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Improving the link between payments and the provision of ecosystem services in agri-environment schemes in UK peatlands

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Abstract

This paper considers how agri-environment schemes under the Common Agricultural Policy could be adapted to derive a higher return of ecosystem services from agricultural land, through deliberation with members of the public, land owners, managers and other stakeholders: i) paying for the ecosystem services that are valued most by society; ii) spatially targeting payments to locations where ecosystem services can most efficiently be provided; and iii) providing incentives for cross-boundary collaboration over the provision of ecosystem services that need to be managed at catchment or wider spatial scales. Using UK upland peatlands as a case study, and drawing on experience tackling these issues in the new Glastir agri-environment scheme in Wales, the paper attempts to find a balance between current input-based schemes that pay for land management activities on the basis of income foregone and output-based schemes that pay by results. The paper reviews evidence that spatially targeted, output-based payments may be more economically efficient than current approaches, but identifies a number of challenges, including: scientific uncertainty; pricing of ecosystem services; timing of payments; increased risk to land managers; compliance with World Trade Organisation regulations; and barriers to cross-boundary collaboration in the management of ecosystem services at habitat, catchment or landscape scales. A number of options are reviewed to overcome these challenges, including: the use of process-based models, pressure-response functions and expert knowledge to establish causal links between management and ecosystem service delivery and reduce the costs of monitoring; the use of competitive bidding or non-market valuation techniques to set prices for ecosystem service delivery; insurance schemes; combining agri-environment schemes with funding from private Payment for Ecosystem Service schemes; and independent facilitation of groups of potential applicants across property boundaries in scheme options that are co-designed with the land management community. Drawing on examples from UK peatlands and experience designing the Glastir scheme, the paper

proposes a number of ways in which agri-environment schemes around the world that make payments on the basis of management inputs can better link payments to the provision of ecosystem services.

1 Introduction

This paper considers how agri-environment schemes under the Common Agricultural Policy could be adapted to derive a higher return of ecosystem services from agricultural land, through deliberation with members of the public, land owners, managers and other stakeholders: i) paying for the ecosystem services that are valued most by society; ii) spatially targeting payments to locations where ecosystem services can most efficiently be provided; and iii) providing incentives for cross-boundary collaboration over the provision of ecosystem services that need to be managed at catchment or wider spatial scales.

Agricultural subsidies have become an important way to maintain (and in some cases change) land management, and are used around the world to support farmer incomes and manage the supply of agricultural commodities. For example, a number of schemes exist in Africa where farmers are given vouchers they can redeem to purchase fertilisers or other inputs to increase production e.g. the Malawi Government's Agricultural Inputs Subsidy Programme (Dorward, 2008). Although in most developed countries the focus is increasingly shifting to support the provision of ecosystem services from agricultural land, the majority of agricultural subsidies still primarily support farmer incomes. For example, although there are a number of conservation programmes in the USA (e.g. the Conservation Reserve Program that takes agricultural land out of production), much of the funding for agricultural subsidies is designed to stabilise farm incomes (via the US Farm Bills, of which there are many), providing direct payments to farmers and guaranteeing a price floor for many crops.

The majority of funding from the European Union's Common Agricultural Policy (CAP) also goes directly to support farmer incomes. The CAP represents around 40% of the total EU budget and influences (to differing extents) land management across around 180 million hectares of land across 27 EU Member States. It consists of two funds, also known as "pillars". Pillar 1 provides direct payments to farmers and other forms of market support, with the goal of building a strong agricultural sector. The smaller Pillar 2 is designed to support "rural development", via a number of "axes". Agri-environment schemes in Axis 2 now account for a significant proportion of Pillar 2 expenditure, and represent its most direct instrument for delivering environmental public goods (Defra, 2009; Natural England, 2009). There are now a growing number of voices within Europe calling for a clearer link between the significant amount of public investment in CAP and enhanced from ecosystem service provision to European society (IEEP reference). Their goal would be for schemes to pay the costs of supplying ecosystem services (and no more), whilst ensuring payments are conditional on ecosystem service delivery and keeping transaction costs to a minimum.

To avoid the burden of administering more complex schemes with higher associated transaction costs, input-based agri-environmental schemes in the EU and elsewhere make a number of simplifications, some of which have been criticised, for example: tying payments to management inputs or actions rather than actual delivery of desired outputs (Armsworth *et al*., 2012); using standardised payment rates that may not reflect spatial variations in biophysical conditions, management costs or ecosystem service values (Armsworth *et al*., 2012); and focusing on individual land management units when some ecosystem services may operate at a greater scale that requires linkages between separate land management units (Moxey *et al*., 1999; Marggraf, 2003; Groth, 2005; Goldman *et al*., 2007; Engel *et al*., 2008; Wunscher *et al*., 2008; Klimek *et al*., 2008; ECA, 2011). Although it may appear cheaper to administer input-based schemes, these simplifications may offer a false economy; for example, working in UK uplands, Armsworth *et al*. (2012) estimated that common simplifications in agri-environment schemes (in particular failing to spatially target payments) resulted in a 49–100% reduction in biodiversity benefits. They argued that the additional implementation costs of more complex schemes would be outweighed by the efficiency gains, even if a substantial amount of payments were spent on administrative costs.

This paper uses the example of UK peatlands and the latest scheme options within Wales' Glastir agri-environment scheme, to investigate a possible approach for addressing these policy simplifications. Peatlands in the UK uplands provide an interesting context in which to gauge the potential for agri-environment schemes to enhance the provision of ecosystem services from land management, for the following reasons:

- Peatlands provide a particularly wide range of ecosystem services to UK and global society (DEFRA, 2009c; National Ecosystem Assessment, 2011). These include goods with existing markets (e.g. livestock or timber production, peat extraction, grouse and deer), but which often involve significant land management interventions, such as drainage, burning or plantation;
- On the other hand, peatlands provide many services that are currently not or only partially traded in markets, such as flood regulation, cultural services associated with the amenity and recreation value of "wild land", and the potential for climate regulation via the sequestration and storage of carbon from the atmosphere, all of which may be negatively impacted by land management activities (IUCN, 2011); and
- Many of the ecosystem service benefits associated with sustainable peatland management have the properties of public goods (i.e. they are "non-excludable" and "non-rival") and represent positive externalities from land management, with little or no incentive for land owners and managers to sustain their provision (Glenk *et al*., this issue).

In this context, the paper considers how the design of agri-environment schemes may be altered to improve delivery of a range of ecosystem services from local to national scales. In part, this is a natural science question of developing an adequate evidence base about the effects of land management on ecosystem functions and services at different scales and in different contexts (see Evans *et al*., this issue). In part, it is a social science question, assessing demand and supply for ecosystem services, and identifying the appropriate institutional mechanisms that address both fairness and efficiency objectives (see Glenk *et al*., this issue; Martin-Ortega *et al*., this issue).

To do this, this paper starts by reviewing literature about how future agri-environment schemes in peatlands could: i) more explicitly link and spatially target payments to the provision of priority ecosystem services; and ii) facilitate collaboration between land managers to deliver ecosystem services at catchment or landscape scale. The paper then reflects on experience tackling these issues in the Glastir agri-environment scheme in Wales, with a focus on examples of scheme options that address peatlands. Specifically, it suggests that greater use of empirical and/or modelled data about dynamic relationships between land management and the provision of ecosystem services (e.g. the “pressure-response functions” described by Evans *et al*., this issue), combined with deliberation between members of the public, land owners, managers and other stakeholders, could derive a higher return on investments in ecosystem services from peatlands. Although UK upland peatlands and agri-environment schemes are the focus of this paper, the proposed approach could be extended to a range of other habitats and locations, and could be applied within privately funded Payments for Ecosystem Services (PES) schemes.

2 The challenge of linking agri-environment payments more effectively to the provision of ecosystem services

Although accounting for a significant proportion of expenditure under the CAP’s Pillar 2, the efficiency of agri-environment schemes could be improved (Natural England, 2009; ECA, 2011). The majority of agricultural support in UK peatlands (e.g. single farm payments, less favoured area payments and entry-level agri-environmental payments) focuses on providing income support and compensating for physical disadvantage rather than explicitly rewarding the provision of public goods[1]. Historically, a lack of routine monitoring to establish baselines and changes in environmental conditions has meant that schemes have typically been evaluated in terms of enrolment or expenditure rather than service delivery. Moreover, although commonly based on scientific advice, management prescriptions have often been specified in relatively vague terms and thus linked only weakly to ecosystem service delivery. An emphasis on individual rather than collective land management has tended to reinforce such weaknesses by neglecting spatial linkage and scale effects (Glenk *et al*., this issue).

Agri-environment schemes have tended not to operate at the scales at which some ecosystem services (e.g. carbon sequestration and water catchment management) must be managed for effective delivery. Payment levels – generally aimed at compensating income foregone – do not take detailed account of the different costs of delivering the same service in different contexts. Moreover, payments tend to focus on single ecosystem services, and therefore ignore possible knock-on effects for other ecosystem services provided by the same piece of land. For example, land managers may be paid to block drainage ditches (to enhance carbon sequestration/storage and restore bog habitats) without considering whether the location of dams in relation to flood peaks might mitigate or exacerbate downstream flooding (Ballard *et al*., 2010; Wilson *et al*., 2010) or disproportionately contribute towards climate change via methane production (Worrall *et al*., 2009).

[1]Keenleyside and Moxey (2011) show that current CAP expenditure on peatland management and restoration is trivial relative to overall CAP funding. It is also significantly less than public expenditure on agricultural drainage in an earlier era (Robinson, 1990).

Broadly speaking, there are two ways to pay for ecosystem services in agri-environment schemes: “output-based systems” (also known as “payment by results”) link payments to the delivered levels of ecosystem services, while “input-based systems” (favoured under the Common Agricultural Policy and in the majority of other agri-environment schemes internationally) pay for land management inputs, making assumptions about the ecosystem services that will result from these activities. Due to multiple inputs and uncertainty, the link between payments and ecosystem service provision is weaker in input-based systems than in output-based systems. While input-based schemes tend to have lower transaction costs, output-based schemes have the potential to allocate financial resources more efficiently, and with more flexible incentives that are more likely to facilitate innovation by landowners and managers (Hasund, 2013).

The sort of value-differentiated payments that characterise output-based agri-environment schemes do not comply with current World Trade Organisation or Common Agricultural Policy regulations, which are based on the principle of paying for the costs of implementing measures and income foregone (Hasund, 2013). Timing of payments may also be problematic: should land owners and managers be paid in advance for appropriate management that will hopefully lead to the desired results, or should they be paid only once such results have been observed? The latter approach appears attractive, but is unlikely to appeal to land managers seeking regular income to cover short-term capital and maintainance costs. Moreover, delivery of services at a given site typically depends on a range of variables, not all within the control of the land manager (e.g. weather, disease or pests). Therefore, paying for the end result introduces an element of additional financial risk, often at times (e.g. when weather is poor, or there are outbreaks of disease or pests) when payments are likely to be most important for keeping a rural business viable (Schwarz *et al.*, 2008).

To effectively link ecosystem service provision with payments, it is necessary to identify and put a price on each service. In a context of comprehensive and “perfectly” functioning markets, supply and demand determine appropriate price levels over time and space. When creating and using markets for ecosystem services, pricing is also likely to be determined by regulatory standards and targets, and the effectiveness of monitoring and enforcement. However, the complexity of ecosystem services and their spatial arrangement pose problems in this respect (see Glenk *et al*., this issue). For example, many services are generated jointly (e.g. by multifunctional agriculture), and are delivered and used as bundles of services rather than individually. As such, pricing individual components can be difficult, while paying for the bundle obscures the price of different services.

Despite significant advances in recent years, scientific understanding of the complex relationships between biophysical processes and service provision remains limited (Daily and Matson, 2008) , and more is known about some services than others (Evans *et al*., this issue). Without adequate scientific understanding of causal relationships between management actions and service delivery (Evans *et al*., this issue), it is difficult to assign payments to providers, or to demonstrate additionality i.e. buyers need to be assured that they are not paying for something that has already been provided.

3 Overcoming the challenge of linking payments to the provision of ecosystem services

Farming and the production of land-based products have of course always been associated with a wide range of risks. It may be possible to insure against some of these risks, and where risks are unavoidable, it may be possible to diversify income to include a wider range of ecosystem services beyond traditional provisioning services to increase the resilience of farm businesses. Assuming that it is possible to combine private payments for ecosystem services with payments from agri-environment schemes, it may be possible to reward landowners and managers for the provision of ecosystem services whilst providing a reliable income that can protect them from market volatility and other risks.

Broadly, two approaches have been proposed to overcome the challenge of putting a price on the delivery of ecosystem services. First, service providers may competitively bid to deliver ecosystem services (an approach used widely in Australia, among other countries), thereby differentiating payments on the basis of the costs of providing ecosystem services by providers focussing on areas where they can be provided most efficiently, but with payments varying between ecosystem services, and between locations for the same ecosystem service ("cost targeting"; Engel *et al.*, 2008). Although, in theory, cost targeting in this way should be economically efficient, there can be significant transaction costs associated with such schemes, and it may be difficult to spatially target measures.

Second, a wide range of techniques has been developed in recent years to value ecosystem services, broadly based on the benefits perceived by those consuming them, rather than the costs of provision (Kroeger and Casey, 2007; Glenk *et al*. this issue). For example, revealed preference techniques might be well suited to capturing use values (e.g. the travel cost method which uses the costs of travelling to a biodiversity-rich area to assess the recreation value of that area; Navrud and Mungatana, 1994; Shrestha *et al.*, 2002). On the other hand, stated preference techniques are more suited to the capture of non-use values, such as contingent valuation of how much people are willing to pay to protect Scotland's 'flow country' (Hanley and Craig, 1991) or an endangered species (Christie 2007). Glenk *et al*. (this issue) discuss the steps required to conduct an economic assessment of the costs and benefits of peatland restoration. Such an approach could help spatially target peatland restoration options within agri-environment schemes, to ensure that locations are prioritised where the greatest ecosystem service benefits can be derived at least cost to the taxpayer.

Robust monitoring and verification of ecosystem service delivery is essential to provide the kind of assurances that buyers want to see. Although the European Commission recommend that any Axis 2 funding programme should allocate 4% of the total programme cost to monitoring and evaluation, the costs of monitoring payment by results schemes would be significantly higher than current schemes, potentially taking away from the efficiency gains that such a scheme should theoretically provide (Schwarz *et al.*, 2008).

In any scheme designed to spatially target payments for ecosystem services, it is necessary to determine which ecosystem services can be provided by different peatlands under different forms of management. To cost-effectively provide information at the resolution necessary for decision-making across wide spatial scales, such an assessment could not rely on empirical data alone. It would probably require a combination of:

- Pressure-response functions that can rapidly and cost-effectively assess the links between management actions, other pressures, ecosystem functions and ecosystem services outputs (Evans *et al*., this issue);
- Although more complex (requiring more assumptions) and less transparent, it may be possible to supplement such pressure-response functions with outputs from process-based biophysical models where these are available (validated and calibrated with empirical data), showing how different forms of peatland management might influence the provision of ecosystem services in different locations (see Reed *et al*., 2013); and
- Where relationships are not adequately captured in pressure-response functions or quantified by models, it may be possible to conduct expert-based assessments of relationships between management actions and the provision of certain ecosystem services (e.g. see Christie and Rayment, 2013).

Using this combination of methods, it may be possible to identify geographical areas where the greatest ecosystem services benefits could be expected from different scheme (management) options, and to prioritise which management interventions would be needed to generate these benefits. Payments could then be directly linked to the level of ecosystem service that is expected from a particular type of management on a particular type of land. This could mean that it would only be possible to claim payments on land that is deemed to be suitable for the provision of a certain ecosystem service, or higher rates of payment may be possible on land that would be expected to yield more of a particular ecosystem service than less suitable land. For example, payments to protect a particular assemblage of species would only be given in the areas most suitable for protecting existing populations or where it would be appropriate to create new habitat (c.f. Schwarz *et al*., 2008). Using this approach, it is likely, for example, that payments to reduce water colour or sediment losses through revegetation or gully/grip-blocking would only be given on deep peats (c.f. United Utilities, 2010), since these soils are the major source of dissolved and particulate organic carbon (DOC and POC) in UK rivers (Hope *et al*., 1997; Martin-Ortega *et al*., this issue). Instead of the intensive monitoring required under a pure “payment-by-results” approach, models and/or pressure-response functions could be parameterised using available spatial data, with much more limited new empirical data necessary to calibrate/validate process-based models where these are used. As response functions and models are refined, so the assumptions upon which payments are based could be further refined.

One of the advantages of a model-based approach is the capacity for dynamic assessment of ecosystem service potential over time, as this is likely to be influenced by factors such as future climate change. For example, Worrall *et al.* (2007) suggested that rates of soil carbon storage in response to peatland management may decline under future climate change. Assuming that the majority of contracts are relatively short-term (as tends to be the case in agri-environment schemes; Lennox and Armsworth, 2011), it is possible to ensure that payments are based on a dynamic evidence base, preventing future payments being made for activities that are no longer likely to provide benefits.

Several projects have begun modelling and mapping peatland ecosystem services around the world, in many cases showing how they would respond to a range of management drivers and changes in land use or climate (Alcamo *et al*., 2005; Schröter*et al*., 2005; Boix-Fayos*et al.,* 2008 and 2009; Bonn *et al*., 2010). In the UK, Bonn *et al*. (2009) mapped a range of ecosystem services for a number of upland and lowland peatland sites. This work used a range of models including those developed by the Sustainable Uplands project[2] for upland peats. By linking hydrological, carbon and ecological models with agent-based models of likely human behaviour (e.g. future livestock stocking decisions), this project has shown how it is possible to model peatland ecosystem service provision at a landscape scale, and how ecosystem services are likely to vary in response to common changes in management such as varying grazing levels, grip-blocking or managed burning (Reed *et al*., 2013).

Finally, it is worth noting that the spatial distribution of ecosystem service beneficiaries varies significantly between sites, and the values that beneficiaries assign to ecosystem services differ between regions, habitats and social groups. For example, flood mitigation services may be more highly valued by people living on a floodplain than on a hillside, and peatlands are likely to have higher recreational values if located near a city than in remote areas in the north of Scotland (National Ecosystem Assessment, 2011). In contrast, the values ascribed to other services such as climate regulation tend not to vary spatially: one tonne of carbon sequestered in a remote blanket bog in Scotland is likely to have equivalent climate regulation benefits as one tonne carbon sequestered close to large conurbations. Taking these considerations into account, DEFRA’s UK Biodiversity Action Plan (BAP) study (Christie *et al.*, 2010) aimed to determine the economic value of implementing the UK BAPs (i.e. the economic value of improving or extending the habitats and protecting threatened species). It showed how it is possible to derive spatially explicit information about the value people put on different ecosystem services from different locations (Figure 2).

4 Overcoming challenges to collaboration

Currently, collaborative provision of ecosystem services is hampered by a mismatches between the scale at which ecosystem services are managed, the scale of the ecological processes that give rise to those services and the scales at which most payments are made (the land holding) (Cumming *et al*., 2006; McMorran, 2008). Although there is little evidence of farmers collaboration regarding agri-environmental issues or ecosystem services provision in the UK, they cooperate in contexts such as labour- and machinery-sharing, as members of commodity cooperatives (e.g. for cereal or timber harvesting, livestock marketing), and Emery and Franks (2012) find that English farmers are open to willing to enrol in collaborative AES if they are designed appropriately.

[2] www.sustainableuplands.org

If land managers do not *perceive* these benefits they will not cooperate, regardless of which benefits may 'objectively' exist (Lubell *et al*. 2002). Tangible benefits can be monetary, e.g. through incentive payments from agri-environment schemes, but these typically neither require nor encourage landscape level coordination. Agglomeration bonuses (Parkhurst *et al*., 2002; Warziniack *et al*., 2007) may ensure coordinated management but do not necessarily require land manager cooperation or buy-in for the joint contribution, since applications can be prepared by consultants without the need for individuals to ever meet and talk. In one case study, Drechsler *et al* (2010) found that agglomeration bonuses led to cost savings of up to 70% compared to homogeneous payments where payment rates were not linked to the way in which habitats were configured across the landscape. However, Windle *et al*. (2009) and Reeson *et al*. (2011) warned that, where such systems operate via auctions, they may be exploited by land owners, located in strategic positions, who may be able to demand high payments for their involvement, reducing the efficiency of the scheme.

Less tangible benefits are often based on trust that an action will be rewarded by other members of the land owning/managing community in the future (reciprocity). Perceived risks relate to a lack of reciprocity, e.g. 'someone could pull out' of an agreement or a collaborative arrangement (Glass *et al*., in press). Trust can only develop if there are opportunities for interaction and sharing views, as this may enable parties to arrive at mutual understanding of each others' interests and concerns (de Vente et al. in press).

In addition to barriers at the individual level, patterns of land ownership and tenure create further complications when administrative, ownership and ecosystem boundaries diverge, and this can increase transaction costs for coordinated landscape management (Goldman *et al*., 2007; Young, 2002).

Financial incentives can be designed to encourage co-operation between land managers (e.g. agglomeration bonuses and additional points in agri-environment schemes for undertaking work adjacent to land already in particular scheme options; c.f. Rural Priorities options relating to deer management in Scotland). However, achieving co-ordination across a landscape will typically require some level of independent facilitation, to bring different actors together across property boundaries. In turn, this raises questions about where responsibility lies, the role of local opinion-leaders, how the interests of different groups are accommodated, and the rigour and transparency of processes for monitoring, keeping records and making payments (WWF, 2010; Franks, 2011, Prager *et al*., 2012). Analogies may be drawn with collective action in other areas, such as agricultural co-operatives and common grazing committees in England. For example, farmers in Pontbren collaborated in the extensification of grazing, planting of shelter belts to increase water infiltration and reduce flooding, and the use of woodchip from plantations to reduce animal housing costs (ref from Chris). In settings with high social capital, such collaboration may occur without external impetus or facilitator.

Genuine participation in agri-environmental policy-making and collaborative approaches to environmental planning and management need to be combined across levels (Prager et al., 2012). Collaboration and co-ordinated action is best achieved by actively managing communication and feedback processes and generating commitment from stakeholders at various levels, allowing for joint monitoring, learning, and scheme adjustments. Insights on how to structure and organise such processes can be gained from, for example, Landcare groups in Germany (Prager and Vanclay, 2010), Landcare in Australia (Cary and Webb, 2001,Prager 2010), environmental cooperatives in the Netherlands (Franks and Mc Gloin, 2007; Slangen and Polman, 2002), or watershed collaboratives in the US (Moore and Koontz, 2003). Most of these models involve facilitators co-ordinating groups of land managers and facilitating dialogue with other stakeholders, authorities and networks (Lane et al., 2009). The core points to for the promotion of cross-boundary collaboration for ecosystem service management include:

- Gauge land managers' problem perceptions, and if necessary invest in awareness-raising activities;
- Establish local ideas about the management of ecosystem services, and land managers' ability and willingness to cooperate. Collaboration may not always be needed or appropriate, and land managers may be resistant for good reason;
- Identify common objectives and whether there is agreement on how to reach them
- Identify formal institutional barriers to a collaborative approach (administrative, political, legal) and create enabling institutional structures where possible;
- Provide an opportunity to trial the cooperation without too much commitment, to minimise associated risks; generally ensure that collaboration is seen to reduce rather than increase risk to land owners and managers;
- Arrange opportunities for communication, try out different modes of communication, and identify effective and low cost ways of communicating;
- Allow discussion of land tenure issues and property rights;
- Consider (initial) compensation for time investment and travel expenses, i.e. transaction costs arising from negotiating voluntary collective action agreements amongst many participants or attending meetings; and
- Ensure that there are demonstrable benefits of collaboration; then there may not even be the need for a financial (state) incentive.

In the UK, some co-operation across boundaries already exists for nature conservation in designated sites (e.g. through the development of management plans in collaboration with conservation agencies) and water quality through River Basin Management Plans and Programmes of Measures under the EU Water Framework Directive (Reed et al., 2011). The experience there emphasises the challenges of more collaborative working. For example, some tenants said that their landlords were reluctant to facilitate collaboration between different estates, despite the willingness of tenants to co-ordinate work together. For example, payments often go directly to land owners under the English Upland Entry/Higher Level Scheme, and in this case tenants have less influence over the way they manage the land, leaving tenants with less influence over the way they manage the land.

In intiatives such as the UK Environment Agency's "Common Ground" workshops, representatives of land owners/managers and other stakeholders were brought together with agency advisors in independently facilitated workshops (Buckmaster et al., 2010). By sharing knowledge and building trust in this way, it may be possible to negotiate land use and management plans at a catchment or broader landscape scale.

To incentivise engagement in such fora, it may be worth designing bonus payments for co-operation across property boundaries for the management of specific ecosystem services. Over time, with sufficient buy-in from local stakeholders, it may be possible to start channelling increasing amounts of financial support through such local groups (who would jointly prioritise and bid for funding with help where necessary from paid facilitators or co-ordinators) (Prager *et al*., 2012).

As part of this negotiation process, it may also be possible to co-ordinate between agri-environment PES schemes and private PES schemes e.g. for water services, carbon offsetting or visitor payback. At its most simple, this co-ordination could ensure the additionality of PES by avoiding duplication between private and public schemes. Alternatively, although complex, it may be possible to integrate private PES schemes within agri-environment schemes, using private funding to finance certain options within a scheme. The payment infrastructure associated with agri-environment schemes could offer a cost-effective way of distributing payments to sellers across the UK within private PES schemes.

5 Case study: Glastir

In 2008 the then Welsh Assembly Government undertook a review of its Axis 2 schemes. The aim of the review and associated consultation was to enable the development of a scheme that was more coherent, more efficient and had a spatially targeted approach to land management. The key objective of the review was to put in place a single land management scheme that better served the needs of society in relation to the securing of ecosystem services and maximised the effectiveness of spending under Axis 2.

The Assembly Government recognised that a number of fundamental issues needed to be addressed in the design of land management schemes, including:

- The need to tackle wider environmental challenges including climate change – reducing emissions and adapting to climate change, water quality and quantity, soil quality access and social capital. Historically schemes within the Axis 2 framework were primarily focussed on biodiversity.

- The effects of CAP reform on land management practices and the likely direction – signposted in the Health Check proposals – of CAP support post 2013, suggesting that farmers need to connect more strongly with markets but also that rural development measures will need to strengthened

- The need to contribute to successfully meeting the requirements of the Water Framework Directive

- The need for greater integration between schemes to attain a wider and more efficient delivery of environmental services for society

In order to ensure that the review was informed and accepted by as wide a spectrum of stakeholders as possible, a stakeholder group was established. The following interests were represented throughout the review, design and now implementation stages of Glastir: the farming unions (NFU Cymru, FUW and CLA); environment agencies (Countryside Council for Wales, Environment Agency Wales and Forestry Commission Wales); environmental NGO's (National Trust, RSPB representing Wales Environment Link); the National Parks (Snowdonia NPA); the Organic sector (Organic Centre Wales); and the wider rural community (Institute of Rural Sciences, Upland Forum).

In 2012 Glastir replaced the existing schemes; Tir Gofal, Tir Cynnal, Organic Farm Scheme, Better Woodlands for Wales and Tir Mynydd. Glastir pays for the delivery of specific environmental goods and services aimed at combating climate change, improving water management and maintaining and enhancing biodiversity. It is designed to deliver measurable outcomes at both a farm and landscape level in a cost effective way.

Glastir consists of five elements: i) the All-Wales Element is a whole farm land management scheme open to application from all farmers and land managers throughout Wales, legally binding them to deliver environmental goods for five years; ii) the Targeted Element is a part farm scheme that runs alongside the All-Wales Element, with funding targeted at locations where actions can deliver significant improvements to the environmental status of a range of habitats, species, soils and water; iii) the Common Land Element is designed to provide support for the collaborative delivery of environmental benefits on common land; iv) the Woodlands Element supports land managers who wish to create new woodland and/or manage existing woodlands; and v) the Agricultural Carbon Reduction and Efficiency Scheme (ACRES) aims to improve business and resource efficiency, and reduce carbon emissions of agricultural and horticultural holdings.

Spatial targeting of intervention measures is one of the more innovative aspects of Glastir. The scheme's Targeted Element utilises environmental data to build a simple process based model, which allows an applicant's land holding to be assed and scored against a range of priority objectives. Priority layers (maps) for a wide range of environmental objectives have been developed in conjunction with stakeholders. Layers include species, habitats, designations, soil (including peatlands), water quality and quantity access and historic environment. In addition to scoring an applicant's land holding, the simple process based model also identifies the range of options and measures most appropriate in order to attain the specific environmental benefits which the land holding offers. Contract managers further interrogate environmental data and enter into a negotiation phase with the landowner so as to agree the most equitable options. Entry into the targeted element is determined by passing a score threshold. Options include capital works and management measures, payments are in line with the regulatory framework based on cost of capital works and also opportunity cost of management measures, income forgone.

For example, an upland common may be designated as a Special Area of Conservation under the EU Habitats Directive, but be heavily modified by significant grazing pressure and containing poor peatland associated habitats and physically degraded organic soils. It would be possible to bring this common into the Glastir scheme to be managed collaboratively through the guidance of the local Grazing Association within the Glastir's Common Land Element. If agreed by the graziers, the Grazing Association could also apply for entry into the Targeted Element of Glastir. Given the nature of the common and its potential to deliver against priority actions, it is likely that the Grazing Association would be accepted to enter the Targeted Element. The contract manager would then enter into negotiations with the Grazing Association and in the case of a designated site, they would also enter into negotiations with the relevant statutory advising agency (in this case the CCW). In the case of this common, a number of capital works and management options would be available, firstly a grazing regime significantly lower that that which is mandatory within the Common Land Element (a CCW specialist would determine the most appropriate grazing regime on a site specific basis). Payment for additional reduced grazing would be on a unit basis, and would only be applicable below the standard Common Land Element requirements. Capital works options would also be available, including grip blocking, fencing and heather restoration via direct seeding. Payment would include the cost of capital works and also ongoing payments associated with the income forgone as a result of adopting these options.

6 Conclusions

This paper has considered how payments for ecosystem services could facilitate more sustainable management of agricultural land, through deliberation with members of the public, land owners, land managers and other stakeholders in UK peatlands: i) paying more for the ecosystem services that are valued most by society; ii) spatially targeting payments to the locations where ecosystem services can most efficiently be provided; and iii) providing incentives for cross-boundary collaboration over the provision of ecosystem services that need to be managed at catchment or wider spatial scales. By improving the evidence base upon which payments for ecosystem services are made in agri-environmental schemes, and targeting management interventions towards locations where the greatest gains in ecosystem services can be delivered at relevant scales, it may be possible to enhance the economic efficiency with which payments deliver ecosystem services in peatlands.

The proposed approach attempts to find a balance between the current approach of paying for activity and the ideal but harder to implement approach of paying for results, i.e. finding a middle ground between input-based and output-based PES schemes. It is suggested that this could be done by using a combination of pressure-response functions (as proposed by Evans *et al*., this issue), and process-based computational models to more clearly target agricultural payments towards those areas and activities that have the highest potential for delivering results. Although payments would still be based on activity rather than results *per se,* it is an approach that represents an improvement on the current set of rather blunt instruments that are being used to achieve very specific policy goals.

There may be a number of challenges associated with operationalising the proposed approach. Models exist to describe the stocks and flows of some but not all ecosystem services, and these models have been calibrated and validated for application in certain locations. More work would be necessary to extend their use to new locations, and to cover a wider range of ecosystem services. While it is possible to model a range of provisioning, supporting and regulating services, cultural ecosystem services present assessment challenges. In some cases, there are a number of different models that could be used to give different outputs, potentially leading to inconsistencies in decision-making or legal challenges to schemes. Although increasingly sophisticated, current models have a number of limitations and make a range of assumptions. As models are further developed and refined, their results may change, with consequent effects on payments within the schemes they support. And, due to the dependence of many ecosystem services on stochastic events such as weather or bird migration patterns, there may be cases where payments are made for expected results that do not materialise.

Ultimately, although the proposed approach may provide better value for taxpayers' money, its acceptability and viability may hinge on its complexity. By capturing some of the complexities of peatland functioning, it may be possible to target management interventions to relevant locations and scales and deliver ecosystem services more efficiently. This complexity was not a barrier to the spatial targeting of options in the Welsh Glastir scheme, which used models to spatially target scheme options to locations where priority ecosystem services and other objectives (e.g. linked to biodiversity conservation) could most efficiently be delivered through land management actions. By co-designing the scheme with land managers, it was possible to introduce spatial targeting with broad support from the land management community. Collaborative scheme options are also increasingly being introduced, that require options to be taken up in adjacent land units, to achieve cross-boundary management of certain ecosystem services (e.g. Scotland's Rural Priorities deer management options). However, the evidence we have presented suggests that financial incentives alone will not be enough to facilitate the scale of collaboration required to manage ecosystem services at a catchment or landscape scale. More research is needed to understand how cross-boundary collaboration may be facilitated at these scales. More sophisticated process-based models and pressure-response curves covering a wider range of ecosystem services could further enhance spatial targeting of measures in Glastir, and could enable spatial targeting to be extended to other areas of the UK and Europe. In this way, it may be possible to more effectively link payments from agri-environment schemes to the provision of ecosystem services, within the context of the EU's current input-based system.

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Table 1: Value of ecosystem services delivered by the UK Biodiversity Action Plan on peatland habitats (£m per annum) (source: Christie *et al*., 2010)

Ecosystem services	**Blanket bog**	**Lowland raised bog**	**Fens**
Wild food	0.43	0	0.04
Non-food products	1.37	0	0.04
Climate regulation	226.88	0.94	0.06
Water regulation	231.57	-0.16	0.08
Sense of place	37.55	0.23	0.00
Charismatic species	80.75	0.27	0.15
Non-charismatic species	28.94	0.21	0.05
Total value	**607.49**	**1.49**	**0.43**

Table 2: Options for policy and practice that could be incentivised under future agri-environment schemes to enhance the sustainability of peatland management and adaptive capacity under future climate change (*based on a combination of facilitated site visit discussions [source a], an expert workshop [source b] and three 'research outcomes workshops' [source c] as part of the Sustainable Uplands project, and interviews and questionnaires using the Delphi technique from the Sustainable Estates project [source d])

Sustainability strategies	Policy and practice options	Source*
Managing risks from inappropriate management and climate change to peatland environments	Restore peatlands, e.g. gully and grip blocking to reduce erosion, riparian improvements	a, c, d
	Manage increasing recreation, e.g. wildfire risk control, access management	a, c, d
	Manage visual and ecological impacts, e.g. balance between grazing and heather burning, bracken control, removing grazing from sensitive areas/ restoration sites	b, c, d
	Include carbon storage/management payments in Environmental Stewardship grant schemes, e.g. future farm payments linked to carbon sequestration	b, d
	Penalise inappropriate or damaging management outcomes	a, d
Managing peatlands for the long term	Draw up long-term, integrated spatial plans for future change, e.g. rewetting peat soils, woodland regeneration	a, b, d
	Diversify income streams and add value to products, widening options, e.g. investment in non-agricultural economic activity, managing for quality rather than quantity	a, b, d
	Develop innovative tax/trading systems, e.g. individual 'carbon allocations' and collection of 'carbon tax', 'offsetting' schemes	a, b
Encouraging creativity in peatland management	Exemplify and reward creative land managers that make adaptive management changes rather than allowing environmental change to dictate practices	a, b, d

	Share best practice, e.g. disseminate peatland restoration techniques/technology, exchange ideas/best practice between innovative practitioners and other stakeholders	a, b, c, d
	Deliver integrated training for land managers that encourages new skills, approaches and imagination	c, d
Managing peatlands collaboratively	Join up thinking and dialogue among stakeholders e.g. finding common ground, involving communities in decision-making and management, peer learning schemes	a, b, d
	Partner across property boundaries at a catchment or landscape scale, e.g. develop habitat linkages, manage increases in recreational activities, membership of cross-boundary for a	a, b, c, d
	Co-ordinate control of common problem species across management units, e.g. new options for deer management and the control of tick populations	c, d
In-depth understanding of peatlands	Long-term, standardised monitoring to grow evidence base and develop best practice, increasing knowledge and management effectiveness, e.g. better understanding of: what allows gullies to revegetate	a, c, d
	Raise public awareness of peatland management, e.g. educate about the multiples uses of peatlands and the role of land managers, provision of ranger service to educate/monitor access	a, d
	Integrate local experience and knowledge into management	a, c, d
	Offer advice for the management of peatlands	a, c

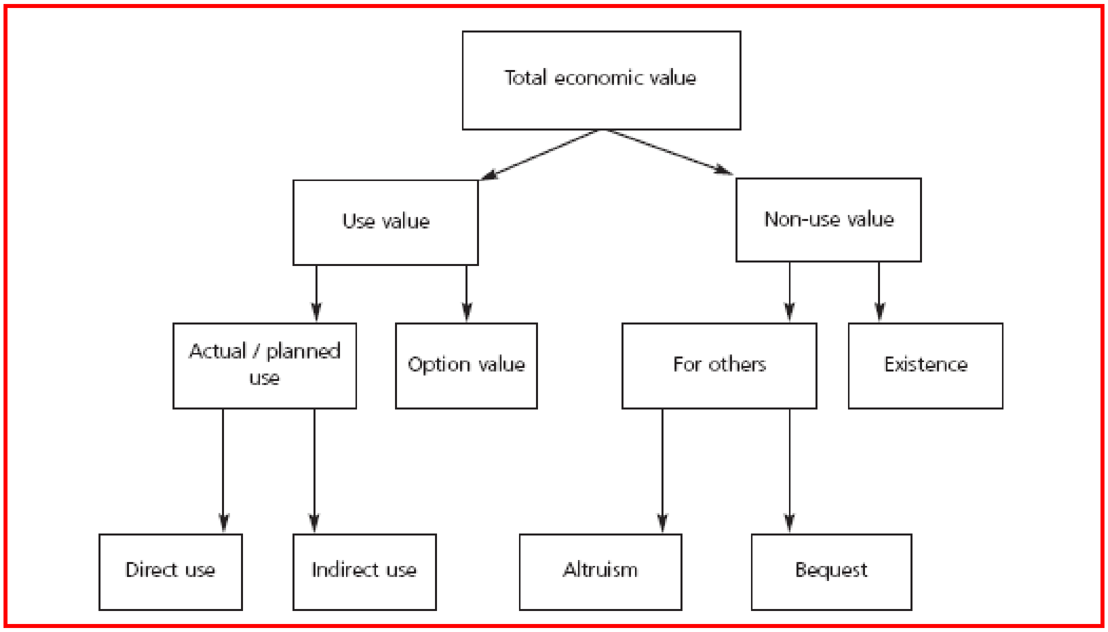

Figure 1: The elements of Total Economic Value (Source: Defra, 2007)

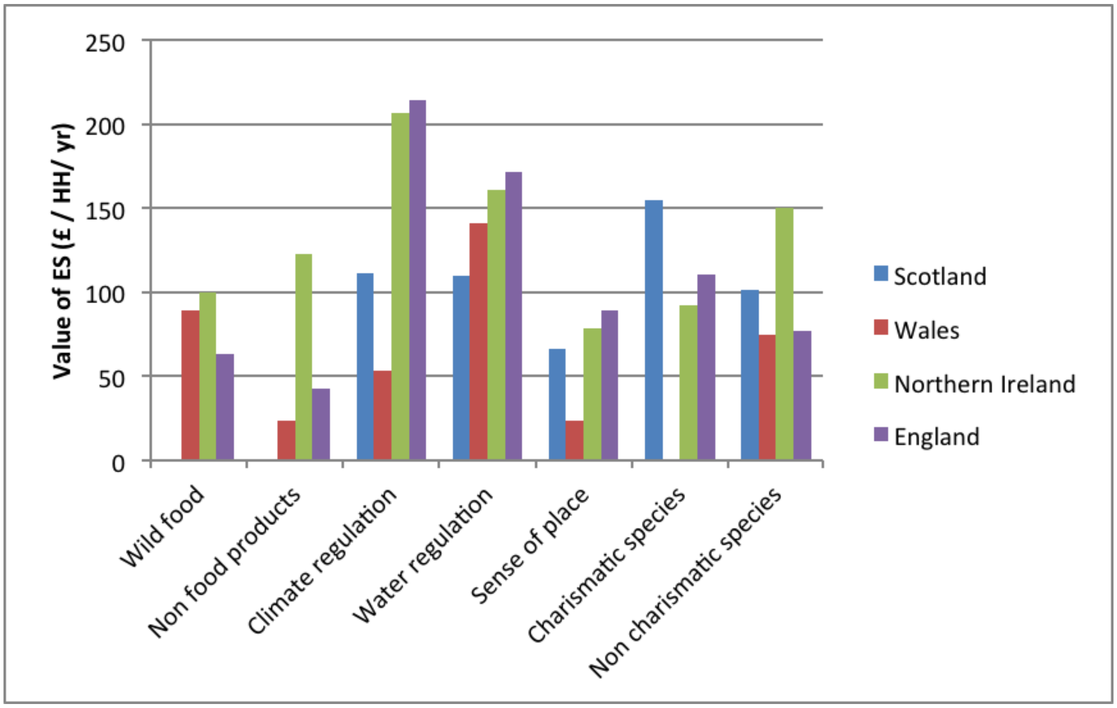

Figure 2: Value of ecosystem services (ES) delivered by UK Biodiversity Action Plan (£ / household /yr)