g. wetland restoration) more than compensating for the payments they make to the land managers. Similarly, the land-managers are better off under than under the business as usual situation, as the payments they receive more than compensate their loss in private profits (accepting that there may be a need for replacement in terms of the type of economic activity).

This simplified representation raises several important issues:

- Firstly, without action, the Business-as-Usual scenario may lead to further ecosystem degradation, to an extent where functionality and associated ES are lost, raising questions of additionality and payment for what should perhaps be funded directly through regulatory compliance.
- Secondly, where the objective is ecosystem restoration (as opposed to maintenance of a healthy one), the initial costs may be higher than the initial benefits. Hence the questions become; over how long a time period should the costs-benefits be assessed? What are the cost consequences of continuing the 'business as usual' scenario (e.g. ecosystem functional integrity is lost and restoration is not feasible)?

PES definition(s)

How are 'Payment for Ecosystem Services' most frequently defined?

Currently, the most commonly used definition of PES is that of Wunder (2005), for whom a PES is:

"A *voluntary* transaction where a *well-defined* ES (or a land-use likely to secure that service) is being 'bought' by a (minimum one) ES *buyer* from a (minimum one) ES *provider* if, and only if, the ES provider secures ES provision (*conditionality*)".

Here the **provider** refers to the land manager. That the scheme is based on a **voluntary** transaction means that it is for actions that are 'above and beyond' what is required to meet regulatory compliance. The **conditionality** of payment requires that the ES produced and provided to the buyer within the PES scheme are measured. This implies that one should be able to distinguish the provision of ES through activities that can be considered as mandatory (through norms, rules and regulations) from those ES for which the buyer should pay. It is commonly agreed that payment should only be made for these additional ES that would not have been produced in the absence of the scheme (Arriagada and Perrings 2009).

Therefore PES is for needs above and beyond what *should be achieved by regulatory compliance* (and arguably established environment management best practice). This requirement above compliance needs refers to the **additionality** of the scheme (Engel et al. 2008), i.e. how much more ES are produced under the scheme, in comparison to what would have been produced in the absence of the PES scheme.

Note: Payment for Natural Capital is a term that has on occasion been used by some stakeholders instead of PES. However, it is not a term used in the academic literature. The term implies (perhaps to a lay audience) that payment is for the capital, rather than the services provided, hence PES is a more appropriate term to use. Similarly the Food and Agriculture organization (FAO) has used the term Payment for Environmental Services: this is synonymous with ecosystem service.

PES definition ranges

Globally, schemes have been used to address a wide range of environmental objectives, in many different contexts. PES has been used in many different types of ecosystems and for associated ES (at a wide range of spatial and temporal scales), and with the aim to address different causes of degradation. Internationally, developed and developing countries have a variety of institutional settings within which schemes have developed.

Because of this multiplicity of objectives and contexts, most schemes labelled as PES deviate from Wunder's 2005 definition (Wunder 2011; Van de Sand 2012). Therefore, there is a need **for other definitions that are more encompassing** and provide a better understanding of the current practices in PES schemes.

Debates about what are and what are not PES schemes mainly rest on:

- Whether the beneficiaries voluntarily pay for the ES and whether the providers (land-manager or other whose actions generate ES) voluntarily provide the ES: the voluntariness of the scheme,
- Whether and which intermediaries are involved in the implementation of the scheme, to coordinate and facilitate the transaction between the multiple beneficiaries and the multiple providers: in other words, the directness of payments.

There is general agreement that a provider's voluntary participation is non-negotiable. Looking at how voluntary a scheme is, from the provider's perspective, is therefore a first stage to separate PES from other approaches aimed at increasing the provision of ES but that are not commonly considered PES. Table 1 below sets out where PES schemes sit in respect of other approaches.

Table 1: PES amongst tools aiming at increasing the provision of ES (adapted and translated from Laurans et al. 2011)

	Providers' participation is mandatory	Providers' participation is voluntary
Regulatory and administrative tools	Norms, rules, regulations	Policies supporting sustainable practices (organic farming for example) or education /information initiatives (e.g. " Farming for a Better Climate "), use of codes and guidelines for cross-compliance etc.
Economic tools	E.g. "polluter pays" tools, such as carbon taxes, tradable emission permits (cap and trade), mandatory carbon offsets	Economic incentives: Agri-environmental schemes; Payments for Environmental Services.

The Drinking Water Protection Scheme (DWPS, see case studies) is a good example as it specifically states that actions for ES must be 'over and above compliance requirements', but participation in the scheme is voluntary.

From this broad scope, we can narrow down the range of schemes considered as PES to **economic tools where providers' participation is voluntary** (bottom right cell Table 1). The range of different definitions within this category can be further distinguished by the *directness* of the payment and the *voluntariness* of beneficiaries' participation.

Directness of payment: This will vary depending on the level of need for intermediaries. Using the framework proposed by Matzdorf et al. (2014), we distinguish two main types of intermediaries between the beneficiaries of ES and their providers (Figure 2):

- “Buyers” (“financiers”), who can facilitate the coordination of the demand for ES and funding coming from multiple beneficiaries;
- “Suppliers” can be necessary for the coordination of the supply of ES when multiple providers are involved.

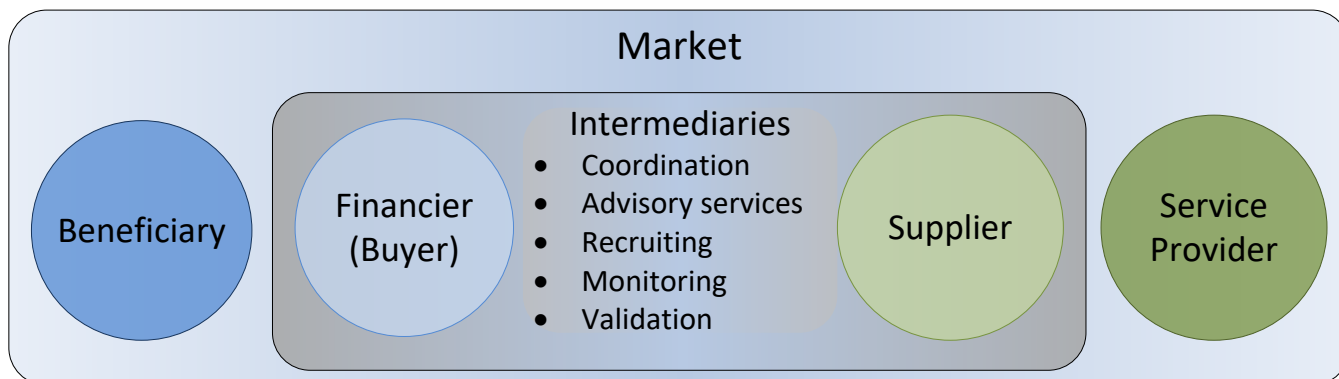


Figure 2: PES actors within the market (adapted from Laurans et al. 2011 and Matzdorf et al. 2014).

“Pure” PES schemes such as defined by Wunder (2005) would involve direct payments from beneficiaries to providers (Wunder et al. 2008). The divergence of many real-life PES schemes from this definition has led Wunder to propose a less restrictive definition of PES schemes (Wunder 2011), in which the voluntary nature of the transaction on the buyers’ (financiers’) side might not hold. This is because the possibility that bundles of ES and land uses can be provided and public entities are recognised as potential buyers and communities as potential providers. Thus the nature of the relationship between buyers and providers has changed as the scope of PES has diversified to encompass a wider range of both types of actors.

“PES-Like” schemes

Departing from this new definition, Table 2 (below) proposes a second classification of PES schemes. It distinguishes:

- (i) Schemes where the buyers are the beneficiaries themselves, from schemes where the buyer is not the group of beneficiaries themselves and;
- (ii) Schemes where the beneficiaries ‘voluntarily’ pay for or buy the provision of ES (e.g. through donations or on voluntary markets for ES) from schemes where they are obliged to pay (e.g. through taxes).

It is also useful to note that, particularly in the case of afforestation schemes (which are of considerable interest for climate change mitigation), PES schemes tend to be a combination of multiple approaches (Ezzine-de-Blas et al. 2016). Funding of the scheme can involve public money from taxes as well as donations from private funders. NGOs often manage the implementation of the scheme as “suppliers” and/or “buyers”. For example, this is the institutional arrangement of the Pumlumon Project in Wales (see case study description below).

Table 2: PES and PES-like tools according to source of funding used to pay ES providers (adapted from Laurans et al. 2011)

	Beneficiaries' participation is mandatory	Beneficiaries' participation is voluntary
Financier = beneficiaries	Usage or entry fees (e.g. to natural reserves), targeted taxes for a specific PES	"Pure" PES Funding through a PES contract directly between beneficiaries and providers
Financier ≠ beneficiaries	Multiple taxes or public funding are used by the State, acting as buyer on behalf of the general public who benefits from the ES, to fund the PES scheme Examples: AES (in SRDP)	Donations (buyers are donors who do not necessarily benefit from the ES) Voluntary Carbon offsetting measures

PES and carbon offsetting

One specific aspect of PES schemes for climate change mitigation is the availability of carbon credit markets as a source of funding. Most of the carbon credits come from offsetting schemes, where businesses or individuals can buy carbon credits to compensate for the emissions generated by their activities. Whether offsetting schemes are PES scheme is debatable. Following Wunder's (2005) definition and the commonly accepted requirement for additionality, carbon offsetting schemes might fail to be considered either voluntary or bringing additional environmental benefits. Let us first address the issue of the voluntary nature of offsetting schemes. Carbon credit buyers can either be required to compensate their emissions under certain regulations (such as the mandatory offsetting of CO₂ emissions under EU Emission Trading System² for heavy energy-using installations in the EU) or voluntarily decide to do so, which would comply with the PES definition.

The *additionality* of such schemes is more difficult to judge and depends on what reference is chosen. By definition, since the objective of offsetting is to compensate for emissions, no additional carbon is stored at the end of the process. However, when comparing the level of carbon emissions when emitters are able to compensate their emissions to what would have happened if no offsetting was possible, then offsetting does provide some additionality effect on climate change mitigation. Ezzine-de-Blas et al (2016) propose the following illustration between offsetting markets and PES (Fig. 3):



Figure 3. Links and breakpoints between payments for ecosystem services and the institutional architecture for accessing offset rights, taking the example of carbon credits (adapted from Ezzine-de-Blas 2016)

Following suggestions from these authors, we therefore propose to include such voluntary carbon offsetting schemes as example of PES-like schemes, where the sale of carbon credits to businesses

² https://ec.europa.eu/clima/policies/ets_en

and individuals who voluntarily compensate their carbon emissions funds the payment of voluntary land-managers for the provision of carbon storage services. Examples of such schemes are the Peatland code, the Woodland Carbon code and MoorFutures, presented in the appendices.



A key context of developing the Payment for Ecosystem Services approach in Scotland for **climate change** purposes is that we have a diverse mix of ecosystems, land uses, climates and human communities. Ecosystem Services are provided by a mosaic of socio-ecological systems (how different natural ecosystems and people interact). Schemes will need to consider the context for relationships between: the actors involved (buyers, providers, intermediaries, beneficiaries), the objectives of the scheme, the ecosystem mosaic, and need for balance between providing multiple ecosystem services (e.g. not reducing one when focusing on another). Hence nationally applied schemes need to be flexible if they are to deliver to local circumstances.

PES schemes for climate change in practice: 9 case studies

We identified nine case studies which cover a range of PES types, with the potential to be applied to carbon sequestration or climate change mitigation. Table 3 (below) gives an overview of how these case studies vary.

The 9 case studies differ depending on the following aspects:

Their objectives

PES schemes may focus on a single objective (e.g. carbon sequestration in the Woodland Carbon Code) or multiple objectives (e.g. positive contributions to environment and climate in the agri-environment and climate scheme, SRDP). Single objective schemes are advantageous in that they can target their efforts to achieving a well-defined objective, with potentially higher efficiency than schemes with multiple objectives. However, single objective schemes also run the risk of failing to account for negative side effects (externalities) onto other ecosystem services (e.g. raising the water table under the Peatland Code will achieve the objective of reduced greenhouse gas emissions but could, despite also aiming to reduce flood risk increase it if poorly implemented).

Table 3. Comparison of characteristics of PES case studies

	Number of objectives		Type of objective			Ecosystem			Spatial scale		Time scale (years)		Buyer		Intermediary		Price setting			Payment type		
	Single	Multiple	Emissions reduction	Carbon sequestration	CC mitigation	Peatland	Woodland	Agriculture	Local	National	Shortest	Longest	Compulsory	Voluntary	Facilitator	Buyer	Fixed price set by buyer	Price based on actual provider's costs	Auction with price set by provider	Price set on carbon	Inputs	Outputs
Case study (see Appendix A)																						
1. Peatland Code	X		X			X			X		30	55		X	X			X			X	
2. Woodland Carbon Code	X			X			X		X			100		X	X			X			X	
3. Agri-environment carbon scheme		X			X			X	X		5		X			X	X				X	
4. Scottish Water Drinking Water Protection Scheme	X							X	X				X			X	X				X	
5. Forestry Grant Scheme		X			X		X		X	6	20	X				X	X				X	
6. Scottish Farm Carbon	X			X			X		X					X	X					X		X
7. Pumlumon Project		X		X		X			X	5	30	X			X		X				X	
8. MoorFutures	X		X			X			X	30	100		X	X			X				X	
9. Conservation Reserve Program		X			X			X	X	10	15	X			X			X			X	

The 'Payment for Ecosystem Services' approach - relevance to climate change

To overcome this many single objective schemes will include clauses that state that damage to other services must be estimated and accounted for (e.g. MoorFutures requires socio-economic impacts of changing grazing rights to be considered). While multiple objective schemes may be less targeted, they are often focused on improving ES across the whole system (e.g. Conservation Reserve Program, USA), and can therefore be better integrated, and account for trade-offs. Schemes may also sit between single and multi-objective schemes, where a single service is valued and traded, but improvements to associated services (e.g. biodiversity improvements following peatland rewetting to reduce greenhouse gas emissions, MoorFutures) are also recognised.

The range of objectives for PES schemes related to carbon sequestration and climate change mitigation varies widely. Schemes can focus on reducing emissions, as is often the case in peatland restoration (e.g. Peatland Code, MoorFutures), carbon sequestration (e.g. Woodland Carbon Code), protection from climate events (e.g. flood or gales, Forestry Grant Scheme) or more broadly ensuring long-term environmental protection (e.g. Conservation Reserve Program, USA).

Their context

PES schemes cover a variety of ecosystems and geographical extent. With relevance to climate change peatlands (e.g. Peatland Code) and woodland (e.g. Woodland Carbon Code) are often targeted due to their potential for carbon sequestration or reduced emissions. Alternatively, schemes may target particular land use types, most often agricultural land (e.g. Agri-environment and climate scheme).

PES schemes also vary in spatial and temporal scale. Spatial targeting of schemes can ensure that PES are suited to local contexts (e.g. Pumlumon Project in a single region in Wales), as well as enabling direct links between buyers and sellers (e.g. MoorFutures allows buyers to directly fund work in, and visit, local sites). However, such local projects also have higher transaction costs, and may be less efficient at the national scale, as they are not able to target the areas most suited to ES production. National level schemes (e.g. Peatland Code, Conservation Reserve Program) can benefit from central bureaucracy and have more option to select those areas producing the highest levels of ES, though limited information may mean that this is not realised in practise. However, uptake could be lower due to differences in site specific knowledge and understanding between buyers and sellers. A further issue is how well targets can be set in locally varying contexts and what the ability is of monitoring to determine the level of achievement.

The temporal scale can be particularly important for PES schemes, especially in the case of carbon sequestration, where it is necessary to ensure that carbon is not subsequently released into the environment. As such an ideal PES scheme would exist in perpetuity, though this is not practically possible. Within our case studies contracts range from 5 years (Agri-environment Climate Scheme) to 100 (Woodland Carbon Code, MoorFutures), with requirements that land is owned or leased over such a period, or that contracts are still applicable even if land is sold. In the case of the Woodland Carbon Code a 100 year long period of woodland growth ensures that woodland will reach a size which is then protected by UK law. It has also been argued that in the case of peatland restoration, where payments are made for reductions in emissions, rather than sequestration, full degradation of peat does not negate the emissions avoided in previous years, as the timescale over which the emissions have occurred is increased (Bonn et al 2014).

Who is involved

In general PES schemes must involve a 'provider' of the services, and a 'beneficiary'. The beneficiary may themselves be the 'buyer', or this may be a third party (e.g. Thorlux Lighting within the Woodland Carbon Code), who purchase the service to offset emissions. Finally, the scheme may include 'intermediaries', who do not themselves provide, buy or benefit (except in a general sense) from the service, but who manage the transaction. In the case of a public good such as climate change mitigation, the number and global geographical spread of beneficiaries makes a direct agreement between beneficiaries and service providers (Figure 1) very unlikely. Intermediaries are therefore essential in the implementation of most PES schemes. Beyond coordination, these intermediaries between beneficiaries and services providers can have multiple roles (e.g. advice, recruitment, monitoring or validation) (Matzdorf et al 2014).

The 'Payment for Ecosystem Services' approach - relevance to climate change

The Peatland Code presents an example of a scheme which incorporates separate providers (peatland owners), buyers (private companies), beneficiaries (general public), and intermediaries who act as facilitators (IUCN-UK). Though IUCN do not handle the funds directly, they connect providers and buyers, and provide validation for the scheme. Alternatively within the agri-environment climate scheme the EU and Scottish Government act as buyers themselves, transferring the funds raised in taxes from the beneficiaries (general public) to the providers (farmers or land owners) through payments and grants.

The actors involved in PES schemes also vary according to the voluntariness of the involvement of the buyers. Many PES schemes are facilitated through government structures and are funded through taxes (e.g. Conservation Reserve Program), therefore removing the voluntary nature of funding (though participation must be voluntary from side of the land owner). This method of funding is advantageous as the funding amount can be predicted and secured in the short term, however over the long term must compete with other priorities, such as education or healthcare.

Alternatively buyers may be entirely voluntary, and include private companies or individuals (e.g. Woodland Carbon Code). Though such buyers are not direct beneficiaries, they gain benefits through improved 'green credentials', which may increase business, or allow them to charge a premium for services. Where the ecosystem service sold is easy to understand (e.g. Woodland Carbon Code) or have strong local ties (e.g. MoorFutures), funds from voluntary buyers can be successful, and are not at risk of being diverted to other projects. However, projects which are less well understood, or more distant, may suffer from low uptake (e.g. Peatland Code) amongst other reasons. Experience in developing schemes will also influence up-take: Germany has a much longer history of such schemes and these are more widely known to the general public and hence more attractive to indirect beneficiaries such as local companies.

Types of PES contractual arrangements with ES providers

Contractual arrangements with ecosystem service providers vary in terms of how contracts are awarded, and whether payments are made for inputs or outputs.

A 'fixed price' system is often employed for national level PES schemes, and offers a set price for either carrying out an action (e.g. agri-environment and climate scheme pays £37.41/ha for management of lowland bog without grazing), or for outputs (e.g. Scottish Farm Carbon will pay for carbon credits according to the market price). Within these schemes ES providers must decide whether the available payment is sufficient to cover the costs of provision, e.g. with farmers for whom the price of ES provision is too high, thus excluding them from the scheme. While such fixed price payments are at risk of over- or under-paying farmers for work, they also have much smaller transaction costs. Depending on the funding available further selection criteria may be used to select providers, typically based on environmental benefits, scale, or added value, such as addressing priority targets.

Alternatively prices may be set by the ecosystem service provider, to cover the estimated costs of service provision. One option to allocate contracts is then to run an auction (agri-environmental, reverse or conservation auction), in which all potential providers can submit a bid describing the ES they offer to provide, or the land managements they offer to adopt and the level of payment they would require in exchange. All bids are then scored and the best ones get awarded a contract (get to enter the PES scheme), until the whole budget is spent (e.g. Conservation Reserve Program). These types of schemes have the potential for higher cost-effectiveness than fixed price schemes, as payments are made for actual costs, however they also incur much higher transaction costs.

In some situations (e.g. MoorFutures) prices are set by providers but contracts are allocated in a less formal process than is seen via auction. In these cases buyers will select providers to work with, based on a number of criteria, including expected environmental benefit and cost, but also including factors such as location or additional benefits. These schemes increase the connection between providers and buyers but are challenging to co-ordinate at a large scale.

Regardless of how contract prices are decided, payments may vary by being based on inputs or outputs. Input based payments are by far the most common, and pay providers for the actions taken which have the intention

The 'Payment for Ecosystem Services' approach - relevance to climate change

of improving ES provision (e.g. Forest Grant Scheme pays landowners for area reforested, not carbon stored). This type of scheme removes risk from the ES provider, payment is made even if external events (e.g. flooding) mean that the actions taken are not successful in increasing ES provision. Though this runs the risk of paying for services which are never delivered, participation is increased.

Only the Scottish Farm Carbon (SFC) scheme within our case studies works on output based payments. In this case ES providers (landowners planting woodlands) will only see financial return when able to sell carbon credits. This places risk on the providers, as the revenue from the carbon is not guaranteed to cover costs, but also presents the opportunity for large profits if the carbon price rises higher. This type of scheme is preferable for ensuring payments are only given for services produced, but requires providers to bear some (as in the SFC) or all of the cost and risk until services are realised.

A further point to note is that PES schemes (except offsetting) will have to be compatible with international regulations on subsidies and payments to land managers, e.g. be World Trade Organisation (WTO) compliant in respect of not distorting international trade. The WTO Agreement on Agriculture limits payments to farmers from governments, therefore EU and government funded PES being required to compensate farmer's income forgone and additional costs, but does not constraint payments from market-based schemes (such as the Peatland code, the Scottish Farm Carbon (SFC) scheme or MoorFutures presented in appendices). However, according to Hasund and Johansson 2016, WTO rules should not currently restrict government funded PES schemes, and results- or action-based payments are both compatible with Common Agricultural Policy (CAP) rules. Similarly there is a requirement to conform to EU regulations on State Aid for agriculture and forestry (EU 2014). The implication appears to be that government funded PES schemes as they develop will need to be in line with WTO rules, and conform to any post-Brexit requirements.

Lessons from the 9 case studies

There are many different types of PES and PES-like schemes, each being context specific in terms of their objectives, scales, structures and approaches to implementation. The following are some of the central issues that inform us about uptake, flow of finance and risks and opportunities.

Differences and issues in participation and up-take of schemes

Targeting

Schemes have different levels of effort to target suppliers and facilitate participation. MoorFutures has had high uptake while the Peatland Code has low uptake due to, for example: scale (Peatland Code is national whilst MoorFutures is local and therefore more targeted); background history and level of understanding of issues (MoorFutures has been running for longer and is based on a better localised knowledge and awareness), whereas conversely an initial challenge for the Peatland Code has been in educating stakeholders on the need for investments. Localised schemes may have greater potential for improved trust and transparency and associated communication of benefits to prospective participants.

Objective

The success of schemes may vary depending on the clarity of the objectives and perceived challenges in achieving them, and particularly on what is actually being sold, e.g. conceptually trees as a form of carbon sequestration may be seen to be easier than peat (e.g. to achieve and measure) by buyers, being a more tangible product (visually and in terms of commercial value). However, the Woodland Code seeks carbon sequestration, whereas the Peatland Code seeks carbon emissions reduction. Hence the two schemes are selling different products and have different levels of uncertainty in respect of achieving the potential of each.

Complexity of scheme

The 'Payment for Ecosystem Services' approach - relevance to climate change

For suppliers the administrative load and time commitment may be the determining factor in deciding on participation. Agri-Environment Schemes (AES) have been widely criticised for their administrative load (high transaction costs). The number of ecosystems and types of services adds complexity: MoorFutures is a regional scale scheme in Germany based on the sale of carbon credits on the voluntary market related to rewetting of peatland, hence targeting one ecosystem but with multiple ES benefits.

Timing of return on investments and payments

Schemes can be inputs based (e.g. woodland grants covering costs of actions) hence payments are at the start of a scheme, or outputs based (e.g. Scottish Farm Carbon sale of carbon credits after long-term woodland establishment) hence payments are received much later (and therefore more speculative in terms of investment). This raises the question of whether earlier payments seem more acceptable (e.g. AES compared to the Scottish Farm Carbon). Input based payments tend to be upfront payments (woodland grant) whereas output based are longer term.

Cost covering

The perception by participants of the financial impacts will be a primary determinant of up-take of a scheme. For example, the Woodland Carbon Code is not considered to work well for small woodlands establishment as the set-up costs are too high and payment is an up-front lump sum (so no further support). Conversely the Scottish Farm Carbon provides some financial support for advice and auditing, but the financial benefits (and risk) are gained (lost) by the cooperative based on the future price of carbon and sale of credits.

Key risk factors

For some schemes (e.g. Pumlumon Project) this may be in the security of funding (donors may withdraw support) or permanence, e.g. to address this the MoorFutures scheme runs for 30-100 years, so land is either purchased or management of land is entered into the register of deeds, ensuring continuation regardless of ownership (Matzdorf 2014)(NB: such a measure was rejected by the landowner community who felt it would not work in the UK). The success of long-term projects (e.g. peatland based – MoorFutures, Peatland Code) in terms of ES supply depends on continued action and support, hence such schemes may be vulnerable to socio-economic fluctuations.

Uncertainty also remains in how successful different alternative management actions and techniques may be, e.g. in peatland restoration, as some are as yet unproven. There is the risk of failure due to external factors, for example physical damage by fire or weather (the woodland code includes a fire risk assessment). Peatland restoration is, by some, considered risky in the face of climate change as the UK peatlands are on the southern limit of peatland in the northern hemisphere (hence vulnerable in the case of warming and/or rainfall deficits).

Requirements for monitoring

There is a cost implication for monitoring, which may be borne by the supplier, provider or buyer. The relative success of the schemes detailed will vary depending on the criteria under which they are assessed. This reflects the need for appropriate monitoring designed to fit with the schemes' objectives. Schemes for climate change mitigation have long timeframes hence evaluation of success may not be viable (e.g. in terms of carbon sequestered) until long after initial participation by providers, or estimated average or modelled values are used.

Strengths and weaknesses of schemes for climate change

The climate change motivated PES schemes considered here are focused on mitigation (e.g. Woodland and Peatland Codes), and less so on adaptation. However, secondary benefits exist in the form of possible flood prevention (woodland establishment). Thus assessing the strengths and weaknesses of a scheme needs to

The 'Payment for Ecosystem Services' approach - relevance to climate change

balance how well it addresses mitigation or adaptation (or more preferably, both) and any possible negative aspects.

The need for climate change mitigation and adaptation presents a dilemma in respect of the definition of PES being based on voluntary participation. In order to meet the required emissions reduction targets, the scale of participation and level of action required may necessitate compliance measures rather than the 'above and beyond compliance' element of PES. To help assess whether such a step is necessary, the factors for assessing strengths and weakness of schemes for climate change can broadly be categorised as:

- The scale of participation by actors, particularly providers. Encouraging land managers to change practices for climate change purposes *per se* is unlikely to lead to adequate levels of uptake, hence the need for an economic incentive (or compliance requirement).
 - Overcoming scepticism: there may be an additional level of reluctance amongst some land managers to participate in schemes due to scepticism over climate change.
 - Ability of a scheme to facilitate shared learning amongst land managers.
-
- The spatial scale of coverage and ability to achieve mitigation potential and adaptation scope. National schemes (Woodland and Peatland Codes) have high spatial potential, whereas targeted schemes (e.g. Pumlumon Project) have possibly better up-take but lower spatial potential.
-
- The ability to secure additional ES benefits. There is good potential to achieve additional ES benefits, even when climate change mitigation is the key objective.
-
- Security of funding and timescales with appropriate length contracts: it is important that climate change focussed schemes have longevity to maintain the required management actions and to avoid the risks of perverse outcomes (e.g. changes in land use that result in increased emissions). A key aspect is the timescale at which beneficial ES can be secured through a scheme for climate change purposes, in that carbon sequestration (e.g. through accumulation in soil and biomass) is a slow process. The time imperative for mitigation however is more immediate, with the need to reduce emissions and store carbon.
-
- Assessing the *conditionality* through measurement and scientific understanding. There are many drivers that influence the functioning of ecosystems (not least climate change impacts themselves) that determines the supply of ES. Thus demonstrating that the provider is able to secure ES through paid for actions implies a greater need for scientific and practical means of measuring and monitoring.
-
- Assessing *additionality* and validation of outcomes through measurement and monitoring over long time periods. A challenge for climate change based PES will be in determining effectiveness in the short- and long-term. Monitoring capability depends on the observability of outputs and actions at the individual scale, and may be easier when observability of outcomes is low. The associated costs and how they are covered within the contract will determine the scale of monitoring capability.
-
- Adaptation to climate change requires more locally tailored schemes because they tend to be more context dependent, particularly for the provider side (land managers). Here the flexibility of contracts with suppliers is a key issue, but under a national scale umbrella scheme for funding to spread financial burden.
-
- The capacity of government funded schemes for climate change mitigation and adaptation, in terms of numbers of participants and coverage of input based costs or results based payments will be limited by the size of the available budget and timescale over which it is to be used. This can be a weakness, but also a strength if it is used to increase the cost-effectiveness of the scheme, e.g. by the use of auctions (see Conservation Reserve Program case study).

The 'Payment for Ecosystem Services' approach - relevance to climate change

-
- Vulnerability of funding: Government and charity (donations) funded schemes are vulnerable to political changes (Brexit, decrease in donations). Market based schemes have no budget constraints, but are potentially constrained by a lack of demand, and subject to (carbon) markets volatility. The current low market carbon price is a big constraint.

Views in the literature on PES and climate change.

“There are three main ways in which PES and adaptation to climate variability and change interact. First, the provision of ES through PES could reduce the vulnerability of the coupled socioecological system and its various system components. Second, the PES scheme could increase the adaptive capacity of the various system components through the ways in which it is implemented and designed. Third, the PES could act as an incentive mechanism for ES providers to promote specific adaptation measures to climate variability and change”. Van de Sand (2012).

“PES contributes to mitigation by reducing greenhouse gas (GHG) concentration and protecting existing forests and the soil carbon stock. It also encourages practices aimed at capturing atmospheric carbon dioxide in plantations and contributes to better carbon management. The climate regulation potential of PES explains why the international initiative on reducing greenhouse gas emissions from deforestation and forest degradation, known by the acronym REDD+,¹ makes frequent use of PES-type instruments. Indirectly, PES also contributes to climate change adaptation policies by protecting ecosystem services that reduce vulnerability, such as hydrological regulation, biodiversity, or services related to multifunctional agriculture (traditional knowledge, pollination, soil conservation, etc.)”. Ezzine de Blas et al 2016

Conclusion and recommendations

The Payment for Ecosystem Services approach to providing finance for environmental management has evolved in response to the need to resolve the market failure of economies to maintain ecosystems in healthy, fully functioning conditions in order to maintain the supply of ecosystem services. The *ad hoc* development of PES schemes to address a wide variety of ecosystem service supply needs has led to a wide range of scheme types. As a result there is some confusion in how the term is used within a range of definitions and interpretations. This has resulted in uncertainty amongst government policy makers, land management professionals and practitioners as to what PES is and how it relates to other environmental management initiatives. There is an expectation amongst these groups that there will be a greater use of PES schemes in the future (Waylen and Martin-Ortega 2018), hence there is need for those developing schemes and implementing them to have a common understanding of the issues. These are:

- There are different actors within a scheme with a range of relationships in how they interact:
 - Providers; Land-managers (or others) whose actions generate ES.
 - Intermediaries; People or organisations that administer and manage transactions between Beneficiaries and Providers. These can be:
 - Buyers (financiers); People or organisations that coordinate the demand for ecosystem services and the funding from beneficiaries.
 - Suppliers: organisations that coordinate the supply of ecosystem services by several providers.
 - Beneficiaries; Those that benefit from the supply of ecosystem services secured through a PES scheme.
- Given the multiple beneficiaries of climate change mitigation and adaptation to climate change, and the multiple potential providers of ES, intermediaries need to step in to facilitate the establishment of PES schemes. The way these intervene can be by acting as intermediaries themselves (buyers or suppliers) or by providing a legal or institutional framework (such as the Peatland Code).
- For the purposes of meeting climate change needs, PES has substantial potential but with several key issues:
 - The degree to which participation by actors, particularly providers can be facilitated.
 - The type of scheme (inputs or results based), the structural arrangement for the relationships between actors and how well it fits with the objectives.
 - How well the scheme balances the need for supply of other ES (and biodiversity).

The 'Payment for Ecosystem Services' approach - relevance to climate change

- PES schemes can take different forms, as they can be:
 - Inputs based, covering the costs of activities to secure Ecosystem Services;
 - Results based, where land managers receive payment on achieving objectives (e.g. carbon credits).
- The ability to monitor land-managers' actions and measuring the ES provided serves as a large constraint on the type of scheme that can be used and its efficiency.
- The source of funding used to implement the PES scheme (taxes, donations, carbon markets), leads to different sources on uncertainty: political uncertainty of future public budgets, financial uncertainty of prices in carbon markets, and uncertainty on long-term sustainability of donations from private parties.
- A key question for PES as a means to achieve mitigation and adaptation targets is whether the scale of uptake based on voluntary participation is sufficient, or whether a compliance based approach is needed due to the scale of ES maintenance required and time frames in which this needs to happen due to the climate change imperative.

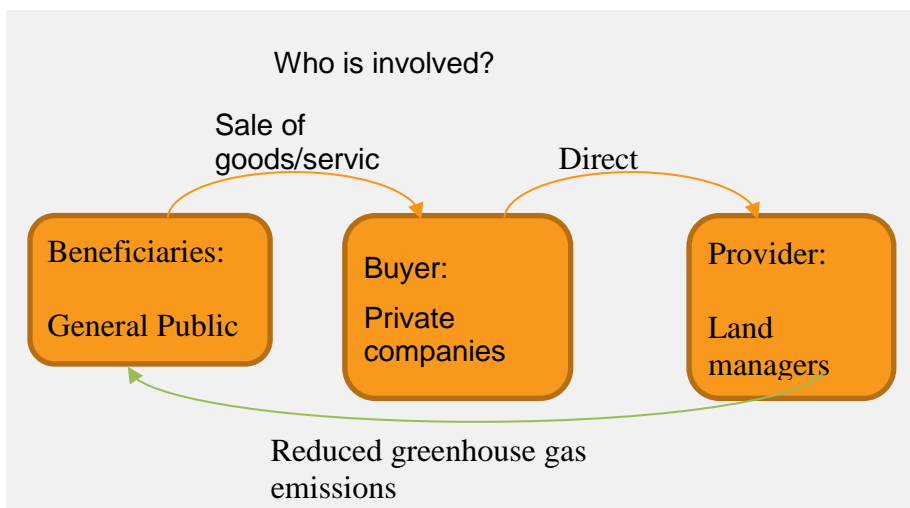
Appendix A. Case Studies

In the following pages we present nine case studies that are representative of the range of PES schemes:

1. The Peatland Code.
2. The Woodland Code.
3. Scottish Rural Development Program - Agri-environment and Climate Scheme.
4. Scottish Water's Drinking Water Protection Scheme.
5. Scottish Rural Development Program - Forest Grant Scheme
6. Scottish Farm Carbon
7. Pumlumon Project (Wales)
8. MoorFutures (Germany).
9. Conservation Reserve Program (United States)

1. Peatland Code UK

Overview: The Peatland code coordinates the sale of carbon credits from landowners to private individuals/ companies, to fund peatland restoration. This restoration aims to reduce greenhouse gas emissions from degraded peatland, and operates on the voluntary market.



General appraisal

This scheme has seen limited uptake, potentially due to operating in the voluntary market, over a national scale. The Peatland Code is also less recognizable than comparable schemes, such as the Woodland Carbon Code.

Additionality

Payments must not cover action required by regulation, and must cover >15% of project costs. Payments must cover action which is otherwise not the most economically viable option for the land, or helps to overcome other barriers to the project.

Monitoring, evaluation and audit

Baseline monitoring before the project, followed up in year 1, year 5, and every 10 years thereafter. Measuring peat depth and peat health category.

Risks, opportunities, unintended consequences

Non-permanence is not considered a risk as projects aim to reduce emissions. Ownership of land is required for the length of the contract, and leakage must be included in GHG emissions estimates for the project.

Market readiness

Relates to carbon credits, which are already active, however limited as can only be used in the voluntary market.

Potential acceptability / reception

Active in Scotland, but has had limited uptake.

Link with other initiatives

Peatland Action provides government funding for restoration.

Key facts

When? Since 2013

Focus on climate change? Yes. Reduction in greenhouse gas emissions.

What ES are being bought? Carbon emissions reduction

Scale? National

How are providers selected? Self-selected

Price setting? Based on costs of restoration work.

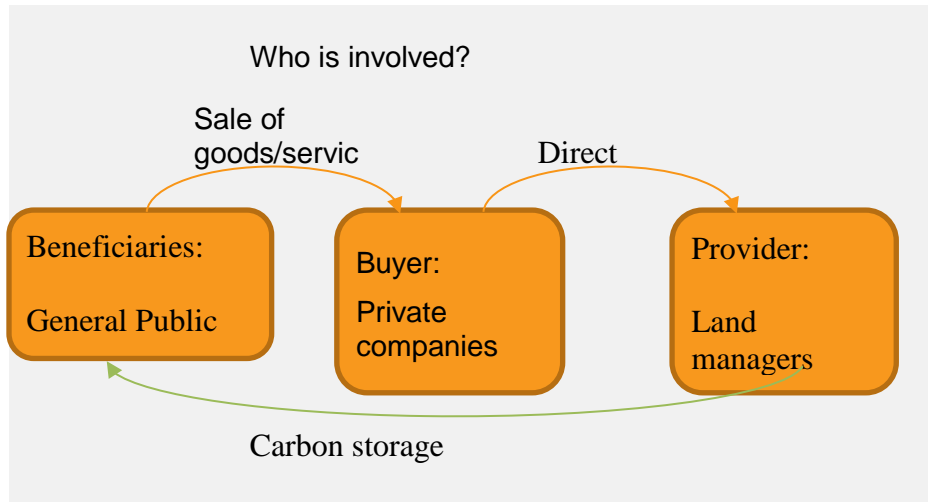
Payment approach? Input based

Length of contract/commitment? 30-55 years (unless peat expected to persist longer than 55 years)

Website: [IUCN Peatland Code](https://www.peatlandcode.org.uk/)

2. Woodland Carbon Code, UK

Overview: The Woodland Carbon Code coordinates sale of voluntary carbon credits between private companies and landowners for the creation of woodland. Carbon storage is the only service sold, but the scheme recognises co-benefits such as air quality, wildlife habitat, wood fuel etc.



General appraisal

Overall this scheme is perceived as being successful, with 242 projects, covering 16,218 ha (?) of woodland by June 2016, and an estimated 6 million tCO₂ sequestered over 100 years project lifetime.

Additionality

Projects must not be under legal requirement to create woodland, and funding must cover >15% of costs. The project must also show that without the funding woodland creation is not the most economically viable use for the land, or that the Woodlands Carbon Code helps to overcome other barriers.

Monitoring, evaluation and audit

Baseline data collected from land use records and maps. Carbon sequestered is calculated directly from the volume of timber. Monitoring after 5 years, and every 10 years thereafter.

Risks, opportunities, unintended consequences

Woodland cannot be established on organic soils more than 50cm deep to prevent release of stored carbon, and contract lengths are 100 years, after which UK regulations prevent woodland removal. Leakage must be included within the carbon budget if it is over 5% of sequestered carbon.

Market readiness

Currently active in the UK, and linked to the voluntary carbon market.

Potential acceptability / reception

Active in Scotland.

Link with other initiatives

Links to regulations on woodland removal after 100 years.

Key facts

When? Since 2013 (pilot 2011)

Focus on climate change? Yes. Carbon sequestration.

What ES are being bought? Carbon credits

Environmental objectives? Increase carbon sequestration

Scale? National, but buyers and sellers are locally based.

How are providers selected? Self selected

Price setting? Based on costs of restoration work.

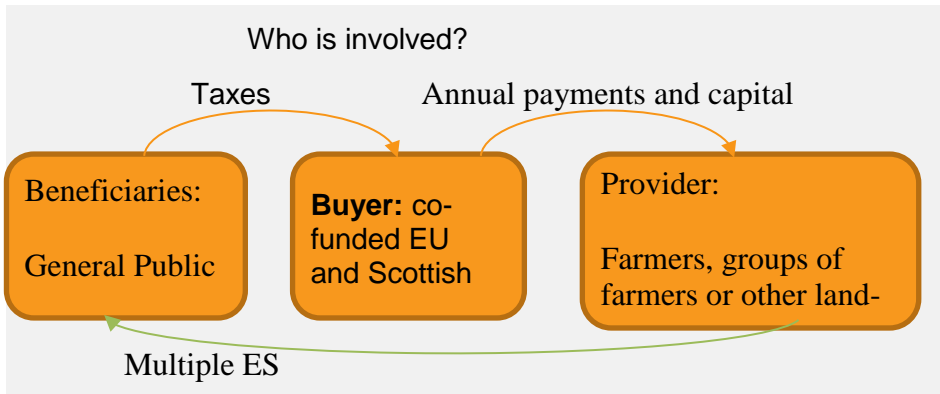
Payment approach? Input based

Length of contract/commitment? 100 years (after this the woodland would be considered established, and therefore covered by UK regulations).

Website: [Forestry Commission Woodland Carbon Code](https://www.forestry.gov.uk/forestry/comm-wc)

3. Agri-Environment and Climate Scheme, SRDP, UK

Overview: The AEC scheme is part of the Scottish Rural Development program (SRDP) and offers payments to preserve and promotes changes to agricultural practices that make a positive contribution to the environment and climate. It includes a wide range of options farmers can choose from to address multiple environmental challenges. Specific options such as wetland, moorland or lowland bogs management can contribute to climate change mitigation as well as adaptation to climate change.



General appraisal

Most options on the AEC scheme focus on biodiversity conservation, water quality improvement or flood risk management. Adaptation to climate change or CC mitigation is only mentioned as a primary objective for very few options (lowland bog and moorland management).

Additionality

AECS offer payments for environmental actions that go beyond minimum national environmental standards. There are suspicions in the academic literature that this type of scheme mainly attracts farmers who would have had environmentally-friendly land-management anyway in the absence of the scheme, leading to low additionality. This is partially addressed by competitive selection of providers and targeting.

Monitoring, evaluation and audit

At least 5% of grant claims are inspected each year, with verification that the practices recorded and observable on site are compliant with specified requirements for the subscribed options.

Risks, opportunities, unintended consequences

The inclusion of more options directly aiming at CC mitigation is an opportunity to be considered, for example payments to develop renewable energy sources on farms, but requires extra public funding.

Market readiness

Similar AECS (previously called AES) was included in the 2007-2013 SRDP.

Potential acceptability / reception

Low uptake is imputed to uncertainty around the long term availability of funding (Brexit), high administrative burden, and low levels of payments.

Link with other initiatives

AECS provide the financial support to farmers to contribute to a large number of EU and national environmental legislation, policies, strategies and action plans, e.g. Flood Risk Management (Scotland) Act 2009, the CC (Scotland) Act 2009 and the Second Report on Proposals and Policies for meeting CC targets.

Key facts

When? 2014-2020

Focus on climate change? No, climate change is one of multiple environmental objectives

What ES are being bought?

Habitats and species preservation, climate change mitigation, water quality, flood risk management, cultural services.

Environmental objectives? See ES

Scale? Scotland

How are providers selected? A target area has been defined for each AEC option. The applicant's holding must be within the target area in order for that operation to be eligible. The AEC scheme is competitive and providers must apply to annual calls. The selection is done based on the following assessment criteria: environmental benefit, scale, long-term benefits, feasibility and value for money. Extra points are given to applications which help deliver at least one of the national priorities, including CC mitigation through peatland restoration.

Payment setting? Annual payment to compensate providers for all or part of the additional cost and income foregone resulting from the environmentally beneficial management commitments undertaken. Payments take the format of grants and are based on nationally set standard costs.

Payment approach? Input based

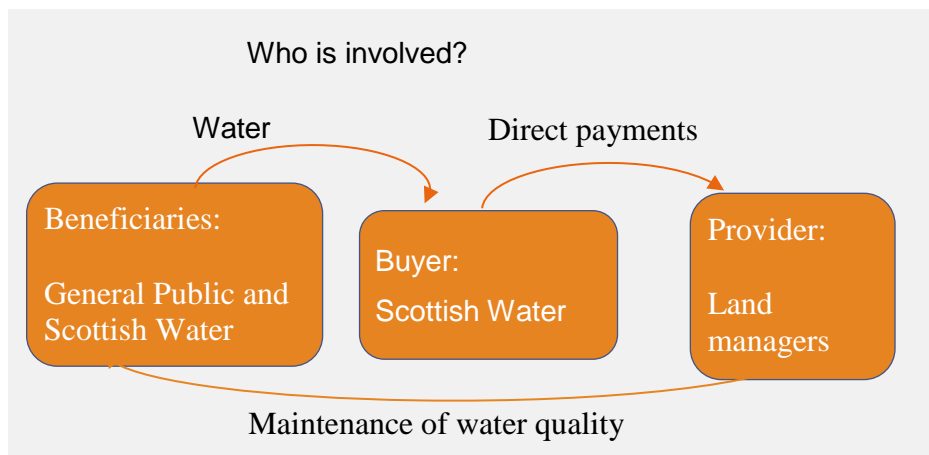
Length of contract? 5 years

Annual budget? £350 million for the whole 2015-2020 period, i.e. about £58 million a year.

Website: [Agri-Environment Climate Scheme](#)

4. Scottish Water Drinking Water Protection Scheme

Overview: The DWPS targets specific drinking water catchments if there is a risk to water quality from diffuse pollution. Land managers are invited to participate and take on additional measures which are over and above regulatory compliance. Finance covers the additional management and capital items needed. It replaced the Sustainable Land Management Incentive Scheme.



General appraisal

The scheme is not open for applications, instead land owners, managers and tenants are selected based on Scottish Water's assessment of risk to water quality and invited to participate. Payments are not made to support meeting regulatory compliance, repairing broken equipment or if finance received from other sources for the same work. The scheme can provide up to 100% of costs in implementing measures per business.

Additionality

There are public health benefits: the aim on the DWPS is to improve the quality of water as it enters the treatment process so it is easier and cheaper to produce compliant water to customers. It potentially assists participants in achieving overall sustainable land management (i.e. reduction in soil erosion), but measures not in place long enough to be certain.

Monitoring, evaluation and audit

Monitors what goes into treatment works before and after interventions – focus is at catchment scale so hard to attribute ES improvement to particular activities.

Risks, opportunities, unintended consequences

Main risk is lack of up-take

Market readiness

Scheme is in place and operating.

Potential acceptability / reception

Limited in geographical scope so only applies to a small number of land managers in designated catchments.

Link with other initiatives

No direct links but relates to Nitrate Vulnerable Zones, CAP and Good Agricultural and Environmental Condition (GAEC)

Key facts

When? Since 2012

Focus on climate change? No, emphasis is on water quality, but can include peat restoration.

What ES are being bought? Water provisioning

Environmental objectives? None directly, minimize pollution entering water system and reduce contamination risk.

Scale? Farm level, and only in 6 designated catchments.

How are providers selected? By invitation

Price setting? According to a set rate per eligible item and land management activity.

Payment approach? Input based.

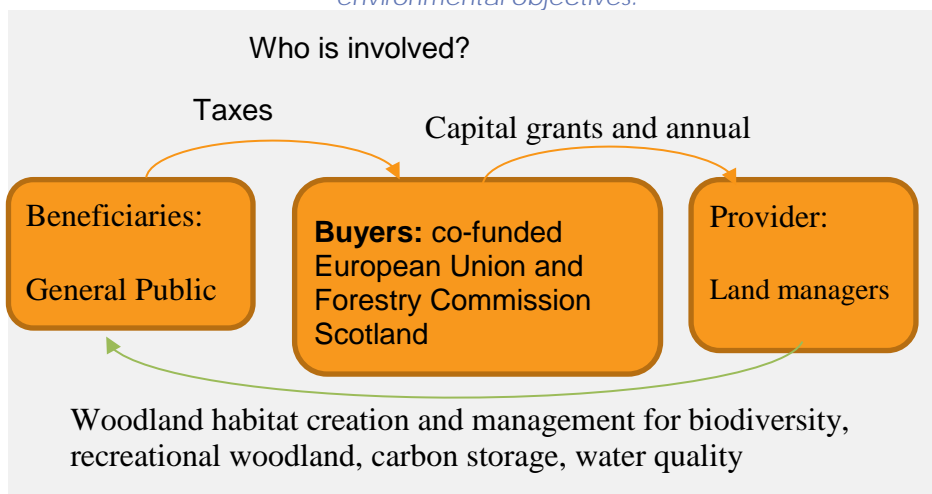
Length of contract/commitment? There is no contract. Applicants get a year to install any capital items but they are not tied into a contract with Scottish Water

Website: DWPS

The 'Payment for Ecosystem Services' approach - relevance to climate change

5. Forestry Grant Scheme, SRDP

Overview: the forestry grant scheme is part of the Scottish Rural Development Program (SRDP) and provides grants to land-managers for woodland creation and sustainable management of existing woodland. This is a government funded PES scheme that has climate change mitigation as one of its multiple environmental objectives.



General appraisal

The grants are decisive in most land owners' decisions regarding woodland planting and management, though the uptake is still too low to meet the initial 10,000 ha/year target.

Additionality

Woodland creation grants support creation of new woodland only. Deep peat (>50cm) lands are ineligible and inappropriate planting of sensitive habitats are avoided in the application process.

Monitoring, evaluation and audit

Woodland management in Scotland and the Highlands must meet the UK Forestry Standard. At least 5% of grant claims are inspected each year, with verification that the area created and management of woodland is compliant with requirements specified by the scheme.

Risks, opportunities, unintended consequences

Forestry Commission Scotland cited insufficient take up of grants as contributing to failures to meet woodland creation targets.

Market readiness

The current Forestry Grant Scheme was preceded by a similar scheme which formed part of the SRDP 2007-13.

Potential acceptability / reception

Tenants might be less willing to participate as would not benefit from long term investments on the land. Low uptake is also imputed to length of application process, uncertainty around the long term availability of funding (Brexit) and low economic attractiveness of forestry on agricultural land due to higher agricultural incomes and grants.

Link with other initiatives

Grants contributes to: EU habitat and species directives; Scottish Biodiversity Strategy; Climate Change (Scotland) Act 2009; Scottish Government target of extending woodland cover by an additional 100,000 hectares over the period of 2012-2022; several planning strategies (e.g. deer management plans, urban woodland management plans etc.).

Key Facts

When? Since March 2015

Focus on climate change? CC mitigation is one of many objectives of the scheme

What ES are being bought? Biodiversity (forest habitat network), recreation (public access), regulation (gales or pests outbreaks), timber, carbon sequestration, soil and water protection, improved landscape.

Environmental objectives? See ES

Scale? Scotland

How are providers selected? The Forestry Grant Scheme is competitive and applications that deliver the greatest benefits against budget priorities are selected through a scoring system. The selection criteria include contribution to local woodland strategies and landscape for woodland creation options and support to priority habitats and species and contribution to multi-purpose objectives for management options.

Payment setting? Contributions to nationally set standard costs of establishment and maintenance. Higher payment rates are offered in priority target areas and priority woodland types.

Payment approach? Input based, grants contribute to establishment and maintenance costs.

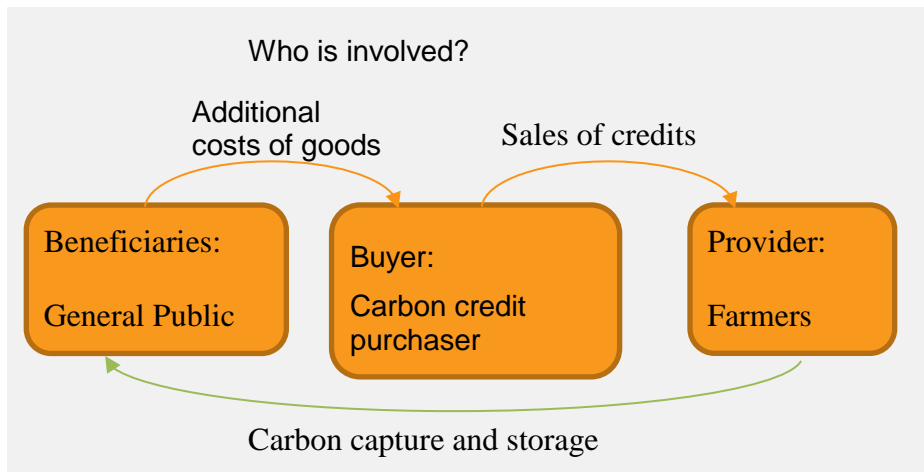
Length of contract? Up to 6 years for management options, 10 years for woodland improvement options, 20 years for woodland creation contracts.

Annual budget? Provisional budget of £252 million for the 2014-2020 period, £36 million per year. Actual expenditures in 2016-2017 were £30.5 million.

Website: [Forestry Grant Scheme](#)

6. Scottish Farm Carbon

Overview: The Scottish Farm Carbon is a cooperative scheme for new farm woodlands for carbon off-setting initiated by the Scottish Agricultural Organisation Society. It is outcomes based, relying on the expectation that the price of carbon will rise, polluters will need to purchase credits and farmers sell these based on assessment of carbon sequestered from initial registration by SAOS.



General appraisal

This is a new scheme and currently confined to a small group of cooperative members (mostly on East Coast of Scotland). There is a fee to pay to SAOS for initial registration and assessment of woodland carbon stocks. The target price of carbon is £15/t. New planting (not re-stocking of existing woodland areas) must be on non-productive land (i.e. not producing food). It applies to areas of <11 ha, hence aims to fill the gap as the Forest Grant Scheme is considered not to be cost effective for small woodlands (due to startup costs etc.).

Additionality

The scheme has additional benefits of improving farm woodland management and associated biodiversity and water benefits.

Monitoring, evaluation and audit

Initial audits conducted two SAOS foresters. Coop members self-monitor supported by SAOS, with carbon sequestered calculated via yield class tables.

Risks, opportunities, unintended consequences

The scheme operates as a cooperative so risks are pooled across members, as are the rewards from participation. Worst case scenarios is that carbon price is only ~£3/t. Non-productive land used may have other ES benefits that would change after planting. The initial costs of setting up the scheme are being borne by SAOS.

Market readiness

Scheme is in operation but limited in current extent.

Potential acceptability / reception

The scheme seeks to break down barriers between farmers and foresters and improve the way woodlands are valued.

Link with other initiatives

As per Forest Grant Scheme (above)

Key Facts

When? Since 2014

Focus on climate change? Yes but also financial return to farmers.

What ES are being bought? Climate regulation through carbon capture.

Environmental objectives? Improved woodland management for multiple benefits.

Scale? Farm level.

How are providers selected? Open publicity and then registration.

Price setting? Certified carbon offsets to be sold when sufficient volume and appropriate carbon price.

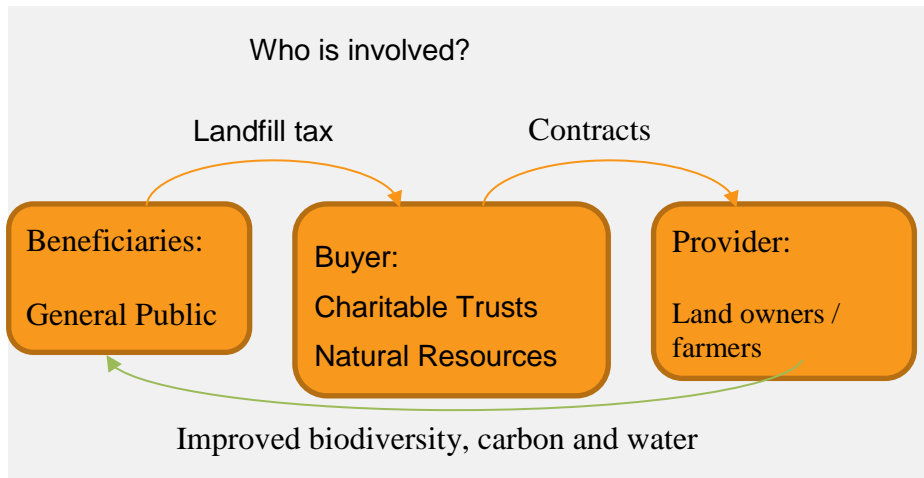
Payment approach? Shared benefits across cooperative members based on sale of carbon credits.

Length of contract/commitment? None as depends on the price of carbon and cooperative decisions on when to sell credits

Website: [Scottish Farm Carbon](http://ScottishFarmCarbon)

7. Pumlumon Project, Wales

Overview: An ecosystem restoration initiative to achieve multiple ecosystem service benefits of biodiversity carbon and flood water storage, initiated by the Montgomeryshire Wildlife Trust. The emphasis is on farm level economic security to achieve changes in land management practices.



General appraisal

This has been a successful scheme, having restored several thousand hectares of wetland habitat and seen biodiversity benefits. It has achieved good ecological benefits and now focusing on socio-economic and societal impact. Contracts are farm specific.

Additionality

This scheme combines multiple objectives at different sites and is contradictory to CAP support in terms of livestock incentives.

Monitoring, evaluation and audit

MWT acts as broker and carries out annual monitoring of maintenance of infrastructures, but not clear on level of assessment of outcomes achieved.

Risks, opportunities, unintended consequences

Risk of withdrawal of financial support by charitable trusts and re-direction of landfill tax. Scheme only pays farmers for maintenance, initial costs directly paid by Wildlife Trust. Poor matching to payment, £50/ha regardless of action or outcome. Lack of permanence with funding only given for 5 years to maintain infrastructure, though plans to extend this to 30 years.

Market readiness

The scheme is already in operation.

Potential acceptability / reception

In the local area this could be high with the potential to extend to a wider geographical range. Success based on political and policy endorsement from the government, ease of participation for landowners and farmers, generating new income for farmers, use of site visits to see changes, local scale, trusted intermediary, small scale allows for flexibility.

Link with other initiatives

Part of a wider range of initiatives from the Wildlife Trust.

Key Facts

When? Since 2007

Focus on climate change? No, but carbon storage a key feature.

What ES are being bought? Biodiversity, Carbon storage and storing flood water.

Environmental objectives? Reconnecting habitats, ecosystem restoration, changing grazing management.

Scale? Multiple local (c. 40k ha)

How are providers selected? Survey of all farmers to determine interest.

Price setting? £50/ha where new MTW infrastructures implemented. Paid annually.

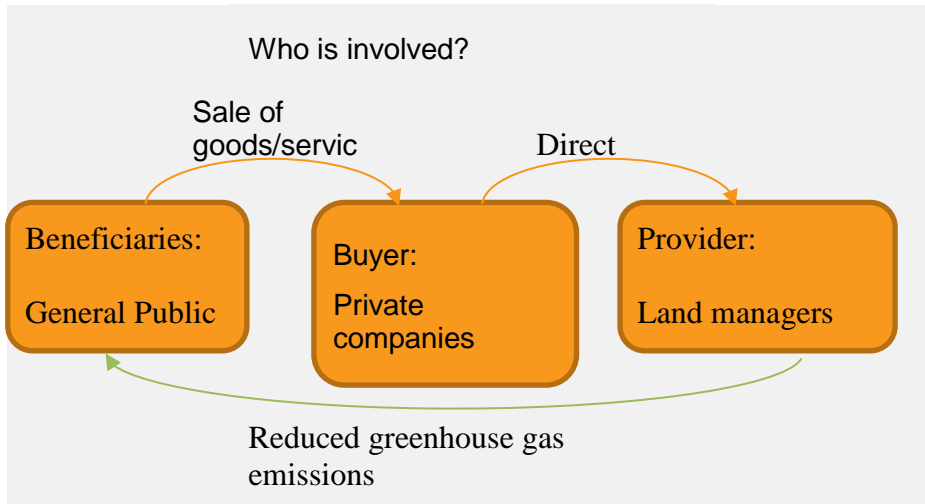
Payment approach? Input based, providers commit to maintain infrastructures

Length of contract/commitment? 5 years initially, aiming to extend to 30 years.

Website: [Pumlumon Project](#)

8. MoorFutures, Germany

Overview: MoorFutures coordinates the sale of voluntary carbon credits for peatland rewetting in Germany, on a local scale. Currently only carbon is valued, but the program is under development to incorporate bundles of



General appraisal

Overall considered to be effective, with high uptake of credits. However there has been some criticism due to potential negative impacts on farmers.

Additionality

Restoration is fully funded through the MoorFutures projects, and does not cover legally required actions.

Monitoring, evaluation and audit

Peat condition measured using water table depth and refined by vegetation present. Measured before rewetting, after three years, and every 10 years thereafter.

Risks, opportunities, unintended consequences

Project permanence may be an issue, with contracts lasting 30-100 years. Socioeconomic impacts of altering grazing patterns is only considered for large projects, and not required to be compensated. Raising of the water table increases flood risk. Bundles of goods provide additional value, and increase local relevance of project.

Market readiness

Linked to voluntary carbon market.

Potential acceptability / reception

Similar project in UK at a national level is not successful, potentially due to the larger spatial scale. A local based scheme may be more accepted.

Link with other initiatives

No clear links.

Key Facts

When? Since 2011 (Initial trail 2009)

Focus on climate change? Yes. Reduced greenhouse gas emissions.

What ES are being bought? Carbon credits

Environmental objectives? Reduce greenhouse gas emissions.

Scale? Local buyers and sellers, based in single province.

How are providers selected? Self selected

Price setting? Based on costs of restoration work. €30-€70/tonne

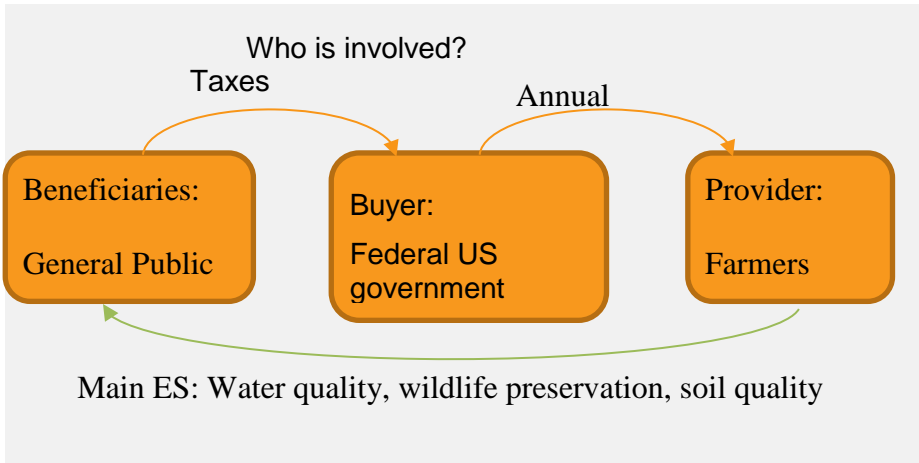
Payment approach? Input based

Length of contract/commitment? 30-100 years

Website: MoorFutures

9. Conservation Reserve Program US

Overview: In the CRP, the US department of Agriculture offers contracts to landowners who accept to retire a parcel of land from agricultural production and install resource-conserving plant species, such as approves grasses or trees, in exchange of an annual payment. It was



General appraisal

This is a successful scheme. The interesting feature is the mechanism used for selecting providers: the literature attributes its success to the use of reverse auctions, where applicants are subject to a competitive selection.

Additionality

Only cropland that has been in production 4 of the past 6 years is eligible. Lubowski *et al.* (2003) estimate that 15% of the engaged cropland would have been retired from production in any case.

Monitoring, evaluation and audit

5 % of fields are visited each year for monitoring. However feasibility of monitoring largely depends on observability of practices' implementation and maintenance. Its environmental performance is assessed yearly based on enrolment data and environmental impact modelling. It's been found that since it was established, CRP has sequestered an annual average of 49 million tons of greenhouse gases, equal to taking 9 million cars off the road.

Risks, opportunities, unintended consequences

Farmers might expand cropland in other areas of their farm to compensate for retired land under CRP (Wu 2000).

Market readiness

Funding mechanism (taken from general government revenue) is similar to SRDP.

Potential acceptability / reception

Some concern could come from the selection mechanism and willingness of farmers to accept bidding in a competitive process for ES funding.

Link with other initiatives

The CRP is complemented with specialized schemes focused on targeted environmental issues (wetlands, grassland) or particularly vulnerable sites.

Key facts

When? Since 1985

Focus on climate change? No, but long term commitment is favoured to sustain climate change mitigation.

What ES are being bought? Main: Water quality, wildlife preservation, soil quality; Secondary: air quality, carbon sequestration, energy conservation.

Environmental objectives? See above

Scale? Federal – US wide. 8 to 10% of US cropland under this scheme – about 10 million hectares (2016).

How are providers selected? Cropland that is highly erodible is eligible. All applicants submit a proposal describing the conservation practices and the payment required. Applications are then scored and ranked according to an Environmental Benefit Index accounting for the application's contribution to wildlife habitats, water quality, erosion control and air quality, the likelihood that benefits will endure beyond the contract period and its cost. Only the top applications are selected until the budget is exhausted or the acreage cap is reached.

Payment setting? Farmers are paid an annual rent and can ask for contributions to cover up to 50% of the cost of establishing land cover for conservation. The maximal annual rental payment is based on estimated agriculture rental value of the land but farmers can ask for lower payments thereby increasing their chances to be selected.

Payment approach? Practice based

Length of contract? 10 to 15 years

Annual budget? \$1.8 billion in 2016

Website: [Conservation Reserve Program](https://www.nrc.gov/conservation-reserve-program)

Appendix B. Glossary

Term	Definition	Alternative or relates to
Additionality	Ability of a scheme to provide ES above and above the ES that would have been produced in the absence of that scheme.	Also referred to as net positive difference
Beneficiaries	Those that benefit from the supply of ecosystem services secured through a PES scheme. A buyer can also be a Beneficiary.	
Buyers (Financiers)	People or organisations that pay for the scheme and coordinate the demand for ecosystem services and the funding from beneficiaries. A buyer can also be a Beneficiary.	
Conditionality	Requirement as part of the scheme that the Provider is able to secure ES provision (and that contracted actions are carried out).	
Credits (Carbon)		
Discriminative payment	A payment is called “discriminative” when each provider of ES is offered a different payment, according to their own cost of provision for example.	By opposition to uniform payment.
Effectiveness	Ability to achieve set objectives	
Efficiency	Ability to achieve set objectives at the lowest cost	
Goods (ecosystem services)	The tangible benefits humans gain from Nature, e.g. food.	Associated with Services
Input based payment	Payment based on the management actions (inputs) implemented by service providers (land managers)	Also referred to as <i>measure-oriented payment</i> . Opposite to output-based payment
Intermediaries	People or organisations that administer and manage transactions between Buyers and Providers.	Also referred to as an <i>agent</i> or <i>broker</i> .
Leakage	If there is no positive net effect on an ecosystem service if a PES does not reduce a negative externality but instead only moves it elsewhere.	

The 'Payment for Ecosystem Services' approach - relevance to climate change

Term	Definition	Alternative or relates to
Natural Capital	Stocks of natural assets such as geology, soil, air, water, living things.	
Term	Definition	Alternative or relates to
Offsetting (carbon)	The process of counteracting carbon dioxide emissions through an equivalent reduction or sequestration elsewhere.	Compensation
Opportunity cost	Loss of revenue if an alternative way of using the ecosystem resource had been used.	
Output-based payment	Payment based on the quantity of ES actually produced by the provider (land-manager).	Opposite to input-based payment. Also referred to as <i>performance</i> or <i>result-oriented payment</i>
Provider	Land-manager (or other) whose actions generate ES	Same as Supplier
Services (ecosystem services)	The intangible benefits humans gain from Nature, e.g. climate regulation.	Associated with Goods
Supplier	Intermediary between buyer(s) and providers who can coordinate the supply of ES from multiple providers, e.g. an NGO, a farmers' cooperative.	
Transaction costs	All costs incurred in transactions between actors with the scheme.	
Uniform payment	A payment is called "uniform" when all providers of ES are offered the same payment, per hectare for example.	Opposite to discriminatory payment

Appendix C: References

Arriagada and Perrings (2009) Making Payments for Ecosystem Services Work. Ecosystem Services Economics Working Papers. United Nations Environment Programme, Nairobi.

Bonn, A., Reed, M. S., Evans, C. D., Joosten, H., Bain, C., Farmer, J., ... Birnie, D. (2014). Investing in nature: Developing ecosystem service markets for peatland restoration. *Ecosystem Services*, 9, 54–65. <https://doi.org/10.1016/j.ecoser.2014.06.011>

DEFRA (2013). Payments for Ecosystem Services: A Best Practice Guide. Ref: pb13932, 85p. Available at: <https://www.gov.uk/government/publications/payments-for-ecosystem-services-pes-best-practice-guide>

Engel, S., Pagiola, S., & Wunder, S. (2008). Designing payments for environmental services in theory and practice: An overview of the issues. *Ecological Economics*, 65(4), 663–674. <https://doi.org/10.1016/j.ecolecon.2008.03.011>

EU (2014) COMMISSION REGULATION (EU) No 702/2014. <http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32014R0702&from=en>

Ezzine-de-blas, D., Hrabanski, M., & Coq, L. (2016). Climate Change and Agriculture Worldwide, 277–288. <https://doi.org/10.1007/978-94-017-7462-8>

Ezzine-De-Blas, D., Wunder, S., Ruiz-Pérez, M., & Del Pilar Moreno-Sanchez, R. (2016). Global patterns in the implementation of payments for environmental services. *PLoS ONE*, 11(3), 1–16. <https://doi.org/10.1371/journal.pone.0149847>

Hasund K and Johansson M (2016). Paying for Environmental Results is WTO Compliant. *EuroChoices* 15(3), 33-38. [Web link](#)

Laurans, Y., Lemenager, T., Aoubid, S. (2011). Les Paiements pour Services Environnementaux. *Report for the Agence Francaise du Développement*, collection A Savoir (7). 218p. <http://recherche.afd.fr>

Matzdorf, B., Biedermann, C., Meyer, C., Nicolaus, K., Sattler, C. and Schomers, S. (2014). Paying for Green? Payments for Ecosystem Services in Practice. Successful examples of PES from Germany, the United Kingdom and the United States. Müncheberg. 208 pages.

O'Brien A et al (2016) How is ecosystem health defined and measured? A critical review of freshwater and estuarine studies. *Ecological Indicators* 69, 722-729. [Web link](#)

Stern, N (2006) The Economics of Climate Change: Stern Review.

van de Sand, I. (2012). Payments for Ecosystem Services in the Context of Adaptation to Climate. *Ecology And Society*, 17(1), 11–25. <https://doi.org/10.5751/ES-04561-170111>

Waylen KJ and Martin-Ortega J (2018) Surveying views on Payments for Ecosystem Services: Implications for environmental management and research. *Ecosystem Services* 29, 23-30. [Web link](#)

Wunder, S. (2005). Payments for environmental services : Some nuts and bolts (Occasional Paper No. No. 42).

Wunder, S., Engel, S., & Pagiola, S. (2008). Taking stock: A comparative analysis of payments for environmental services programs in developed and developing countries. *Ecological Economics*, 65(4), 834–852. <https://doi.org/10.1016/j.ecolecon.2008.03.010>

Wunder, S. (2011) Payments for Environmental Services: Institutional Preconditions in Developing Countries. Presentation to the International Conference on Payments for Ecosystem Services, Berlin, 10/11 November 2011. <http://pes-conference.civiland-zalf.org/>

Appendix D: Further web based information

Ecosystems Knowledge Network: [About PES](#) / [Natural Capital Accounting](#)

Natural Capital Coalition: [PES global examples and issues](#)

Scotland's Environment: [Ecosystem Health Indicators](#)

United Nations Development Programme: [Financing solutions for Sustainable Development](#)

YouTube video: [PES explained](#)