Barriers and Opportunities to the Use of Payments for Ecosystem Services

Final Report

September 2011

Prepared for:

www.urs-scottwilson.com

Revision Schedule

Final Report
September 2011

Rev	Date	Details	Prepared by	Reviewed by	Approved by
03	18 September 2011	Final Report	**Petrina Rowcroft** Principal Consultant, URS Scott Wilson **Steven Smith** Associate, URS Scott Wilson **Liz Clarke** Senior Assistant Consultant, URS Scott Wilson **Ken Thomson** The James Hutton Institute **Mark Reed** University of Aberdeen	**Jeremy Richardson** Technical Director, URS Scott Wilson	**Stuart Coventry** Director, URS Scott Wilson
02	29 July 2011	Draft Final Report (2) for client comment			
01	03 June 2011	Draft Final Report (1) for client comment			

URS Scott Wilson
6 – 8 Greencoat Place
London SW1P 1PL

Tel 020 7798 5000
Fax 020 7798 5001

www.urs-scottwilson.com

Limitations

URS Scott Wilson Ltd ("URS Scott Wilson") has prepared this Report for the sole use of Defra ("Client") in accordance with the Agreement under which our services were performed. No other warranty, expressed or implied, is made as to the professional advice included in this Report or any other services provided by URS Scott Wilson. This Report may not be relied upon by any other party without the prior and express written agreement of URS Scott Wilson.

The conclusions and recommendations contained in this Report are based upon information provided by others and upon the assumption that all relevant information has been provided by those parties from whom it has been requested and that such information is accurate. Information obtained by URS Scott Wilson has not been independently verified by URS Scott Wilson, unless otherwise stated in the Report.

The methodology adopted and the sources of information used by URS Scott Wilson in providing its services are outlined in this Report. The scope of this Report and the services are accordingly factually limited by these circumstances.

Where assessments of works or costs identified in this Report are made, such assessments are based upon the information available at the time and where appropriate are subject to further investigations or information which may become available.

URS Scott Wilson disclaim any undertaking or obligation to advise any person of any change in any matter affecting the Report, which may come or be brought to URS Scott Wilson's attention after the date of the Report.

Certain statements made in the Report that are not historical facts may constitute estimates, projections or other forward-looking statements and even though they are based on reasonable assumptions as of the date of the Report, such forward-looking statements by their nature involve risks and uncertainties that could cause actual results to differ materially from the results predicted. URS Scott Wilson specifically does not guarantee or warrant any estimate or projections contained in this Report.

Copyright

Table of Contents

List of Figures

List of Tables

List of Boxes

List of abbreviations

ASSI	Areas of Special Scientific Interest
BINGO	Big International Non-Governmental Organisation
BIS	Department of Business, Innovation and Skills
BNDES	Brazilian Development Bank
BRE	Building Research Establishment (UK)
CABE	Commission for Architecture and the Built Environment
CCC	Commodity Credit Corporation
CCT	Conditional Cash Transfer
CES	Classification of Ecosystem Services
CLA	Country Land & Business Association
CLG	Department of Communities and Local Government
CLS	Changing Landscapes Scheme
CROW	Countryside and Rights of Way
CSS	Countryside Stewardship
CVI	Conservation Value Index
DWQR	Drinking Water Quality Regulator
EEA	European Environment Agency
ESA	Environmentally Sensitive Area
ESS	Ecosystem Service
EWGS	English Woodland Grant Scheme
FAO	Food and Agriculture Organization
FCF	Forest Conservation Fund (Tasmania)
FFE	Food-for-Education
FONAFIFO	National Fund for Forestry Financing
GCF	Global Conservation Fund
GDM	Green Development Mechanism
HTZ	Humber Trade Zone
InVEST	Integrated Valuation of Ecosystem Services and Trade-offs
IPES	International Payments for Ecosystem Services
IUCN	International Union for Conservation of Nature
IWAC	Inland Waters Advisory Council
JNCC	Joint Nature Conservation Committee
LDNPA	National Park Authority
LEADER	Liaison Entre Actions de Développement de l'Economie Rurale
MARE	Maritime Affairs and Fisheries (European Commission Directorate-General)
MCS	Marine Conservation Society
MCZ	Marine Conservation Zones

MMO	Marine Management Organisation
MPS	Marine Policy Statement
MRV	Monitor, Report and Verify
NENW	Natural Economy Northwest
NERC	Natural Environment and Rural Communities
NFU	National Farmers' Union
NPA	National Park Authority
NYMNPA	North York Moors National Park Authority
OFWAT	Water Services Regulation Authority (Office of Water)
PEFC	Programme for the Endorsement of Forest Certification Schemes
PFE	Public Forest Estate
PNAS	Proceedings of the National Academy of Sciences
PSA	Pagos por Servicios Ambientales (Costa Rica PES)
RFF	Resources for the Future
RPA	Rural Payments Agency
SANBI	South African National Biodiversity Institute
SDNPA	South Downs National Park Authority
SLCP	Sloping Land Conversion Policy
SMP	Shoreline Management Plans
SOAS	School of Oriental and African Studies
SRDP	Scotland Rural Development Programme
SSSI	Site of Special Scientific Interest
STEP	Sustainable Tourism in Estuary Parks
TEV	Total Economic Value
UELS	Upland Entry Level Scheme
UKBAP	UK Biodiversity Action Plan
UKFS	UK Forestry Standard
VCS	Voluntary Carbon Standard
WCTF	Woodland Carbon Task Force
WRP	Wetlands Reserve Program
WRT	Westcountry Rivers Trust
YDNPA	Yorkshire Dales National Park Authority
ZSL	Zoological Society of London

Executive summary

Introduction

URS Scott Wilson – in partnership with the James Hutton Institute, the University of Aberdeen and a range of academic specialists from across the UK[1] – were commissioned by the Department for Environment, Food and Rural Affairs (Defra) to identify the barriers and opportunities to the use of Payments for Ecosystem Services in England across a range of policy contexts.

Research findings

What is PES?

The term Payments for Ecosystem Services (PES) is often used to describe a variety of schemes in which the beneficiaries, or users, of ecosystem services provide payment to the stewards, or providers, of ecosystem services. A review of the literature suggests that, at a minimum, the following five principles should underpin any arrangement labelled PES:

- stakeholders enter into a PES agreement on a **voluntary** basis;
- payment is made by the **beneficiaries** of ecosystem services (individuals, communities and businesses or governments acting on their behalf);
- payments are made **directly** to ecosystem service providers;
- ecosystem service benefits are **additional** or over-and-above business-as-usual (i.e. land managers must go beyond regulatory compliance) or, if current benefits are demonstrably threatened, then the status quo is at least maintained and continued service provision therefore guaranteed (either way an agreed baseline is a prerequisite); and
- payment is **conditional** on the delivery of ecosystem service benefits (although these may be assumed to occur with the implementation of certain proxy land use practices).

Since PES is based on the 'beneficiary-pays' principle, the research did not address 'trading' systems designed to compensate for damage in one place through improvements elsewhere (such as biodiversity offsets) as these invoke the polluter-pays principle. The research also excluded consideration of certification (e.g. eco-labelling) schemes although these may technically constitute PES and like biodiversity offsets are certainty PES-like. Generally speaking, given the specific principles which underpin PES, we take the view that PES is best considered separately from broader 'ecosystem markets', which include the full array of economic tools used to reward the conservation of ecosystem services.

Scale of PES

PES programmes can be developed at a wide variety of spatial scales. National schemes, for example Environmental Stewardship, which pays about £400 million a year to farmers and land managers in return for more environmentally sensitive farming, tend to be government-financed (whereby government buys ecosystem services on behalf of users, in this case the public). Smaller schemes, in particular those at the scale of individual catchments, are more likely to be user-financed (whereby the buyers are the direct beneficiaries of the services in question). Very small scale PES schemes can also be envisaged. For

[1] Professor Steve Albon, the James Hutton Institute; Dr Maria Nijnik, the James Hutton Institute; Dr Lee Ann Sutherland, the James Hutton Institute; Dr Bob Ferrier, the James Hutton Institute; Dr Bedru Balana, the James Hutton Institute; Dr Andrew Moxey, Pareto Consulting; Professor Philip Lowe, University of Newcastle; Dr Alister Scott, Birmingham City University; Dr Aylwin Pillai, University of Aberdeen; Dr Ioan Fazey, University of St Andrews; and Dr Mark Mulligan, King's College London. We are particularly grateful for Dr Alister Scott's contributions in relation to PES for urban areas.

example, following the provision of green space in a new housing development, residents might choose to collectively fund a warden or an environmental NGO to manage the land with flood risk attenuation or biodiversity in mind, thus providing additional ecosystem service benefits.

Ecosystem services provided

The majority of PES programmes globally focus on four broad types of ecosystem service: watershed protection (including erosion management); carbon sequestration; biodiversity conservation; and landscape aesthetics. Others services that sometimes form part of PES include public access (i.e. recreation or cultural services). While some services lend themselves to user-financed PES programmes, others tend to feature in government-financed schemes. For example, watershed protection often forms the basis for user-financed schemes in which the beneficiaries of downstream ecosystem services such as water quality contract directly with service providers such as upstream watershed managers via localised exchange arrangements ('self organised private deals'). These schemes tend to arise because many water-related services are club goods, i.e. only those located in the watershed benefit and, as such, it is possible to exclude 'free riders'. In contrast, biodiversity conservation often figures strongly in government-financed schemes in which the government contracts with ecosystem service providers on behalf of the public. Government-financed schemes tend to include a focus on wildlife enhancement because public goods such as biodiversity are widely enjoyed by diffuse beneficiaries and, as such, a market is unlikely to spontaneously arise in the absence of government intervention.

Barriers to the use of PES

The research identified a series of key barriers or challenges to the use of PES – see the table below.

Barriers to the use of PES

Category	Challenges
Informational	• Lack of awareness among beneficiaries and providers
Technical	• Scientific uncertainty • Establishing baselines • Diffuseness • Appropriate programme size • Avoiding leakage • Ecosystem valuation • Excludability and free riding • Shortage of skills and experience
Spatial	• Spatial variability
Temporal	• Permanence • Time lags • Differing time horizons
Financial	• Perceived risks • High start-up costs • High transaction costs
Institutional	• Collective action problems

	• Perverse incentives • Complex policy environment
Legal	• Property rights and other issues
Cultural	• Aversion to paying for ecosystem services • Lack of trust among land managers • Terminology
Equity considerations	• Perceived unfairness

While there are numerous challenges in establishing PES programmes, none of these necessarily represent insurmountable barriers to implementation and this report includes a series of suggested next steps for overcoming the challenges identified. Generally speaking, a considered choice of the services to be provided together with careful programme design can address many of the challenges involved in delivering PES schemes.

Opportunities for PES

The table overleaf sets out the opportunities for establishing PES across England in relation to key ecosystem services. Existing UK and widespread international experience suggests that the promise for new PES schemes appears to be greatest in relation to **water quality** and **water quantity** (including both water resource supply and flood risk attenuation); in particular, it is relatively straightforward to identify providers and beneficiaries and there are numerous examples globally on which programme designers can draw. There are, nevertheless, other opportunities worthy of consideration, particularly in relation to **carbon sequestration** (from woodlands and peatland restoration), **cultural services** and wild species diversity (through, for example, user fees or visitor payback schemes) and better targeting of public payments to farmers and woodland managers for the regulating and supporting services they provide. Importantly, PES may be able to help target policy incentives to areas where they can optimise the supply of services in places where they are most needed, and where they can be most efficiently delivered and function in harmony with other environmental objectives. More specifically, by rewarding land owners and managers on the basis of the services they provide, PES provides an explicit financial incentive for land owners and managers to provide public goods for which they are not currently paid (e.g. carbon sequestration and recreation). There is evidence that spatial targeting of payments in this way enhances the economic efficiency of payment schemes[2], offering the possibility of providing better value for taxpayers' money.

The Natural Environment White Paper includes a Government commitment to publish an action plan in 2012 to expand PES schemes in which the provider of nature's services is paid by the beneficiaries.[3] In addition, the White Paper includes a Government commitment to publish a best practice guide for designing PES programmes and states that the Government will also encourage pilots to develop across a broad spectrum of nature's services and beneficiaries.

While there are clear opportunities to promote the emergence of further PES schemes in England, PES remains only one environmental policy instrument among many and is unlikely to represent a universally applicable solution to ecosystem degradation. Rather than revolutionising environmental protection, PES is more likely to promote enhancements in the delivery of existing ecosystem service provision.

[2] Wünscher, T., Engel, S. and Wunder, S. (2008). Spatial targeting of payments for environmental services: a tool for boosting conservation benefits. *Ecological Economics*, 65 (4): 822-33; Klimek S., Richter gen. Kemmermann A., Steinmann H.-H., Freese J., and Isselstein J. (2008). Rewarding farmers for delivering vascular plant diversity in managed grasslands: A transdisciplinary case-study approach. *Biological Conservation*, 141 (11): 2888-2897.
[3] HM Government (2011). *The Natural Choice: securing the value of nature* [online] available at: http://www.official-documents.gov.uk/document/cm80/8082/8082.pdf (accessed 11 July 2011).

Opportunities for PES in England

Ecosystem Service	Habitat*	Providers / Sellers	Beneficiaries	Buyers	Opportunities
Regulating					
Climate	Mountains, Moorlands & Heath, Enclosed Farmland; Semi-Natural Grasslands; Woodlands; Freshwaters; **Urban**; Coastal Margins; **Marine**	• Farmers and tenant land managers (Enclosed Farmland; Semi-Natural Grasslands) • Woodland owners and managers • Communities, local authorities, private landholders (Urban)	• **Local residents** (relief from climate stress) • **Global population** (carbon sequestration)	**Government (on behalf of the public), for example** • Payments to farmers under Environmental Stewardship Schemes **Private businesses (on behalf of investors):** • Investment in woodland planting schemes (as a Corporate Social Responsibility initiative) that allows companies to report carbon reduction activities and achieve 'carbon neutrality' where this investment meets the requirements of the UK Woodland Carbon Code under DECC's Greenhouse Gas Monitoring and Reporting Guidelines. **Charitable organisations (on behalf of their members), for example:** • RSPB, Wildlife Trusts, Rivers Trusts; Wildfowl and Wetlands Trust; Woodlands Trust; Marine Conservation Society	• Better targeting of existing AES schemes • Business investment in woodland carbon as a means of abating (but not 'offsetting') unavoidable emissions, e.g. through the Woodland Carbon Code or similarly accredited schemes. . • The Country Land and Business Association has expressed an interest in selling carbon to finance peatland restoration on land owned by those they represent. • There may be opportunities in future (through a Peatland Carbon Code similar to the Woodland Carbon Code) to reduce emissions / sequester carbon through peatland restoration on non-forested land (e.g. through grip/gully blocking and/or revegetation of bare/eroding peat).
Hazard	**Mountains, Moorlands & Heath**, **Enclosed Farmland**; Semi-natural Grasslands; Woodlands; **Freshwaters**; **Urban**; Coastal Margins; **Marine**	• Farmers and tenant land managers (Enclosed Farmland) • Woodland owners and managers	**Government:** • Local Authorities (reduced spending on flood, coastal defence and erosion control measures and/or clean-up costs) **Private businesses:** • Water and energy companies (reduced water treatment and dredging costs) • Port owners and shipping companies (reduced dredging costs) • Insurers (reductions in claims) • Businesses located in river floodplains or at risk of coastal flooding **Local residents:** • Residents located in areas	**Government (on behalf of the public), for example:** • Local Authorities (on behalf of residents and visitors) **Private businesses:** • Water and energy companies • Coastal businesses and businesses located in properties at risk of flooding • Port owners and operators • Insurers (on behalf of premium holders) **Local residents**	• Payments by port-owners and operators and possibly recreational waterway users (e.g. canal boats) to upstream land managers to prevent siltation of navigation channels • Payments by water companies to upstream land managers to prevent sedimentation of reservoirs • Insurers may be interested in opportunities to reduce liability with regards to flooding, dredging and water treatment costs. • Targeting woodland owners and managers of woodlands in suitable locations as providers for flood management services

Ecosystem Service	Habitat*	Providers / Sellers	Beneficiaries	Buyers	Opportunities
			vulnerable to flooding (reduced vulnerability to flooding)		
Disease and pests	**Enclosed Farmland**; **Freshwaters; Marine**	• Farmers and tenant land managers (Enclosed Farmland)	Crop and livestock farmers Timber producers Water companies (where, for example, alien vegetation affects water supplies) Visitors to cultural landscapes	**Government (on behalf of the public), for example:** • Payments to farmers under Environmental Stewardship Schemes **Private businesses:** • Agri-business • Commercial and recreational fisheries • Timber and woodfuel producers • Water companies **Charitable organisations (on behalf of their members), for example:** • RSPB, Wildlife Trusts, Rivers Trusts; Wildfowl and Wetlands Trust; Woodlands Trust; Marine Conservation Society	Payments to land managers (not already enrolled in agri-environment schemes) to clear alien vegetation.
Pollination	**Semi-natural Grasslands; Enclosed Farmland;** Urban	Farmers and tenant land managers (Enclosed Farmland)	**Private businesses:** • Crop farmers and horticultural enterprises	**Private businesses:** • Crop farmers and horticultural enterprises	• Crop farmers and horticultural enterprises (including orchards and flower-growers) may be willing to pay for pollination services supported by SNGLs and EFLs
Noise	Woodlands; **Urban**, Coastal Margins	Land owners and managers with tracts of land / woodland that acts as a noise screen	Local residents, workers, local business	**Government (on behalf of the public):** • Local authorities (on behalf of residents and visitors)	• National government and Local Authorities may be interested in investing in woodlands, urban greenspace and coastal margins to mitigate the adverse impacts of noise on human health, productivity and amenity. • Local businesses may be willing to invest in the noise regulating services provided by ecosystems in order to provide a more conducive working environment and/or opportunities for workers to relieve stress, etc.
Water quality	Mountains, Moorlands & Heath, **Enclosed Farmland**; Semi-natural Grasslands; Woodlands; **Freshwaters; Urban**; Coastal Margins	Farmers and tenant land managers (Enclosed Farmland)	**Local residents** **Private businesses:** • Water companies • Producers /retailers of bottled water • Tourism & leisure industry	**Government (on behalf of the public)** • Environment Agency • Local Authorities **Private businesses:** • Water companies • Producers /retailers of bottled water • Tourism & leisure industry	• Water companies may be interested in paying farmers and land managers in SNGLs to capture and immobilise organic nitrogen, thereby reducing nitrate leaching to surface water systems. Payments to SNGL land owners and managers for maintenance or improvement of surface water quality may be more cost-effective for

Ecosystem Service	Habitat*	Providers / Sellers	Beneficiaries	Buyers	Opportunities
			More distant consumers: • Consumers of piped water supplies and bottled water		utilities than conventional chemical treatment processes • Promoting investment in wetland construction for water treatment as a more cost-effective alternative to engineering solutions.
Soil quality	Mountains, Moorlands & Heath, **Enclosed Farmland**; **Semi-natural Grasslands**; Woodlands; **Freshwaters; Urban**	• Farmers and tenant land managers (Enclosed Farmland and Semi-Natural Grasslands) • Woodland owners and managers • Upland farmers and land managers (mountains, moorlands and heath)	• Farmers (particularly producers of organic crops) • Market gardeners / allotment gardeners in urban and peri-urban settings	**Private businesses:** • Agricultural producers (particularly those supplying organic goods) **Charitable organisations (on behalf of their members), for example:** • RSPB, Wildlife Trusts, Rivers Trusts; Wildfowl and Wetlands Trust; Woodlands Trust; Marine Conservation Society	
Air quality	Enclosed Farmland; Semi-natural Grasslands; Woodlands; Urban; Marine	Farmers and tenant land managers (Enclosed Farmland)	**Local residents** who gain amenity value and health benefits from good air quality **Visitors** (including workers) who obtain amenity and health benefits from good air quality **Private businesses** who may benefit from increased productivity where workers do not suffer from the effects of poor air quality	**Government (on behalf of the public)** • Local Authorities (on behalf of residents and visitors)	• Local Authorities may be interested in investing in woodlands in urban and peri-urban areas to provide a screen for noise and improve local air quality.
Cultural					
Wild species diversity	Mountains, Moorlands & Heath, **Semi-natural Grasslands**; Woodlands; **Freshwaters**; Urban; **Coastal Margins; Marine**	Farmers and tenant land managers (Enclosed Farmland)	**Local residents** who may have chosen their homes partly on the expectation of enjoying local biodiversity. **Private businesses** who benefit from tourism to areas containing high species diversity **Tourists and visitors,** including special interest groups (e.g. birdwatchers) who may be attracted to particular sites simply because of their biodiversity.	**Government (on behalf of the public):** • Payments to farmers under Environmental Stewardship Schemes **Private businesses:** • Developers who may wish to voluntarily offset impacts on habitats and biodiversity **Charitable organisations (on behalf of their members), for example:** • RSPB, Wildlife Trusts, Rivers Trusts; Wildfowl and Wetlands Trust; Woodlands Trust; Marine Conservation Society **Local residents**	• Developers (e.g. house-builders) may be interested in voluntary biodiversity offsetting schemes • Visitor Payback Schemes in National Parks and Nature Reserves

Ecosystem Service	Habitat*	Providers / Sellers	Beneficiaries	Buyers	Opportunities
				• Payments to developers to provide or safeguard habitat for wild species that might not otherwise be provided. **Visitors** • Special interest groups (e.g. birdwatchers; researchers, etc) • Tourists	
Environmental settings: local places	Mountains, Moorlands & Heath, Enclosed Farmland; Semi-natural Grasslands; Woodlands; Freshwaters; Urban; Coastal Margins	Farmers and tenant land managers (Enclosed Farmland) Individuals, companies, clubs or syndicates who hold land-related rights such as those over game sports, including access to water areas for, e.g. fishing or recreation, or forests for, e.g. walking, mountain-biking.	**Local residents** who may have chosen their homes partly on the expectation of being able to enjoy the local setting. **Visitors,** including tourists and specialist groups, who are attracted to local places because of their cultural, historical or spiritual significance, or for recreational purposes. **Private businesses** who benefit from tourism to local places.	**Government (on behalf of the public):** • Payments to farmers near urban areas for recreational opportunities • Local authorities (for amenity) • National Park Authorities **Private businesses:** • Payments to farmers near urban areas for recreational opportunities • Tourism and leisure operators (on behalf of tourists and visitors) may pay for maintenance of places with cultural or archaeological heritage **Charitable organisations (on behalf of their members), for example:** • RSPB, Wildlife Trusts, Rivers Trusts; Wildfowl and Wetlands Trust; Woodlands Trust; Marine Conservation Society • Community organisations, e.g. Groundwork UK, Community Forests, etc	• Farmland near major urban areas is under demand for informal recreation such as walking, running, riding, and cycling. Where these pressures are major, it may be attractive to both farmers and recreationalists (perhaps represented by Local Authorities or others) to agree on routes for these activities rather than coping with the impacts of unmanaged recreation. However, the problems of securing payment from the individuals involved are significant, and it may be simpler to arrange long-term purchase or leasing of land, for country parks or pathways. • Payments by anglers for recreational fishing rights through, for example, more widespread uptake by Rivers Trusts of the Angling Passport Scheme.
Environmental settings: landscapes/seascapes	Mountains, Moorlands & Heath, Enclosed Farmland; Semi-natural Grasslands; Woodlands; Freshwaters; Urban; Coastal Margins; Marine	Farmers and tenant land managers (Enclosed Farmland)	**Local residents** who may have chosen their homes partly on the expectation of being able to enjoy the local setting and because of the health benefits that certain designations or landscape features may provide. **Visitors** who derive enjoyment or inspiration from the aesthetic experience of a landscape/seascape, or who benefit from recreational and educational opportunities.	**Government (on behalf of the public):** • National Park Authorities and National Nature Reserves **Private businesses:** • Tourism and leisure operators (on behalf of tourists and visitors) may pay for preservation of iconic English landscapes **Charitable organisations (on behalf of their members), for example:** • RSPB, Wildlife Trusts, Rivers Trusts; Wildfowl and Wetlands Trust; Woodlands Trust; Marine Conservation Society	• Visitor payback schemes emerging that enable visitors to pay for environmental management that supports cultural services such as recreation, cultural heritage and landscape aesthetics. • Payments to forest owners / managers to reward them for the cultural services they provide.

Ecosystem Service	Habitat*	Providers / Sellers	Beneficiaries	Buyers	Opportunities
			Private businesses who benefit from tourism to local places.	**Visitors:** • Tourists • Special interest groups, e.g. hikers, orienteerers • Educational groups and researchers • Religious / spiritual groups	
Provisioning					
Crops	Enclosed Farmland; Urban	Farmers and tenant land managers; market gardeners and allotment managers	**Farmers and tenant land managers** who benefit from consumption and sale of crops produced within EFL. **Secondary industries** supported by the crop-farming industry **Retailers** **Consumers**	**Private businesses:** • Retailers • Energy companies (biomass for biofuel) **Consumers** **Producer and certification organisations** (on behalf of consumers)	Markets for crops produced on Enclosed Farmlands and urban / peri-urban market gardens are already well-established
Livestock / Aquaculture	Enclosed Farmland; Marine	Farmers and tenant land managers	**Farmers and tenant land managers** who benefit from consumption and sale of livestock / aquatic species **Secondary industries** supported by the livestock and aquaculture industries **Retailers** **Consumers**	**Private businesses:** • Retailers **Consumers** **Producer and certification organisations** on behalf of consumers	Markets for livestock and aquaculture are already well-established
Fish	**Freshwaters**, **Coastal Margins**, **Marine**	**Farmers and tenant land managers** (riverine fisheries); **Clubs and syndicates** who hold land-related rights, including access to water areas for fishing, etc. **Government and associated agencies:** • Environment Agency (riverine fisheries); • Marine Management Organisation (marine fisheries)	Commercial fishers; secondary industries supported by the fishing industry, recreational anglers	**Government (on behalf of the public):** • Environment Agency **Private businesses:** • Commercial fisheries **Visitors:** • Recreational anglers • Sports clubs and special interest groups (e.g. Angling Associations, Wild Trout Association) **Conservation organisations, for example:** • Rivers Trusts, Marine Conservation	Markets for commercial fisheries are already well-established but there may be opportunities to expand existing payment schemes in riverine fisheries, i.e. the Angling Passport Scheme

Ecosystem Service	Habitat*	Providers / Sellers	Beneficiaries	Buyers	Opportunities
				Society Consumers and retailers	
Trees, standing vegetation, peat	**Mountains, Moorlands & Heaths**, Enclosed Farmland; Woodlands, **Freshwaters**; Urban	**Government and associated agencies:** • Forestry Commission • The Crown Estate • The Ministry of Defence **Private landowners and tenant managers:** • Farmers and tenant land managers (Enclosed Farmland) • Forestry estate owners		**Private businesses:** • Timber and bio/woodfuel producers • Wood-products industry including manufacturing, construction and paper)	Markets for timber and non-timber forest products are already well established.
Water supply	Mountains, Moorlands & Heath; **Enclosed Farmland**; **Freshwaters**; Urban	**Government and associated agencies** • The Crown Estate • Forestry Commission • Ministry of Defence • Farmers and tenant land managers (Enclosed Farmland) **Private companies** with significant land holdings (e.g. water, mining and energy companies.	Intermediate and end-consumers of water supplies	**Government (on behalf of the public):** • Payments to farmers under Environmental Stewardship Schemes • Local authorities **Private businesses:** • Water and energy companies (on behalf of consumers) • Water-dependent enterprises (e.g. producers of bottled water) • Farmers (for irrigation) **Charitable organisations (on behalf of their members), for example:** • RSPB, Wildlife Trusts, Rivers Trusts; Wildfowl and Wetlands Trust; Woodlands Trust; Marine Conservation Society	• Water and energy companies may also be willing to pay upland land managers to manage their land to enhance the supply of good quality water downstream.

* The Broad Habitat types listed in this column are those assessed by the UK NEA having High or Medium-High for delivering the ecosystem service. Those demarcated in bold are where these has been a deterioration of the ecosystem service in that habitat since 1990. Note, however, that this assessment represents a UK-wide overview and will vary nationally, regionally and locally.
† Provisioning services are shown in faded text to reflect the fact that these are already largely traded in private markets and are therefore not the subject of PES.

Potential next steps

Following on from the research, this section sets out a range of potential next steps for promoting the development of PES schemes across England. The emphasis here is on facilitating the emergence of user-financed schemes but modifications to government-financed schemes to enhance their efficiency and effectiveness should also be explored (for example, through the use of 'inverse auctions'). In order to implement the next steps suggested here, a wide range of stakeholders will need to be proactively engaged including Government, the Environment Agency, Natural England, local authorities, environmental NGOs as well as landowners and managers.

Planning for ecosystem services

The identification of prospects for private, user-financed PES programmes to emerge together with opportunities to enhance the efficiency and effectiveness of existing government-financed schemes (e.g. Environmental Stewardship) are likely to be facilitated through planning for ecosystem services on a spatial basis (referred to by one workshop attendee as 'bioregional planning'). Planning for ecosystem services on a spatial basis (note we are consciously avoiding the term 'spatial planning' as this has an accepted meaning in the context of local authority development planning) would involve undertaking a range of activities within a defined area (for example, a catchment) including: gathering evidence to identify geographical variations in ecosystem service provision; identifying areas at risk of seeing services lost or degraded; establishing the spatial variation in opportunity costs associated with enhanced service provision; and determining the land uses and land management techniques likely to deliver improved provision. Armed with this knowledge, those responsible – including perhaps local authorities, the Environment Agency, Natural England and other stakeholders including local landowners – could begin the process of targeting areas with the greatest potential for service enhancement and start to bring together potential buyers and sellers, establish baselines and so on and ultimately develop appropriate PES schemes. The OECD has argued that *"…biodiversity and ecosystem benefits tend to vary from one location to another… The greater the spatial variation in costs and benefits, the larger the potential cost-effectiveness gains are when PES programmes are designed to take these differences into account"*.[4] Planning for ecosystem services on a spatial basis could also assist in identifying areas for potential habitat creation/restoration into which Section 106 or Community Infrastructure Levy (CIL) monies secured from developers for the purposes of biodiversity offsetting could be most effectively channelled. Planning for ecosystem service provision in this way could also help to bring together the policies and proposals contained in a wide range of relevant plans and strategies including Local Plans, River Basin Management Plans/Programmes of Measures, Catchment Flood Management Plans, Catchment Abstraction Management Strategies, and local authority green infrastructure strategies. The Natural Environment White Paper includes a Government commitment to support the creation of Nature Improvement Areas (NIAs) and Natural England is tasked with establishing a competition to identify 12 initial areas.[5] These areas could provide a valuable opportunity to pilot the concept of planning for ecosystem services on a spatial basis.

Further develop the evidence base

Designing a PES programme requires evidence. For example, for a PES scheme to be feasible it will be necessary to identify cause-and-effect, i.e. will a certain land use or management practice yield an increase in the desired service and can the basic terms for payment therefore be established? In some cases, the evidence will be clear cut; for example, hedgerows may have an established role in promoting biodiversity. In other cases, the evidence may be less conclusive; for example, downstream communities may be uncertain as to which areas of land are currently or could be best placed to alleviate flood risk

[4] OECD (2010). *Paying for biodiversity: enhancing the cost-effectiveness of payments for ecosystem services*. OECD: Paris.
[5] HM Government (2011). *The Natural Choice: securing the value of nature* [online] available at: http://www.official-documents.gov.uk/document/cm80/8082/8082.pdf (accessed 11 July 2011).

through changes in land management. For regulated issues such as water quality a wide range of stakeholders may need to be convinced by the evidence (including Ofwat and the Drinking Water Inspectorate). In light of this, a concerted effort will be needed to further develop the evidence around ecosystem service provision but also, in particular, to disseminate this among key stakeholders (e.g. utilities, statutory consultees). In particular, further evidence will need to be assembled and communicated in relation to:

- the links between biodiversity, ecosystem function and ecosystem services;
- the values people attach to the benefits derived from ecosystems;
- links between land management practices and ecosystem service outcomes; and
- metrics to measure service provision (e.g. carbon stores under different management regimes or biodiversity indices).

Several recent initiatives should serve to strengthen the general evidence base around ecosystem services. These include the Valuing Nature Network, sponsored by the Natural Environment Research Council (NERC) and NERC's Biodiversity & Ecosystem Service Sustainability (BESS) research programme. Further research could potentially include the development of rapid biophysical assessment methods to reduce the cost of establishing baselines and so promote cost-effectiveness and scalability.[6] Establishing the links between land management practices and ecosystem service outcomes (i.e. cause-and-effect) will be particularly important for PES. As an illustration, the RSPB has observed that *"when scientific understanding of the causes of the loss of bees is further advanced, it is possible to envisage a private PES where landholders that rely on pollination pay for a reduction in damaging actions elsewhere"*.[7] The existing evidence surrounding land management and ecosystem service provision could be usefully included in the Government's proposed best practice guide for designing PES programmes or perhaps in a compendium accompanying it.

Promote open source databases

The scientific and economic evidence required to develop PES programmes and undertake wider spatial planning for ecosystem services needs to be easily accessible to a wide range of potential PES actors including providers, beneficiaries and brokers or intermediaries. An open source approach to data provision facilitated by the Government could be very helpful. Related to this, the Natural Environment White Paper includes a Government commitment to bring together web-based Government information on the natural environment and make this available through a single 'My Environment' web portal, including facilities to search by post code for environmental features.[8]

Establish a PES Capacity Building Group

Forest Trends, the Katoomba Group, and UNEP (2008) have argued that *"Due to the amount of specialized information needed to get PES deals off the ground, support institutions may be a cost-effective – and perhaps unavoidable – investment"*.[9] Although a new body would be arguably inappropriate, the capacity building necessary to promote PES will need to be coordinated and, as such, we would recommend establishing a dedicated PES Capacity Building Group. The Group's objectives could include contributing to the Government's proposed best practice guide to designing PES

[6] Wunder (2008) cited in WWF (2010). *Payments for Ecosystem Services: Literature Review* [online] available at: http://www.planvivo.org/wp-content/uploads/Framework-for-PES-feasibility_WWF_MorrisonAubrey_2010.pdf (accessed 21 July 2011).
[7] RSPB (2010). *Financing nature in an age of austerity* [online] available at: http://www.rspb.org.uk/Images/Financingnature_tcm9-262166.pdf (accessed 26 April 2011).
[8] HM Government (2011). *The Natural Choice: securing the value of nature* [online] available at: http://www.official-documents.gov.uk/document/cm80/8082/8082.pdf (accessed 11 July 2011).
[9] Forest Trends, the Katoomba Group, and UNEP (2008). *Payments for Ecosystem Services: Getting Started – A Primer* [online] available at: http://www.katoombagroup.org/documents/publications/GettingStarted.pdf (accessed 30 April 2011).

programmes; running awareness raising and training events for key stakeholders (utilities, local authorities, statutory consultees, environmental NGOs etc.); providing capacity building for brokers or intermediaries; assembling case studies and disseminating relevant research; and overseeing pilots and the Government's proposed PES seed fund (see below).

Case studies for dissemination will include Defra 'multi-objective demonstrator projects' (which seek to apply the ecosystem services approach to three flood risk management schemes, Pickering, Honicote and the Derwent); Natural England's ecosystem approach pilots (Bassenthwaite Lake catchment, Cumbria; South Pennines National Character Area, Yorkshire; and Dartmoor and Exmoor, South West); and WATER (a partnership including various Rivers Trusts, the Environment Agency and South West Water to take forward a market-based catchment restoration scheme based on a PES model). Engel *et al.* (2008) point out that, despite considerable interest in the use of PES worldwide, few PES mechanisms have been carefully documented and discussion of PES mechanisms has remained largely confined to the grey literature (in which, moreover, proposals for PES mechanisms are more common than assessments of actual working mechanisms).[10] Formal evaluations of user-financed PES programmes in the UK and subsequent journal papers would therefore be helpful.

Identify and develop 'honest brokers'

The PES literature consistently emphasises the importance of **'honest brokers'** in developing PES programmes and the identification and development of independent and credible brokers will be key to developing user-financed schemes. Brokers can undertake a wide range of activities, including:

- help sellers assess an ecosystem service 'product' and its value to prospective buyers;
- assist sellers with establishing relationships and rapport with potential buyers;
- enable sellers get to know potential buyer(s);
- assist with proposal development; and
- administering PES programmes.

Jack *et al.* (2008) point out that PES schemes are often focused on many individual landowners whose collective activities alter the levels of a given ecosystem service and this feature will increase costs. However, they argue that working with a third-party intermediary such as an NGO or a community could reduce the costs of working with a large number of providers.[11] In addition, as Perrot-Maître (2006) argues, the primary reasons for the success of most PES schemes are not financial. Instead, the fundamental conditions of success include trust-building through the creation of an intermediary institution (locally based and led by a "champion" sympathetic to the providers' cause); the development of a long-term participatory process to identify alternative practices and a mutually acceptable set of incentives; the ability to link incentives to land tenure and debt cycle issues; and to substitute the old technical and social support networks with new ones.

Learn by doing

Given the challenges inherent in establishing PES programmes, a significant element of 'learning by doing' will be inevitable and key stakeholders including utilities, statutory consultees and environmental groups will need to adopt a pragmatic approach to programme development which allows flexibility for modifications in light of practical experience.

[10] Engel, S., Pagiola, S., and Wunder, S. (2008). Designing payments for environmental services in theory and practice: an overview of the issues. *Ecological Economics* 65(4): 663–674.
[11] Jack, B.K., Kouskya, C. and Simsa, K.R.E. (2008). Designing payments for ecosystem services: Lessons from previous experience with incentive-based mechanisms. *PNAS* 105(28): 9465-9470.

Establish a PES seed fund

In order to promote the emergence of user-financed PES programmes, Defra could consider establishing a seed fund and invite applications for small scale grants to kick off the development of PES programmes. Grants could contribute to start-up costs, initial workshops between buyers and sellers, buying in expert assistance (e.g. facilitation) etc. In order to evaluate applications, it will be important to consider what constitutes a PES programme and reference to the five principles outlined above could be helpful in this regard. The Natural Environment White Paper includes a Government commitment to introduce a new research fund targeted at PES schemes.[12]

Mobilising PES finance

The OECD argues that there is considerable scope for scaling-up private sector financing in PES programmes, especially as business becomes more aware of the opportunities that investment in ecosystem services can provide.[13] Private sector engagement in PES involving water quality and quantity and carbon sequestration should be actively explored and encouraged. In particular, there may be potential to package payments for clean water, carbon sequestration and biodiversity together in schemes designed to restore degraded peatlands. Indeed, market research suggests that there is substantial interest among UK-based companies in making payments for carbon sequestration that have associated co-benefits.[14] The Natural Environment White Paper includes a Government commitment set up a business-led Ecosystem Markets Task Force to review the opportunities for UK business from expanding the trade in green goods and the market for sustainable natural services.[15] This could provide a useful forum for discussing sources of PES finance and how to best to engage the private sector. Other sources of PES finance might include the Government's proposed Green Investment Bank, which is set to play a vital role in addressing market failures and unlock significant new private investment in 'green infrastructure' projects.[16]

Evaluate the effectiveness of PES

In order to promote PES it will be crucial to monitor and evaluate the effectiveness of existing programmes in satisfying key objectives, particularly the degree of additionality secured and any equity implications. In particular, evaluations of any instances in the use of inverse auctions would be particularly beneficial since these are viewed by the OECD as a key means for promoting efficiency in PES schemes.[17]

Pursue a different approach for biodiversity in PES

The OECD argues that in cases where the ecosystem services in question are public goods, such as biodiversity, the incentives to free-ride may preclude the establishment of direct user-financed PES programmes.[18] One approach may be for biodiversity conservation organisations help to cover the significant start-up costs of a PES scheme in return for not having to pay the recurrent future costs. Another approach might be for the Government to provide part funding for benefits that do not accrue to business.[19]

[12] HM Government (2011). *The Natural Choice: securing the value of nature* [online] available at: http://www.official-documents.gov.uk/document/cm80/8082/8082.pdf (accessed 11 July 2011).
[13] OECD (2010). *Paying for biodiversity: enhancing the cost-effectiveness of payments for ecosystem services*. OECD: Paris.
[14] Rabinowitz, R. and Este d'Hoare, J. (2009). *The Feasibility of Creating a Funding Mechanism for UK Carbon Reduction Projects: Key Findings from a BRE Research Project*. BRE, unpublished report.
[15] HM Government (2011). *The Natural Choice: securing the value of nature* [online] available at: http://www.official-documents.gov.uk/document/cm80/8082/8082.pdf (accessed 11 July 2011).
[16] For further information, see http://www.bis.gov.uk/greeninvestmentbank (accessed 29 July 2011).
[17] Inverse auctions require potential ecosystem service sellers to submit bids indicating the minimum payment they are willing to accept for the provision of an ecosystem service).
[18] OECD (2010). *Paying for biodiversity: enhancing the cost-effectiveness of payments for ecosystem services*. OECD: Paris.
[19] RSPB (2010). *Financing nature in an age of austerity* [online] available at: http://www.rspb.org.uk/Images/Financingnature_tcm9-262166.pdf (accessed 26 April 2011).

1 Background

1.1 Introduction

URS Scott Wilson – in partnership with the James Hutton Institute, the University of Aberdeen and a range of academic specialists from across the UK[20] – was commissioned by the Department for Environment, Food and Rural Affairs (Defra) to identify the barriers and opportunities to the use of Payments for Ecosystem Services in England across a range of policy contexts. This report sets out our findings and has helped to inform the Natural Environment White Paper which was published in June 2011.

1.2 Ecosystem Services

Ecosystem services have been defined as *"the benefits that people obtain from ecosystems"*[21] and *as "the aspects of ecosystems utilised (actively or passively) to produce human wellbeing"*.[22] Ecosystem services include the provision of food, water, timber and fibre (provisioning services); the regulation of climate, water quality and flood risk (regulating services); opportunities for recreation, tourism and cultural development (cultural services); and underlying functions such as photosynthesis and pollination (supporting services). The principal challenge in managing ecosystem services is that they are not independent of each other; attempts to optimise a single service often lead to reductions or losses of other services, i.e. there are trade-offs.[23]

In 2005, the Millennium Ecosystem Assessment (MA) concluded that, on a global scale, the majority of ecosystem services have been degraded.[24] More recently, The Economics of Ecosystems and Biodiversity (TEEB), a major international initiative, published a series of reports highlighting the growing costs of biodiversity loss and ecosystem degradation. Following the MA, in 2007 the House of Commons Environmental Audit Committee recommended that the Government should conduct a full MA-type assessment for the UK to enable the identification and development of effective policy responses to ecosystem service degradation.[25] The UK National Ecosystem Assessment (NEA) was published in June 2011 and emphasised that many ecosystem services, particularly those related to air, water and soil quality, declined during the second half of the 20th Century.[26]

Ecosystem services are underpinned by **ecosystem functions**, such as primary production, nutrient cycling, soil formation and water retention, and it is these functions which give rise to the ecosystem services which are of value to people. For example, woodlands or wetlands

[20] Professor Steve Albon, the James Hutton Institute; Dr Maria Nijnik, the James Hutton Institute; Dr Lee Ann Sutherland, the James Hutton Institute; Dr Bob Ferrier, the James Hutton Institute; Dr Bedru Balana, the James Hutton Institute; Dr Andrew Moxey, Pareto Consulting; Professor Philip Lowe, University of Newcastle; Dr Alister Scott, Birmingham City University; Dr Aylwin Pillai, University of Aberdeen; Dr Ioan Fazey, University of St Andrews; and Dr Mark Mulligan, King's College London. We are particularly grateful for Dr Alister Scott's contributions in relation to PES for urban areas.
[21] Millennium Ecosystem Assessment (2005). *Ecosystems and Human Well-being: Biodiversity Synthesis* [online] available at: http://www.maweb.org/documents/document.354.aspx.pdf (accessed 25 April 2011).
[22] Fisher, B., Kerry Turner, R. and Morling, P. (2009). Defining and classifying ecosystem services for decision making. *Ecological Economics* 68: 643-653.
[23] Rodríguez, J. P., Beard, T.D. Jr., Bennett, E.M., Cumming, G.S., Cork, S., Agard, J., Dobson, A.P. and Peterson, G.D. (2006). Trade-offs across space, time, and ecosystem services. *Ecology and Society* 11(1): 28 [online] available at: http://www.ecologyandsociety.org/vol11/iss1/art28/ (accessed 25 April 2011).
[24] Millennium Ecosystem Assessment (2005). *Ecosystems and Human Well-being: Biodiversity Synthesis* [online] available at: http://www.maweb.org/documents/document.354.aspx.pdf (accessed 25 April 2011).
[25] House of Commons Environmental Audit Committee (2007). *Government Response to the Committee's First Report of Session 2006–07: The UN Millennium Ecosystem Assessment* [online] available at: http://uknea.unep-wcmc.org/LinkClick.aspx?fileticket=/OapxUhqmeY=&tabid=85 (accessed 25 April 2011).
[26] UK National Ecosystem Assessment (2011). *The UK National Ecosystem Assessment: Synthesis of the Key Findings*. UNEP-WCMC, Cambridge [online] available at: http://uknea.unep-wcmc.org/Resources/tabid/82/Default.aspx (accessed 6 July 2011).

within a catchment may have the capacity (function) of slowing the passage of surface water, thereby attenuating flood risk; whether this function is regarded as a service depends on whether or not 'flood control' is considered a benefit (since communities value this function differently in different places at different times).[27]

The authors of the MA argued that **biodiversity** underpins ecosystem function. However, it is important to recognise that some uncertainty surrounds the relationship between biodiversity and ecosystem functioning and this continues to be a focus for research.[28] The European Academies Science Advisory Council has argued that, in many instances, we do not well understand the mechanism by which biodiversity enhances the delivery of ecosystem services.[29] Moreover, Balvanera *et al.* (2006) maintain that our capacity to make linkages between biodiversity and ecosystem services *"at [the] spatial (landscape) scales relevant to the human enterprise is limited at present"*.[30] Nevertheless, Hooper *et al.* (2005), in an evaluation of current knowledge, concluded that, *"A long history of ecological experimentation and theory supports the postulate that ecosystem goods and services, and the ecosystem properties from which they are derived, depend on biodiversity, broadly defined"*.[31]

It is important to recognise that our understanding of the linkages between biophysical systems, ecosystem functions, ecosystem services and benefits continues to improve. For example, an integrated assessment of data from the Countryside Survey (CS)[32] in relation to selected ecosystem services was published in October 2010 and this identified several key trends at the Great Britain scale. For example, indicators linked to freshwaters and soils were stable or improving and, as these underpin many regulating and supporting services, these service categories were also generally stable or improving (in particular, topsoil carbon density has shown very little change since 1978 suggesting no major loss of carbon to the atmosphere). In contrast, plant diversity indicators were found to be in decline as was nectar plant diversity (an indicator for the regulating service of pollination).[33]

The Government recently published an independent review of England's wildlife areas which considered the extent to which these represent a coherent and robust ecological network capable of responding to the challenges posed by climate change and other pressures (the 'Lawton Review'). The Lawton Review emphasised that as our understanding of the links between biodiversity, ecosystem function and ecosystem services continues to improve and we are increasingly able to place values on such services, *"The urgent and logical next step is to develop [ecosystem]* ***markets*** *that enable these values to be realised for services such as water quality, flood risk management, climate regulation and other benefits"*.[34] In particular, the Lawton Review argued that there is an urgent need to develop market mechanisms through

[27] Haines-Young, R. and Potschin, M. (2008). *England's Terrestrial Ecosystem Services and the Rationale for an Ecosystem Approach*. Full Technical Report, 89 pp. plus excel spread sheet as appendix. (Defra Project Code NR0107).
[28] For example, Naeem, J. and Wright, P. (2003). Disentangling biodiversity effects on ecosystem functioning: deriving solutions to a seemingly insurmountable problem. *Ecology Letters* 6(6): 567–579.
[29] European Academies Science Advisory Council (2009). Ecosystem services and biodiversity in Europe [online] available at: http://uknea.unep-wcmc.org/LinkClick.aspx?fileticket=WHVFYRtXu44=&tabid=85 (accessed 4 May 2011).
[30] Balvanera, P., Pfisterer, A. B., Buchmann, N., He, J. S., Nakashizuka, T., Raffaelli, D. and Schmid, B. (2006). Quantifying the evidence for biodiversity effects on ecosystem functioning and services. *Ecology Letters* 9:1146-1156
[31] Hooper, D. U., Chapin, F.S., Ewel, J.J., Hector, A., Inchausti, P., Lavorel, S., Lawton, J.H., Lodge, D.M., Loreau, M., Naeem, S., Schmid, B., Setälä, H., Symstad, A.J., Vandermeer, J. and Wardle, D.A. (2005). Effects of Biodiversity on Ecosystem Functioning: A Consensus of Current Knowledge. *Ecological Monographs* 75: 3 – 35.
[32] The CS provides a unique time series of data which incorporates measures of soil, water, vegetation and landscape made at the same locations in 1978, 1990, 1998 and 2007.
[33] Smart, S., Dunbar, M.J., Emmett, B.A., Marks, S., Maskell, L.C., Norton, L.R., Rose, P., Simpson, I.C. (2010). *An Integrated Assessment of Countryside Survey data to investigate Ecosystem Services in Great Britain*. Technical Report No. 10/07 NERC/Centre for Ecology & Hydrology 230pp. (CEH Project Number: C03259) [online] available at: http://www.ceh.ac.uk/news/news_archive/2010_news_item_41.html (accessed 4 May 2011).
[34] Lawton, J.H., Brotherton, P.N.M., Brown, V.K., Elphick, C., Fitter, A.H., Forshaw, J., Haddow, R.W., Hilborne, S., Leafe, R.N., Mace, G.M., Southgate, M.P., Sutherland, W.A., Tew, T.E., Varley, J., and Wynne, G.R. (2010). *Making Space for Nature: a review of England's wildlife sites and ecological network*. Report to Defra [online] available at: http://archive.defra.gov.uk/environment/biodiversity/documents/201009space-for-nature.pdf (accessed 25 April 2011).

which landowners can realise the value of the ecosystem services that their land provides to society.[35] The Government's response to the Lawton Review acknowledges that *"Harnessing the use of markets and ensuring correct economic incentives are in place could have an increasingly important role in delivering our natural environment outcomes"*.[36]

1.3 Payments for Ecosystem Services

Payments for Ecosystem Services (PES) is often used as an umbrella term for a wide variety of schemes in which the beneficiaries, or users, of ecosystem services provide payment to the stewards, or providers, of ecosystem services.[37] PES is frequently used in reference to schemes which involve a continuing series of payments to rural land managers in return for a guaranteed flow of ecosystem services. The basic idea behind PES is that those who provide ecosystem services – like any service – should be compensated for doing so. In some cases, payments are made directly by beneficiaries of ecosystem services, for example water users and hydropower companies; in other cases, different tiers of government pay on behalf of beneficiaries. Agri-environment schemes (AES), in which farmers are paid in return for farming in a more environmentally sensitive manner, are an example of the latter type of PES system.

Critically, payment as part of PES schemes should lead to the provision of ecosystem services and subsequent benefits where they would not otherwise have occurred; that is the service must be 'additional' or 'over-and-above' 'business-as-usual'.[38] In addition, to be considered a PES scheme, the nature of the transaction has to be voluntary (i.e. participants are not obligated to participate on the basis of regulation).[39] Overall, the PES approach provides opportunities to link up those involved in 'supplying' ecosystem services more closely to those benefiting from those same services and, in doing so, it *potentially* provides cost-effective ways of developing new streams of financing for conservation.[40]

1.4 A greater role for PES?

The need to protect and enhance ecosystem services is increasingly recognised. For example, an Intergovernmental Science Policy Platform on Biodiversity and Ecosystem Services has been established and is expected to mirror the activities of the Intergovernmental Panel on Climate Change. The tenth meeting of the Conference of the Parties to the Convention on Biological Diversity, in Nagoya, Japan in October 2010, saw the adoption of a Strategic Plan for Biodiversity 2011-2020 and the 'Aichi Biodiversity Targets'. The Strategic Plan's vision is of a world 'Living in harmony with nature' where *"[b]y 2050, biodiversity is valued, conserved, restored and wisely used, maintaining ecosystem services, sustaining a healthy planet and delivering benefits essential for all people"*.[41] The Aichi Targets comprise 20 headline targets for 2015 or 2020, including that *"[b]y 2020, ecosystems that provide essential services, including services related to water, and contribute to health, livelihoods and well-being, are*

[35] Lawton, J.H., Brotherton, P.N.M., Brown, V.K., Elphick, C., Fitter, A.H., Forshaw, J., Haddow, R.W., Hilborne, S., Leafe, R.N., Mace, G.M., Southgate, M.P., Sutherland, W.A., Tew, T.E., Varley, J., and Wynne, G.R. (2010). *Making Space for Nature: a review of England's wildlife sites and ecological network*. Report to Defra [online] available at: http://archive.defra.gov.uk/environment/biodiversity/documents/201009space-for-nature.pdf (accessed 25 April 2011).
[36] Defra (2011). *Government response to the Making Space for Nature review* [online] available at: http://www.defra.gov.uk/publications/files/pb13537-lawton-response-110607.pdf (accessed 6 July 2011).
[37] From http://www.ecosystemmarketplace.com (accessed 25 April 2011).
[38] Forest Trends, the Katoomba Group, and UNEP (2008). *Payments for Ecosystem Services: Getting Started – A Primer* [online] available at: http://www.katoombagroup.org/documents/publications/GettingStarted.pdf (accessed 25 April 2011).
[39] Defra (2010). *Payments for ecosystem services: A short introduction* [online] available at: http://archive.defra.gov.uk/environment/policy/natural-environ/documents/payments-ecosystem.pdf (accessed 25 April 2011).
[40] *Ibid*
[41] Convention on Biological Diversity (2010). *Report of the Tenth Meeting of the Conference of the Parties to the Convention on Biological Diversity* [online] available at: http://www.cbd.int/doc/notifications/2010/ntf-2010-223-cop10-en.pdf (accessed 25 April 2011).

restored and safeguarded, taking into account the needs of women, indigenous and local communities, and the poor and vulnerable" (Target 14).

The EU has adopted the target of halting the loss of biodiversity and the degradation of ecosystem services in the EU by 2020, and restoring them in so far as feasible.[42] On May 3 2011, the European Commission adopted a new strategy to halt the loss of biodiversity and ecosystem services in the EU. The strategy includes a commitment to *"promote the development and use of innovative financing mechanisms, including market-based instruments"* and goes on to state that *"Payments for Ecosystem Services schemes should reward public and private goods from agricultural, forest and marine ecosystems"*.[43] Following the MA, the European Environment Agency (EEA) has also launched EURECA (European Ecosystem Assessment), which will assess the stocks, flows and value of selected ecosystem goods and services under different policy-relevant scenarios. The EEA is set to deliver the first assessments in 2011, with more following in subsequent years.[44] The European Commission is currently working towards a new Communication, envisaged for mid-2011, on ways of financing the Natura 2000 network of protected sites. It is exploring various options including securing private investment using innovative and market-based instruments and linking payments to results in relation to conservation objectives.[45]

Closer to home, Defra's 'Ecosystem Approach Action Plan' (EAAP) (first published in 2007 and evaluated in February 2010), seeks to promote an 'ecosystem approach' to policy- and decision-making which, in particular, ensures *"that the value of ecosystem services is fully reflected in policy and decision making in Defra and across Government at all levels"*.[46] The UK NEA, published in June 2011, emphasised that ecosystem services are consistently undervalued in conventional economic analyses and decision making and that, of the range of services delivered in the UK by eight habitat types and their constituent biodiversity, about 30% have been assessed as currently declining with many others in a reduced or degraded state.[47]

Market-based approaches to conserving and sustaining ecosystem services are increasingly seen as an important means to combat ecosystem degradation. In particular, the last 10 – 15 years have witnessed a rapid proliferation of PES schemes around the world.[48] According to a recent OECD report, there are already more than 300 PES programmes in place at national, regional and local levels.[49] The OECD report also highlights the emergence of international payments for ecosystem services (IPES) citing IPES-like activities such as afforestation and reforestation projects under the Clean Development Mechanism (CDM), bio-prospecting agreements and Reducing Emissions from Deforestation and forest Degradation (REDD+) to help address the challenge of climate change. Internationally, discussions are also ongoing around the establishment of a Green Development Mechanism (GDM) for transferring financial resources to biodiversity-rich developing countries.

[42] Council of the European Union (2010). *Biodiversity: Post-2010 - EU and global vision and targets and international ABS regime* [online] available at: http://register.consilium.europa.eu/pdf/en/10/st07/st07536.en10.pdf (accessed 25 April 2011).
[43] European Commission (2011). *Our life insurance, our natural capital: an EU biodiversity strategy to 2020* [online] available at: http://ec.europa.eu/environment/nature/biodiversity/comm2006/pdf/2020/1_EN_ACT_part1_v7[1].pdf (accessed 10 May 2011).
[44] See http://www.eea.europa.eu/highlights/biodiversity-loss-and-climate-change-the-need-for-an-ecosystem-approach (accessed 25 April 2011).
[45] European Commission (2010). *Consultation on Future EU co-financing of Natura 2000* [online] available at: http://ec.europa.eu/environment/consultations/natura2000_en.htm (accessed 25 April 2011).
[46] Department for Environment, Food and Rural Affairs (2010). *Delivering a healthy natural environment - An update to "Securing a healthy natural environment: An action plan for embedding an ecosystems approach"* [online] available at: http://archive.defra.gov.uk/environment/policy/natural-environ/documents/healthy-nat-environ.PDF (accessed 25 April 2011).
[47] UK National Ecosystem Assessment (2011). *The UK National Ecosystem Assessment: Synthesis of the Key Findings*. UNEP-WCMC, Cambridge [online] available at: http://uknea.unep-wcmc.org/Resources/tabid/82/Default.aspx (accessed 6 July 2011).
[48] Parker, C. and Cranford, M. (2010). *The Little Biodiversity Finance Book* [online] available at: http://www.globalcanopy.org/sites/default/files/LBFB_EN.pdf (accessed 25 April 2011).
[49] OECD (2010). *Paying for biodiversity: enhancing the cost-effectiveness of payments for ecosystem services* (Executive Summary) [online] available at: http://www.oecd.org/dataoecd/25/55/46135424.pdf (accessed 25 April 2011).

TEEB concluded that economic incentives play a major role in influencing the use of natural capital and that, in some contexts, the principle of 'beneficiary pays' can be invoked to support new positive incentives such as PES.[50] England already has a major PES scheme in place, Environmental Stewardship, which pays about £400 million a year to farmers and land managers in return for them farming in a more environmentally sensitive manner (spread over the total utilisable agricultural area of England this represents £48 per ha/yr).[51] Nevertheless, Defra is committed to undertaking further analytical work on PES and is particularly interested in the potential for private PES schemes to emerge, i.e. those financed voluntarily by businesses and individuals, for example, downstream water users paying for watershed management on upstream land.[52]

1.5 This report

This report identifies the barriers and opportunities for the use of PES in England across a range of policy contexts. The research was based on:

- A comprehensive **literature review** of the theoretical and practical application of PES in England, the UK and overseas; in addition to the policy context, a review of the NEA and key literature on the state of England's ecosystems was undertaken.
- A series of **semi-structured interviews** with key actors, including the Environment Agency and Natural England, and others with academic and practical experience in delivery of PES programmes. Questions were designed to examine expectations from PES, the design of PES schemes, the stakeholders involved, the payment modalities, monitoring and verification, perceived barriers and opportunities, and where additional support might be of use and in what form.
- An **expert roundtable** held in Aberdeen on 9th December 2010, with academics from the James Hutton Institute and Aberdeen University, including Professor Steve Albon, Co-Chair of the NEA. The round table critically assessed the findings to date, and drew upon experience and expert opinion to identify and agree a way forward for the research, focusing on the review of English broad habitats and associated ecosystem services.
- A **regional workshop** drawing on PES experience in the South West in Exeter on 9th February 2011, bringing together key stakeholders and practitioners in the water sector to canvass views on: understanding and experience of PES; the barriers and practical challenges associated with the implementation of PES, both real and perceived and how these might be reduced; aspects of PES design that might incentivise their engagement; how existing or potential future PES schemes might be expanded to capture the value of a wider range of ecosystem services; and transferable aspects of existing water PES schemes. The attendance list and agenda for this workshop is included in Appendix 1.
- A **national workshop** in London on 8th April 2011, to bring together a wide range of actors with a potential role in future PES schemes including government departments, statutory bodies (including the Environment Agency and Natural England), landowners and land managers and NGOs. The workshop focused on disseminating the emerging research findings and discussing potential actions for promoting PES across England. The attendance list and agenda for this workshop are also included in Appendix 1.

[50] TEEB (2010). *The Economics of Ecosystems and Biodiversity: Mainstreaming the Economics of Nature: A synthesis of the approach, conclusions and recommendations of TEEB* [online] available at: http://www.teebweb.org/LinkClick.aspx?fileticket=bYhDohL_TuM%3d&tabid=924&mid=1813 (accessed 25 April 2011).
[51] Natural England (2009). *Agri-environment schemes in England 2009: A review of results and effectiveness* [online] available at: http://www.naturalengland.org.uk/Images/AE-schemes09_tcm6-14969.pdf (accessed 6 July 2011).
[52] Defra (2010). *Payments for ecosystem services: A short introduction* [online] available at: http://archive.defra.gov.uk/environment/policy/natural-environ/documents/payments-ecosystem.pdf (accessed 25 April 2011).

The remainder of this report is structured as follows:

- **Chapter 2** introduces PES theory and practice including international examples of PES
- **Chapter 3** identifies the general barriers to the use of PES
- **Chapter 4** identifies the specific opportunities and barriers to the use of PES across England based on the ecosystem services generated by eight broad habitat types
- **Chapter 5** sets out the conclusions from the research and our suggestions to Defra and other stakeholders for facilitating the emergence of future PES

2 PES theory and practice

2.1 Introduction

This chapter introduces the rationale for PES and discusses its definition and the principles that underpin it. It then goes on to consider the conditions for successful PES, the variables in the design of PES agreements and examples of PES internationally.

2.2 The rationale for PES

Jack *et al.* (2008) argue that when the benefits of an ecosystem service accrue mainly to those who make management decisions, as in the production of crops or livestock, private markets are likely to work relatively well in inducing service provision. However, when the benefits of an ecosystem service flow primarily to others, for example in the case of water purification or climate regulation, public interests and the interests of the resource manager may be misaligned.[53] Jack *et al.* go on to identify a wide range of solutions for addressing this mismatch between private and public benefits (the problem of 'externalities'[54]) including direct government regulation; the public provision of goods and services; private contracts between providers and recipients; the encouragement of voluntary efforts by firms and individuals; and various incentive or market-based mechanisms.[55] These market-based mechanisms include charges (e.g. taxes and user fees); subsidies; tradable permits (including markets for pollution reduction); measures to reduce market friction (e.g. eco-labelling); and, more recently, Payments for Ecosystem Services (PES).[56]

PES is therefore one instrument among many for combating ecosystem degradation and is thought to have been first introduced in the 1880s in the form of conservation easements in the US.[57] Salzman and Thompson (2007) argue that in selecting an instrument to change the behaviour of landholders, governments can choose from an "Environmental Policy Toolkit" comprising prescription, penalty, persuasion, property rights, and, finally, payments (see Box 1 for an illustration in relation to riparian buffers in a watershed).[58] The OECD argues that PES can be used in isolation or as part of a policy mix in conjunction with other instruments; for example, PES can be used to incentivise enhancements in the provision of ecosystem services over and above that required by existing command and control regulation.[59] Engel *et al.* (2008) maintain that, in effect, PES programmes attempt to put into practice the Coase theorem, which stipulates that the problems of external effects can, under certain conditions, be overcome through private negotiation between affected parties.[60] [61] Wunder *et al.* (2010) argue that PES

[53] Jack, B.K., Kouskya, C. and Simsa, K.R.E. (2008). Designing payments for ecosystem services: Lessons from previous experience with incentive-based mechanisms. *PNAS* 105(28): 9465-9470.
[54] Externalities occur when activities have a negative (or positive) impact on a third party, and when the resulting welfare loss is not compensated for.
[55] Jack, B.K., Kouskya, C. and Simsa, K.R.E. (2008). Designing payments for ecosystem services: Lessons from previous experience with incentive-based mechanisms. *PNAS* 105(28): 9465-9470.
[56] *Ibid*
[57] WWF (2010). *Payments for Ecosystem Services: Literature Review* [online] available at: http://www.planvivo.org/wp-content/uploads/Framework-for-PES-feasibility_WWF_MorrisonAubrey_2010.pdf (accessed 21 July 2011).
[58] Salzman and Thompson (2007) cited in Salzman, J. (2009). *A Policy Maker's Guide to Designing Payments for Ecosystem Services*. Duke Law Faculty Scholarship. Paper 2081 [online] available at: http://scholarship.law.duke.edu/faculty_scholarship/2081 (accessed 9 May 2011).
[59] OECD (2010). *Paying for biodiversity: enhancing the cost-effectiveness of payments for ecosystem services*. OECD: Paris.
[60] Engel, S., Pagiola, S., and Wunder, S. (2008). Designing payments for environmental services in theory and practice: an overview of the issues. *Ecological Economics* 65(4): 663–674.

belongs to the larger generic family of conditional cash transfer (CCT) programmes, which are generating encouraging results in other sectors, such as education[62]; examples include *Bolsa Familia* in Brazil and Food-for-Education (FFE) in Bangladesh.

Box 1: The Environmental Policy Toolkit in a watershed[63]

Prescription	Regulations requiring riparian buffers
Property rights	Combine regulations with tradable right of buffers
Penalty	Tax farmers who do not have buffers
Persuasion	Pilot projects demonstrating benefits of buffers
Payment	Pay for planting of buffers

Jack *et al.* (2008) also note the potential for PES to offer incentives to adopt or invent innovative approaches to providing ecosystem services at lower cost. However, because most PES policies base rewards on proxy actions rather than on production of final ecosystem services, the incentive to innovate may not be as direct. For example, the RUPES project in Indonesia bases rewards to farmers on erosion-control activities on coffee farms, not on sedimentation loads in nearby streams.[64] This type of system provides incentives to innovate relative to current practices but does not encourage innovative approaches to reducing sediment loads. Allowing flexibility in methods by basing rewards on reductions in sediment loads would encourage additional innovation but would be more expensive to monitor and would force landowners to bear the risk that a given activity might not actually reduce sediment loading.[65]

2.3 Defining PES

The novelty of PES arises from its focus on the 'beneficiary-pays' principle[66] (as opposed to the polluter-pays principle[67]). PES differs from other incentive-based mechanisms in that it aims to identify the stakeholder group(s) that benefits from a specific service (or 'bundle' of services) provided by an ecosystem and creates a mechanism through which a payment can be made to

[61] A well known Coase example is the following. Consider a railroad that passes through wheat fields. The passing trains let off sparks which can burn the wheat. If the legal rights are on the side of the farmers, then they could require the trains to buy and install spark catchers to eliminate these fires. However, if that is expensive (i.e. more than the value of the burned wheat), the train owners may just pay the farmers for the damage done to the crops. If the legal rights are with the trains, the farmers may just put up with burned crops or (if that is expensive) they could pay the trains to put on spark catchers. Either way, the socially efficient outcome (install spark catchers or burn crops) is what happens and the legal rights determine who has to pay (source http://faculty.wcas.northwestern.edu/~mwitte/pf/handouts/coase.html accessed 3 May 2011).
[62] Wunder, S., Wertz-Kanounnikoff, S. and Ferraro, P. (2010). *Payments for Environmental Services and the Global Environment Facility: A STAP advisory document* [online] available at: http://www.thegef.org/gef/sites/thegef.org/files/publication/STAP_PES_2010.pdf (accessed 1 May 2011).
[63] Salzman, J. (2009). *A Policy Maker's Guide to Designing Payments for Ecosystem Services*. Duke Law Faculty Scholarship. Paper 2081 [online] available at: http://scholarship.law.duke.edu/faculty_scholarship/2081 (accessed 9 May 2011).
[64] For further information on RUPES see http://rupes.worldagroforestry.org/ (accessed 18 September 2011).
[65] Jack, B.K., Kouskya, C. and Simsa, K.R.E. (2008). Designing payments for ecosystem services: Lessons from previous experience with incentive-based mechanisms. *PNAS* 105(28): 9465-9470
[66] Baranzini, A., Faust, A. and Huberman, D. (undated). *Understanding the private demand for international ecosystem services – public attitudes and preferences towards REDD* [online] available at: http://cmsdata.iucn.org/downloads/ruig_ipes_final_report_0603_complet.pdf (accessed 27 April 2011).
[67] Engel, S., Pagiola, S., and Wunder, S. (2008). Designing payments for environmental services in theory and practice: an overview of the issues. *Ecological Economics* 65(4): 663–674.

the provider of the service.[68] PES is therefore based on a theoretically straightforward proposition: pay individuals or communities to undertake actions that increase levels of desired ecosystem services.[69] Wunder (2005) formally defined PES as:

1. a *voluntary* transaction where
2. a *well-defined* ES (or a land-use likely to secure that service)
3. is being 'bought' by a (minimum one) ES *buyer*
4. from a (minimum one) ES *provider*
5. if and only if the ES provider secures ES provision (*conditionality*)[70]

Consequently, Engel *et al.* (2008) argued that that there are at least three necessary conditions for the design of a 'genuine' PES scheme:

- the relationship between the type of land use being promoted and the provision of the ecosystem service must be clear;
- stakeholders must have the possibility to terminate the contractual relationship (i.e. it is a voluntary transaction); and
- a monitoring system must accompany the intervention, in order to ensure that the provision of services is taking place (additionality, see below, and conditionality).[71]

Muradian *et al.* (2010), however, argued that most PES experiences do not comply strictly with these conditions.[72] For example, PES may be implemented without previously establishing a clear-cut causal relationship between land use practices and the expected enhancement of the targeted ecosystem services and, in many cases, the efficiency of PES is therefore difficult to demonstrate.[73] Moreover, monitoring may be restricted to checking compliance with the promoted land use practices, instead of verifying changes in the *actual* provision of the targeted services.[74] Salzman (2009) also argued that the shortcoming in the Wunder definition is that only a small percentage of PES schemes satisfy Condition 5; he maintained that with the exception of carbon markets, most PES are based on inputs (i.e. land management practices) rather than outputs (i.e. a measurable change in service provision), whether this increases the service provision or not.[75] Perrot-Maître (2006) also argued that so few existing schemes actually fulfil these conditions that the question has been raised as to whether these schemes actually exist in practice, and if aiming for a perfect PES scheme makes any practical sense at all.[76] Muradian *et al.* argue that a prescriptive definition of PES that excludes the bulk of PES cases can be deemed at least flawed. Furthermore, they argue that dividing PES into 'genuine'

[68] Baranzini, A., Faust, A. and Huberman, D. (undated). *Understanding the private demand for international ecosystem services – public attitudes and preferences towards REDD* [online] available at: http://cmsdata.iucn.org/downloads/ruig_ipes_final_report_0603_complet.pdf (accessed 27 April 2011).
[69] Engel, S., Pagiola, S., and Wunder, S. (2008). Designing payments for environmental services in theory and practice: an overview of the issues. *Ecological Economics* 65(4): 663–674.
[70] Wunder, S. (2005). *Payments for environmental services: Some nuts and bolts*. Center for International Forestry Research Occasional Paper No. 42 [online] available at: http://www.cifor.cgiar.org/publications/pdf_files/OccPapers/OP-42.pdf (accessed 25 April 2011).
[71] Engel, S., Pagiola, S., and Wunder, S. (2008). Designing payments for environmental services in theory and practice: an overview of the issues. *Ecological Economics* 65(4): 663–674.
[72] Muradian, R. Corbera, R. Pascual, U., Kosoy, N. and May, P.H. (2010). Reconciling theory and practice: an alternative conceptual framework for understanding payments for environmental services. *Ecological Economics*. 69(6):1202-1208.
[73] *Ibid*
[74] Muradian, R. Corbera, R. Pascual, U., Kosoy, N. and May, P.H. (2010). Reconciling theory and practice: an alternative conceptual framework for understanding payments for environmental services. *Ecological Economics*. 69(6):1202-1208.
[75] Salzman and Thompson (2007) cited in Salzman, J. (2009). *A Policy Maker's Guide to Designing Payments for Ecosystem Services*. Duke Law Faculty Scholarship. Paper 2081 [online] available at: http://scholarship.law.duke.edu/faculty_scholarship/2081 (accessed 9 May 2011).
[76] Perrot-Maître, D. (2006). *The Vittel payments for ecosystem services: a "perfect" PES case?* International Institute for Environment and Development, London, UK [online] available at: http://pubs.iied.org/pdfs/G00388.pdf (accessed 27 April 2011).

(good) and PES-like (less good) may cause a mismatch between theory and practice.[77] Parker and Cranford (2010) argue that with such a rapid proliferation of PES and PES-like schemes globally over the past 10-15 years, the term "PES" has been stretched to suit various purposes and, in particular, is now often used to describe markets for ecosystem services in general.[78] In light of this, Parker and Cranford (2010) make reference to 'Direct PES'; mechanisms that hold closest to the traditional definition of PES as money that is raised as a direct payment for an ecosystem service.[79]

In practice, PES is often used as an umbrella term for a wide variety of schemes in which the beneficiaries, or users, of ecosystem services provide payment to the stewards, or providers, of ecosystem services.[80] According to the Ecosystem Marketplace website, PES frequently acts as a descriptor for schemes that do not depend upon a formal market, but rather rely upon a continual series of payments to rural landowners who agree to steward ecosystem services.[81] Although TEEB stopped short of defining PES, the final synthesis report stated that: *"The basic idea is that landowners or communities should be rewarded for practices that keep [ecosystems] intact and maintain their services"*[82]. A recent Defra paper defined PES *"in terms of payments to land managers and others to undertake actions that increase the quantity and quality of desired ecosystem services, which benefit specific or general users, often remotely"*.[83]

Forest Trends, the Katoomba Group, and UNEP (2008) argue that *the* critical, defining factor of a PES transaction is not just that money changes hands and that an environmental service is delivered or maintained; rather, the key is that *the payment causes the benefit to occur where it would not have done so otherwise*.[84] The OECD has also argued that payments compensate individuals for the additional costs of ecosystem service conservation and sustainable use, *over and above* that which is required by any existing regulations.[85] The RSPB has also emphasised that *"Payments should typically be for actions that are **additional** to what is usually expected of landholders – they should not be compensated for obeying the law, but rather for actions that society considers beyond the landholder's responsibility"* (our emphasis).[86] Baselines are critical to ensuring that any payment leads to additional benefits relative to the *status quo*; for example, payments for habitat protection are only additional if in their absence the habitat would be lost.[87] Moreover, for payments to be **conditional**, it must be possible to establish a baseline against which additional units 'provided' [or losses avoided] can be measured.[88] It should be noted that, in the case of some PES programmes, payment is made not to change land use but to maintain the *status quo* (e.g. payments to landowners in

[77] Muradian, R. Corbera, R. Pascual, U., Kosoy, N. and May, P.H. (2010). Reconciling theory and practice: an alternative conceptual framework for understanding payments for environmental services. *Ecological Economics*. 69(6):1202-1208.
[78] Parker, C. and Cranford, M. (2010). *The Little Biodiversity Finance Book* [online] available at: http://www.globalcanopy.org/sites/default/files/LBFB_EN.pdf (accessed 27 April 2011).
[79] *Ibid*
[80] See http://www.ecosystemmarketplace.com/pages/dynamic/web.page.php?section=about_us&page_name=glossary (accessed 27 April 2011).
[81] *Ibid*
[82] TEEB (2010). *The Economics of Ecosystems and Biodiversity: Mainstreaming the Economics of Nature: A synthesis of the approach, conclusions and recommendations of TEEB* [online] available at: http://www.teebweb.org/LinkClick.aspx?fileticket=bYhDohL_TuM%3d&tabid=924&mid=1813 (accessed 27 April 2011).
[83] Defra (2010). *Payments for ecosystem services: A short introduction* [online] available at: http://archive.defra.gov.uk/environment/policy/natural-environ/documents/payments-ecosystem.pdf (accessed 27 April 2011).
[84] Forest Trends, the Katoomba Group, and UNEP (2008). *Payments for Ecosystem Services: Getting Started – A Primer* [online] available at: http://www.katoombagroup.org/documents/publications/GettingStarted.pdf (accessed 26 April 2011).
[85] OECD (2010). *Paying for biodiversity: enhancing the cost-effectiveness of payments for ecosystem services* (Executive Summary) [online] available at: http://www.oecd.org/dataoecd/25/55/46135424.pdf (accessed 26 April 2011).
[86] RSPB (2010). *Financing nature in an age of austerity* [online] available at: http://www.rspb.org.uk/Images/Financingnature_tcm9-262166.pdf (accessed 26 April 2011).
[87] OECD (2010). *Paying for biodiversity: enhancing the cost-effectiveness of payments for ecosystem services*. OECD: Paris.
[88] Engel, S., Pagiola, S., and Wunder, S. (2008). Designing payments for environmental services in theory and practice: an overview of the issues. *Ecological Economics* 65(4): 663–674.

upper watersheds to keep their lands forested and ensure the continued flow of ecosystem services).[89] In these cases, additionality might not be an explicit objective of the programme. Nevertheless, additionality would exist if there was any possibility that the forest might be felled or degraded to the point that it no longer provided an adequate level of service provision.

The OECD emphasises that participation in PES programmes is **voluntary** and that rational land managers will enter into PES agreements as long as the payments cover at least the opportunity costs of changing their land use practices.[90] The OECD also argues that, since payments are made **directly** to those who influence the provision of ecosystem services, PES agreements can yield potentially large cost-effectiveness gains compared with other indirect and regulatory approaches.[91] This is because, whereas command and control approaches tend to impose uniform restrictions across landholders, requiring the same level of conservation from all, a PES approach is more flexible because participation is voluntary – landholders for whom conservation is relatively costly will therefore tend to conserve less than those with lower costs.[92].

The potential for social benefits to be derived from PES programmes depends, in part, on the coincidence between opportunity cost and social exclusion. For example, poorer farmers may tend to own marginal lands with higher slope and lower soil quality, in which case the opportunity cost of leaving the land in natural vegetation to increase ecosystem service provision may be lower.[93] In relation to uplands, remoteness, climate, soil and topography can exacerbate the challenges associated farming, and incomes on English upland farms have on average, been consistently lower than those of lowland farms. [94] However, this is due mainly to the higher proportion of grazing livestock (i.e. beef and sheep) farms in the uplands since grazing livestock farming is currently almost always uneconomic without public payments.[95] On one hand, the relative deprivation of many remote upland communities may suggest that additional income streams from PES could significantly improve social welfare. However, many of the most disadvantaged land managers are tenant farmers, and there are questions about whether benefits from PES would be passed on from land owners. In addition, the costs of delivering PES via upland management may be highest in the most remote (and disadvantaged) areas (e.g. peatland restoration involving helicopters to move material), meaning that PES schemes focus first on less remote areas where costs are lower, but where social welfare benefits are also likely to be lower. PES could also conceivably detract from social welfare if, for example, PES payments are reflected in higher water bills. The links between PES and social welfare are therefore complex and would ideally need to be considered on a case-by-case basis.

Engel *et al.* (2008) make an important distinction between **user-financed** PES in which the buyers are the users of the ecosystem service(s), and **government-financed** PES in which government is the buyer acting on behalf of ecosystem service(s) users.[96] Forest Trends, the Katoomba Group and UNEP (2008) also differentiate between self-organised private deals in which beneficiaries of ecosystem services contract directly with service providers via localised exchange arrangements (e.g. downstream beneficiaries with upstream watershed managers)

[89] Salzman, J. (2009). *A Policy Maker's Guide to Designing Payments for Ecosystem Services*. Duke Law Faculty Scholarship. Paper 2081 [online] available at: http://scholarship.law.duke.edu/faculty_scholarship/2081 (accessed 9 May 2011).
[90] OECD (2010). *Paying for biodiversity: enhancing the cost-effectiveness of payments for ecosystem services*. OECD: Paris.
[91] *Ibid*
[92] *Ibid*
[93] Jack, B.K., Kouskya, C. and Simsa, K.R.E. (2008). Designing payments for ecosystem services: Lessons from previous experience with incentive-based mechanisms. PNAS 105(28): 9465-9470
[94] Defra (2011). *Uplands Policy Review* [online] available at: http://archive.defra.gov.uk/rural/documents/interim2/upland-policy-review2011.pdf (accessed 9 July 2011).
[95] *Ibid*
[96] Engel, S., Pagiola, S., and Wunder, S. (2008). Designing payments for environmental services in theory and practice: an overview of the issues. *Ecological Economics* 65(4): 663–674.

and public payment schemes for private land owners to maintain or enhance ecosystem services in which the government is the main or only buyer on behalf of the wider populace that it is assumed will benefit.[97] Wunder *et al.* (2010) argue that the former are typically smaller (e.g. at the watershed scale), more focused in their interventions (e.g. target zones and differential PES rates), more conditional, and thus ultimately more efficient in delivering ecosystem services.[98] Government-financed PES, in contrast, tend to be more diffuse (less targeted, based on uniform payments, with sometimes inadequate monitoring and sanction systems) which typically renders them less efficient in achieving environmental targets.[99] However, Wunder *et al.* argue that government-financed PES operate at larger scales and are often the only feasible mechanism for financing environmental outcomes whose values are diffusely spread across large numbers of people (e.g. biodiversity conservation).[100] Moreover, Blackman and Woodward (2010) argue that the main advantage of government-financed PES is economies of scale. PES programmes entail significant transaction costs that stem from identifying and matching service providers and users, negotiating conditional contracts, monitoring compliance, and enforcing contract terms and they maintain that national programmes are able to spread these costs over a large number of agents, in theory facilitating PES agreements that would be too costly for private parties to negotiate on their own.[101] However, Blackman and Woodward (2010) also point out that because national governments are not direct users of environmental services, they generally do not have detailed local knowledge about the value, provision, and use of these services. As a result, they may often do a poor job of identifying providers of important environmental services, negotiating cost-effective contracts, and monitoring compliance.[102] A crucial difference between user- and government-financed approaches is that user-financed PES transactions can be sustained if, and only if, private demand supports them, while the maintenance of government-financed approaches will depend partly on political priorities.[103]

A review of the literature therefore suggests that, at a minimum, the following principles should underpin any arrangement labelled PES:

- stakeholders enter into a PES agreement on a **voluntary** basis;
- payment is made by the **beneficiaries** of ecosystem services (individuals, communities and businesses or governments acting on their behalf);
- payments are made **directly** to ecosystem service providers;
- ecosystem service benefits are **additional** or over-and-above business-as-usual (i.e. land managers must go beyond regulatory compliance) or, if current benefits are demonstrably threatened, then the status quo is at least maintained and continued service provision therefore guaranteed (either way an agreed baseline is a prerequisite); and

[97] Forest Trends, the Katoomba Group, and UNEP (2008). *Payments for Ecosystem Services: Getting Started – A Primer* [online] available at: http://www.katoombagroup.org/documents/publications/GettingStarted.pdf (accessed 26 April 2011).
[98] Wunder, S., Wertz-Kanounnikoff, S. and Ferraro, P. (2010). *Payments for Environmental Services and the Global Environment Facility: A STAP advisory document* [online] available at: http://www.thegef.org/gef/sites/thegef.org/files/publication/STAP_PES_2010.pdf (accessed 1 May 2011).
[99] *Ibid*
[100] Wunder, S., Wertz-Kanounnikoff, S. and Ferraro, P. (2010). *Payments for Environmental Services and the Global Environment Facility: A STAP advisory document* [online] available at: http://www.thegef.org/gef/sites/thegef.org/files/publication/STAP_PES_2010.pdf (accessed 1 May 2011).
[101] Blackman, A. and Woodward, R.T. (2010*). User Financing in a National Payments for Environmental Services Program: Costa Rican Hydropower*. Resources for the Future, Washington [online] available at: http://www.rff.org/documents/RFF-DP-09-04-REV.pdf (accessed 1 May 2011).
[102] *Ibid*
[103] Food and Agriculture Organization of the United Nations (2007). *The State of Food and Agriculture 2007: Paying Farmers for Environmental Services* [online] available at: ftp://ftp.fao.org/docrep/fao/010/a1200e/a1200e00.pdf (accessed 1 May 2011).

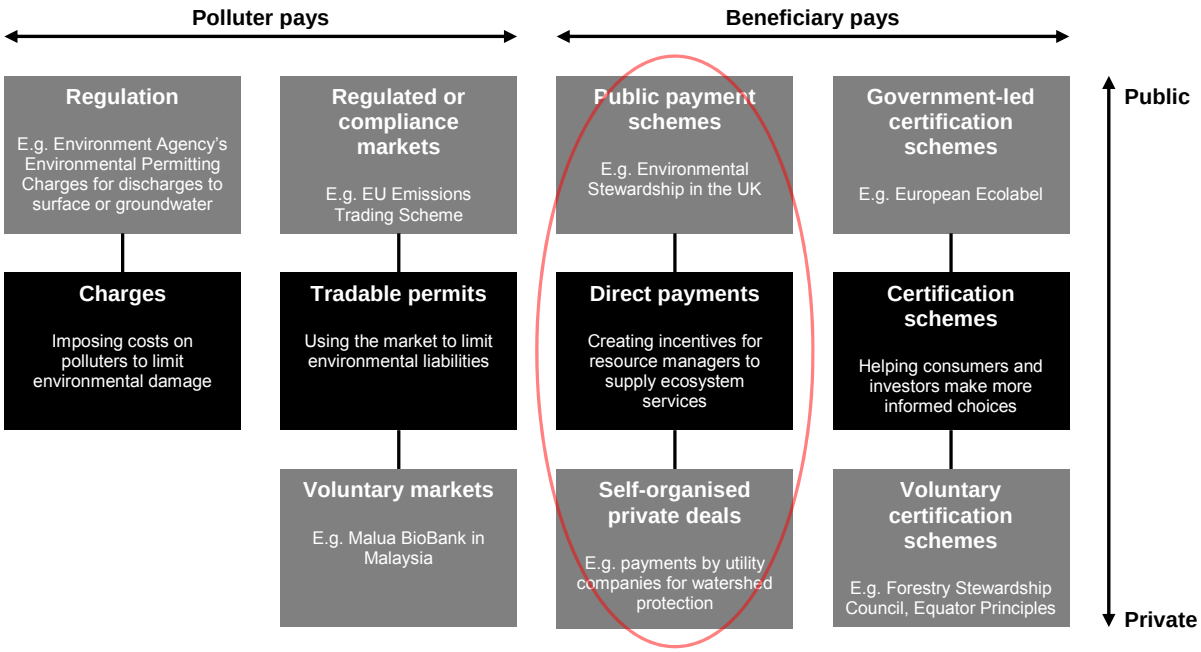
- payment is **conditional** on the delivery of ecosystem service benefits (although these may be assumed to occur with the implementation of certain proxy land use practices).

These principles are largely captured by the UN Food and Agricultural Organisation's definition of PES as: *"voluntary transactions where a service provider is paid by, or on behalf of, service beneficiaries for agricultural land, forest, coastal or marine management practices that are expected to result in continued or improved service provision beyond what would have been provided without the payment"*.[104]

Since PES is based on the 'beneficiary-pays' principle, this report does not address 'trading' systems designed to compensate for damage in one place through improvements elsewhere (such as biodiversity offsets) as these involve the polluter-pays principle. Biodiversity offsetting can be viewed as one provider (e.g. a conservation NGO) undertaking measures to enhance publicly-valued biodiversity that a buyer (e.g. a housing developer) purchases (via an agent that might be a local authority) in order to offset their 'consumption' of nature elsewhere. Biodiversity offsetting therefore features both 'provider gets' as well as 'polluter-pays' and, as such, can be considered PES-like. The Natural Environment White Paper includes a commitment on the part of the Government to establish a new, voluntary approach to biodiversity offsetting and to test the approach in pilot areas.[105] The question of whether or not PES includes certification (e.g. eco-labelling) schemes is a matter for some debate. In payment programmes involving certification, the payment is linked to a characteristic of the product or its production process that is associated with the supply of an ecosystem service and the payment mechanism is via price premiums and/or market access.[106] As the FAO points out, certified products involve three sets of buyers along the supply chain: the point-of-sale buyer (the green consumer); the retailer (companies buying wholesale before selling to the consumer); and, ironically, the supplier of the green product, who must pay the certification organisation for use of the label and sometimes separate certifiers.[107] In light of the indirect nature of the payments made we have scoped out certification schemes for the purposes of this research; however, they may technically be considered by some to constitute PES and like biodiversity offsets are certainty closely related. Figure 1 illustrates the focus of this report and locates PES within a broader suite of market based instruments.

[104] Food and Agriculture Organization of the United Nations (2007). *The State of Food and Agriculture 2007: Paying Farmers for Environmental Services* [online] available at: ftp://ftp.fao.org/docrep/fao/010/a1200e/a1200e00.pdf (accessed 1 May 2011).
[105] HM Government (2011). *The Natural Choice: securing the value of nature* [online] available at: http://www.official-documents.gov.uk/document/cm80/8082/8082.pdf (accessed 11 July 2011).
[106] Food and Agriculture Organization of the United Nations (2007). *The State of Food and Agriculture 2007: Paying Farmers for Environmental Services* [online] available at: ftp://ftp.fao.org/docrep/fao/010/a1200e/a1200e00.pdf (accessed 1 May 2011).
[107] *Ibid*

Figure 1: Locating PES within a broader suite of market-based instruments[108]

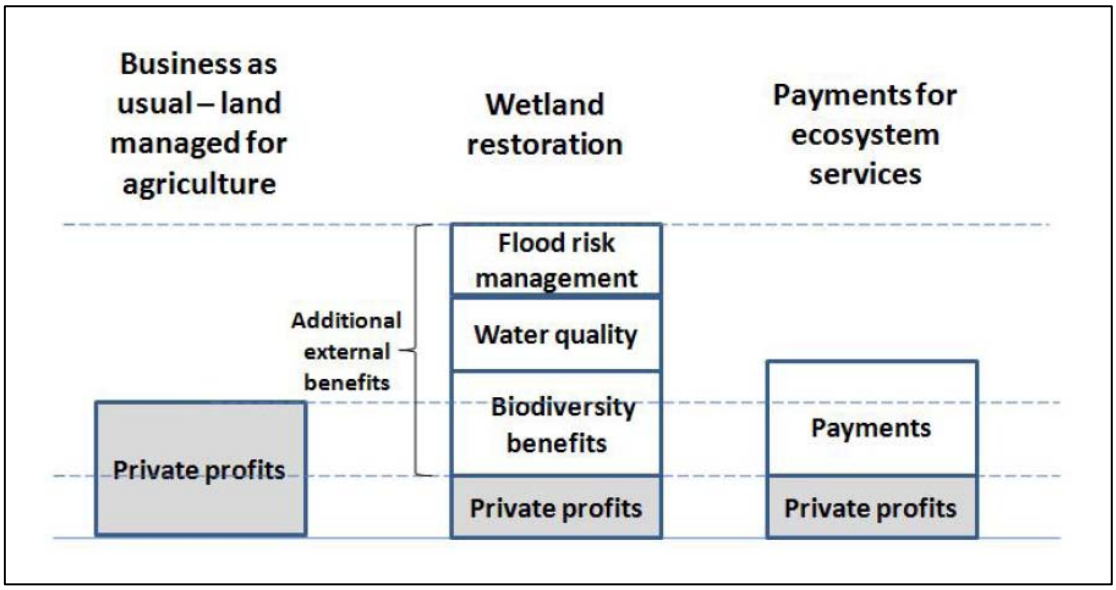


2.4 What does PES involve?

Defra's short introduction to PES[109] includes an illustration of a simple example of a PES scheme – see Figure 2 – in which land is being managed primarily for agricultural purposes but where opportunities for wetland restoration exist and could yield an enhanced level of ecosystem services including flood risk management, water quality and biodiversity benefits. However, in order to encourage the necessary land use practices, land managers would require an incentive which could take the form of a PES.

[108] Adapted from WBCSD and IUCN (2007). *Business and Ecosystems: Markets for Ecosystem Services – New Challenges and Opportunities for Business and the Environment. A Perspective* [online] available at http://www.wbcsd.org/DocRoot/7g8VZQpq0LeF1xNwsbGX/market4ecosystem-services.pdf (accessed 7 July 2011)
[109] Defra (2010). *Payments for ecosystem services: A short introduction* [online] available at: http://archive.defra.gov.uk/environment/policy/natural-environ/documents/payments-ecosystem.pdf (accessed 25 April 2011).

Figure 2: A simple example of a PES[110]



In practice, the 'minimum payment' that the land manager will be willing-to-accept as compensation to restore wetlands is the foregone opportunity cost of the alternative land use. The 'maximum payment' the ecosystem service beneficiary is willing-to-pay for restoration is the total costs of damage incurred when the land is managed primarily for agricultural purposes. Therefore if the potential benefits of restoration are larger than the minimum payment there is the potential for a mutually beneficial PES programme to emerge.[111]

Forest Trends, the Katoomba Group, and UNEP (2008) set out four core steps for the development of PES deals – see Box 2.

[110] Defra (2010). *Payments for ecosystem services: A short introduction* [online] available at: http://archive.defra.gov.uk/environment/policy/natural-environ/documents/payments-ecosystem.pdf (accessed 25 April 2011).
[111] OECD (2010). *Paying for biodiversity: enhancing the cost-effectiveness of payments for ecosystem services*. OECD: Paris.

Box 2: Core steps in the development of PES deals[112]

Step 1: Identifying ecosystem service prospects and potential buyers
- Defining, measuring, and assessing the ecosystem services in a particular area
- Determining marketable value
- Identifying potential buyers who benefit from the service
- Considering whether to sell as individuals or as a group

Step 2: Assessing institutional and technical capacity
- Assessing legal, policy, and land ownership context
- Examining existing rules for PES markets and deals
- Surveying available PES support services and organisations

Step 3: Structuring agreements
- Designing management and business plans to provide the ecosystem service that is the focus of the PES deal
- Reducing transaction costs
- Reviewing options for payment types
- Establishing the equity and fairness criteria for evaluating payment options
- Selecting a contract type

Step 4: Implementing PES agreements
- Finalising the PES management plan
- Verifying PES service delivery and benefits
- Monitoring and evaluating the deal

2.5 Success factors

Forest Trends, The Katoomba Group and UNEP (2008) also identify a series of ideal conditions for PES deals to flourish, including:

- **Demand for ecosystem services is clear and financially valuable to one or more players**; PES are most likely to occur when there is at least one beneficiary of ecosystem services with both an incentive to invest in the maintenance of this service and available funds for doing so
- **Supply is threatened**; if resources are clearly diminishing to the point of scarcity because of a declining ecosystem service then a PES deal holds potential
- **Specific resource management actions have the potential to address supply constraints**; for PES to be a viable option, it is essential to identify what resource management practices could be changed and what ecosystem services results will ensure improvement of 'supply' issues
- **Effective brokers or intermediaries exist**; these can assist with tasks including documenting ecosystem service conditions, identifying specific resource management alternatives, engaging and negotiating with prospective buyers, and activities related to implementation (including monitoring, certification, verification, etc.)

[112] Forest Trends, the Katoomba Group, and UNEP (2008). *Payments for Ecosystem Services: Getting Started – A Primer* [online] available at: http://www.katoombagroup.org/documents/publications/GettingStarted.pdf (accessed 30 April 2011).

- **Resource tenure is clear**; the supplier must have control over the area where the PES agreement is to be implemented, and the buyer must have assurance, and recourse to ensure, that contract provisions of the deal are secure.[113]

Several of these factors are echoed in an analysis of the PES programme developed and implemented by Vittel (Nestlé Waters) in north-eastern France which concluded that *"The Vittel experience is most likely to be replicable in places where land cannot be purchased and set aside for conservation, and where the risk to business is high while the link between ecosystem health and farming practices is well understood and expected benefits are sufficiently high to justify the investment"*.[114] The analysis also indicated that the primary reasons for the programme's success were not financial, with the fundamental success factors including: trust-building through the creation of an intermediary institution (locally based and led by a "champion" sympathetic to the farmers' cause); the development of a long-term participatory process to identify alternative practices and a mutually acceptable set of incentives; the ability to link incentives to land tenure and debt cycle issues; and to substitute the old technical and social support networks with new ones.[115] However, overall the analysis concluded that establishing PES is a very complex undertaking, one that requires the consideration of scientific but also social, economic, political, institutional, and power relationships.[116]

Engel *et al.* (2008) argue that the emergence of PES may be facilitated when the ecosystem services in question are *not* public goods.[117] **Public goods** are goods whereby consumption by one individual does not reduce availability of the good for consumption by others (non-rival); and whereby no one can be effectively excluded from using the good (non-excludable).[118] Leaving provisioning services aside, Engel *et al.* (2008) emphasise that not all ecosystem services are pure public goods. For example, while the climate regulation services provided by forests are global public goods[119], many water-related services are **club goods**, i.e. only those holding water rights or those located in a well delineated watershed benefit.[120] Other ecosystem services are **quasi-public goods**, being either excludable or rival, such as parks (excludable, non-rival), or fish stocks (non-excludable, rival).[121] The OECD argues that in cases where the ecosystem services in question are public goods, such as biodiversity, the incentives to free-ride may preclude the establishment of direct user-financed PES programmes.[122] In these circumstances, the OECD argues that governments often have an especially important role to play in facilitating PES programmes.[123] Salzman (2009) echoes this arguing that in the case of public goods such as biodiversity, there is no sufficiently discrete class of beneficiaries with whom landholders can negotiate, and the transaction costs of gathering enough beneficiaries together to negotiate for the service are too high[124] (hence governments must step in). Muradian *et al.* (2010) argue that since the ecosystem services that PES deal with are often public goods, it may therefore be convenient to define PES *"as a*

[113] Forest Trends, the Katoomba Group, and UNEP (2008). *Payments for Ecosystem Services: Getting Started – A Primer* [online] available at: http://www.katoombagroup.org/documents/publications/GettingStarted.pdf (accessed 26 April 2011).
[114] Perrot-Maître, D. (2006) The Vittel payments for ecosystem services: a "perfect" PES case? International Institute for Environment and Development, London, UK [online] available at: http://pubs.iied.org/pdfs/G00388.pdf (accessed 27 April 2011).
[115] *Ibid*
[116] *Ibid*
[117] Engel, S., Pagiola, S., and Wunder, S. (2008). Designing payments for environmental services in theory and practice: an overview of the issues. *Ecological Economics* 65(4): 663–674.
[118] OECD (2010). *Paying for biodiversity: enhancing the cost-effectiveness of payments for ecosystem services*. OECD: Paris.
[119] *Ibid*
[120] Engel, S., Pagiola, S., and Wunder, S. (2008). Designing payments for environmental services in theory and practice: an overview of the issues. *Ecological Economics* 65(4): 663–674.
[121] OECD (2010). *Paying for biodiversity: enhancing the cost-effectiveness of payments for ecosystem services*. OECD: Paris.
[122] *Ibid*
[123] *Ibid*
[124] Salzman, J. (2009). *A Policy Maker's Guide to Designing Payments for Ecosystem Services*. Duke Law Faculty Scholarship. Paper 2081 [online] available at: http://scholarship.law.duke.edu/faculty_scholarship/2081 (accessed 9 May 2011).

transfer of resources between social actors, which aims to create incentives to align individual and/or collective land use decisions with the social interest in the management of natural resources".[125]

The OECD has recently set out twelve key criteria that it considers essential to enhancing PES effectiveness.

Box 3: Key criteria for enhancing environmental and cost effectiveness of PES programmes[126]

1. ***Remove perverse incentives***: For a PES programme to produce clear and effective incentives any conflicting market distortions, such as environmentally-harmful subsidies, should be removed.

2. ***Clearly define property rights***: The individual or community whose land use decisions affect the provision of ecosystem services must have clearly defined and enforceable property rights over the land in question. Otherwise, risks associated with, for example, illegal logging or land appropriation will undermine the ability of a landholder to provide the ecosystem service, rendering the PES ineffective.

3. ***Clearly define PES goals and objectives***: Clear PES goals help to guide the design of the programme, enhance transparency and avoid ad-hoc political influence.

4. ***Develop a robust monitoring and reporting framework***: Monitoring and reporting of biodiversity and ecosystem services is fundamental, enabling the assessment of PES programme performance, and allowing for improvements over time.

5. ***Identify buyers and ensure sufficient and long-term sources of financing***: Whether the buyers of services are the beneficiaries themselves, or third-parties acting on behalf of the beneficiaries, the finance must be sufficient and sustainable to ensure that the objective of the PES programme can be achieved.

6. ***Identify sellers and target ecosystem service benefits***: Accounting for spatial variation in ecosystem service benefits via economic valuation, benefit scoring, and mapping tools allows payments to be prioritised to those areas that provide the highest benefits. If the total PES budget available is limited, this can substantially increase the cost-effectiveness of the programme in comparison to, say, allocating payments on a first-come first-served basis.

7. ***Establish baselines and target payments to ecosystem services that are at risk of loss, or to enhance their provision***: A PES programme should only make payments for ecosystem services that are additional to the business-as-usual baseline (i.e. in the absence of the programme).

8. ***Differentiate payments based on the opportunity costs of ecosystem service provision***: PES programmes that reflect ecosystem providers' opportunity costs via differentiated payments are able to achieve greater aggregate ecosystem service provision per unit cost.

9. ***Consider bundling or layering multiple ecosystem services***: Joint provision of

[125] Muradian, R. Corbera, R. Pascual, U., Kosoy, N. and May, P.H. (2010). Reconciling theory and practice: an alternative conceptual framework for understanding payments for environmental services. *Ecological Economics*. 69(6):1202-1208.
[126] OECD (2010) Paying for Biodiversity: Enhancing the Cost-Effectiveness of Payments for Ecosystem Services. OECD: Paris

multiple services can provide opportunities to increase the benefits of the programme, while reducing transaction costs, especially if finance for multiple benefits is available. The potential synergies and trade-offs involved in joint ecosystem service provision need to be identified.

10. ***Address leakage***: Leakage occurs when the provision of ecosystem services in one location increases pressures for conversion in another. If leakage risk is expected to be high, the scope of the monitoring and accounting framework may need to be expanded to enable assessment of the potential leakage so that appropriate measures can be introduced to address it.

11. ***Ensure permanence***: Events such as forest fires or illegal logging may undermine the ability of a landholder to provide an ecosystem service as stipulated in a PES agreement. If these risks are high, this will impede the effective functioning of a PES market. Insurance mechanisms can be introduced to address this.

12. ***Deliver performance-based payments and ensure adequate enforcement***: Ideally, payments should be ex-post, conditional on ecosystem service performance. When this is not feasible, effort-based payments (such as changes in management practices) are a second best alternative, provided that changes in ecosystem management practices will bring about the desired change in service provision. Sufficient disincentives to breaching the PES agreement must also be provided and enforced, especially if payments are based on efforts rather than on actual ecosystem service delivery.

2.6 Design variables

PES programmes vary with respect to which ecosystem services are provided, who the sellers, buyers and intermediaries are, how payments are funded, the eligibility rules for participation, the land management practices paid for, the performance measure used, and the payment mode and amount.[127] [128] Table 1 sets out some of the key variables in PES programmes.

[127] Engel, S., Pagiola, S., and Wunder, S. (2008). Designing payments for environmental services in theory and practice: an overview of the issues. *Ecological Economics* 65(4): 663–674.
[128] Jack, B.K., Kouskya, C. and Simsa, K.R.E. (2008). Designing payments for ecosystem services: Lessons from previous experience with incentive-based mechanisms. *PNAS* 105(28): 9465-9470.

Table 1: PES programme variables

Defining characteristics	Examples
Type of habitat / land use from which saleable services are generated	Semi-natural grasslands; enclosed farmlands; woodlands; open waters, wetlands and floodplains; mountains, moors and heaths; coastal margin habitats; marine; urban
Type of ecosystem services to which applied	Carbon sequestration, water quality, flood risk management, landscape quality, biodiversity conservation
Type of provider / seller	Agricultural land owner, forest land owner, government estate
Type of intermediary	Government, NGO, investor
Location of beneficiaries	Local, regional, national, global
Type of buyer / financing source	Government (e.g. EU funding, UK government funding, local government funding sources); business (e.g. water companies, energy companies, tourism and leisure, developers, etc); NGO (e.g. River Trusts, RSPB, National Trust, Wildlife Trusts); individual (households, communities, clubs and societies); investor (e.g. pension funds, banks, co-operatives)
Type of payment approach	Output-based (payment by results) or input or activity-based (payment for action)
Type of 'packaging' of ecosystem services	A package of services from the same area of land is paid for by a single buyer (bundling), by multiple buyers (layering) or one service is sold as an umbrella service and other services 'free ride' ('piggy-backing')

Salzman (2009) argues that it is helpful to think of PES design as a problem of **asymmetric information**: whereas landholders know both the opportunity cost of a specific land use change and the price they are willing to accept to implement this change, potential buyers, including government agencies or water suppliers know how much they willing to pay and which types of land use changes would be most valuable for service provision. According to Salzman, the design challenge lies in how to efficiently transfer both types of information – (i) willingness to pay/accept, and (ii) service provision resulting from a land use change – from one party to another in a mutually reinforcing fashion.[129] Although knowledge deficit and transfer are key issues, there are, of course, other significant challenges to successful PES design.

In terms of the ecosystem services provided, Salzman argues that, globally, payments cluster around four broad types of services: watershed protection; carbon sequestration; biodiversity conservation; and landscape beauty.[130] Table 2 provides some further examples of ecosystem service beneficiaries and potential buyers. In terms of who should be paid, the FAO argue that perhaps the most controversial issue is whether payments should be directed to those who currently provide services or to those whose land parcels have the greatest potential for increased service provision.[131] The FAO points out that those already providing the service

[129] Salzman, J. (2009). *A Policy Maker's Guide to Designing Payments for Ecosystem Services*. Duke Law Faculty Scholarship. Paper 2081 [online] available at: http://scholarship.law.duke.edu/faculty_scholarship/2081 (accessed 9 May 2011).
[130] *Ibid*
[131] Food and Agriculture Organization of the United Nations (2007). *The State of Food and Agriculture 2007: Paying Farmers for Environmental Services* [online] available at: ftp://ftp.fao.org/docrep/fao/010/a1200e/a1200e00.pdf (accessed 1 May 2011).

would not qualify for participation in a PES programme assuming that the additionality standard is applied.[132]

Table 2: Ecosystem services and examples of beneficiaries and buyers[133]

Ecosystem service	Beneficiaries	Buyers
Carbon sequestration	• Global community	• Local, regional and national governments • International organizations (World Bank – BioCarbon Fund) • National carbon funds (Italian Carbon Fund, The Netherlands CDM Facility) • Conservation groups • Land trusts • Corporations • Hedge funds and investment groups
Biodiversity	• Global community	• International and national NGOs
Water quality	• Local community (potable water) • Fishers (pollution) • Farmers (salinity)	• Municipalities • Private water suppliers • Public water suppliers • Bottled water companies • Farming organisations
Erosion control	• Local community (potable water) • Dam owners (sedimentation) • Fishers (sedimentation)	• Hydroelectric energy providers • Port authorities

Engel *et al.* (2008) argue that payments would ideally be made directly on the basis of the ecosystem services provided as, for example, payments for carbon sequestration or increases in wildlife populations (**'output-based' payments**).[134] The OECD also argues that ideally, payments should be ex-post, and conditional on ecosystem service performance. However, they contend that when this is not feasible, **effort-based payments** (such as changes in management practices) are a second-best alternative, provided that changes in ecosystem management practices will bring about the desired change in service provision.[135] They also caution that sufficient disincentives to breaching the PES agreement must be provided and

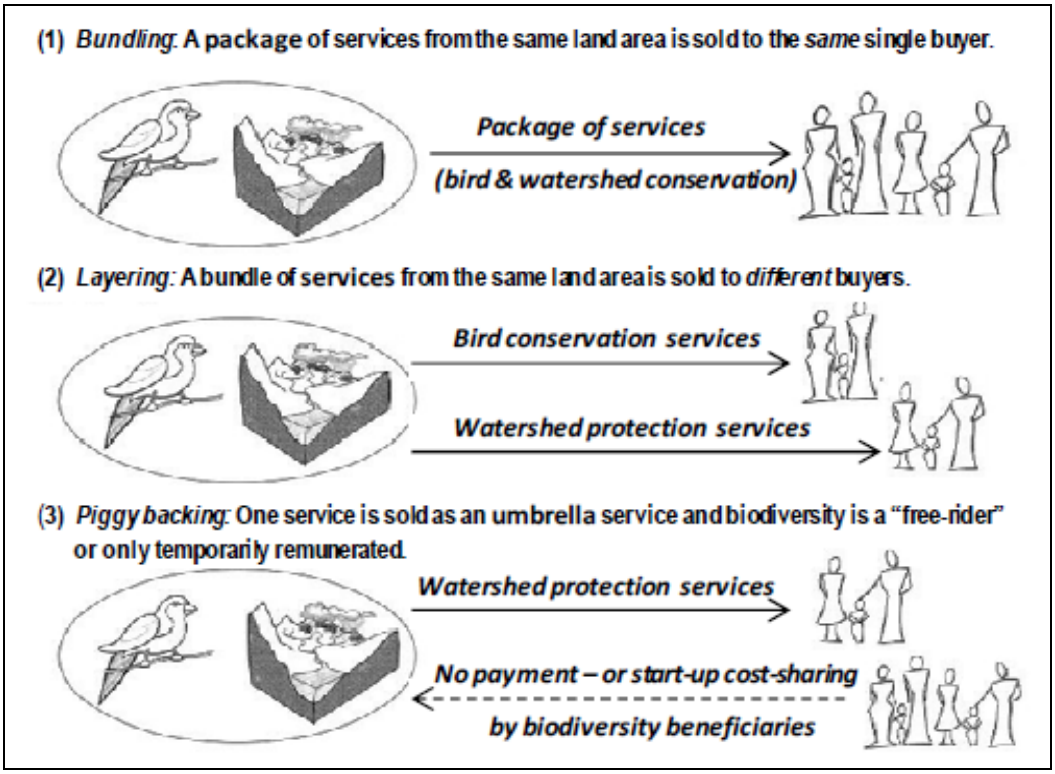
[132] Food and Agriculture Organization of the United Nations (2007). *The State of Food and Agriculture 2007: Paying Farmers for Environmental Services* [online] available at: ftp://ftp.fao.org/docrep/fao/010/a1200e/a1200e00.pdf (accessed 1 May 2011).
[133] Adapted from Food and Agriculture Organization of the United Nations (2007). *The State of Food and Agriculture 2007: Paying Farmers for Environmental Services* [online] available at: ftp://ftp.fao.org/docrep/fao/010/a1200e/a1200e00.pdf (accessed 1 May 2011).
[134] Engel, S., Pagiola, S., and Wunder, S. (2008). Designing payments for environmental services in theory and practice: an overview of the issues. *Ecological Economics* 65(4): 663–674.
[135] OECD (2010). *Paying for biodiversity: enhancing the cost-effectiveness of payments for ecosystem services*. OECD: Paris.

enforced, especially if payments are based on efforts rather than on actual ecosystem service delivery.[136] In practice, most PES programmes base payments on the adoption of particular land uses.[137]

In terms of 'packaging' ecosystem services, there are several possibilities. Nature conservation typically provides a series of simultaneous ecosystem services and, as such, securing payments for various services from their respective beneficiaries (e.g. carbon buyers and water users) can help make conservation economically viable.[138] Three main variants of joint financing for multiple ecosystem services have been distinguished (see Figure 3):

- **bundling** – a single buyer pays for a package of ecosystem services from the same plot of land (the case with most government-financed, but also some user-financed, PES);
- **layering** – multiple buyers pay for separate ecosystem services from the same plot of land; and
- **piggy-backing** – one service is sold as an umbrella service and other services 'free ride'.[139]

Figure 3: Bundling, layering and piggy-backing[140]



[136] OECD (2010). *Paying for biodiversity: enhancing the cost-effectiveness of payments for ecosystem services*. OECD: Paris.
[137] Engel, S., Pagiola, S., and Wunder, S. (2008). Designing payments for environmental services in theory and practice: an overview of the issues. *Ecological Economics* 65(4): 663–674.
[138] Wunder, S., Wertz-Kanounnikoff, S. and Ferraro, P. (2010). *Payments for Environmental Services and the Global Environment Facility: A STAP advisory document* [online] available at: http://www.thegef.org/gef/sites/thegef.org/files/publication/STAP_PES_2010.pdf (accessed 1 May 2011).
[139] Adapted from Wunder, S., Wertz-Kanounnikoff, S. and Ferraro, P. (2010). *Payments for Environmental Services and the Global Environment Facility: A STAP advisory document* [online] available at: http://www.thegef.org/gef/sites/thegef.org/files/publication/STAP_PES_2010.pdf (accessed 1 May 2011).
[140] OECD (2010). *Paying for biodiversity: enhancing the cost-effectiveness of payments for ecosystem services*. OECD: Paris.

2.7 PES internationally

According to a recent OECD report, there are more than 300 PES programmes in place worldwide, predominantly used to address biodiversity conservation, watershed services, carbon sequestration and landscape beauty.[141] Blackman and Wood (2010) indicate that the majority of these have a limited geographic scope and are financed directly by users of specific environmental services, for example, payments by downstream users of hydrological services to upstream land managers in a single watershed. However, a handful of programmes – including in China, Costa Rica, Mexico, and South Africa – have a national scope and are financed by government acting on behalf of users of environmental services throughout the country.[142] The OECD has estimated that over USD 6.53 billion is channelled by national PES programmes in China, Costa Rica, Mexico, the UK and the United States alone (to put this into context, in 2007, OECD Development Assistance Committee members allocated approximately USD 3.5 billion in bilateral Official Development Assistance to biodiversity-related activities).[143] Three case studies from the United States, Costa Rica and China are introduced below and these highlight some of the key issues associated with developing PES programmes. The OECD report also highlights the emergence of international payments for ecosystem services (IPES) citing IPES-like activities including afforestation and reforestation projects under the Clean Development Mechanism (CDM), bio-prospecting agreements, and Reducing Emissions from Deforestation and forest Degradation (REDD) to help address the challenge of climate change. These are further discussed in section 2.7.4 below.

2.7.1 Case study: US Conservation Reserve Program

According to the FAO, PES initiatives currently in operation have two main origins: agricultural policy in OECD countries, dating from the 1980s, and forest conservation initiatives in Latin America, which began in the 1990s.[144] The Conservation Reserve Program (CRP) in the United States is an example of the former and was introduced in 1985 with the aim of preventing soil erosion in cropland.[145] The CRP is primarily a land set-aside programme whereby the government offers landholders incentives to enter into contracts to change the land use on a specified plot thereby providing ecosystem service benefits.[146]

The CRP is funded by the government-owned and -operated Commodity Credit Corporation (CCC) which makes annual rental payments based on the agriculture rental value of the land, and provides cost-share assistance for up to 50 percent of the participants' costs in establishing approved conservation practices.[147] Participants enrol in CRP contracts for 10 to 15 years[148] and over 80% of the CRP land is registered using a competitive bidding process, making the CRP the largest and longest-running PES programme utilising **inverse auctions**.[149] Inverse auctions require potential ecosystem service sellers to submit bids indicating the minimum payment they are willing to accept for the provision of an ecosystem service.[150] The OECD argues that inverse auctions are appropriate when there are a large

[141] OECD (2010). *Paying for biodiversity: enhancing the cost-effectiveness of payments for ecosystem services*. OECD: Paris.
[142] Blackman, A. and Woodward, R.T. (2010*). User Financing in a National Payments for Environmental Services Program: Costa Rican Hydropower*. Resources for the Future, Washington [online] available at: http://www.rff.org/documents/RFF-DP-09-04-REV.pdf (accessed 1 May 2011).
[143] OECD (2010). *Paying for biodiversity: enhancing the cost-effectiveness of payments for ecosystem services*. OECD: Paris.
[144] Food and Agriculture Organization of the United Nations (2007). *The State of Food and Agriculture 2007: Paying Farmers for Environmental Services* [online] available at: ftp://ftp.fao.org/docrep/fao/010/a1200e/a1200e00.pdf (accessed 1 May 2011).
[145] *Ibid*
[146] OECD (2010). *Paying for biodiversity: enhancing the cost-effectiveness of payments for ecosystem services*. OECD: Paris.
[147] See http://www.fsa.usda.gov/FSA/webapp?area=home&subject=copr&topic=crp (accessed 2 May 2011).
[148] *Ibid*
[149] OECD (2010). *Paying for biodiversity: enhancing the cost-effectiveness of payments for ecosystem services*. OECD: Paris.
[150] *Ibid*

number of bidders, since they induce competition for payments, and that they provide an innovative way to reflect sellers' opportunity costs in PES programmes while delivering large cost-effectiveness gains.[151] The United States Department of Agriculture (USDA) ranks the bids received according to potential environmental benefits as well as costs and incorporates this information into an Environmental Benefit Index (EBI) which facilitates selection of the contracts offering the highest benefits for least cost.[152] The CRP initially focused on reducing soil erosion but its objectives have expanded over time to encompass protecting environmentally sensitive lands, improving water quality, enhancing wildlife habitat and improving air quality, and these goals are achieved through the retirement of cropland and the implementation of specified management practices.[153] The perceived importance of each objective is reflected in the EBI; currently wildlife, water quality and local erosion control benefits each carry a maximum of 100 points while up to 50 points are available for benefits enduring past contract expiration, 45 points for air quality benefits, and up to 150 points for relative cost.[154]

A series of eligibility requirements are also intended to ensure that the environmental benefits of a CRP contract are **additional** to the *status quo*.[155] For example, producers must have owned or operated the land for at least 12 months prior to the close of the sign-up period, or must prove that the land was not acquired for the purpose of enrolling it in the CRP.[156] In terms of additionality, Sullivan *et al.* (2004) estimated that 51% of CRP land would be returned to crop production in the absence of CRP payments (and that spending on outdoor recreation would decrease by as much as $300 million per year in rural areas).[157] Various measures have been proposed to improve the environmental performance of the CRP, including rewarding management practices appropriate to the native wildlife and using GIS data to evaluate the spatial nature of bids, giving greater priority to those adjacent to existing conservation lands.[158] Concerns have been expressed over **fairness**, in that participating farmers are paid to adopt practices that other farmers may have adopted voluntarily (without compensation).[159] Overall, as the OECD concludes, ultimately, to ensure the future of the CRP, the payments made must continue to be competitive against a backdrop of rising crop demand and revenues.[160]

2.7.2 Case study: Costa Rica Payments for Environmental Services (*Pagos por Servicios Ambientales, PSA*)

In 1996, Costa Rica replaced an ineffective system of tax deductions for reforestation[161] with a national programme of payments for environmental services (PES) generated by forest and agro-forestry ecosystems in which participants are paid for the delivery of carbon sequestration, water quality, biodiversity protection and scenic beauty services.[162] Payments are made in return for four land use activities: the protection of natural forest; the establishment

[151] OECD (2010). *Paying for biodiversity: enhancing the cost-effectiveness of payments for ecosystem services*. OECD: Paris.
[152] *Ibid*
[153] *Ibid*
[154] *Ibid*
[155] OECD (2010). *Paying for biodiversity: enhancing the cost-effectiveness of payments for ecosystem services*. OECD: Paris.
[156] *Ibid*
[157] Sullivan P., D. Hellerstein, L. Hansen, R. Johansson, S. Koenig, R. Lubowski, R. McBride, D. McGranahan, M. Roberts, S. Vogel and Bucholtz, S. (2004). *The Conservation Reserve Program: economic implications for rural America*, Agricultural Economic Report, Vol. 834, USDA Economic Research Service [online] available at: http://www.ers.usda.gov/publications/aer834/aer834.pdf (accessed 2 May 2011).
[158] OECD (2010). *Paying for biodiversity: enhancing the cost-effectiveness of payments for ecosystem services*. OECD: Paris.
[159] Food and Agricultural Organization of the United Nations (2007). *The State of Food and Agriculture 2007: Paying Farmers for Environmental Services* [online] available at: ftp://ftp.fao.org/docrep/fao/010/a1200e/a1200e00.pdf (accessed 1 May 2011).
[160] OECD (2010). *Paying for biodiversity: enhancing the cost-effectiveness of payments for ecosystem services*. OECD: Paris.
[161] *Ibid*
[162] Wünscher, T., Engel, S. and Wunder, S. (2006). Payments for environmental services in Costa Rica: increasing efficiency through spatial differentiation. *Quarterly Journal of International Agriculture* 45(4): 319-337.

of timber plantations; natural forest regeneration; and the establishment of agro-forestry systems.[163] Between 1997 and 2005, forest protection was supported on 451,420 ha and timber plantations on 27,096 ha.[164]

To date, the bulk of **financing** for the PES programme has come from allocating 3.5% of the revenues from a fossil fuel sales tax to the National Fund for Forestry Financing (FONAFIFO) (about US$ 3.5 million a year) [165], although the World Bank, the Global Environment Fund and the German aid agency KfW have also contributed.[166] The OECD argues that while the fuel tax is not directly levied on the beneficiaries of the PES programme, it nevertheless represents a sustainable source of finance from a related environmentally damaging activity.[167] In addition, the programme invites individual hydroelectric plants, breweries, irrigated farms, and other organisations that benefit from environmental services to pay FONAFIFO to negotiate contracts with the providers of these services; to date, more than 40 entities have voluntarily contributed some US$8 million to FONAFIFO under these provisions.[168] However, overall direct user financing from all sources has funded less than 3 percent of the area enrolled under the PES programme.[169]

Wünscher *et al.* (2006) emphasise that the paperwork associated with applying to the programme and the necessary technical studies sometimes impose high **transaction costs** on the applicant. Although a number of forestry organisations offer support, taking over most of the burdensome paper work and technical assistance, they charge the applicant a percentage that can represent up to 18% of the programme payments.[170]

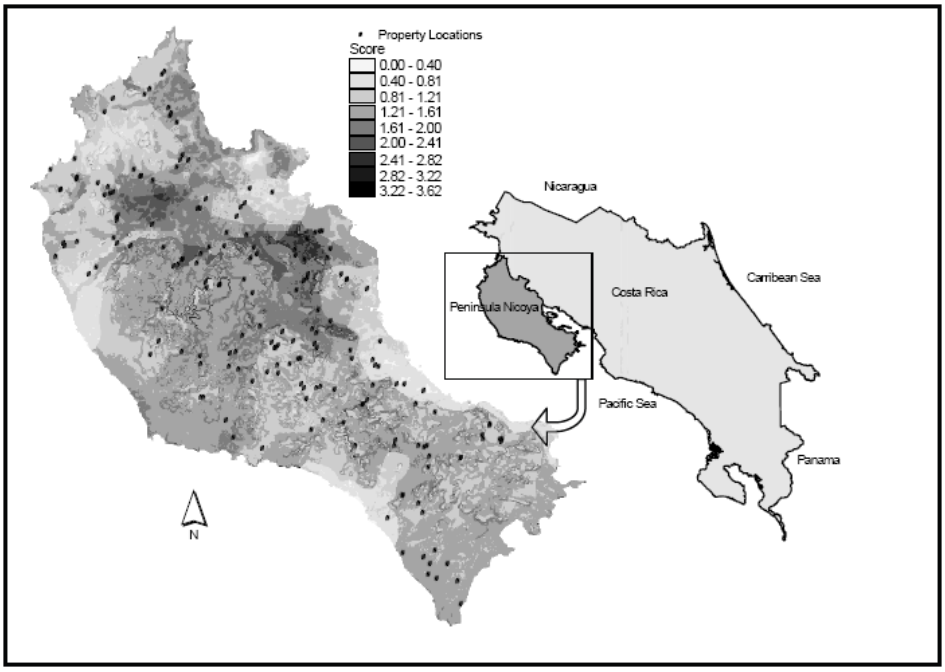
The FAO emphasise that the programme was initially untargeted, with participation on a "first-come, first-served" basis and this resulted in the inclusion of land at low risk of deforestation.[171] According to Pfaff *et al.* (2006), the programme annually inhibited deforestation on only a small portion of the enrolled forest*, "…over 99 percent of the PSA funds allocated did not change land use"*.[172] According to Blackman and Woodward (2010), virtually all rigorous statistical analyses based on forest cover data derived from satellite images find that the PSA program has done little to slow deforestation, largely because land at high risk of deforestation has not been volunteered into the program.[173] The FAO states that it is clear that only a part of the enrolled area represents actual land-use change indicating a lack of **additionality** (although the FAO argues that this should be seen in context; for example, an overall trend of falling livestock prices rendered the conversion of forest to pastures much less profitable).[174]

[163] Wünscher, T., Engel, S. and Wunder, S. (2006). Payments for environmental services in Costa Rica: increasing efficiency through spatial differentiation. *Quarterly Journal of International Agriculture* 45(4): 319-337.
[164] *Ibid*
[165] *Ibid*
[166] OECD (2010). *Paying for biodiversity: enhancing the cost-effectiveness of payments for ecosystem services*. OECD: Paris.
[167] *Ibid*
[168] Blackman, A. and Woodward, R.T. (2010*). User Financing in a National Payments for Environmental Services Program: Costa Rican Hydropower*. Resources for the Future, Washington [online] available at: http://www.rff.org/documents/RFF-DP-09-04-REV.pdf (accessed 1 May 2011).
[169] *Ibid*
[170] FONAFIFO (2005) cited in Wünscher, T., Engel, S. and Wunder, S. (2006). Payments for environmental services in Costa Rica: increasing efficiency through spatial differentiation. *Quarterly Journal of International Agriculture* 45(4): 319-337.
[171] Food and Agricultural Organization of the United Nations (2007). *The State of Food and Agriculture 2007: Paying Farmers for Environmental Services* [online] available at: ftp://ftp.fao.org/docrep/fao/010/a1200e/a1200e00.pdf (accessed 1 May 2011).
[172] Pfaff, A., Kerr, S., Lipper, L., Cavatassi, R., Davis, B., Hendy, J. & Sanchez, A. (2007). Will buying tropical forest carbon benefit the poor? Evidence from Costa Rica. *Land Use Policy* 24(3): 600–610.
[173] Blackman, A. and Woodward, R.T. (2010*). User Financing in a National Payments for Environmental Services Program: Costa Rican Hydropower*. Resources for the Future, Washington [online] available at: http://www.rff.org/documents/RFF-DP-09-04-REV.pdf (accessed 1 May 2011).
[174] *Ibid*

The payment provided through the PES programme is a fixed amount per hectare irrespective of the quality and amount of environmental services delivered.[175] Contracts are prioritised according to predefined spatial criteria, including officially acknowledged biological corridors, private property located within protected areas, zones with a low social development index, and expiring contracts.[176] The OECD emphasises that fixed **uniform payments** on a per hectare basis would be cost-effective if the costs and benefits of biodiversity and ecosystem service provision were constant across geographic space.[177] However, assuming that more complex spatial differences existed, Wünscher *et al.* (2006) argued that the efficiency of the PES programme might be increased by paying more attention to the capacity of a site to actually deliver ecosystem services and by making, not a fixed, but a flexible payment according to the site's opportunity costs as these might be lower in remote or less productive areas.[178]

Wünscher *et al.* (2006) analysed the Costa Rican PES programme, focusing on the Nicoya Peninsula in the northwest of the country.[179] Sites in the area were scored, giving equal importance to water quality, biodiversity protection, carbon sequestration, scenic beauty and an index of social development. Data on opportunity costs were also elicited through a series of interviews with property owners. Figure 4 shows the distribution of score values; the conservation of lighter areas secure less environmental services (lower scores) than the conservation of darker areas (higher scores).

Figure 4: Location of study area and the distribution of service scores on Nicoya Peninsula[180]



[175] Wünscher, T., Engel, S. and Wunder, S. (2006). Payments for environmental services in Costa Rica: increasing efficiency through spatial differentiation. *Quarterly Journal of International Agriculture* 45(4): 319-337.
[176] Pagiola (2006) cited in OECD (2010). *Paying for biodiversity: enhancing the cost-effectiveness of payments for ecosystem services*. OECD: Paris.
[177] OECD (2010). *Paying for biodiversity: enhancing the cost-effectiveness of payments for ecosystem services*. OECD: Paris.
[178] Wünscher, T., Engel, S. and Wunder, S. (2006). Payments for environmental services in Costa Rica: increasing efficiency through spatial differentiation. *Quarterly Journal of International Agriculture* 45(4): 319-337.
[179] *Ibid*
[180] Wünscher, T., Engel, S. and Wunder, S. (2006). Payments for environmental services in Costa Rica: increasing efficiency through spatial differentiation. *Quarterly Journal of International Agriculture* 45(4): 319-337.

Wünscher *et al.* (2006) then ran three different scenarios in order to compare the impact of different types of site selection processes:

- **Baseline Scenario** ('Baseline', largely reflecting the selection system currently employed by FONAFIFO whereby sites are identified on the basis of predefined programme areas);
- **Fixed Payment Score** ('FixScore', in which sites were selected from all areas with the highest average environmental service scores until the programme budget was exhausted); and
- **Flexible Payment Score** ('FlexScore', in which sites were selected from all areas on the basis of their score/cost ratio with costs including opportunity plus transaction and conservation costs).

Table 3 shows the key findings from the research.

Table 3: Main differences between scenarios and principal results[181]

	Baseline	Fixed payment	Flexible payment
Payment	Uniform	Uniform	Differentiated
Selection Criteria	Priority area	Environmental score	Environmental score
Total Cost (USD)	69,476 (100%)	69,429 (99.9%)	69,471 (99.9%)
Area (ha)	1,736.9 (100%)	1,735.7 (99.9%)	3,417.8 (196.8%)
Mean Site Size (ha)	72.4 (100%)	43.4 (60%)	41.7 (57.6%)
Environmental Score	27,421 (100%)	31,325 (114%)	55,724 (203%)
Score per USD	0.395 (100%)	0.451 (114%)	0.802 (203%)

The research found that the fixed or uniform payment scenario enrolled 14% higher benefits than the baseline scenario, at the same cost, while the flexible payment scenario enrolled almost twice the land area (196.8%), giving more than double the benefits (203%).[182] According to Wünscher *et al.*, the increases observed under the FlexScore scenario could be attributed to two factors: the effect of more land being enrolled due to decreased average payments, and the effect of improved targeting towards land with a high environmental score/cost ratio.[183] As the OECD emphasises, the FlexScore scenario was able to use savings from the efficient pricing of low-quality sites to fund the enrolment of higher-quality sites.[184] The decrease in mean site size under the FixScore and FlexScore scenarios also indicates that these approaches would increase the participation of landowners with smaller properties (and,

[181] Wünscher, T., Engel, S. and Wunder, S. (2006). Payments for environmental services in Costa Rica: increasing efficiency through spatial differentiation. *Quarterly Journal of International Agriculture* 45(4): 319-337 / OECD (2010). *Paying for biodiversity: enhancing the cost-effectiveness of payments for ecosystem services*. OECD: Paris.
[182] OECD (2010). *Paying for biodiversity: enhancing the cost-effectiveness of payments for ecosystem services*. OECD: Paris.
[183] Wünscher, T., Engel, S. and Wunder, S. (2006). Payments for environmental services in Costa Rica: increasing efficiency through spatial differentiation. *Quarterly Journal of International Agriculture* 45(4): 319-337
[184] OECD (2010). *Paying for biodiversity: enhancing the cost-effectiveness of payments for ecosystem services*. OECD: Paris.

assuming that land size and wealth are positively correlated, encourage the participation of the poor).[185]

2.7.3 Case study: China's Sloping Land Conversion Policy (SLCP)

China's Sloping Land Conversion Policy (SLCP) was initiated following devastating floods in the Yangtze River in 1998 and signalled a significant change in the country's approach to ecosystem management. The Yangtze floods, which were partly attributed to deforestation in the watershed, killed 4,150 people, displaced more than 18 million people and caused economic losses of 255 billion Yuan (about US$38 billion).[186] Of the 34 million ha farmland in the Yangtze and Yellow River basins, 4.25 million ha is on slopes greater than 25º and average erosion levels on these slopes is 4000 t km^{-2} a^{-1}; however, with proper forest coverage erosion can be reduced by 80 - 90%.[187] The SLCP aims to reduce soil erosion and flood risk and help alleviate poverty and is set to run until 2018. Also known as *Grain for Green*, it is the largest land retirement program in the developing world.[188] It promotes the return of farmland on slopes over 25º to forest or grassland by providing compensation to farmers who plant trees and grass. Farmers receive annual compensation for loss of agricultural production of 100-175 kg of grain per mu (1 mu = 0.067 ha), 20 Yuan per mu to increase access to health and education, and 50 Yuan per mu for seedlings or saplings planted (which are free in the first year).[189] The SLCP is currently being implemented in more than 2,000 counties across 25 provinces and involves tens of millions of rural households[190]; by the end of 2006, the SLCP had contributed to the conversion to forest of 9 million ha of cropland.[191]

A wide variety of issues have been raised in relation to the design and implementation of the SLCP. For example, the extent to which implementation reflects **local circumstances** is a key factor; the Forest and Grassland Taskforce of China argued that *"Implementation has not been tailored to local conditions, and there has been an overemphasis on tree planting rather than restoring original vegetation cover. The SLCP does not give sufficient consideration to the ecological and economic functions of grasslands in semi-arid areas and the need to restore these ecosystems".*[192] Bennett and Xu (2005) argue that sanction mechanisms for non-compliance are not credible, indicating that the programme is not truly **conditional**. For example, survey results indicate that low survival rates for planted trees have not generally led to subsidies being withheld (with the main reason for this said to be the programme's dual goals of environmental amelioration and poverty reduction, which place local leaders in a dilemma).[193] Bennett and Xu (2005) maintain that, in general, the SLCP has been designed with little scope for substantive **differentiation** across targeted areas and participants such as,

[185] Wünscher, T., Engel, S. and Wunder, S. (2006). Payments for environmental services in Costa Rica: increasing efficiency through spatial differentiation. *Quarterly Journal of International Agriculture* 45(4): 319-337
[186] Embassy of the People's Republic of China in the United States of America (2010). *Yangtze River flow set to exceed level of catastrophic 1998 floods* [online] available at: http://www.china-embassy.org/eng/gdxw/t718036.htm (accessed 5 May 2011).
[187] Xu, J., Yin, R., Li, .Z and Liu, C. (2006). China's ecological rehabilitation: Unprecedented efforts, dramatic impacts, and requisite policies. *Ecological Economics*. 57: 595– 607
[188] Bennett, M.T. and Xu, J. (2005). *China's Sloping Land Conversion Program: Institutional Innovation or Business as Usual?* Workshop on "Payments for Environmental Services (PES) – Methods and Design in Developing and Developed Countries" [online] available at: http://www.cifor.cgiar.org/pes/publications/pdf_files/China_paper.pdf (accessed 5 May 2011).
[189] Weyerhaeuser, H., Wilkes, A. and Kahrl, F. (2005). Local Impacts and Responses to Regional Forest Conservation and Rehabilitation Programs in China's Northwest Yunnan Province. Agricultural Systems 85: 234–253.
[190] Bennett, M.T. and Xu, J. (2005). *China's Sloping Land Conversion Program: Institutional Innovation or Business as Usual?* Workshop on "Payments for Environmental Services (PES) – Methods and Design in Developing and Developed Countries" [online] available at: http://www.cifor.cgiar.org/pes/publications/pdf_files/China_paper.pdf (accessed 5 May 2011).
[191] TEEB (2009). *TEEB for Policy Makers – Summary: Responding to the Value of Nature* [online] available at: http://www.teebweb.org/Portals/25/Documents/TEEB%20for%20National%20Policy%20Makers/TEEB%20for%20Policy%20exec%20English.pdf (accessed 5 May 2011).
[192] Forest and Grassland Taskforce of China, 2003. In Pursuit of a Sustainable Green West. Newsletter, January.
[193] Bennett, M.T. and Xu, J. (2005). *China's Sloping Land Conversion Program: Institutional Innovation or Business as Usual?* Workshop on "Payments for Environmental Services (PES) – Methods and Design in Developing and Developed Countries" [online] available at: http://www.cifor.cgiar.org/pes/publications/pdf_files/China_paper.pdf (accessed 5 May 2011).

for example, bidding mechanisms or a more varied menu of contract choices.[194] They also argue that short subsidy periods provided under the programme raise concerns that regarding the **permanence** of ecosystem services provided by SLCP; for example, although the five year subsidy period might provide participants with sufficient time to establish sustainable orchards or plantations of trees with medicinal value, the eight year period for "ecological forests" (i.e. timber forests) is far too short.[195] Various suggestions for improving the SLCP have been proposed including increasing local community input in design and implementation, clarifying the environmental services targeted, and verifying the measures needed to acquire these services.[196]

2.7.4 International Payments for Ecosystem Services (IPES)

IPES involves direct transfers between buyers and sellers of ecosystem services at the international level.[197] The OECD argues that whereas domestic PES programmes typically focus on ecosystem services that generate benefits at local or regional levels, such as hydrological regulation, erosion prevention, and aesthetic improvements (i.e. landscape beauty), IPES is well-positioned to focus on services such as carbon sequestration, genetic information, and non-use values that national governments and domestic private sector stakeholders have less incentive to finance due to their global public good characteristics.[198] Two examples of IPES are discussed below – REDD+ and the mooted Green Development Mechanism – and these further illustrate some of the key issues associated with PES.

Reducing and/or preventing deforestation and forest degradation is a crucial means to mitigate climate change; UN Secretary-General Ban Ki-moon has described it as the 'shortest shortcut'.[199] The basic idea behind **Reducing Emissions from Deforestation and Degradation (REDD)** is simple: countries that are willing and able to reduce emissions from deforestation should be financially compensated for doing so.[200] Although REDD is primarily about emissions reductions[201], as the international negotiations on REDD progressed, it was argued that the 'conservation, sustainable management of forests and enhancement of forest carbon stocks'[202] should be given the same level of priority in the negotiations as deforestation and forest degradation; since then, REDD has been referred to as **REDD+**.[203] The negotiations culminated in December 2010 at the UN Climate Change Conference in Cancún with an agreement on REDD+ which set out some of the details regarding its implementation.[204] These include an obligation on the part of developed countries to finance REDD+ *("…in the context of the provision of adequate and predictable support to developing*

[194] Bennett, M.T. and Xu, J. (2005). *China's Sloping Land Conversion Program: Institutional Innovation or Business as Usual?* Workshop on "Payments for Environmental Services (PES) – Methods and Design in Developing and Developed Countries" [online] available at: http://www.cifor.cgiar.org/pes/publications/pdf_files/China_paper.pdf (accessed 5 May 2011).
[195] *Ibid*
[196] Bennett, M.T. (2008). China's sloping land conversion program: Institutional innovation or business as usual? *Ecological Economics* 65(4): 699-711.
[197] OECD (2010). *Paying for biodiversity: enhancing the cost-effectiveness of payments for ecosystem services*. OECD: Paris.
[198] Klemick and Simpson (2010) cited in OECD (2010). *Paying for biodiversity: enhancing the cost-effectiveness of payments for ecosystem services*. OECD: Paris.
[199] Guardian (2010). Cancún forests deal is 'wrapped up and ready to move' – or is it? [online] 9 December 2010 available at: http://www.guardian.co.uk/environment/blog/2010/dec/09/cancun-climate-change-summit-forests (accessed 3 May 2011).
[200] Parker, C., Mitchell, A., Trivedi, M. and Mardas, N. (2009). *The Little REDD+ Book: An updated guide to governmental and non-governmental proposals for reducing emissions from deforestation and degradation*. Global Canopy Programme, Oxford [online] available at: http://www.globalcanopy.org/sites/default/files/lrb_en.pdf (accessed 3 May 2011).
[201] *Ibid*
[202] United Nations Framework Convention on Climate Change (2007). *Report of the Conference of the Parties on its thirteenth session, held in Bali from 3 to 15 December 2007* [online] available at: http://unfccc.int/resource/docs/2007/cop13/eng/06a01.pdf (accessed 3 May 2011).
[203] Carbon Planet (2009). *Carbon Planet White Paper: the History of REDD Policy* [online] available at: http://unfccc.int/files/methods_science/redd/application/pdf/the_history_of_redd_carbon_planet.pdf (accessed 3 May 2011).
[204] United Nations Framework Convention on Climate Change (2011). Decision 1/CP.16. The Cancun Agreements: Outcome of the work of the Ad Hoc Working Group on Long-term Cooperative Action under the Convention [online] available at: http://unfccc.int/resource/docs/2010/cop16/eng/07a01.pdf#page=2 (accessed 3 May 2011).

country Parties, Parties should collectively aim to slow, halt and reverse forest cover and carbon loss…") and a request that developing countries develop a national strategy or action plan; a national forest reference emission level and/or forest reference level; a robust and transparent national forest monitoring system; and a system for providing information on how safeguards (including in relation to biodiversity) are being addressed and respected.[205] The UN-REDD Programme anticipates that the agreement on REDD+ reached at Cancún will lead to increased funding in support of REDD+ and invigorate donor pledges, which currently amount to US$5 billion for early actions until 2012.[206] While efforts to set up an international legal framework for REDD+ continue, various mechanisms for promoting REDD+ on the ground have been developed including the UN-REDD Programme, the World Bank's Forest Carbon Partnership Facility (FCPF) and the Amazon Fund promoted by the Brazilian Development Bank (BNDES).

There are numerous issues and challenges associated with implementing REDD+. As an example, the question of whether biodiversity-rich REDD+ programmes should be treated preferentially under REDD payment schemes remains unanswered: *"The issue is whether tomorrow's carbon buyers should be expected to pay a premium for carbon with biodiversity, or whether the community interested in biodiversity should mobilize the additional finances that may be needed to ensure that climate change mitigation through REDD plus also produces positive outcomes for biodiversity"*.[207] The notion of a 'biodiversity premium' has been mooted that could be estimated for emissions from biodiversity-rich areas.[208] As the OECD points out, supplemental co-financing from biodiversity investors (via **bundling** or **layering**) could enable biodiversity benefits to be targeted directly, and voluntary initiatives to bundle carbon and biodiversity benefits in REDD+ are already emerging.[209]

Internationally, discussions are also ongoing around the establishment of a **Green Development Mechanism (GDM)** for transferring financial resources to biodiversity-rich developing countries. According to the OECD, by facilitating a functional market, a GDM would enable the sale of certified biodiversity conservation to willing buyers, including businesses and individuals.[210] It has been argued that the potential to exploit private sector engagement is substantial, especially given the growing evidence that some parts of the corporate sector already see it as in their long-term commercial (and reputational) interests to invest in biodiversity conservation.[211] One of the key issues, as the OECD points out, is the issue of **monitoring** biodiversity loss and degradation, the challenges of which are at least as great, if not greater, than those for monitoring greenhouse gas emission reductions from deforestation in developing countries.[212] The OECD emphasises that this is due mainly to the multidimensional nature of biodiversity and hence the lack of a single agreed metric or indicator for biodiversity. For a GDM to operate at the international scale, providing certainty to investors on what they are paying for, agreement would be needed on how to quantify a GDM certificate,

[205] United Nations Framework Convention on Climate Change (2011). Decision 1/CP.16. The Cancun Agreements: Outcome of the work of the Ad Hoc Working Group on Long-term Cooperative Action under the Convention [online] available at: http://unfccc.int/resource/docs/2010/cop16/eng/07a01.pdf#page=2 (accessed 3 May 2011).
[206] UN-REDD Programme (2010). UN-REDD Programme Applauds the COP16 Agreement on REDD+ Reached in Cancun [online] available at: http://www.un-redd.org/NewsCentre/COP16_Press_Release_en/tabid/6595/Default.aspx (accessed 3 May 2011).
[207] The World Bank Group (2009). *Environment Matters at the World Bank: Banking on Biodiversity* [online] available at: http://siteresources.worldbank.org/EXTENVMAT/Resources/3011350-1271279658247/EMatters09.pdf (accessed 3 May 2011).
[208] Strassburg, B.B.N., Kelly, A., Balmford, A., Davies, R.G., Gibbs, H.K., Lovett, A., Miles, L., David, C., Orme, L., Price, J., Turner, R.K. and Rodrigues, A.S.L. (2010). Global congruence of carbon storage and biodiversity in terrestrial ecosystems. *Conservation Letters* 3:2
[209] OECD (2010). *Paying for biodiversity: enhancing the cost-effectiveness of payments for ecosystem services*. OECD: Paris.
[210] *Ibid*
[211] Metcalfe, J. and Vorhies, F. (2010). *Exploring the case for a green development mechanism*, Prepared for the International Workshop on Innovative Financial Mechanisms First meeting, Bonn, Germany, 27-29 January 2010 [online] available at: http://www.cbd.int/financial/doc/gdm-exploring-the-case-en.pdf (accessed 3 May 2011).
[212] OECD (2010). *Paying for biodiversity: enhancing the cost-effectiveness of payments for ecosystem services*. OECD: Paris.

and thus how to monitor, report and verify (MRV) the biodiversity benefits.[213] The OECD suggest that a GDM certificate could, for example, provide continuous incentives for improvement by setting up two-levels of compensation: one for proxy-based biodiversity payments, which would be discounted according to the uncertainty inherent with the proxy, and a second, higher-level of compensation associated with more rigorous MRV methodologies.[214]

Other examples of IPES are emerging. Wunder *et al.* (2010) argue that some of the larger non-governmental international conservation organisations (the so-called BINGOs) increasingly recognise that a lot of valuable biodiversity on private lands can only be conserved through continuous performance payments for biodiversity conservation.[215] As such, they are raising corporate funds to build biodiversity **trust funds**, the periodical financial return on which can pay for PES payments to landowners and other recurrent costs – in principle, forever.[216] Wunder *et al.* cite examples including Conservation International with their conservation concessions (now broadened to 'conservation incentive agreements' in the Conservation Stewardship Program), and the Global Conservation Fund (GCF), both providing continuous, conditional biodiversity payments.

The OECD has also noted that many domestic PES programmes contribute to the provision of global ecosystem services concurrently with local and regional services.[217] They highlight the possibility of establishing agreements whereby national governments make concerted efforts to establish well-designed and effective domestic PES programmes (to internalise local and regional ecosystem benefits) and that these efforts are **layered** with international payments to internalise global ecosystem benefits (such as carbon sequestration and biodiversity conservation).[218] The OECD cites the example of a recently established PES programme in the Los Negros valley in Bolivia, which involves the simultaneous purchase of two ecosystem services, watershed protection and bird habitat. While downstream irrigators through the Municipality of Pamagrande are paying for watershed services, the US Fish and Wildlife Service is paying for the protection of habitat for migratory bird species.[219]

[213] OECD (2010). *Paying for biodiversity: enhancing the cost-effectiveness of payments for ecosystem services*. OECD: Paris.
[214] *Ibid*
[215] Wunder, S., Wertz-Kanounnikoff, S. and Ferraro, P. (2010). *Payments for Environmental Services and the Global Environment Facility: A STAP advisory document* [online] available at: http://www.thegef.org/gef/sites/thegef.org/files/publication/STAP_PES_2010.pdf (accessed 3 May 2011).
[216] Wunder, S., Wertz-Kanounnikoff, S. and Ferraro, P. (2010). *Payments for Environmental Services and the Global Environment Facility: A STAP advisory document* [online] available at: http://www.thegef.org/gef/sites/thegef.org/files/publication/STAP_PES_2010.pdf (accessed 3 May 2011).
[217] OECD (2010). *Paying for biodiversity: enhancing the cost-effectiveness of payments for ecosystem services*. OECD: Paris.
[218] Karousakis and Corfee-Morlot (2007) cited in OECD (2010). *Paying for biodiversity: enhancing the cost-effectiveness of payments for ecosystem services*. OECD: Paris.
[219] Asquith, Vargus and Wunder (2008) cited in OECD (2010). *Paying for biodiversity: enhancing the cost-effectiveness of payments for ecosystem services*. OECD: Paris.

3 Barriers to the use of PES

3.1 Introduction

An overview of the literature review and discussions with experts and practitioners highlighted a series of general barriers or challenges to the use of PES and this chapter explores these under series of headings:

- Informational
- Technical
- Spatial
- Temporal
- Financial
- Institutional
- Legal
- Cultural
- Equity considerations

The barriers or challenges associated with PES are summarised in Table 4, and are discussed in the following sections.

Table 4: Barriers to the use of PES

Category	Challenges
Informational	• Lack of awareness among beneficiaries and providers
Technical	• Scientific uncertainty • Establishing baselines • Diffuseness • Appropriate programme size • Avoiding leakage • Ecosystem valuation • Excludability and free riding • Shortage of skills and experience
Spatial	• Spatial variability
Temporal	• Permanence • Time lags • Differing time horizons
Financial	• Perceived risks • High start-up costs • High transaction costs
Institutional	• Collective action problems

Category	Challenges
	• Perverse incentives • Complex policy environment
Legal	• Property rights and other issues
Cultural	• Aversion to paying for ecosystem services • Lack of trust among land managers • Terminology
Equity considerations	• Perceived unfairness

3.2 Informational

3.2.1 Lack of awareness among beneficiaries and providers

Put simply, if a land use provides valuable ecosystem services but they are neither widely recognised nor appreciated by beneficiaries, it is unlikely that a market for services will arise in the absence of government intervention. Thus, education and outreach may prove an important part of designing a PES programme.[220] Furthermore, potential buyers of ecosystem services (consumers, businesses, utilities, government agencies at all levels, and even conservation NGOs) are often unaware of their dependence on ecosystem services[221]. This presents an obstacle to expanding user-financed schemes beyond ecosystem services that already have some sort of market value, e.g. water companies paying upstream land managers to deliver water treatment savings. In addition, potential sellers are often not aware of ecosystem service payments and markets and even when they are, do not know how to find potential buyers. To compound the situation, few policymakers and regulators are knowledgeable about the policy requirements and implications of PES.

Lack of awareness also has an impact on the ability to find willing and able buyers of ecosystem services. The concept of PES may be perceived as too new and complex and therefore risky. Another key issue for buyers is the lack of clarity over what it is they are buying, as the linkages between specific management practices and ecosystem services outcomes are often unclear, particularly related to water and soil sequestration of carbon. Addressing these issues often requires specific technical skills to bring the right kind of information to the buyers – including information on the value of the ecosystem service and what benefits it delivers. Ideally, intermediaries would exist with the skills to assess linkages between management and ecosystem service outcomes.

3.3 Technical

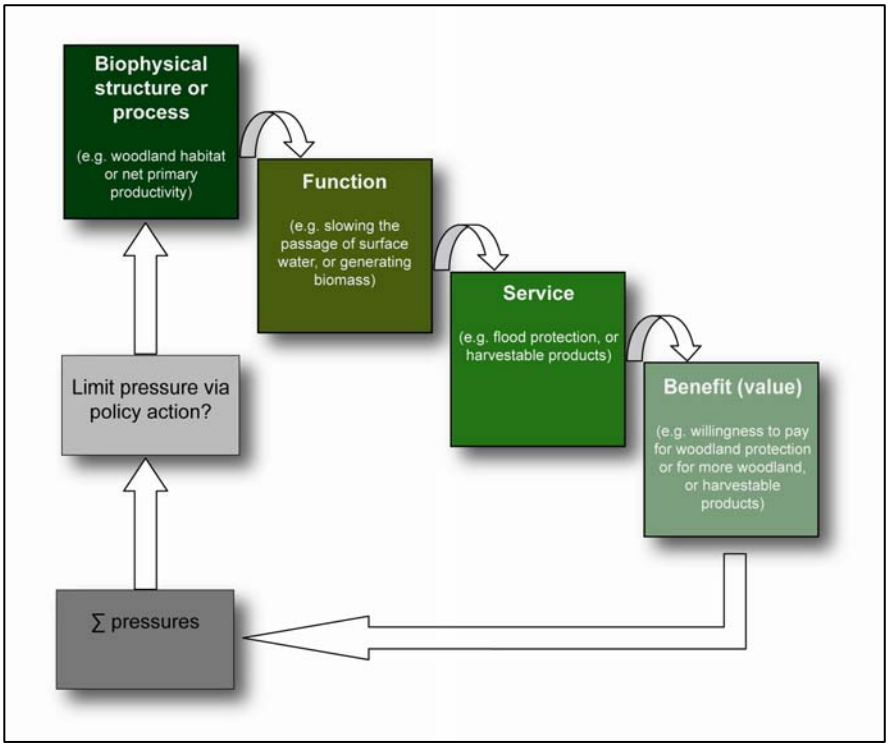
3.3.1 Scientific uncertainty

The Millennium Ecosystem Assessment (MA) defined 'ecosystem services' as simply *"the benefits people obtain from ecosystems"*.[222] The authors of the MA argued that biodiversity

[220] Salzman, J. (2009). *A Policy Maker's Guide to Designing Payments for Ecosystem Services*. Duke Law Faculty Scholarship. Paper 2081 [online] available at: http://scholarship.law.duke.edu/faculty_scholarship/2081 (accessed 9 May 2011).
[221] Kroeger, T., and Casey, F. (2007). An assessment of market-based approaches to providing ecosystem services on agricultural lands. *Ecological Economics* 64(2):321-332.
[222] Millennium Ecosystem Assessment (2005). *Ecosystems and Human Well-being: Biodiversity Synthesis* [online] available at:

underpins ecosystem function and these functions, in turn, give rise to ecosystem services. These linkages are illustrated in Figure 5.

Figure 5: The relationship between biophysical systems, functions, services and benefits (values)[223]



Defra has argued that a necessary condition for the design of 'genuine' PES is a clear relationship between the type of land use being promoted and the provision of ecosystem services.[224] It is therefore imperative to develop a sufficient understanding of the links between biophysical systems, functions, services and, ultimately, benefits or values in order to design a workable PES programme. However, a recent integrated assessment of data from the Countryside Survey (CS) highlighted the scientific challenge posed by ecosystem services and the difficulties that arise in their definition, valuation and in the measurement of stocks and flows.[225] As the FAO has emphasised, many ecosystem services arise from complex processes, making it difficult to determine which actions affect their provision and precisely who

http://www.maweb.org/documents/document.354.aspx.pdf (accessed 4 May 2011).

[223] Adapted from Haines-Young, R., Potschin, M. and Cheshire, D. (2006). *Defining and identifying Environmental Limits for Sustainable Development. A Scoping Study*. Final Full Technical Report to Defra, 103 pp + appendix 77 pp, Project Code NR0102 [online] available at: http://randd.defra.gov.uk/Default.aspx?Menu=Menu&Module=More&Location=None&Completed=0&ProjectID=13901#RelatedDocuments (accessed 4 May 2011).

[224] Defra (2010). *Payments for ecosystem services: A short introduction* [online] available at: http://archive.defra.gov.uk/environment/policy/natural-environ/documents/payments-ecosystem.pdf (accessed 4 May 2011).

[225] Smart, S., Dunbar, M.J., Emmett, B.A., Marks, S., Maskell, L.C., Norton, L.R., Rose, P., Simpson, I.C. (2010). *An Integrated Assessment of Countryside Survey data to investigate Ecosystem Services in Great Britain*. Technical Report No. 10/07 NERC/Centre for Ecology & Hydrology 230pp. (CEH Project Number: C03259) [online] available at: http://www.ceh.ac.uk/news/news_archive/2010_news_item_41.html (accessed 4 May 2011).

the providers and beneficiaries are.[226] They argue that *"[g]etting the science right is crucial and requires a clear understanding of the biophysical relationships between [land managers'] actions and their environmental consequences"*.[227] Salzman (2009) maintains that if the linkage between landscape management and service provision is poorly understood, then the buyer will have little confidence he is receiving value for his payments.[228] Muradian *et al.* (2010) argue that to achieve a 'genuine' PES requires developing sound, context specific, socio-ecological research prior to implementation, which could guarantee a realistic connection between payments, services and economic benefits.[229] However, as they point out, gathering technical information for establishing and clarifying causal relationships between land use practices and the provision of ecosystem services (and their associated economic benefits) is costly, which in turn increases transaction costs, perhaps tilting the benefit–cost ratio in favour of alternative environmental policy instruments.[230] As such, very often, practitioners base their decisions on assumptions about the relationship between the promoted land use, the impact on the provision of ecosystem services and finally the induced changes in welfare.[231] Muradian *et al.* (2010) argue that this does not necessarily have to be seen as a design drawback; it might also be a 'precautionary' strategy for dealing with uncertainty and incomplete information.[232] The FAO concludes that whether to pay for the ecosystem service itself or for some **proxy** is an important design consideration.[233]

Indeed, because direct monitoring of ecosystem service outputs is difficult or costly, most PES schemes rely on observable proxies, such as actions or outcomes (e.g., the presence of buffer strips or the amount of forest cover).[234] For example, in the well known New York City and Catskills Watershed PES (see Chapter 4), payments were made for changes in land use and management and not directly for water quality improvements.[235] As Jack *et al.* (2008) emphasise, devising appropriate proxies nonetheless requires an understanding of how activities, such as planting trees, relate to ecosystem functions such as carbon storage and, ultimately, to ecosystem services such as climate regulation[236]. Salzman (2009) emphasises that, at the outset, PES designers need to explicitly challenge their assumptions about service provision and cites the debate over the extent to which forests regulate water flow over time.[237] Either way, in order to establish a genuine PES programme, demonstrable cause-and-effect or an observable proxy will need to be established, and both approaches will require research and consensus among PES actors.

[226] Food and Agricultural Organization of the United Nations (2007). *The State of Food and Agriculture 2007: Paying Farmers for Environmental Services* [online] available at: ftp://ftp.fao.org/docrep/fao/010/a1200e/a1200e00.pdf (accessed 1 May 2011).
[227] Food and Agricultural Organization of the United Nations (2007). *The State of Food and Agriculture 2007: Paying Farmers for Environmental Services* [online] available at: ftp://ftp.fao.org/docrep/fao/010/a1200e/a1200e00.pdf (accessed 1 May 2011).
[228] Salzman, J. (2009). *A Policy Maker's Guide to Designing Payments for Ecosystem Services*. Duke Law Faculty Scholarship. Paper 2081 [online] available at: http://scholarship.law.duke.edu/faculty_scholarship/2081 (accessed 9 May 2011).
[229] Muradian, R. Corbera, R. Pascual, U., Kosoy, N. and May, P.H. (2010). Reconciling theory and practice: an alternative conceptual framework for understanding payments for environmental services. *Ecological Economics*. 69(6):1202-1208.
[230] *Ibid*
[231] *Ibid*
[232] *Ibid*
[233] Food and Agricultural Organization of the United Nations (2007). *The State of Food and Agriculture 2007: Paying Farmers for Environmental Services* [online] available at: ftp://ftp.fao.org/docrep/fao/010/a1200e/a1200e00.pdf (accessed 1 May 2011).
[234] Jack, B.K., Kouskya, C. and Simsa, K.R.E. (2008). Designing payments for ecosystem services: Lessons from previous experience with incentive-based mechanisms. *PNAS* 105(28): 9465-9470.
[235] Food and Agricultural Organization of the United Nations (2007). *The State of Food and Agriculture 2007: Paying Farmers for Environmental Services* [online] available at: ftp://ftp.fao.org/docrep/fao/010/a1200e/a1200e00.pdf (accessed 1 May 2011).
[236] *Ibid*
[237] Salzman, J. (2009). *A Policy Maker's Guide to Designing Payments for Ecosystem Services*. Duke Law Faculty Scholarship. Paper 2081 [online] available at: http://scholarship.law.duke.edu/faculty_scholarship/2081 (accessed 9 May 2011).

3.3.2 Establishing baselines

The OECD argues that baselines are an essential element of any mechanism aiming to address ecosystem service loss and degradation.[238] Salzman (2009) emphasises that *"One cannot determine if there has been a change in service provision unless one first establishes a baseline to compare against"*.[239] Overall, the OECD argues that baselines provide:

- information on the expected trends in the provision of ecosystem services and hence the magnitude of the incentives that will be needed to attain a certain goal;
- a reference against which programme performance can be assessed over time;
- a means to demonstrate that payment leads to additional benefits relative to the *status quo*; and
- a basis for developing eligibility criteria for participation in a PES programme (and therefore enhancing additionality).[240]

The FAO argues that the establishment of a baseline requires consideration not just of the level of services when payments start, but also of potential changes in external factors during the period when the environmental service payments are being made.[241] This equates to the 'counterfactual', i.e. not just the current level of services but what but could, would, or might happen under differing conditions. Establishing a robust and defensible counterfactual can be highly challenging, particularly given scientific uncertainty and the need to take into account natural ecosystem changes as well as variables including government policy, the impacts of anthropogenic climate change and food prices. As environmental, socio-economic, and political contexts change over time, the signals created by incentive-based mechanisms will also change. Possible future changes should be taken into account when designing PES policies because these dynamic changes in context can alter how a policy performs, determining whether it is able to maintain a high degree of cost-effectiveness, environmental effectiveness, and equity over time.[242]

The OECD maintains that a robust monitoring and reporting framework is fundamental for an effective PES programme and allows for an assessment of whether the PES programme is delivering its intended objective. It therefore also enables decision-makers to adjust and improve PES programme design over time. They argue that monitoring should be undertaken at three levels:

(i) the implementation level, to assess that landholders are undertaking the contracted land use;

(ii) the ecosystem services level, to ensure that changes in land use are enhancing the provision of services; and

(iii) the participants level, to assess socio-economic impacts and ensure that welfare of participants is improved.[243]

[238] OECD (2010). *Paying for biodiversity: enhancing the cost-effectiveness of payments for ecosystem services*. OECD: Paris.
[239] Salzman, J. (2009). *A Policy Maker's Guide to Designing Payments for Ecosystem Services*. Duke Law Faculty Scholarship. Paper 2081 [online] available at: http://scholarship.law.duke.edu/faculty_scholarship/2081 (accessed 9 May 2011).
[240] OECD (2010). *Paying for biodiversity: enhancing the cost-effectiveness of payments for ecosystem services*. OECD: Paris.
[241] Food and Agricultural Organization of the United Nations (2007). *The State of Food and Agriculture 2007: Paying Farmers for Environmental Services* [online] available at: ftp://ftp.fao.org/docrep/fao/010/a1200e/a1200e00.pdf (accessed 1 May 2011).
[242] Jack, B.K., Kouskya, C. and Simsa, K.R.E. (2008). Designing payments for ecosystem services: Lessons from previous experience with incentive-based mechanisms. *PNAS* 105(28): 9465-9470.
[243] OECD (2010). *Paying for biodiversity: enhancing the cost-effectiveness of payments for ecosystem services*. OECD: Paris.

Monitoring data should ideally feed into a wider evaluation, particularly for government-financed PES programmes. The Treasury's Magenta Book provides in-depth guidance on how evaluation should be designed and undertaken and emphasises that evaluation examines the actual implementation and impacts of a policy to assess whether the anticipated effects, costs and benefits were in fact realised.[244]

3.3.3 Diffuseness

The complex nature of ecosystem service provision means that it can be difficult to, firstly, identify which land uses and / or managers are providing a particular service(s) and, secondly, who is benefiting from that service(s). As a consequence, identifying who should pay whom (and where property rights lie to underpin this) can be problematic[245].

Whereas the providers of some provisioning services may be relatively easy to identify, the diffuse nature of many other ecosystem services makes it difficult to locate precisely who is responsible for their provision. For example, whereas food and fibre producers can relatively easily prove who they are and thus claim payment for their products, proving (and differentially rewarding) responsibility for say water purification or carbon sequestration is more difficult without incurring significant transaction costs through monitoring efforts over an extended period of time. In the case of biodiversity, the impacts of individual actions can be hard to separate from those undertaken on neighbouring landholdings.[246]

The benefits of ecosystem services can be spread diffusely among different people, leaving little incentive for any individual to pay for them.[247] Salzman (2009) argues that if a land use provides valuable ecosystem services but enjoyed by diffuse beneficiaries, it is unlikely that a market for services will arise in the absence of government intervention.[248] This can lead to the emergence of different payment systems with taxpayers tending to fund the provision of diffuse services such as biodiversity and landscape beauty (e.g. through national agri-environment schemes) and direct ecosystem service beneficiaries paying privately for a defined service(s). As an intermediate case, a watershed/river basin may serve as a basis for facilitating negotiations between (downstream) water users and (upstream) land managers since the geographical boundary is relatively clear and linkages between management practices and service provision and between service provision and consumption are also relatively clear even if the specific contribution of each individual land manager is not.

It should be noted that some cases, an NGO or another agency financed by voluntary contributions (e.g. the Global Environment Facility) may take on the role of ecosystem services buyer, for example, through making payments for an existence value like biodiversity conservation.[249] These schemes are similar to government-financed PES programmes in the sense that a third party is taking the decision on how to spend funds, but they are also somewhat like a user-financed programme in the sense that users' contributions are voluntary,

[244] HM Treasury (2011). *The Magenta Book: Guidance for evaluation* [online] available at: http://www.hm-treasury.gov.uk/d/magenta_book_combined.pdf (accessed 11 July 2011).
[245] Kroeger, T., and Casey, F. (2007) An assessment of market-based approaches to providing ecosystem services on agricultural lands. *Ecological Economics* 64(2): 321-332.
[246] Engel, S., Pagiola, S., and Wunder, S. (2008). Designing payments for environmental services in theory and practice: an overview of the issues. *Ecological Economics* 65(4): 663–674.
[247] Forest Trends and the Katoomba Group (2010). *Beyond Borders: PES and REDD in the ASEAN Region* [online] available at: http://www.forest-trends.org/documents/files/doc_2447.pdf (accessed 16 July 2011).
[248] Salzman, J. (2009). *A Policy Maker's Guide to Designing Payments for Ecosystem Services*. Duke Law Faculty Scholarship. Paper 2081 [online] available at: http://scholarship.law.duke.edu/faculty_scholarship/2081 (accessed 9 May 2011).
[249] Engel, S., Pagiola, S., and Wunder, S. (2008). Designing payments for environmental services in theory and practice: an overview of the issues. *Ecological Economics* 65(4): 663–674.

and users could, in principle, withdraw future funding if they felt that the agency was investing funds inappropriately.[250]

3.3.4 Appropriate programme size

Wunder and Santiago (2010) emphasise that, *"A key question of any Payment for Ecosystem Services Scheme is how big – or small – to go. Size brings economies of scale, but often at the cost of focus"*.[251] In the case of a watershed PES, they argue that if a programme was too small and didn't integrate enough local service providers, there might be a risk that non-paid upstream actors could jeopardise service delivery.[252] Wunder and Santiago maintain that the costs of both starting and running a PES scheme tend to be lower at larger scales.[253] They also argue that marketing to investors may also be easier at larger scales and that donors financing the start-up costs of PES schemes often like the prospect of larger-scale impacts that benefit more people[254] (this argument could apply if, for example, Defra was to finance the initial start up costs for PES programmes in the future). Large-scale programmes may also help to guard against leakage (see below) and "free-riding," (i.e., non-paying users exploiting non-excludable services) and have the capacity to replicate good ideas quickly.[255]

However, Wunder and Santiago also identify several advantages in relation to small PES schemes. For examples, they are better able to maintain flexibility and focus and tend to foster a participatory process and negotiated solutions.[256] In addition, because risk and uncertainty are higher at the outset of a PES programme, at least starting out small (and 'upscaling' later) may make it possible to manage and adapt the programme more effectively.[257] Starting from scratch with a single-design, large-scale scheme also precludes important learning experiences and experimentation. [258]

For user-financed schemes, Wunder and Santiago argue that scheme's scale should fit closely with the scale of the principal biophysical service that users want. In the case of a watershed PES, they argue that the most logical spatial unit with which to begin is often the micro watershed.[259] Overall, Wunder and Santiago argue that decisions over the scale of PES programmes should be made according to the subsidiarity principle; in other words, PES schemes should be organised at the least-centralised, competent level of authority, given the nature of the environmental problem the programme is trying to solve.[260]

3.3.5 Avoiding leakage

Leakage occurs when securing an ecosystem service in one location leads to increased pressure to convert or degrade ecosystem services in another.[261] Put another way, leakage (or spillage) refers to the inadvertent displacement of activities damaging service provision to

[250] Engel, S., Pagiola, S., and Wunder, S. (2008). Designing payments for environmental services in theory and practice: an overview of the issues. *Ecological Economics* 65(4): 663–674.
[251] Wunder, S. and Santiago, C. (2010). Payments for Ecosystem Services: Scaling Up…and Down. In: Forest Trends and the Katoomba Group. *Beyond Borders: PES and REDD in the ASEAN Region* [online] available at: http://www.forest-trends.org/documents/files/doc_2447.pdf (accessed 16 July 2011).
[252] Wunder, S. and Santiago, C. (2010). Payments for Ecosystem Services: Scaling Up…and Down. In: Forest Trends and the Katoomba Group. *Beyond Borders: PES and REDD in the ASEAN Region* [online] available at: http://www.forest-trends.org/documents/files/doc_2447.pdf (accessed 16 July 2011).
[253] *Ibid*
[254] *Ibid*
[255] *Ibid*
[256] *Ibid*
[257] *Ibid*
[258] *Ibid*
[259] *Ibid*
[260] *Ibid*
[261] OECD (2010). *Paying for biodiversity: enhancing the cost-effectiveness of payments for ecosystem services*. OECD: Paris.

areas outside the geographical zone of PES intervention.[262] If leakage takes place, the environmental benefits obtained from PES can obviously be overestimated.[263] As such, there is an argument that a systems-level assessment must be undertaken to ensure that actions by 'providers' are sustainable.[264] The OECD emphasises that if risk of leakage is anticipated to be high, the monitoring framework may need to be extended beyond the geographic boundaries of the PES programme so as to assess the magnitude of leakage and measures introduced in the design of PES to address this.[265]

Wunder *et al.* (2008) argue that leakage can occur at the local level (e.g. a PES recipient clearing one plot of land to substitute for another under conservation contract), or indirectly at a broader level (e.g. if maintaining forest results in higher crop prices due to the reduced availability of cropland, which induces additional deforestation elsewhere).[266] Overall, Wunder *et al.* maintain that leakage is only relevant when the spatial scope of intervention is lower than that of the desired service.[267] They also argue that, by definition, leakage will always be a relevant concern for global services like carbon storage.[268] However, whether or not leakage is a concern for more localised services will depend on the scale of intervention, for example, whether the entire watershed is included, or only part of it.[269] Jack *et al.* (2008) caution that if landowners are credit constrained, receiving cash payments for good behaviour on one parcel of land may provide the income needed to begin an environmentally harmful use on another. [270] According to the OECD, estimating the extent to which leakage occurs is a difficult empirical problem because the current situation must be compared to a scenario without the programme.[271] Nevertheless, Wunder *et al.* (2008) conclude that with careful design of contracts and appropriate monitoring, the risk of local leakage can be reduced.[272] They argue, however, that broader or indirect leakage is harder to assess and deal with. However, given their small size, most user-financed PES programmes are very unlikely to induce indirect leakage effects, but government-financed programs, with their much larger scale, have the potential to do so.[273]

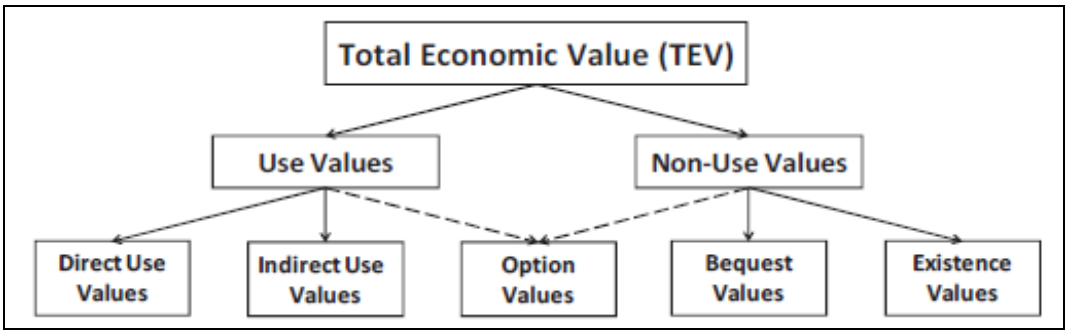
3.3.6 Ecosystem valuation

The OECD emphasises that the benefits of ecosystem services can be identified by estimating the different components of Total Economic Value (TEV)[274] – see Figure 6. A range of different methods are available, both economic and non-economic, for eliciting values depending on the components of value in question (for a discussion of these see *An introductory guide to valuing*

[262] Robertson, N. and Wunder, S. (2005). *Fresh Tracks in the Forest: Assessing Incipient Payments for Environmental Services Initiatives in Bolivia*. CIFOR, Bogor [online] available at: http://www.cifor.cgiar.org/pes/publications/pdf_files/BRobertson0501.pdf (accessed 16 July 2011).
[263] Engel, S., Pagiola, S., and Wunder, S. (2008). Designing payments for environmental services in theory and practice: an overview of the issues. *Ecological Economics* 65(4): 663–674.
[264] Defra (2010). *Payments for ecosystem services: A short introduction* [online] available at: http://archive.defra.gov.uk/environment/policy/natural-environ/documents/payments-ecosystem.pdf (accessed 4 May 2011).
[265] OECD (2010). *Paying for biodiversity: enhancing the cost-effectiveness of payments for ecosystem services*. OECD: Paris.
[266] Wunder, S., Engel, S. and Pagiola, S. (2008). *Taking Stock: A comparative analysis of Payments for Environmental Services Programs in Developed and Developing Countries* [online] available at: http://www.pepe.ethz.ch/news/Wunder_Engel_Pagiola_EE_08_personal_version.pdf (accessed 17 July 2011).
[267] *Ibid*
[268] *Ibid*
[269] *Ibid*
[270] Jack, B.K., Kouskya, C. and Simsa, K.R.E. (2008). Designing payments for ecosystem services: Lessons from previous experience with incentive-based mechanisms. *PNAS* 105(28): 9465-9470.
[271] OECD (2010). *Paying for biodiversity: enhancing the cost-effectiveness of payments for ecosystem services*. OECD: Paris.
[272] Wunder, S., Engel, S. and Pagiola, S. (2008). *Taking Stock: A comparative analysis of Payments for Environmental Services Programs in Developed and Developing Countries* [online] available at: http://www.pepe.ethz.ch/news/Wunder_Engel_Pagiola_EE_08_personal_version.pdf (accessed 17 July 2011).
[273] *Ibid*
[274] OECD (2010). *Paying for biodiversity: enhancing the cost-effectiveness of payments for ecosystem services*. OECD: Paris.

ecosystem services, Defra, 2007).[275] The OECD emphasises that, for a variety of reasons, estimating the total value of the benefits associated with ecosystem services is difficult.[276] In particular, the OECD argues that the inherent ecological complexity and multidimensionality of biodiversity and ecosystems requires consideration of: uncertainty and imperfect information; thresholds and irreversibilities; the degree of substitutability between natural resources and other inputs; the treatment of the (very) long-run and distributional concerns; and, endogenous adaptation to changing conditions.[277]

Figure 6: Total Economic Value framework[278]

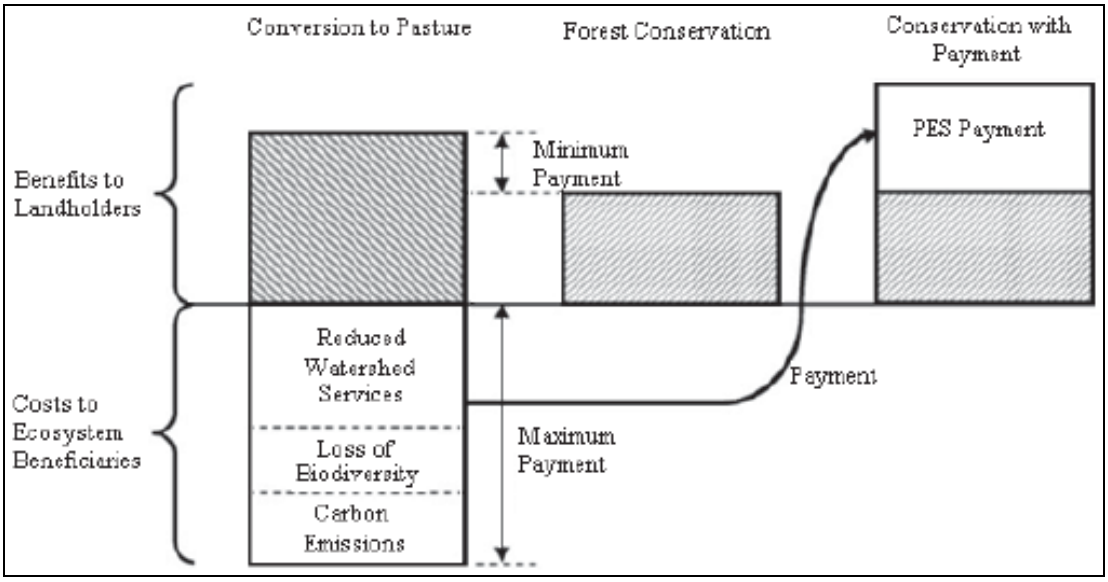


The pricing of ecosystem services is fraught with difficulties. In a functioning market, supply and demand determine the appropriate price level. In creating new markets for ecosystem services, pricing is likely to be determined by regulatory standards and targets. Furthermore, market price can in some cases be a poor approximation of value; this is particularly true of many of the goods produced by the natural environment.[279] The complexity of ecosystem services and their spatial arrangement also pose problems. For example, many services are generated jointly (e.g. by multi-functional agriculture) and both delivered and utilised as bundles of services rather than individually. As such, pricing individual components can be difficult. In addition, the effect of site-specific conditions and local scarcity mean that the value of services generated from (e.g.) a hectare of peat will vary between different locations.[280]

Evidence of the value of ecosystem services can nonetheless be helpful in identifying potential buyers and sellers and can also assist stakeholders in negotiations as part of PES programmes. In practice, however, the 'minimum payment' that a land manager will be willing-to-accept as compensation to, for example, restore wetlands is the foregone opportunity cost of the alternative land use. The 'maximum payment' the ecosystem service beneficiary is willing-to-pay for wetland restoration is the total costs of damage incurred when the land is managed primarily for other, for example agricultural, purposes. Therefore if the potential benefits of restoration are larger than the minimum payment there is the potential for a mutually beneficial PES programme to emerge – see Figure 7.[281]

[275] Defra (2007). *An introductory guide to valuing ecosystem services* [online] available at: http://archive.defra.gov.uk/environment/policy/natural-environ/documents/eco-valuing.pdf (accessed 25 July 2011).
[276] OECD (2010). *Paying for biodiversity: enhancing the cost-effectiveness of payments for ecosystem services*. OECD: Paris.
[277] OECD (2010). *Paying for biodiversity: enhancing the cost-effectiveness of payments for ecosystem services*. OECD: Paris.
[278] *Ibid*
[279] Bateman, I.J., Mace, G.M., Fezzi, C., Atkinson, G. and Turner, K. (2010). Economic Analysis for Ecosystem Service Assessments. *Environmental and Resource Economics* [online] available at: http://uknea.unep-wcmc.org/LinkClick.aspx?fileticket=0sKywlVUSuM%3d&tabid=38 (accessed 28 October 2010).
[280] *Ibid*
[281] OECD (2010). *Paying for biodiversity: enhancing the cost-effectiveness of payments for ecosystem services*. OECD: Paris.

Figure 7: The PES mechanism[282]



Valuation can help in both informing an appropriate payment level and in determining whether the PES scheme is worth implementing. If the overall willingness-to-pay is overestimated, then the buyer will purchase too much of the service at too high a price. Conversely, an underestimate of the value to beneficiaries will result in an under-provision of the ecosystem services or may result in no PES being agreed. Reliable estimates of ecosystem service benefits depend, however, on the robustness of the underlying science and, more particularly, on our capacity to quantify the relationship between ecosystem service provision and human wellbeing. It is important to note that difficulties in assessing the true value of trade-offs amongst competing ecosystem services or beneficiaries can result in inequitable PES systems. Economic valuations generally reflect the current distribution of income with those with higher ability to pay being better able to reflect their preferences through higher willingness to pay.[283]

To date, ecosystem valuation initiatives have been dominated by the public sector and NGOs.[284] However, a recent WBCSD study[285] found that a number of private companies are starting to show considerable interest in factoring ecosystem costs and benefits into their assessment and reporting frameworks, so as to better respond to ecosystem opportunities and risks. This signals significant opportunity for mechanisms such as PES, especially for those businesses (e.g. utilities) whose activities and income depend upon a reliable supply of one or more ecosystem services.

[282] OECD (2010). *Paying for biodiversity: enhancing the cost-effectiveness of payments for ecosystem services*. OECD: Paris.
[283] Bateman, I.J., Mace, G.M., Fezzi, C., Atkinson, G. and Turner, K. (2010). Economic Analysis for Ecosystem Service Assessments. *Environmental and Resource Economics* [online] available at: http://uknea.unep-wcmc.org/LinkClick.aspx?fileticket=0sKywIVUSuM%3d&tabid=38 (accessed 28 October 2010).
[284] World Business Council on Sustainable Development (2009). *Business and Ecosystems: A Scoping Report – Corporate Ecosystem Valuation*, a report prepared for the WBCSD by Environment Management Group and Ecosystem Economics LLC [online] available at: http://www.wbcsd.org/DocRoot/pdK9r5TpPijC1XXpx7QR/EcosystemsServices-ScopingReport_280509.pdf (accessed 6 August 2010).
[285] WBCSD (2010) *Corporate Ecosystem Valuation: Building the Business Case* [online] available at http://www.wbcsd.org/DocRoot/sTRJLXdog8SPdrViIYHq/CorporateEcosytemsValuation-BuildingTheBizCase.pdf (accessed 3 August 2010)

3.3.7 Excludability and free riding

Public goods are goods whereby consumption by one individual does not reduce availability of the good for consumption by others (non-rival); and whereby no one can be effectively excluded from using the good (non-excludable).[286] As a consequence, the OECD emphasises that there are limited incentives for individuals to invest in the provision of public goods, and everyone contributes too little, preferring the costs to be borne by their neighbours (referred to as **free-riding**).[287] Put another way, individuals or firms have low incentives to pay for the provision of ecosystem services because others cannot be excluded from enjoying the benefits and this can lead to an under supply of ecosystem services.[288]

Different ecosystem services display different degrees of **excludability**. Those ecosystem services that are privately owned and sold through a market are classified as 'excludable' and include most provisioning services (moreover, the provider is able to regulate access to the service, normally via price).[289] For example, food and fibre are usually highly excludable and complex property rights and market supply-chains have evolved to connect land managers to end consumers. Similarly, via market intermediaries' control of infrastructure distribution systems, access to drinking water is also typically excludable and free riding is not therefore generally possible. However, some services are 'open access' or 'common pool' resources, from which it is very difficult to exclude potential users. [290] Haines-Young and Potschin (2009) identify marine fisheries as an example of a rival, non-excludable service and emphasise that many regulating services, like flood protection are open access but non-rival.[291] To some extent, free-riders can also be excluded from some cultural services, for example through the use of fences and controlled access points to visitor attractions. The OECD point out that ecosystem service benefits accruing at larger geographic scales are subject to greater free-riding incentives (particularly for ecosystem services that provide non-use values).[292] In practical terms, the FAO emphasises that coordinating the purchasers of public goods is necessary in order to overcome problems of free riding.[293]

Variation in the scope for excludability leads to different payment systems for ecosystem services. For example, a high degree of excludability (typically manifest in well-defined and enforceable property rights associated with tangible, physical products) favours market exchange between providers and recipients. In contrast, low excludability (typically manifest in ill-defined property rights and more often associated with less tangible ecosystem services) hinders market exchange and tends to favour public sector interventions with taxpayers collectively funding payments to service providers.

3.3.8 Shortage of skills and experience

A key issue in developing future PES programmes is likely to be a shortage of skills and experience. Establishing a PES programme will involve a range of activities, many of which will require specialist knowledge and expertise. These include establishing an ecosystem services baseline; identifying appropriate land management interventions; negotiating complex agreements which potentially extend over many years; handling financial transactions; and

[286] OECD (2010). *Paying for biodiversity: enhancing the cost-effectiveness of payments for ecosystem services*. OECD: Paris.
[287] *Ibid*
[288] *Ibid*
[289] Haines-Young, R.H. and Potschin, M.B. (2009). *Methodologies for defining and assessing ecosystem services*. Final Report, JNCC, Project Code C08-0170-0062, 69 pp [online] available at: http://www.nottingham.ac.uk/cem/pdf/JNCC_Review_Final_051109.pdf (accessed 22 July 2011).
[290] *Ibid*
[291] *Ibid*
[292] *Ibid*
[293] Food and Agricultural Organization of the United Nations (2007). *The State of Food and Agriculture 2007: Paying Farmers for Environmental Services* [online] available at: ftp://ftp.fao.org/docrep/fao/010/a1200e/a1200e00.pdf (accessed 1 May 2011).

undertaking monitoring, evaluation and review. A wide range of actors and institutions are also likely to be involved in PES including buyers, sellers, brokers, government departments, regulatory agencies, business support services, financial institutions, and third party certifiers and verifiers.[294] As such, establishing a PES programme is likely to require a wide range of competencies including technical, financial, negotiating and engagement skills. An analysis of the PES programme developed and implemented by Vittel (Nestlé Waters) in north-eastern France concluded that establishing PES is a very complex undertaking, one that requires the consideration of scientific but also social, economic, political, institutional, and power relationships.[295] The shortage of skills and experience as well as case studies on which to draw is likely to increase the perceived risks associated with establishing PES programmes in England and could present a significant barrier to further development.

The literature on PES consistently emphasises the importance of **'honest brokers'** in developing PES programmes.[296] Forest Trends, the Katoomba Group, and UNEP (2008) argue that PES deals are most likely to flourish where effective brokers or intermediaries exist who can assist with tasks including documenting ecosystem service conditions; identifying specific resource management alternatives; aggregating multiple landowners/resource users, engaging and negotiating with prospective buyers, and any other activities related to implementation (including monitoring, certification, verification, etc.).[297] The FAO emphasises that NGOs can play a fundamental role as mediators between buyers and sellers, as neutral brokers or by helping to facilitate collective action on the part of land managers.[298] Forest Trends, the Katoomba Group, and UNEP (2008) have identified some of the potential roles for honest brokers – see Box 4.

[294] Forest Trends, the Katoomba Group, and UNEP (2008). *Payments for Ecosystem Services: Getting Started – A Primer* [online] available at: http://www.katoombagroup.org/documents/publications/GettingStarted.pdf (accessed 25 July 2011).
[295] Perrot-Maître, D. (2006). *The Vittel payments for ecosystem services: a "perfect" PES case?* International Institute for Environment and Development, London, UK [online] available at: http://pubs.iied.org/pdfs/G00388.pdf (accessed 27 April 2011).
[296] Forest Trends, the Katoomba Group, and UNEP (2008). *Payments for Ecosystem Services: Getting Started – A Primer* [online] available at: http://www.katoombagroup.org/documents/publications/GettingStarted.pdf (accessed 25 July 2011).
[297] *Ibid*
[298] Food and Agricultural Organization of the United Nations (2007). *The State of Food and Agriculture 2007: Paying Farmers for Environmental Services* [online] available at: ftp://ftp.fao.org/docrep/fao/010/a1200e/a1200e00.pdf (accessed 1 May 2011).

Box 4: Potential Roles for Honest Brokers of PES Deals[299]

Potential Roles for Honest Brokers of PES Deals

- **Helping sellers assess an ecosystem service 'product' and its value to prospective buyers**, through identifying and documenting:
  - what ecosystem services may be available to sell,
  - how much exists,
  - what the market context is (such as regulated or voluntary),
  - what business case exists for a company to invest in, and
  - what value the ecosystem service has and what market price has been paid (ideally based on comparative prices from the same area).
- **Assisting sellers with establishing relationships and rapport with potential buyers**, through:
  - developing a list of potential buyers,
  - setting up meetings between prospective sellers and buyers, and
  - facilitating meetings to ensure that expectations of both buyers and sellers are met.
- **Enabling sellers get to know potential buyer(s) well**, by ensuring that meetings reveal key details, such as:
  - prices paid for comparable payments for ecosystem services (and why these are the prices),
  - buyer's views on potential business benefits, and risks, of entering into agreements and making payments for ecosystem services, and
  - challenges being faced by the company that may inform their interest and price sensitivity related to a purchase.
- **Assisting with proposal development**, by:
  - quantifying ecosystem services to ensure appeal to buyers,
  - pricing of services,
  - addressing, and lessening as much as possible, transaction costs,
  - structuring agreement,
  - selecting a payment type that interests both seller and buyer
  - assessing various approaches to financing,
  - identifying and getting agreement on corporate point people, and
  - keeping the discussions in motion.
- **Ensuring that the final agreement is in sellers' best interest and providing risk management advice and services**, as well as negotiating on behalf of the community.

3.4 Spatial

3.4.1 Spatial variability

The OECD has identified three factors in relation to ecosystem services which vary **spatially**:

- the benefits of ecosystem services;
- the risk of loss or degradation; and
- the opportunity costs associated with providing those services.[300]

The potential for a given site to generate ecosystem services is affected by a number of factors including biophysical characteristics (e.g. soils and topography), history (i.e. previous management), neighbouring sites (e.g. the presence of seed banks and habitats) and local managerial capacity (e.g. skills and access to capital). Such characteristics are highly variable, meaning that the marginal costs of delivering services also vary spatially. However, many PES programmes, especially those that are government-financed as opposed to user-financed, often make fixed uniform payments on a per hectare basis. The OECD argues that such payments could be cost-effective if the benefits and costs of ecosystem service provision were constant across geographic space; however, this is not typically the case.[301]

In order to take into account the spatial variation in ecosystem benefits, the OECD highlights the use of economic valuation, scoring and benefit indices, and mapping tools to increase the environmental effectiveness of PES programmes.[302] The FAO argues that as ecosystem service supply is inherently linked to location, the use of geographical criteria represents a low

[299] Forest Trends, the Katoomba Group, and UNEP (2008). *Payments for Ecosystem Services: Getting Started – A Primer* [online] available at: http://www.katoombagroup.org/documents/publications/GettingStarted.pdf (accessed 25 July 2011).
[300] OECD (2010). *Paying for biodiversity: enhancing the cost-effectiveness of payments for ecosystem services*. OECD: Paris.
[301] *Ibid*
[302] *Ibid*

cost means of targeting programmes.[303] However, as the OECD points out, some benefits are easier to target than others; for instance, biodiversity benefits are particularly difficult to target in comparison with, for example, carbon-related ecosystem services, where a clear metric, tCO_2e, is available.[304] The FAO also argues that an important tactic for targeting suppliers of ecosystem services is to identify areas where threats are projected to emerge[305], thus promoting the principle of additionality. In addition to targeting payments to those ecosystem services with highest benefits and highest risk of loss, the OECD emphasises that differentiated payments, equivalent to the opportunity costs of ecosystem service supply, can significantly enhance PES cost-effectiveness.[306] One approach to establishing a system of differentiated payments is to implement an **inverse auction** whereby landholders provide sealed bids for the amount they are willing to accept for changes in land-use management.[307] The auction therefore acts a price revelation mechanism.[308] Funding is provided in the order of the bidders providing the greatest service provision at the lowest cost, and the process continues until the available funds run out.[309] Ferraro (2008) points out a potential disadvantage of auctions in that they require a large pool of bidders to induce competitive pressures and to reduce incentives to collude or otherwise behave strategically.[310] The OECD argues that, should inverse auctions prove controversial, pilot auctions can nevertheless be used as an effective price-revelation mechanism, to help inform the design of a scaled-up uniform price PES programme.[311] Box 5 introduces some of the terminology around inverse auctions.

[303] Food and Agricultural Organization of the United Nations (2007). *The State of Food and Agriculture 2007: Paying Farmers for Environmental Services* [online] available at: ftp://ftp.fao.org/docrep/fao/010/a1200e/a1200e00.pdf (accessed 1 May 2011).
[304] OECD (2010). *Paying for biodiversity: enhancing the cost-effectiveness of payments for ecosystem services*. OECD: Paris.
[305] Food and Agricultural Organization of the United Nations (2007). *The State of Food and Agriculture 2007: Paying Farmers for Environmental Services* [online] available at: ftp://ftp.fao.org/docrep/fao/010/a1200e/a1200e00.pdf (accessed 1 May 2011).
[306] OECD (2010). *Paying for biodiversity: enhancing the cost-effectiveness of payments for ecosystem services*. OECD: Paris.
[307] Food and Agricultural Organization of the United Nations (2007). *The State of Food and Agriculture 2007: Paying Farmers for Environmental Services* [online] available at: ftp://ftp.fao.org/docrep/fao/010/a1200e/a1200e00.pdf (accessed 1 May 2011).
[308] Karousakis, K. (2010). *Enhancing the Cost-Effectiveness of Payments for Ecosystem Services*. Presentation to the CBD [online] available at: http://www.cbd.int/financial/doc/presentation-wgri-03-training-katia-en.pdf (accessed 19 May 2011).
[309] Food and Agricultural Organization of the United Nations (2007). *The State of Food and Agriculture 2007: Paying Farmers for Environmental Services* [online] available at: ftp://ftp.fao.org/docrep/fao/010/a1200e/a1200e00.pdf (accessed 1 May 2011).
[310] Ferraro, P.J. (2008). Asymmetric information and contract design for payments for environmental services. *Ecological Economics* 65: 810-821.
[311] OECD (2010). *Paying for biodiversity: enhancing the cost-effectiveness of payments for ecosystem services*. OECD: Paris.

Box 5: PES procurement auction vocabulary[312]

Bidding units: In the case of PES auctions, the relevant units are contracts that specify, for a period of time, a level of environmental services or an observable set of land uses that are offered in exchange for a payment. Landowners may be allowed to offer single or multiple units, which may be divisible or indivisible, homogenous or heterogeneous.

Discriminative-price auction: Winning bidders are paid their own winning offer prices.

Uniform-price auction: Winning bidders are all paid the same price. This price may be the highest winning offer price or, more typically, the lowest rejected offer price.

Simultaneous auction: Each bidder makes offers only once.

Sequential auction: Each bidder has the opportunity to revise his or her offers.

Single-shot auction: The auction is conducted once and will not be repeated (i.e., the same units will not be procured again in the future).

Repeated auction: The auction is repeated over a sequence of time periods. The results are binding for each time period, but there will be future opportunities to tender offers on the same or similar units.

Sealed-bid auction: Bidders make offers without being able to observe competitors' offer prices.

Open-bid auction: Bidders can see competitors' offer prices when formulating their own offers.

Private value auction: Bidders have perfect information about their own opportunity costs of offering the auctioned unit, but they do not know competitors' costs. These private values may be independent or affiliated (the latter implies that changes in one bidder's offer price affect other bidders' offer prices and thus are often considered as an auction having elements of private and common values).

Common value auction: Bidders have imperfect information about their own opportunity costs of offering the auctioned unit and these costs are the same for all bidders. The true value of the opportunity costs is determined by external factors such as alternative markets for auctioned units.

The US Conservation Reserve Program (CRP) (see section 2.7.1) employs inverse auctions which involve potential ecosystem service sellers submitting bids indicating the minimum payment they are willing to accept for the provision of an ecosystem service. The United States Department of Agriculture (USDA) ranks the bids received according to potential environmental benefits as well as costs and incorporates this information into an **Environmental Benefit Index (EBI)** which facilitates selection of the contracts offering the highest benefits for least cost.[313] The CRP's objectives include reducing soil erosion, improving water quality, enhancing wildlife habitat and improving air quality and the perceived importance of each objective is reflected in the configuration of the EBI. Currently wildlife, water quality and local erosion control benefits each carry a maximum of 100 points while up to

[312] OECD (2010). *Paying for biodiversity: enhancing the cost-effectiveness of payments for ecosystem services*. OECD: Paris.
[313] *Ibid*

50 points are available for benefits enduring past contract expiration, 45 points for air quality benefits, and up to 150 points for relative cost.[314]

Other examples of geographical targeting include the **Conservation Value Index (CVI)** used to help target sites with high biodiversity benefits in the Tasmanian Forest Conservation Fund (FCF). The aim of the FCF is to protect up to 45,600 hectares of forested private land in Tasmania, including a minimum of 25,000 hectares of old growth forest.[315] The FCF was developed to address several issues including insufficient private incentives to protect high value biodiversity and the high variability in environmental benefits and opportunity costs for different parcels of native vegetation.[316] The FCF included inverse auction, differentiated take it or leave it offers, and direct negotiation approaches.[317] The inverse auction ('conservation tender') component was adopted in recognition of:

- the significant variance in conservation benefits from the different parcels of vegetation and the proposed management actions;
- the difference in the cost of conservation, including opportunity costs, and positive environmental management actions; and
- the 'public good' nature of the project objectives.[318]

The CVI was developed to assess the relative conservation benefits of individual proposals and was based on the objectives outlined in the Fund Strategic Plan with significant input and research by nationally recognised experts.[319] The CVI was developed to assess three aspects of a landholder's proposal:

- the *significance* of the proposal in contributing to the Fund's conservation objectives;
- the *conservation management* provided by the proposal in relation to current conditions and risks that would not have been undertaken in the absence of the Fund; and
- the *security* of the proposal measured as the covenant length offered (12, 24, 48 years and in-perpetuity).[320]

The CVI incorporates several considerations including a forestry priority score; an assessment of the current condition of proposed areas based on benchmark forest conditions; a regional threat index, which assesses the threat to the proposed forest area from surrounding land uses and conditions; and the likely impacts of any voluntary conservation management activities on improving conditions.[321]

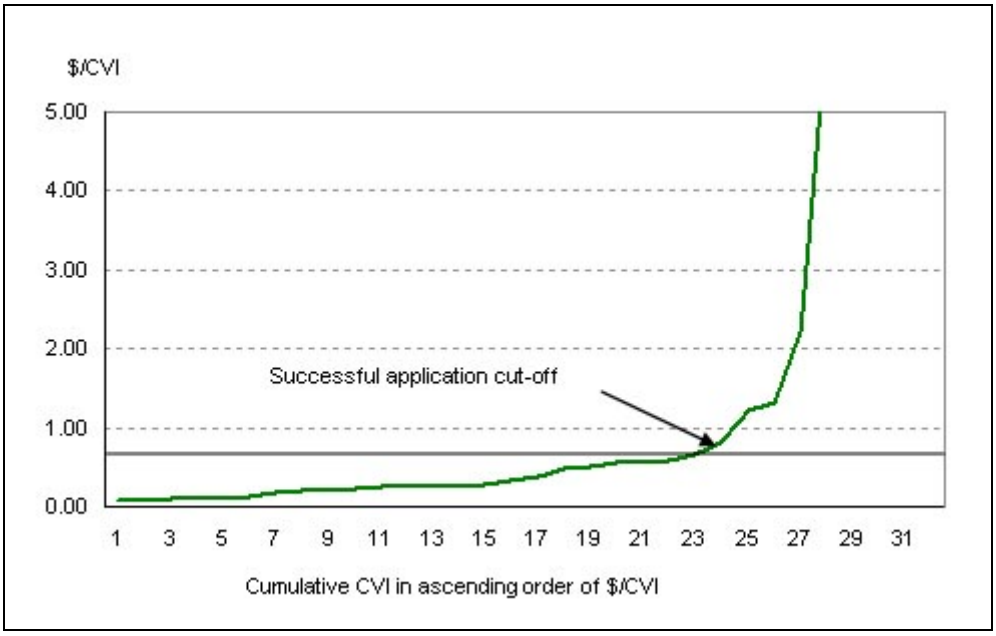
As part of the evaluation, each proposal was allocated a score to enable relative comparisons based on conservation benefits. The value for money represented by each bid was determined by dividing the cost of the proposal by the CVI point score (value for money = $(bid)/CVI score).[322] Crucially, the utility of the CVI to differentiate between proposals is highly reliant on the data collected through field assessments.[323] A number of actions were undertaken to ensure the quality and appropriateness of these assessments including:

[314] OECD (2010). *Paying for biodiversity: enhancing the cost-effectiveness of payments for ecosystem services*. OECD: Paris.
[315] See http://www.marketbasedinstruments.gov.au (accessed 19 May 2011)
[316] Binney, J. and Zammit, C. (undated). *Australian case study: Tasmanian Forest Conservation Fund*. OECD, Paris [online] available at: http://www.oecd.org/dataoecd/4/61/44903552.pdf (accessed 19 May 2011).
[317] OECD (2010). *Paying for biodiversity: enhancing the cost-effectiveness of payments for ecosystem services*. OECD: Paris.
[318] See http://www.marketbasedinstruments.gov.au (accessed 19 May 2011)
[319] OECD (2010). *Paying for biodiversity: enhancing the cost-effectiveness of payments for ecosystem services*. OECD: Paris.
[320] *Ibid*
[321] *Ibid*
[322] See http://www.marketbasedinstruments.gov.au (accessed 19 May 2011)
[323] OECD (2010). *Paying for biodiversity: enhancing the cost-effectiveness of payments for ecosystem services*. OECD: Paris.

- employing field officers (Conservation Advisors) that had appropriate formal qualifications and survey experience (e.g. forest ecology, forest and/or conservation management);
- formal training was provided for all Conservation Advisors in the on-ground application process and development of data for the CVI;
- the development of a specific field assessment manual to assist with on-ground assessments; and
- a process of quality assurance to ensure consistency in the assessment between Conservation Advisors and the comparability of all proposals received.[324]

The OECD argues that these actions reduced the risk of poor data quality impacting on the assessment process.[325] Overall, the OECD contends that the CVI is theoretically robust, practical, repeatable, transparent, and pragmatic given the data, knowledge, and programme constraints.[326] According to Binney and Zammit, the use of the CVI to underpin proposal selection achieved 19% more biodiversity benefits than using an area based assessment (since the CVI considers not only forest extent but also *condition*, including current and future condition under management actions).[327] Research indicates that FCF has performed as expected, enabling the most cost-effective set of proposals to be selected (and conservation benefits therefore maximised within the budget available); in particular, the inverse auction approach has elicited proposals with significant variance in relative cost-effectiveness (measured as $(bid)/CVI score), see Figure 8.[328]

Figure 8: Variation in value for money provided by bids to the Tasmanian Forest Conservation Fund[329]



[324] OECD (2010). *Paying for biodiversity: enhancing the cost-effectiveness of payments for ecosystem services*. OECD: Paris.
[325] *Ibid*
[326] *Ibid*
[327] Binney, J. and Zammit, C. (undated). *Australian case study: Tasmanian Forest Conservation Fund*. OECD, Paris [online] available at: http://www.oecd.org/dataoecd/4/61/44903552.pdf (accessed 19 May 2011).
[328] See http://www.marketbasedinstruments.gov.au (accessed 19 May 2011)
[329] See http://www.marketbasedinstruments.gov.au (accessed 19 May 2011)

The FAO argues that inverse auctions are well suited to situations in which there is only one buyer and many sellers, for example, as is often the case with water quality when a utility seeks to change the behaviour of multiple landowners.[330] However, they point out that geographical targeting is potentially complicated by **'holdouts'** – individuals who try to exploit their location or choose not to participate in a programme but capture the benefits of actions on the part of others.[331] The FAO emphasise that effectiveness of holdouts depends on the extent to which ecosystem service provision requires coordination among suppliers; for example, a functioning wildlife corridor usually depends on contiguous land parcels.[332]

As an alternative to inverse auctions, the OECD suggests that, in order to establish a system of differentiated payments, the opportunity costs of ecosystem services provision can be determined using **costly-to-fake signals**. These refer to information that is correlated with opportunity costs, but is expensive or difficult for the landholder to artificially produce.[333] Soil type and forest type are examples of attributes that are often correlated with opportunity costs and, importantly, are impossible or costly for landowners to fake.[334] These attributes can then be used to establish contract prices and create eligibility requirements for receiving a given contract type and price.[335] Ferraro (2008) argues that collecting information on costly-to-fake signals of opportunity costs is technically less challenging than implementing inverse auctions.

One of the problems with reverse auctions is that a number of landowners who wish to manage their land in an environmentally beneficial way will not receive funding if their bid is not competitive[336] or provides good value for money.[337] Despite being economically efficient, this may not be an optimum strategy for AES where environmental concerns are paramount.

Overall, the OECD maintains that the issue of targeting ecosystem service payments is the main determinant in enhancing the cost-effectiveness of PES.[338] In particular, *"the greater the spatial heterogeneity in costs and benefits of ecosystem service provision, the larger the gains that can be reaped by targeting and differentiating payments accordingly"*.[339]

3.5 Temporal

3.5.1 Permanence

The OECD defines **permanence** as the ability to ensure the provision of the ecosystem service in question over the long-term.[340] Similarly, Engel *et al.* (2008) argue that permanence refers to the ability of PES to achieve long-run improvements in environmental service provision, including *beyond* the period of the payments proper when payment horizons are finite.[341] They acknowledge, however, that that it is not very useful to talk of permanence 'after payments end' and argue that there cannot be any expectation of permanence in the absence of payments.[342]

[330] Food and Agricultural Organization of the United Nations (2007). *The State of Food and Agriculture 2007: Paying Farmers for Environmental Services* [online] available at: ftp://ftp.fao.org/docrep/fao/010/a1200e/a1200e00.pdf (accessed 1 May 2011).
[331] *Ibid*
[332] *Ibid*
[333] OECD (2010). *Paying for biodiversity: enhancing the cost-effectiveness of payments for ecosystem services*. OECD: Paris.
[334] Ferraro, P.J. (2008). Asymmetric information and contract design for payments for environmental services. *Ecological Economics* 65: 810-821.
[335] *Ibid*
[336] Ferraro, P.J. (2008). Asymmetric information and contract design for payments for environmental services. *Ecological Economics* 65: 810-821.
[337] *Ibid*
[338] OECD (2010). *Paying for biodiversity: enhancing the cost-effectiveness of payments for ecosystem services*. OECD: Paris.
[339] *Ibid*
[340] *Ibid*
[341] Engel, S., Pagiola, S., and Wunder, S. (2008). Designing payments for environmental services in theory and practice: an overview of the issues. *Ecological Economics* 65(4): 663–674.
[342] *Ibid*

Permanence therefore depends on a continued flow of programme finance. Engel *et al.* argue that lack of long-term funding may be a problem for government-financed PES programmes, since funding may be subject to policy cycles or the duration of particular projects; it is less likely to be an issue for user-financed programmes, as long as the programmes are delivering the ecosystem services that users are paying for.[343]

The OECD emphasises that if ecosystem service payments cease, the land manager will no longer have the added incentive to provide a greater level of ecosystem service provision.[344] Indeed, the OECD argues that this is one of the advantages of PES in that it allows for flexibility and adjustments in PES programmes to reflect changes in market conditions (such as changing agricultural food prices).[345] They also emphasise that PES agreements entail contracts of a specified length, at the end of which all involved can consider contract renewal.[346] Engel *et al.* maintain that, as long as participation is voluntary for both buyers and sellers, both have the option to walk away at any point if conditions change[347] (contractual arrangements permitting).[348] They argue that what might, therefore, appear to be the epitome of *impermanence*, however, is in fact the means by which permanence is assured: by giving both parties the ability to require that contracts be re-negotiated to cater for the new conditions.[349] Engel *et al.* go as far as to suggest that should conditions change so much that there is no longer scope for a deal between buyers and sellers, then it is actually desirable that the programme cease, as continuing would be socially inefficient.[350]

The OECD cautions that the long-term provision of ecosystem services may be compromised by unforeseen events such as fires and the invasion of alien species.[351] As such, they advise that the allocation of responsibility and risk needs to be specified in the PES contract. Moreover, if the risks of non-permanence are particularly high, insurance payments can be considered.[352]

3.5.2 Time lags

The OECD argues that in order to successfully deliver the desired ecosystem service outcome, payments should be ex-post and conditional upon actual delivery of the ecosystem service(s) in question[353] (a 'payments-by-results' approach). They recognise, however, that in some cases, performance based payments might not be feasible due to concerns such as the high costs of monitoring ecosystem services directly, or the ***time delay*** between the implementation of the management practice and the provision of the ecosystem service[354] (which could be many years in the case of some ecosystem services, for example erosion control). In these circumstances, the OECD argues that an alternative is to use proxy-based payments.[355] These include effort-based payments, whereby payments are made based on actions presumed to supply a given ecosystem service.[356] The OECD maintains that such payments

[343] Engel, S., Pagiola, S., and Wunder, S. (2008). Designing payments for environmental services in theory and practice: an overview of the issues. *Ecological Economics* 65(4): 663–674.
[344] OECD (2010). *Paying for biodiversity: enhancing the cost-effectiveness of payments for ecosystem services*. OECD: Paris.
[345] *Ibid*
[346] *Ibid*
[347] Engel, S., Pagiola, S., and Wunder, S. (2008). Designing payments for environmental services in theory and practice: an overview of the issues. *Ecological Economics* 65(4): 663–674.
[348] It should be noted that changes in external conditions could, in principle, be addressed through the design of flexible contracts (Engel *et al*, 2008).
[349] Engel, S., Pagiola, S., and Wunder, S. (2008). Designing payments for environmental services in theory and practice: an overview of the issues. *Ecological Economics* 65(4): 663–674.
[350] *Ibid*
[351] OECD (2010). *Paying for biodiversity: enhancing the cost-effectiveness of payments for ecosystem services*. OECD: Paris.
[352] *Ibid*
[353] *Ibid*
[354] *Ibid*
[355] *Ibid*
[356] OECD (2010). *Paying for biodiversity: enhancing the cost-effectiveness of payments for ecosystem services*. OECD: Paris.

are suitable as long as there is a strong relation between the management practices undertaken by the landholder and the resulting ecosystem service provided[357], i.e. clearly demonstrable cause-and-effect. It should also be noted that a payments-by-results approach is unlikely to find favour with land managers seeking regular income to cover ongoing costs. Moreover, given that ecosystem service delivery at a given site typically depends on a range of variables, not all within the land manager's control, payment-by-results introduces an additional element of financial risk from the land manager's perspective. Adverse weather, outbreaks of disease or pests, or fire or flood may jeopardise the capacity of a land manager to provide the agreed level of service at a time when payments could be critical in terms of business viability.

3.5.3 Differing time horizons

In some cases, there may be a tension between the time horizons envisaged for a PES deal and the period of funding necessary to adequately support providers and promote genuine conservation returns. For example, the Lawton Review expresses concerns over the 10 year term of Higher Level Stewardship (HLS) agreements,[358] arguing that while this may be a long time in terms of European and domestic funding streams, it is not long in terms of many farm businesses and it is very short when considering the long-term aims of a resilient and coherent ecological network.[359]

3.6 Financial

3.6.1 Perceived risks

Jack *et al.* (2008) emphasise that for suppliers to be willing to modify their land use practices to engage in a PES initiative, they must perceive security in their ability to receive compensation for the modification.[360] Furthermore, landowners may have strong views on the reliability of various forms of payments, and will assess the variability or risk of a PES system against the equivalent characteristics of market returns, i.e. trend over time versus inflation, sudden peaks and troughs, etc. Risk can arise from unforeseen events such as fires and the arrival of invasive species which can compromise service provision (see section 3.5.1 on permanence). As such, the OECD advises that the allocation of responsibility and risk needs to be specified in the PES contract.[361] The FAO emphasises that, from a seller's perspective, a contract for a specific land management change, such as planting and maintaining a riparian buffer, involves much less risk than a contract based on payments for water purification services, which might be affected not only by land-management changes but also by a drought or a major rainfall that could wash nutrients and soil into watercourses.[362] Employing proxies for ecosystem service provision can therefore significantly reduce risk on the part of providers. Nevertheless, insurance against variability in the supply of an ecosystem service is an important transaction cost in PES exchanges. One approach to mitigating this risk involves self-insurance, where

[357] OECD (2010). *Paying for biodiversity: enhancing the cost-effectiveness of payments for ecosystem services*. OECD: Paris.
[358] HLS aims to deliver significant environmental benefits in priority areas. It involves more complex environmental management requiring support and advice from Natural England local advisers, to develop a comprehensive agreement that achieves a wide range of environmental benefits over a longer period of time. HLS agreements last for ten years. See http://www.naturalengland.org.uk/ourwork/farming/funding/es/hls/default.aspx (accessed 21 July 2011).
[359] Lawton, J.H., Brotherton, P.N.M., Brown, V.K., Elphick, C., Fitter, A.H., Forshaw, J., Haddow, R.W., Hilborne, S., Leafe, R.N., Mace, G.M., Southgate, M.P., Sutherland, W.A., Tew, T.E., Varley, J., and Wynne, G.R. (2010). *Making Space for Nature: a review of England's wildlife sites and ecological network*. Report to Defra [online] available at: http://archive.defra.gov.uk/environment/biodiversity/documents/201009space-for-nature.pdf (accessed 21 July 2011).
[360] Jack, B.K., Kouskya, C. and Simsa, K.R.E. (2008). Designing payments for ecosystem services: Lessons from previous experience with incentive-based mechanisms. *PNAS* 105(28): 9465-9470.
[361] OECD (2010). *Paying for biodiversity: enhancing the cost-effectiveness of payments for ecosystem services*. OECD: Paris.
[362] Food and Agricultural Organization of the United Nations (2007). *The State of Food and Agriculture 2007: Paying Farmers for Environmental Services* [online] available at: ftp://ftp.fao.org/docrep/fao/010/a1200e/a1200e00.pdf (accessed 1 May 2011).

sellers produce more services than they have contracted (e.g. by planning extra area for carbon offsets) or buyers contract for more services than they need, is one approach.[363]

3.6.2 High start-up costs

Finance for PES is needed to cover different types of costs and the OECD identifies two categories: short-term design and capacity building costs; and longer term implementation costs which cover the ecosystem service payments necessary to induce land use change.[364] They emphasise that the design and capacity building phase may require a relatively large injection of up-front finance.[365] The OECD argues that up-front costs may include short-term funding for research, stakeholder consultation and the creation of the necessary institutions, including those for legal aspects, contract allocation, and for data collection and monitoring.[366] Participation in a PES programme may also entail initially high investment costs on the part of the seller in order to implement the land use changes required under the agreement. Engel *et al.* (2008) emphasise that when PES programmes involve changing land uses (for example, reforesting land that has been deforested), costs tend to be much higher than when programmes focus on retaining existing land uses (for example, preserving forests threatened by clearing).[367] Wunder (2008) argues that in order to create meaningful incentives where inputs are mainly up-front or in the early years of a PES contract (e.g. for tree-planting), schemes may benefit from weighting payments in the early years.[368] 'Frontloading' payments in this way can help to incentivise participants in the crucial stages when there are high establishment costs, high labour costs, and when project activities have yet to bear fruit.[369]

With respect to implementation costs, the OECD emphasises that PES programmes require a sustainable long-term source of financing to cover ecosystem service provision (consisting of the landholders' opportunity costs, transaction costs and any management or protection costs), and the programme maintenance costs, including monitoring, reporting, verification and review.[370]

3.6.3 High transaction costs

A PES programme will involve a wide rage of activities including identifying the ecosystem service(s) in question and the scale at which it is best addressed; establishing appropriate land management techniques; identifying, recruiting and organising buyers and sellers; holding negotiations, possibly mediated; demonstrating outcomes or practices; establishing protocols; arranging payments; and, in time, reviewing and/or renewing the programme. As such, there is considerable scope for high transaction costs. A review of PES for the WWF emphasised that requirements for service agreements, monitoring and continued participation and record keeping amongst other things mean that PES schemes tend to be relatively 'information intensive', resulting in high transaction costs, particularly in the initial phases of a scheme's design.[371] The initial transaction costs can include identifying and bringing together

[363] Food and Agricultural Organization of the United Nations (2007). *The State of Food and Agriculture 2007: Paying Farmers for Environmental Services* [online] available at: ftp://ftp.fao.org/docrep/fao/010/a1200e/a1200e00.pdf (accessed 1 May 2011).
[364] OECD (2010). *Paying for biodiversity: enhancing the cost-effectiveness of payments for ecosystem services*. OECD: Paris.
[365] *Ibid*
[366] *Ibid*
[367] Engel, S., Pagiola, S., and Wunder, S. (2008). Designing payments for environmental services in theory and practice: an overview of the issues. *Ecological Economics* 65(4): 663–674.
[368] Wunder, S. (2008) cited in WWF (2010). *Payments for Ecosystem Services: Literature Review* [online] available at: http://www.planvivo.org/wp-content/uploads/Framework-for-PES-feasibility_WWF_MorrisonAubrey_2010.pdf (accessed 21 July 2011).
[369] WWF (2010). *Payments for Ecosystem Services: Literature Review* [online] available at: http://www.planvivo.org/wp-content/uploads/Framework-for-PES-feasibility_WWF_MorrisonAubrey_2010.pdf (accessed 21 July 2011).
[370] OECD (2010). *Paying for biodiversity: enhancing the cost-effectiveness of payments for ecosystem services*. OECD: Paris.
[371] WWF (2010). *Payments for Ecosystem Services: Literature Review* [online] available at: http://www.planvivo.org/wp-content/uploads/Framework-for-PES-feasibility_WWF_MorrisonAubrey_2010.pdf (accessed 21 July 2011).

stakeholders, negotiating contract structures and payment mechanisms, identifying sites and setting the ecosystem service 'baseline', and other aspects of system design.[372] The WWF review identified several factors likely to lead to higher transaction costs, including:

- multiple small-scale service providers;
- multiple small-scale buyers (as opposed to 'monopsonies' or 'oligopsonies', i.e. schemes with one or a few large buyers respectively);
- social diversity of sellers; and
- where the service being delivered, and measurement and monitoring of it is biophysically complex (e.g. monitoring changes in soil carbon).[373]

As an example of high transaction costs, the Lawton Review argues that the HLS's main current limitations are the amount of total funds available and the fact that agreements can be quite complicated to set up and require considerable and ongoing advice to achieve the best quality agreements (consequently, due to resource limitations, HLS is not available to all land managers).[374]

The FAO emphasise that direct negotiation between buyers and sellers – an approach to price setting – results in individually crafted agreements that reflect the different levels of service that different landholders can provide and the specific conditions faced by each landholder (this approach was adopted by Vittel in France and in the New York City water case). The FAO argue that this approach can result in highly optimised contracts, but can also incur high transaction costs.[375]

3.7 Institutional

3.7.1 Collective action problems

Another precondition for functioning markets is the presence of discrete providers and beneficiaries.[376] Economists describe this as a problem of collective action. Unless a relatively small number of providers and beneficiaries can get together, transaction costs become too high for contract formation. The public goods nature of many services makes this a real concern. Examples include managing watersheds, communal lands and fisheries, where changes on the part of one producer aimed at improving a habitat or reducing erosion in a watershed or reducing overfishing are unlikely to be sufficient to provide these environmental services, unless the producer controls a large proportion of the land and water resources important for the service provision. This means that considering change at a landscape level is as important as it is at the scale of the individual production unit. It also means that the effectiveness of any given change may depend critically on co-ordinating the actions of a number of producers.[377] The atomistic nature of farming is pertinent here. While there is, at present, little evidence to suggest that larger farming estates and companies are more likely to

[372] WWF (2010). *Payments for Ecosystem Services: Literature Review* [online] available at: http://www.planvivo.org/wp-content/uploads/Framework-for-PES-feasibility_WWF_MorrisonAubrey_2010.pdf (accessed 21 July 2011).
[373] *Ibid*
[374] Lawton, J.H., Brotherton, P.N.M., Brown, V.K., Elphick, C., Fitter, A.H., Forshaw, J., Haddow, R.W., Hilborne, S., Leafe, R.N., Mace, G.M., Southgate, M.P., Sutherland, W.A., Tew, T.E., Varley, J., & Wynne, G.R. (2010) *Making Space for Nature: a review of England's wildlife sites and ecological network*. Report to Defra [online] available at: http://www.defra.gov.uk/environment/biodiversity/documents/201009space-for-nature.pdf (accessed 26 October 2010).
[375] Food and Agricultural Organization of the United Nations (2007). *The State of Food and Agriculture 2007: Paying Farmers for Environmental Services* [online] available at: ftp://ftp.fao.org/docrep/fao/010/a1200e/a1200e00.pdf (accessed 1 May 2011).
[376] Salzman, J. (2009). *A Policy Maker's Guide to Designing Payments for Ecosystem Services*. Duke Law Faculty Scholarship. Paper 2081 [online] available at: http://scholarship.law.duke.edu/faculty_scholarship/2081 (accessed 9 May 2011).
[377] *Ibid*

be attracted to PES than smaller owner occupiers, restructuring of farming towards larger farming units could possibly help address the collective action problem and reduce the transaction costs faced by prospective buyers.

In order to overcome collective action problems, a supporting institutional environment is needed.[378] Most successful service markets to date operate as monopsonies, where one buyer pays multiple service providers. Both public and private groups can serve as intermediaries or brokers to overcome collective action problems. For example, The Nature Conservancy has played a central role in brokering forest carbon projects in Belize, Bolivia and Brazil[379], and small farmers in the Macquarie River Valley in Australia have relied on their local organisation (Macquarie River Fruit and Fibre) to negotiate with upper watershed ranchers.[380] It is inconceivable that the water users in New York City could have negotiated with the communities and land owners in the Catskills watershed. Only because a single purchaser, namely New York City's water authority, could act on their behalf was the PES scheme possible. Nor is this solely the case for watershed services; in the case of biodiversity, for example, governments can pay for services on behalf of citizens.

3.7.2 Perverse incentives

Jack *et al.* (2008) cautioned that the subsidy-like structure of many PES schemes carries with it many of the problems characteristic of subsidies.[381] In particular, the pollution control literature has demonstrated theoretically that a subsidy that provides firms with incentives not to pollute could also make it more profitable in the long run for some firms to enter the industry or to stay in the industry when they otherwise would not have; these firms produce additional pollution, reducing the environmental effectiveness of the subsidy.[382] Similarly, the additional environmental benefits provided by a PES scheme may be compromised by new entry or other responses to subsidies over time. Paying farmers to keep land in woodland on some plots might increase the profitability of farming, leading to the clearing of additional plots.[383] Or, if landowners are credit-constrained, receiving cash payments for good behaviour on one parcel of land may provide the income needed to begin an environmentally harmful use on another. Incentive-based mechanisms can also create the conditions for "ransom behaviour"[384] [385], threats or undesirable actions aimed at leveraging compensation, for example, felling natural forest in order to qualify for a reforestation-based PES scheme. This problem can be alleviated by basing policies on a clear historical baseline or by basing incentives on levels of activities rather than on changes. Providing incentives for levels, however, may create trade-offs between avoiding ransom behaviour and paying landholders for activities that might have occurred in the absence of the programme. To the extent that PES schemes are small, do not change regional prices, and are carefully designed and monitored, then this type of behaviour is less likely to occur. These secondary effects should nevertheless be taken into account when trying to gauge the ecosystem benefits gained as a result of PES policies.

[378] Food and Agricultural Organization of the United Nations (2007). *The State of Food and Agriculture 2007: Paying Farmers for Environmental Services* [online] available at: ftp://ftp.fao.org/docrep/fao/010/a1200e/a1200e00.pdf (accessed 1 May 2011).
[379] Wunder, S., The, B.D. & Ibarra, E. 2005. Payment is good, control is better. Why payments for forest environmental services in Vietnam have so far remained incipient. Bogor, Indonesia, Center for International Forestry Research.
[380] Food and Agricultural Organization of the United Nations (2007). *The State of Food and Agriculture 2007: Paying Farmers for Environmental Services* [online] available at: ftp://ftp.fao.org/docrep/fao/010/a1200e/a1200e00.pdf (accessed 1 May 2011).
[381] Jack, B.K., Kouskya, C. and Simsa, K.R.E. (2008). Designing payments for ecosystem services: Lessons from previous experience with incentive-based mechanisms. *PNAS* 105(28): 9465-9470.
[382] *Ibid*
[383] See, for example, Wu, J. (2000) Slippage effects of the conservation reserve programs. American Journal of Agricultural Economics, 82:979–992 and Roberts MJ, and Bucholtz, S. (2005) Slippage in the Conservation Reserve Program or Spurious Correlation? American Journal of Agricultural Economics, 87:244–250.
[384] Jack, B.K., Kouskya, C. and Simsa, K.R.E. (2008). Designing payments for ecosystem services: Lessons from previous experience with incentive-based mechanisms. *PNAS* 105(28): 9465-9470.
[385] WWF (2010). *Payments for Ecosystem Services: Literature Review* [online] available at: http://www.planvivo.org/wp-content/uploads/Framework-for-PES-feasibility_WWF_MorrisonAubrey_2010.pdf (accessed 21 July 2011).

3.7.3 Complex policy environment

Overlaps, interactions and unclear boundaries may exist between various national and international policies and regulations, e.g., the Water Framework Directive (WFD)[386] and Nitrates Directive[387] on water ecosystem services and the Habitats Directive[388] and CAP reform on conservation/biodiversity ecosystem services. This may lead to problems of 'double counting' and additionality for PES schemes and, in the case of the CAP, arguably dampened incentives to take up private sector PES and/or voluntary measures. Strengthening Directive regulations may weaken the case for PES schemes by shifting the relevant property rights (or subsidy entitlement) so that non-compliance becomes a matter of illegal destruction, neglect, 'pollution' or irresponsibility. This is not necessarily a bad thing - what is difficult is how to establish a clear regulatory baseline from which PES can develop, especially if the baseline is likely to change over time.

On the other hand, the UK government's commitment to international agreements on, for example, biodiversity and climate change ensures that it, and often lower-level agencies such as local authorities, are compelled to ensure the provision of ecosystem services, and thus a certain level of funding for PES schemes, even if regulation and low-level 'seed corn' funding are also used.

Effective PES institutional mechanisms are needed for achieving the efficiency in certification, monitoring and the creation of a national registry of ecosystem services, and their market-based management. For example, the lack of official bodies in the estimation of accurate financial values of various forest ecosystem services and their certification undermines efforts to create a fully functioning PES market. There is also a need for community-level institutions and the involvement of various stakeholders in the process of marketing ecosystem services and setting up the payment schemes. The presence of financial agents in findings and negotiations with buyers of ecosystem services could help to avoid increasing PES transaction costs and originate the efficient delivery mechanism of payments.

In many cases, however, there is confusion about appropriate government roles in development and operation of specific types of PES.[389] For example, there is a controversy in existing rights on ecosystem services concerning the estimation, delivery and payment for the ecosystem services as 'private goods' received from private forest owners versus 'public goods' delivered from forests belonging to the Forestry Commission or placed in community ownership. Without legislative and regulatory frameworks, the continuing development of PES in English forestry causes policy confusion over the promotion of ecosystem services and acceptability to the public (who may feel entitled to 'public good' benefits) and to business.

Businesses can benefit by establishing privately-financed payments for ecosystem service schemes, yet there are clear limitations to how much more non-government sectors can do alone.[390] This is due to a lack of information and understanding about the benefits from

[386] European Commission (2000) Directive 2000/60/EC of the European Parliament and of the Council establishing a framework for the Community action in the field of water policy [online] available at: http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CONSLEG:2000L0060:20090625:EN:PDF (accessed 16 September 2011).
[387] European Commission (1991) Council Directive 91/676/EEC of 12 December 1991 concerning the protection of waters against pollution caused by nitrates from agricultural sources [online] available at: http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:1991:375:0001:0008:EN:PDF (accessed 16 September 2011).
[388] European Commission (1992) Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora [online] available at: http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:31992L0043:EN:HTML (accessed 16 September 2011).
[389] Forest Trends, the Katoomba Group, and UNEP (2008). *Payments for Ecosystem Services: Getting Started – A Primer* [online] available at: http://www.katoombagroup.org/documents/publications/GettingStarted.pdf (accessed 25 July 2011).
[390] RSPB (2010). *Financing nature in an age of austerity* [online] available at: http://www.rspb.org.uk/Images/Financingnature_tcm9-262166.pdf (accessed 26 April 2011).

biodiversity and ecosystem services, and the absence of private benefits in the short term which reduces the incentive to pay for the delivery of natural services.[391]

PES programmes require a great deal of cooperation that depends on state and/or community engagement. Local confidence often has to be won, and small stakeholders often need increased bargaining power to deal with more powerful stakeholders.

For PES schemes to be sustainable, governments can play a number of roles in capitalising on PES opportunities.[392] Governments are potential buyers, and have been playing this role in a number of PES initiatives. Governments can also be potential facilitators in bringing together buyers and sellers. This intermediary role has often been played by NGOs, but government agencies, especially those dealing at the community level, can play a larger role in this area.

Moving towards payment by results which specify desired outcomes rather than prescribed inputs will require the development of cost-effective technologies to monitor the provision of ecosystem services. While payment by results is conceptually preferable as farmers would become more involved in delivering quality environmental goods, and able to check and adjust management practices themselves, there are some serious drawbacks, particularly in relation to public PES schemes. The time lags that are inherent in payment-by-results schemes impose significant additional risks to farmers in terms of concerns over failure to deliver. Consequently, farmers would need to be paid a premium to overcome those extra costs. However, while such payments may be applicable to private contracts, WTO rules would prevent the inclusion of such payments in public contracts such as agri-environment schemes.

Based on the above, it is clear that PES schemes require an institutional framework where the following functions can be carried out:

- Development and implementation of a mechanism to collect and manage payments from service beneficiaries (i.e. the buyers of the ecosystem service)
- Development and implementation a mechanism to negotiate with and contract service providers, quantify the ecosystem service they are providing and monitor their participation (including record keeping)
- Development and implementation of a governing structure for making decisions and resolving disputes.[393]

Given the wide range of ecosystem services and payment systems for these covered by this report, there are a vast number of organisations, structures and processes (together, "institutions") actually or (especially) potentially involved in PES programmes in England. These range from the large and formal (e.g. Defra-administered agri-environmental schemes under CAP Pillar 2) to the small and informal (e.g. recreational or educational access arranged between local landowners and community groups). The timescales, spatial geographies and range of ecosystem services vary similarly from, for example, global concerns over climatic regulation to one-off or infrequent events such as the sighting of a rare species. Because of this range, institutional challenges to the creation and delivery of PES schemes can be treated only very generally here.

What is perhaps needed is guidance – in the form of a typology – that defines the appropriate role(s) for different levels of government during the various stages of PES set-up, operation

[391] RSPB (2010). *Financing nature in an age of austerity* [online] available at: http://www.rspb.org.uk/Images/Financingnature_tcm9-262166.pdf (accessed 26 April 2011).
[392] Lelmona, B. and Lee, E. (2008). *Pro-Poor Payment for Environmental Services Some Considerations* [online] available at: http://www.recoftc.org/site/uploads/content/pdf/Pro_Poor_Policy_Brief_60.pdf (accessed 18 September 2011).
[393] WWF (2010). *Payments for Ecosystem Services: Literature Review* [online] available at: http://www.planvivo.org/wp-content/uploads/Framework-for-PES-feasibility_WWF_MorrisonAubrey_2010.pdf (accessed 21 July 2011).

and ongoing monitoring. So, for example, once the potential for a PES scheme has been identified, the role of Government may be defined by the type of PES transaction being considered – see Table 5.

Table 5: The role of government in different types of PES transaction

Type of PES transaction	Example	Government role
Public sector buys ecosystem services from individuals or business	Catchment sensitive farming	Funding, checking compliance etc
Business to business transaction	Water company pays farmer to reduce nutrients to improve water quality	Providing information and helping to encourage / facilitate transactions
Civil organisations buy eco-services from individuals or business	River Trust pays farmers to change farm systems from intensive to extensive	Information provision and checking compliance with contracts
Investors provide finance for business to provide eco-services	Water company debt finance to fund catchment schemes	Legal rules and regulatory framework
Individuals (possibly co-fund) and buy the eco-service	Households purchase land for local nature reserve	Information provision, legal rules, access to finance, etc.

Trusted intermediaries are also critically important actors in facilitating PES. They typically assist with documenting ecosystem service conditions, identifying specific resource management alternatives, aggregating multiple landowners/resource users (if needed), engaging and negotiating with prospective buyers, and any other activities related to implementation (including monitoring, certification, verification, etc.).[394] More importantly, they act as service and information providers, mediators, arbitrators, representatives, watchdogs, developers of standards and bridge-builders.[395] These intermediaries are often locally-based, trustworthy and enduring organisations (e.g. the Rivers Trusts) who have a good understanding of the local environment (i.e. the relationship between actual land use practices and ecosystem services) and who already have (or can nurture) effective relationships with land managers.

Essentially, intermediaries act as the corner stone of any PES scheme, acting as a focal point for all stakeholders. While several other institutions will be involved at different points in time and at different levels, it is important that there is an enduring focal point to push the entire process, from design and implementation, to operation and continuous adjustment.[396] In some cases, this intermediary role may take the shape of a PES programme committee built on a trust fund to where contributions from all beneficiaries converge. According to the FAO, this new entity can include representation from all the main bodies involved - user associations, farmer cooperatives, local government authorities, NGOs - and is collectively responsible for steering the programme.[397]

[394] Forest Trends, the Katoomba Group, and UNEP (2008). *Payments for Ecosystem Services: Getting Started – A Primer* [online] available at: http://www.katoombagroup.org/documents/publications/GettingStarted.pdf (accessed 30 April 2011).
[395] Pham, T.T., Campbell, B.M., Garnett, S.T., Aslin, H. and Hoang, M.H. (2010). Importance and impacts of intermediary boundary organizations in facilitating payment for environmental services in Vietnam. *Environmental Conservation* (2010), 37: 64-72.
[396] FAO (2010). *Payments for Environmental Services from Agricultural Landscapes* [online] available at: http://www.fao.org/es/esa/pesal/index.html (accessed 28 July 2011).
[397] *Ibid*

The FAO emphasises that its duties may range from leading the negotiations between providers and beneficiaries and making the bridge between them and the relevant partner and statutory institutions consulted, and often even international donors. Moreover, it can deal with hiring expertise at different levels and stages, coordinating response from national regulatory bodies to identify priority areas and eligible land use/management and set payment levels.[398] In some cases, this institution may also take on the role of monitoring the environmental performance of the measure introduced (or this could also be provided by an independent body), and for adjusting eligible areas, activities and correspondent payments as appropriate.[399] The table below shows the possible roles of intermediaries and facilitators in PES schemes.

Table 6: Roles of intermediaries and facilitators in PES schemes[400]

Roles of Facilitators (International to Local Institutions)		Roles of Intermediary (Local institutions or with local representation)	
Finance	**Information**	**Technical / Governance**	**Governance**
Providing donations (or loans) for feasibility studies and start-up costs	• Providing policy guidance • Establishing social and biophysical baseline	• Promotion • Co-ordinating buyers and sellers • Collecting and transferring payments • Monitoring	• Negotiation • Management • Supervision • Revision

3.8 Cultural factors

3.8.1 Aversion to paying for ecosystem services

To some, the very idea of paying in monetary terms for nature-based ecosystem services is objectionable; they may consider that providers should be forced to act in ways that ensure a certain level of service, i.e. a restriction of property rights such as the ability to choose land uses freely. To others, there is a social class aspect, since in practice most payments would be made – directly or indirectly – by 'ordinary' citizens (or taxpayers) to land owners or managers who control the use of a valuable resource with specific legal characteristics. When many of these providers are already recipients of substantial public funds in the form of CAP payments (and tax preferences), negative attitudes may intensify.

3.8.2 Lack of trust amongst land managers

PES often implies collaboration between land managers. Dependent on the ecosystem service under consideration (e.g. habitat maintenance), it may be important for land to be contiguous (meaning that it is important to recruit specific farmers, not just volunteers) or for the entire

[398] FAO (2010). *Payments for Environmental Services from Agricultural Landscapes* [online] available at: http://www.fao.org/es/esa/pesal/index.html (accessed 28 July 2011).
[399] *Ibid*
[400] *Ibid*

group of land managers in an area to agree to a shared action, and shared payment. However, mutual trust between land managers is not a given and may be difficult to generate. This is exacerbated if some land is deemed more important as a service provider than others: negotiating 'shares' of payments or adequacy of services provided (e.g. differing standards of action, penalties for non-compliance) will need to be carefully thought through.

It will be important that land management experts express positive attitudes towards PES, particularly amongst targeted groups of landholders: research in England in 2007-2008 (Sutherland, pers. comm.) found numerous farmers who were discouraged from applying for Higher Level Stewardship schemes by professional agricultural advisors (rightly or wrongly) on the basis that the schemes were oversubscribed and highly competitive, and thus the farmers would have little chance of success.

3.8.3 Terminology

Another limiting factor to the uptake of PES schemes amongst potential suppliers and buyers is a lack of awareness or understanding amongst stakeholders of the specific meanings of 'ecosystem services' and 'PES'. It is possible that the establishment of PES may be enhanced by translating the language and process around PES into something that may be more readily understood by a more general audience or, alternatively, tailored to a very specific audience, for example using the language of business to convey concepts and benefits, in terms of their supply chains, their values, and the opportunities for business.

3.9 Legal

3.9.1 Property rights and other issues

Legal barriers to designing and implementing a PES depend on the nature of the PES, the parties to the agreement and what is required. It is difficult for legal mechanisms to take in the complexity of the ecosystem. The law is not concerned with the practical implications of a particular course of land management but with the specific and enforceable rights and duties of the contracting parties.

There are therefore boundaries to what can be achieved through this means. The limits of what can be done will be set by legal rights and responsibilities within and beyond the specific PES scheme: i.e. regulatory constraints; rights of other proprietors; other legal rights e.g. mortgage held over heritable property.

Appropriate forms of property rights or tenure security play a key role in both economic incentives and payment arrangements because they control access to benefits and also define responsibilities for actions needed to ensure their provision. Thus they determine who has access to particular resources, and whether those who pay the costs of management practices have access to any of the benefits, and therefore have an incentive for conservation. The OECD argues that a key pre-requisite for a well-functioning PES programme is that property rights are clearly defined and enforced[401]; however, this is likely to much more of an issue in developing rather than developed countries. Salzman (2009) distinguishes between *de jure* and *de facto* land titles: *de jure* title describes ownership of the land, while *de facto* recognises only the occupancy and the practices taking place on the land.[402] In relation to agri-

[401] OECD (2010). *Paying for biodiversity: enhancing the cost-effectiveness of payments for ecosystem services*. OECD: Paris.
[402] Salzman, J. (2009). *A Policy Maker's Guide to Designing Payments for Ecosystem Services*. Duke Law Faculty Scholarship. Paper 2081 [online] available at: http://scholarship.law.duke.edu/faculty_scholarship/2081 (accessed 9 May 2011).

environment schemes here, Environmental Stewardship is open to all farmers, land managers and tenants in England.[403]

Identifying the appropriate party with whom to enter into a PES is a vital preliminary step, and this may not always be easy. Further, legal ownership vehicles such as the trust present a veil of secrecy in practical terms, since one might be able to identify the trust as the landowner but may have difficulty identifying key personnel with which to negotiate and develop an ongoing relationship.

English proprietary rights to land are complex. The fee or freehold estate comprises the right to use and enjoy the land for the duration of the life of the granter and that of his heirs and successors. The leasehold estate comprises the right to use the land exclusively as owner for a stated period of time. The fee tail and life interest are rare in modern land law. Interests in land giving the holder the equivalent of a right of ownership for a defined period in time include easements, mortgages, restrictive covenants and options. Further rights may be 'legal' or 'equitable'.

Further, PES raises questions not only of rights of ownership of the 'land' but also of rights to crops, including, for example, forestry, and to water. It raises questions as to who has the right to use and enjoy the physical asset (e.g. landlord and tenant).

Opportunities to design and implement a PES will depend on the nature of the PES, the parties to the agreement, and what is required. While PES might be seen as a useful tool to encourage participation, it must eventually lead to prioritisation of values and exclusion of some interests. Use of legal mechanisms such as private management agreements will exclude those not party to the legal arrangement.

Personal rights must be differentiated from proprietary rights, i.e. those that pass with the land. There is a need to attach PES to proprietary rights if buyers seek to ensure that the responsibilities will pass with the land, and that they will endure for a sufficient period of time to deliver the benefit. Similar considerations exist with respect to the need to attach PES to secure tenure.

Other key legal issues include:

- *Lack of accountability* – where a contractual approach is taken the delivery of PES will be binding only on the parties to the contract, unless statute provides otherwise.
- *Lack of effective enforcement mechanisms* - Need to consider the effectiveness of enforcement mechanisms if the 'seller' fails to deliver the required service.
- *The need to consider the burden of proving that failure is the 'sellers' responsibility* rather than, for example, another upstream water proprietor.

Once the relevant landowner or manager has been identified, do they have the capacity to contract? This comes down to proprietary rights. The issue again may extend beyond ownership of land to, for example, ownership of intellectual property. It raises questions as to whether the parties have the power to enter into the agreement (e.g. tenant farmer – rights of tenant and term of tenancy will both have implications for effective operation of PES); does the landowner, for example, owe legal rights to others which could conflict with the PES (e.g. restrictive freehold covenants which may regulate the future development of the land)?

[403] Natural England (2011). *Look after your land with Environmental Stewardship* [online] available at: http://naturalengland.etraderstores.com/NaturalEnglandShop/NE124 (accessed 26 July 2011).

There is a need to avoid a fragmentary approach, which is perhaps likely to occur where PES is delivered through legal agreements with specific parties. There is a need for an overarching, harmonious and coherent approach to the delivery of environmental quality objectives. Thus the role and responsibility of the 'sellers' and the institutions delivering or facilitating the PES approach will be vitally important.

3.10 Equity considerations

3.10.1 Perceived unfairness

The FAO highlights the controversial issue of whether environmental service payments should be directed to those who currently provide services or to those whose land parcels have the greatest potential for increased service provision.[404] While the former provide the greatest level of current service provision, directing payments towards the latter represents the most efficient use of payments to enhance services.[405] This brings the argument back to the notion of **additionality** (see section 2.3) with Forest Trends, the Katoomba Group, and UNEP (2008) arguing that *the* critical, defining factor of a PES transaction is that *the payment causes the benefit to occur where it would not have done so otherwise*.[406] Those land managers already providing services would not therefore qualify for payments under a PES programme which included an additionality standard.[407] Perhaps inevitably, programmes based on additionality may be perceived as "not fair" and as "rewarding the bad guys".[408] The FAO argues that, given social and political realities, it may be very difficult to implement programmes based on strict additionality criteria, particularly publicly funded programmes.[409] Costa Rica's *Pagos por Servicios Ambientales* (PSA) (see section 2.7) programme is explicitly non-additional (in principle, given a sufficient budget, the PSA programme would pay every forest owner for the services that the forest provides).[410] However, as the FAO emphasises, budgets are generally limited and some choices need to be made in terms of how best to distribute funds.[411] One approach is to target payments towards those sites that provide a disproportionate level of benefits or where the risk of ecosystem service loss or degradation is high or on the basis of the opportunity costs associated with service provision (see section 3.4). However, concerns have been raised in the context of some programmes (e.g. the Scottish Challenge Fund) that landholders perceive differentiated payments as unfair.[412] Furthermore, where a PES programme has a fixed budget, differentiating payments so as to reflect opportunity costs implies a trade-off between larger payments for fewer people and smaller payments for more people.

The varying scales of land manager can be problematic. For example, while it may be worthwhile for a representative of a landholding of thousands of hectares to attend the meetings necessary to secure an agreement, this is less likely to be the case for small to medium-scale land holders, particularly if the outcome of participation/negotiation is uncertain.

[404] Food and Agricultural Organization of the United Nations (2007). *The State of Food and Agriculture 2007: Paying Farmers for Environmental Services* [online] available at: ftp://ftp.fao.org/docrep/fao/010/a1200e/a1200e00.pdf (accessed 1 May 2011).
[405] *Ibid*
[406] Forest Trends, the Katoomba Group, and UNEP (2008). *Payments for Ecosystem Services: Getting Started – A Primer* [online] available at: http://www.katoombagroup.org/documents/publications/GettingStarted.pdf (accessed 26 April 2011).
[407] Food and Agricultural Organization of the United Nations (2007). *The State of Food and Agriculture 2007: Paying Farmers for Environmental Services* [online] available at: ftp://ftp.fao.org/docrep/fao/010/a1200e/a1200e00.pdf (accessed 1 May 2011).
[408] Dobbs and Pretty (2004) cited in Food and Agricultural Organization of the United Nations (2007). *The State of Food and Agriculture 2007: Paying Farmers for Environmental Services* [online] available at: ftp://ftp.fao.org/docrep/fao/010/a1200e/a1200e00.pdf (accessed 1 May 2011).
[409] Food and Agricultural Organization of the United Nations (2007). *The State of Food and Agriculture 2007: Paying Farmers for Environmental Services* [online] available at: ftp://ftp.fao.org/docrep/fao/010/a1200e/a1200e00.pdf (accessed 1 May 2011).
[410] *Ibid*
[411] *Ibid*
[412] OECD (2010). *Paying for biodiversity: enhancing the cost-effectiveness of payments for ecosystem services*. OECD: Paris.

This could result in agreements being reached primarily with large-scale land owners. This might also be politically unpalatable, given the negative publicity surrounding 'large' subsidy payments made to 'wealthy' landowners.

The FAO emphasises that decisions on how to set and implement targeting criteria are, of course, strongly related to the overall programme objectives.[413] They cite research comparing two hypothetical PES schemes – one with a flat payment and a cap on the amount of land that could be enrolled by any one participant and another that took deforestation risk and land productivity into account. The simulations revealed that targeted payments were far more efficient in terms of generating environmental services, but that the flat payment scheme was more egalitarian.[414] The results indicate the importance of considering tradeoffs between efficiency and equity.[415]

[413] Food and Agricultural Organization of the United Nations (2007). *The State of Food and Agriculture 2007: Paying Farmers for Environmental Services* [online] available at: ftp://ftp.fao.org/docrep/fao/010/a1200e/a1200e00.pdf (accessed 1 May 2011).
[414] Alix-Garcia, de Janvry and Sadoulet (forthcoming) cited in Food and Agricultural Organization of the United Nations (2007). *The State of Food and Agriculture 2007: Paying Farmers for Environmental Services* [online] available at: ftp://ftp.fao.org/docrep/fao/010/a1200e/a1200e00.pdf (accessed 1 May 2011).
[415] *Ibid*

4 The scope for PES in England

4.1 Introduction

This chapter briefly describes the range of ecosystem services derived from each of the eight broad habitat types identified by the NEA. It then explores where the potential may lie for maintaining or enhancing the supply of ecosystem services through changes to the ways in which the habitats that give rise to these services are managed. This chapter neither attempts to comprehensively assess all ecosystem services nor to examine the full range of management activities that may be taken to enhance the provision of ecosystem services. Rather, it is intended to build on the work of the NEA by examining the opportunities for capturing the value of ecosystem services that offer tangible benefits for which beneficiaries may be willing to pay.

The NEA (p2) defines ecosystems as *"a complex where interactions among the biotic (living) and abiotic (non-living) components of that unit determine its properties and set limits to the types of processes that take place there"*.[416] Ecosystems exist at various scales, ranging from individual species and habitats to regional biomes[417] which may themselves be an assemblage of different ecosystems. The main identifying feature of an ecosystem is that it is indeed a system, with interactions between its living elements and their environment. While the location or size of an ecosystem is important, these are secondary to its properties as a system. Ecosystems are often defined in terms of their dominant vegetation or environmental features, for example, a wetland, forest, grassland, lake, rock pool, or mountain ecosystem.

In the UK and much of Europe, the classification of ecosystems can be considered as significantly overlapping with that of habitats. A definition of a habitat is an ecological or environmental area that is inhabited by a particular animal or plant species. In Europe, Annex I of the EU Habitats Directive[418] lists 231 European natural habitat types, including 71 priority types (i.e. habitat types in danger of disappearance and whose natural range mainly falls within the territory of the EU).

Following the lead of the NEA, this study adopts the land cover types identified by the Countryside Survey of the UK as the basis for the classification of English ecosystems. The Countryside Survey land cover types correspond with the UK Biodiversity Action Plan (UK BAP) classification of broad habitats as shown in Table 7.

[416] UK National Ecosystem Assessment (2011). *The UK National Ecosystem Assessment: Technical Report*. UNEP-WCMC, Cambridge [online] available at: http://uknea.unep-wcmc.org/Resources/tabid/82/Default.aspx (accessed 6 July 2011).
[417] Various definitions exist in the literature but a biome is essentially a major regional ecological community of plants and animals characterised by a specific climate.
[418] Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora [online] available at: http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:31992L0043:EN:NOT (accessed 25 February 2011).

Table 7: Example of ecosystem classification by UK BAP habitat[419]

UK ecosystems (NEA)	UK Broad Habitats
Enclosed farmlands	Arable and Horticulture
	Improved Grassland
	Boundary and Linear Features
Woodlands	Broadleaved, Mixed and Yew Woodlands
	Coniferous Woodlands
Semi-natural grasslands	Neutral Grasslands
	Calcareous Grasslands
	Acid Grasslands
Open waters, wetlands and floodplains	Rivers and Streams
	Standing Open Water and Canals
Mountains, moors and heaths	Bogs
	Bracken
	Dwarf Shrub Heath
	Fen, Marsh and Swamp
	Inland Rock
	Montane Habitats
Coastal margins	Sand Dunes
	Machair
	Saltmarsh
	Shingle
	Sea Cliffs
	Lagoons
Urban environment	Built-up areas and gardens
	Urban
Marine environment	Continental Shelf Slope
	Inshore sublittoral rock
	Inshore sublittoral sediment
	Littoral rock
	Littoral sediment

As noted by Haines-Young and Potschin (2007)[420], a clear advantage of using these habitats as a framework for representing the output of goods and services is that, as distinct ecological units, they may be seen in terms of the 'bundles' of services that they can deliver. This makes it easier to assess their relative importance as elements of 'natural capital', and any trade-offs in

[419] There may be overlap between habitats and different ecosystems and alternative ways of assigning UK habitats; this table is an attempt at loose classification and should be taken as non-prescriptive.
[420] Haines-Young, R. and Potschin, M. (2007). *The Ecosystem Concept and the Identification of Ecosystem Goods and Services in the English Policy Context*. Review Paper to Defra, Project Code NR0107, 21pp [online] available at: http://www.ecosystemservices.org.uk/docs/NR0107_pos%20paper%20EA_D1.3.pdf (accessed 25 February 2011).

the output of ecosystem goods and services that arise through current or future management choices can be better understood.

However, a framework structured around habitats may not capture all the important goods and services that England's natural capital can deliver. For example, there may be some functions and services that arise from the combination of habitats in a broader mosaic of land cover types or in distinct topographical units such as drainage basins. The delivery of services may also be highly context-dependent (for example, comparing a small, high-gradient river in sparsely populated terrain with a larger and flatter lowland river running close to, or through, densely populated areas). Such higher-level services might be difficult to assess by looking at habitats separately. It may, for example, be a combination of regulating functions from mountain, woodland and riverine habitats that deliver water quality to downstream beneficiaries.

This is important when considering the potential for PES where, in order to satisfy the additionality condition of PES schemes, it is necessary to identify clear cause-effect relationships between changes in land management practices and changes in the level of quality of ecosystem service(s) delivered. This study therefore considers the origin of ecosystem services in the context of the land cover or habitat types where actions may be taken to maintain or enhance ecosystem service provision.

4.1.1 Defining ecosystem services to determine the scope for PES

The following discussion differentiates, as a matter of necessity, between ecosystem functions, ecosystem services and benefits. As Banzhaf and Boyd (2005)[421] and Boyd and Banzhaf (2005[422], 2006[423]) have noted, the literature is ambiguous about how to distinguish between ecosystem functions and services, and what this means for the way one might value the benefits that people ultimately enjoy from them. The extent to which ecosystems give rise to discernible benefits (for which people may be willing to pay) depends largely on local circumstances. Drawing largely on Boyd and Banzhaf (2007)[424], Fisher *et al.* (2008, p646)[425] propose that "*ecosystem services are the aspects of ecosystems utilised (actively or passively) to produce human well-being*". Defined this way, ecosystem services include ecosystem organisation or structure as well as processes and/or functions if they are consumed or utilised by humanity either directly or indirectly. The functions or processes therefore only become services if there are people who benefit from them.

For the purposes of economic analysis within the NEA, Bateman *et al.* (2010)[426] also draw the distinction between supporting primary processes and intermediate ecosystem services (e.g. nutrient cycling), final ecosystem services (e.g. growth of trees), goods (e.g. timber) and benefits. Final ecosystem services are simply the last item in the chain of ecosystem functioning which inputs to the production of goods. They are the aspects of the natural environment which most directly affect human wellbeing. The focus on the final item in the chain of ecosystem services is simply to avoid the double counting which would occur if an attempt is made to directly value those ecological processes (e.g. weathering, soil formation,

[421] Banzhaf, S. and Boyd, J. (2005). *The architecture and measurement of an ecosystem service index*. Discussion Paper. Resources for the Future DP 05-22, 54pp.
[422] Boyd, J. and Banzhaf, S. (2005) Ecosystem services and government accountability: The need for a new way of judging nature's value. *Resources*. Summer 2005: 16-19.
[423] Boyd, J. and Banzhaf, S. (2006). What are ecosystem services? Discussion Paper. Resources for the Future DP06-02, 26pp.
[424] Boyd, J. and Banzhaf, S. (2007). What are ecosystem services? The need for standardized environmental accounting units. *Ecological Economics* 63 (2–3): 616–626.
[425] Fisher, B., Kerry Turner, R. and Morling, P. (2008). Defining and classifying ecosystem services for decision making. *Ecological Economics*, 68(3): 643-653.
[426] Bateman, I.J., Mace, G.M., Fezzi, C., Atkinson, G. and Turner, K. (2010). Economic Analysis for Ecosystem Service Assessments. *Environmental and Resource Economics*, 48(2): 177-218.

nutrient cycling, etc.) which support multiple ecosystem services. A 'good' is the term used for any object or construct which generates human wellbeing. A 'benefit' is simply the change in human wellbeing generated by a good. Whereas previous ecosystem services assessments have sometimes used the terms 'good' and 'benefit' synonymously and many earlier classifications of ecosystem services used the term 'good' to describe tangible ecosystem outputs which were classified as provisioning services under the MA, Bateman *et al.* draw a sharp distinction between the two, to highlight the fact that the same good can generate very different benefit values depending on its context (e.g. location) and timing of delivery, particularly in relation to alternative quantities of the same good ('marginal benefit'). So, for example, flood control is not necessarily a valued benefit (i.e. one for which people are willing to pay) unless those downstream gain from flood risk alleviation, above and beyond existing flood management measures. In assessing the scope for PES, this study focuses on the final ecosystem services, goods and benefits derived from each of the habitat types.

4.1.2 Ascribing importance to ecosystem services

Ascribing 'importance' to ecosystem services is a largely subjective process based upon a range of factors. For example, some ecosystem services may be rare but highly valued per unit (e.g. per hectare), while others may be common but with low unit values. Some may be at risk while others are less so; some (e.g. water supply) may be more amenable to PES than others, such as those generated in the marine environment.

The NEA presents an analysis of the relative importance of different habitats in delivering ecosystem services across the UK. Figure 9 overleaf presents the NEA's analysis of the relative importance of different Broad Habitats in delivering ecosystem services and the overall direction of change in service flow over the last two decades.

In keeping with the definition of PES set out in Section 2.3, and to satisfy the 'additionality' criterion in particular, the assessment of the scope for PES in each of the Broad Habitat types focuses on those ecosystem services that:

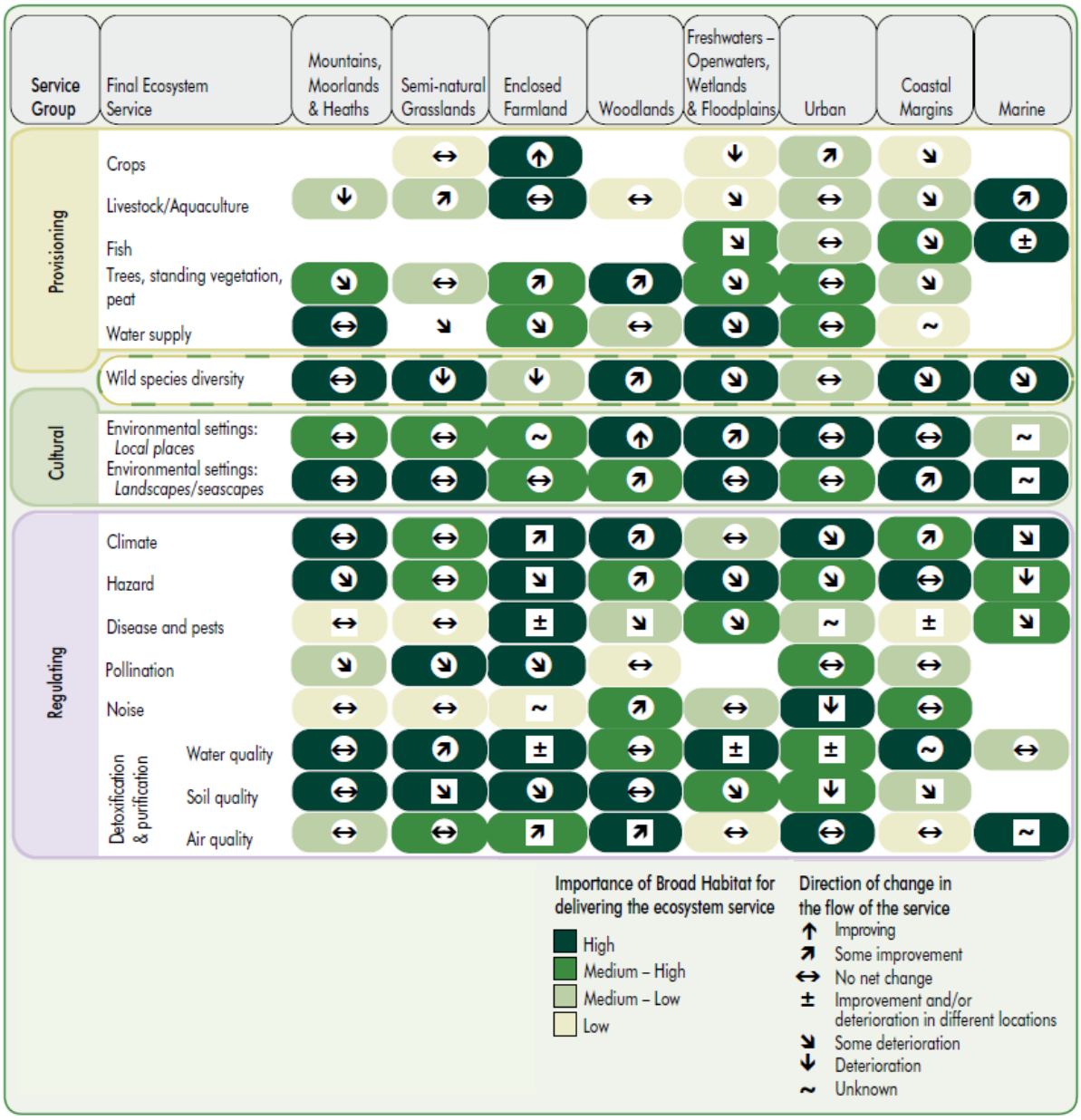
- Are important within each Broad Habitat type (i.e. denoted as being of medium to high or high importance in the NEA)
- Have experienced at least some deterioration since 1990

The NEA also examines the importance of different drivers of biodiversity change. Interestingly, although perhaps not unexpectedly, the principal drivers of biodiversity loss to date (i.e. land-use change and pollutants) are also typically the ones that incentives offered through PES-type schemes may be able to help address. While climate change, invasive species and exploitation have been assessed as being of relatively less of a threat to UK biodiversity to date, this may change in future as the impacts of climate change take effect.

The remainder of this chapter describes the significance of each of the broad habitat types in terms of the ecosystem services derived from each. To ensure comparability between habitat types, the discussion draws extensively on information from the most recent (2007) Countryside Survey[427] and the NEA Synthesis of Key Findings[428] and Technical Report[429].

[427] Countryside Survey (2008). *Countryside Survey: England Results from 2007* [online] available at: http://www.countrysidesurvey.org.uk/eng_reports2007.html (accessed 13 December 2010).
[428] UK National Ecosystem Assessment (2011). *The UK National Ecosystem Assessment: Synthesis of the Key Findings*. UNEP-WCMC, Cambridge [online] available at http://uknea.unep-wcmc.org/Resources/tabid/82/Default.aspx (accessed 6 July 2011).
[429] UK National Ecosystem Assessment (2011). *The UK National Ecosystem Assessment: Technical Report (Chapter 7: Enclosed Farmland)*. UNEP-WCMC, Cambridge [online] available at: http://uknea.unep-wcmc.org/Resources/tabid/82/Default.aspx (accessed 6 July 2011).

Figure 9: Relative importance (coloured cells) of Broad Habitats in delivering ecosystem services and overall direction of change (arrows) in service flow since 1990[430]



[430] UK National Ecosystem Assessment (2011). *The UK National Ecosystem Assessment: Synthesis of the Key Findings*. UNEP-WCMC, Cambridge [online] available at: http://uknea.unep-wcmc.org/Resources/tabid/82/Default.aspx (accessed 6 July 2011). This information is based on information synthesized from the habitat and ecosystem service chapters of the UK NEA Technical Report (Chapters 5-16), as well as expert opinion. This figure represents a UK-wide overview and will vary nationally, regionally and locally. It will therefore also inevitably include a level of uncertainty; full details can be found in the UK NEA Technical Report. Arrows in circles represents where there is high confidence in the direction of service flow amongst experts; arrows in squares represent where there is less evidence for, or confidence in, the direction of service flow. Blank cells represent services that are not applicable to a particular Broad Habitat.

4.2 Enclosed farmland (EFL)

4.2.1 Description

Approximately 60% of the land area of England is composed of enclosed farmland that may be further classified into two broad habitats: Arable and Horticulture (henceforth Arable Broad Habitat) and Improved Grassland.[431] These contain the most intensively farmed and managed land, providing much of the agricultural produce of the UK.

Intensive management of cultivated land has generally resulted in environments with relatively few plant species, in which small pockets of less intensively managed (or unmanaged) land provide an important refuge for plants. The Arable Broad Habitat covers around 30.4% of the total area of England and is concentrated in eastern England, while Improved Grasslands account for around 21.7% of total land area and occupy the wetter western parts of the country.[432]

The area of arable and horticultural land in England decreased by 8.8% between 1998 and 2007, but evidence from the Countryside Survey suggests that species richness increased with a notable increase in numbers of plant species that are used by farmland wildlife for food. However, it is not clear whether the benefits observed were driven by policy or economic responses, and hence whether they are likely to be sustained into the future. More generally, there has been a trend towards specialisation and landscape homogenisation due to mechanisation, use of inorganic fertilizers, economies of scale and market forces in combination with EU agricultural policies. An increase in the area of improved grassland of 5.2%[433] over the same period is largely attributed to the introduction of agri-environmental schemes, which now cover 8.45 million ha, and set-aside policies.[434]

The EFL broad habitat also includes the boundary and linear features which often 'enclose' farmland and which are important components of the English landscape, and of its ecosystems. In 2007, there were 547,000km of woody linear features in England (including those in semi-natural grassland and other habitats, treated below)[435]. The total length of managed hedgerows was 402,000km, a decrease of 6.1% (26,000km) since 1998, largely as a result of reduced hedge management and the subsequent conversion of managed hedges into lines of trees and relict hedges. There were also 82,000km of walls and 42,000km of banks and grass strips[436].

There are a number of interactions between EFL and other habitats as a result of:

- co-management with upland grazing areas on the same farms;
- transport of pollutants between them in air and water;
- the high value placed on landscape matrices in terms of landscape quality; and
- impacts on habitat change beyond the UK through trade of food and, increasingly, bio-energy.

[431] Countryside Survey (2008). *Countryside Survey: England Results from 2007* [online] available at: http://www.countrysidesurvey.org.uk/eng_reports2007.html (accessed 13 December 2010).
[432] *Ibid.*
[433] *Ibid.*
[434] UK National Ecosystem Assessment (2011). The UK *National Ecosystem Assessment: Technical Report.* UNEP-WCMC, Cambridge [online] available at: http://uknea.unep-wcmc.org/Resources/tabid/82/Default.aspx (accessed 6 July 2011).
[435] Countryside Survey (2008). *Countryside Survey: England Results from 2007* [online] available at: http://www.countrysidesurvey.org.uk/eng_reports2007.html (accessed 13 December 2010).
[436] *Ibid.*

4.2.2 Ecosystem services provided by enclosed farmlands

The key ecosystem services generated by EFL in England, as identified by the NEA, are outlined in the table below, together with an indication of the relative importance of enclosed farmlands in delivering each of the listed ecosystem services.

Table 8: Main ecosystem services from enclosed farmland[437]

Provisioning		Cultural		Regulating	
Crops	H	Local places	M-H	Climate	H
Livestock / Aquaculture	H	Landscapes / seascapes	M-H	Hazard	H
Fish				Disease and pests	H
Trees, standing vegetation, peat	M-H			Pollination	H
Water supply	M-H			Noise	L
Wild species diversity	M-L	Wild species diversity	M-L	Water quality	H
				Soil quality	H
				Air quality	M-H
Key					
High	H	Blank cells represent services that are not applicable to the Broad Habitat			
Medium – High	M-H				
Medium – Low	M–L				
Low	L				

Provisioning is the major ecosystem service provided by Enclosed Farmland, underpinning the UK agri-food sector which contributes around 6.7% to UK GDP[438] (note: these figures include production from the uplands as well as from Enclosed Farmland. The UK NEA report indicates that levels of provisioning services (**agricultural production**) have increased since World War II, while many other ecosystem services from enclosed farmlands have declined. However, since the 1990s, a slowing of farm output and, in some cases, a reversal in ecosystem services loss has been observed. While Enclosed Farmland produces around 70% of the UK's food[439], the contribution of food production to the UK GDP has fallen from almost 3% in 1973 to 1.5% in 1996 and around 0.6% in 2009.

Arable and horticulture and improved grasslands, alongside the neutral and acid grassland habitats (covered under Semi-Natural Grasslands (SNGLs), provide **distinctive landscapes**,

[437] UK National Ecosystem Assessment (2011). *The UK National Ecosystem Assessment: Synthesis of the Key Findings*. UNEP-WCMC, Cambridge [online] available at: http://uknea.unep-wcmc.org/Resources/tabid/82/Default.aspx (accessed 6 July 2011).
[438] Defra (2010). *Agriculture in the United Kingdom 2009*. Defra, DARDNI, SEERAD, WAG Department for Rural Affairs and Heritage. [online] available at: http://www.defra.gov.uk/evidence/statistics/foodfarm/general/auk/latest/index.htm (accessed 10 July 2011).
[439] UK National Ecosystem Assessment (2011). *The UK National Ecosystem Assessment: Synthesis of the Key Findings*. UNEP-WCMC, Cambridge [online] available at: http://uknea.unep-wcmc.org/Resources/tabid/82/Default.aspx (accessed 6 July 2011).

as recognised by National Character Areas[440]. Agriculture is not considered to have altered the character of these landscapes; indeed, English farmland offers a landscape mosaic that is aesthetically valued. Farmland can also protect historical environments and has **cultural heritage** value[441]. Some areas of enclosed farmland also support game sports such as partridge shooting and thus have **recreational** value.

Farmland and its accompanying features (e.g. hedges) also offer a number of regulating services, which in turn support other services (provisioning and cultural). For example, **pollination** (e.g. of orchards) underpins certain types of crop, thus supporting jobs and creating and maintaining distinctive landscapes. Farmland can also regulate **biodiversity** by offering suitable conditions for farmland birds and other wildlife. Birds influence many services, including cultural services in farmland, although quantitative data is lacking on the values and benefit they provide (the farmland bird index declined by 43% between 1970 and 1998, and by a further 4% between 1998 and 2008). During the 20th century as a whole, agriculture was associated with major declines in the diversity and numbers of plants, terrestrial invertebrates and vertebrates. The trends in biodiversity on Enclosed Farmland are evident when looking at the condition of sites designated for conservation. The UK NEA notes that, across the UK as a whole, in 2006, only 26 out of 710 Areas of Special Scientific Interest (ASSIs) and Sites of Special Scientific Interest (SSSIs) on Arable Horticultural sites and Improved Grasslands were in favourable condition[442].

The soils and vegetation of agricultural land also provide a **carbon store**, though in very different amounts depending on type. Arable and horticultural soils contain only about 43 tonnes of carbon per hectare (and crops about 1 tonne per hectare) and improved grassland about 60 tonnes, compared to about 260 tonnes for heath and bog land (and 2 tonnes in its vegetation)[443]. Moreover, amounts of carbon held by arable and horticultural land fell between 1998 and 2007. However, current agricultural management often generates emissions of greenhouse gases and releases nutrients to air and water, resulting in Enclosed Farmland causing net disbenefits.

4.2.3 Scope for PES from Enclosed Farmland

Because of its role as England's major land user, agriculture represents a **key policy area in relation to ecosystem services** and it is likely that payments for ensuring continued provision of ecosystem services will form a significant proportion of future agricultural incomes.[444] Moreover, the modification of ecosystems as a result of agricultural practice has significance in relation to a number of policy areas, including food and energy production, waste disposal, carbon sequestration, habitat creation, landscape management and water cycle management[445], many of which are relevant to potential PES schemes.

Agricultural policy in England operates largely within the EU Common Agricultural Policy (CAP), which consists of two 'Pillars'. Pillar 1 comprises direct payments to farmers (subject to environmental conditions) and market management measures (e.g. export subsidies). Pillar 2 focuses on rural development measures (including agri-environment schemes). While direct

[440] Natural England. http://www.naturalengland.org.uk/ourwork/landscape/englands/character/areas/default.aspx
[441] Countryside Survey (2008). *Countryside Survey: England Results from 2007* [online] available at: http://www.countrysidesurvey.org.uk/eng_reports2007.html (accessed 13 December 2010).
[442] UK National Ecosystem Assessment (2011). *The UK National Ecosystem Assessment: Technical Report*. UNEP-WCMC, Cambridge [online] available at: http://uknea.unep-wcmc.org/Resources/tabid/82/Default.aspx (accessed 6 July 2011).
[443] Ostlea, N. J., Levy, P. E., Evans, P. and Smith, P. (2009). UK land use and soil carbon sequestration, *Land Use Policy,* 26S (2009) S274–S283 [online] available at: http://www.bis.gov.uk/assets/bispartners/foresight/docs/land-use/jlup/31_uk_land_use_and_soil_carbon_sequestration.pdf (accessed 18 September 2011).
[444] Parliamentary Office of Science and Technology (2007). *Postnote number 281: Ecosystem Services* [online] available at: http://www.parliament.uk/documents/post/postpn281.pdf (accessed 25 April 2011).
[445] *Ibid*

payments to farmers under Pillar 1 accounts for around three-quarters of the CAP budget, just under one-quarter is spent on rural development measures.[446] Direct payments to farmers under the so-called Single Payment Scheme (SPS) scheme are not linked to production and therefore leave farmers free to farm in accordance with market demand subject to the requirements of cross-compliance. SPS payments totalling over £1.5 billion are paid to over 100,000 farmers in England each year and administered by the Rural Payments Agency (RPA).[447] Although these payments are largely unrelated to decisions over land use, in order to receive payment, claimants must comply with EU standards covering public, animal and plant health, environmental and animal welfare (known as 'cross-compliance') on all their agricultural land.[448] The payments ensure management structures (and thus practices) on many smaller farms that would otherwise be uneconomic, and are argued to provide wider 'public benefits' in terms of food security and a viable farming population, though others, e.g. Tangermann (p15)[449] contend that the current SPS instrument is "blunt" and not efficient for such purposes. There are several types of cross-compliance requirements including domestic legal obligations requiring that land be kept in Good Agricultural and Environmental Condition (GAEC). GAEC standards set requirements for farmers in respect of soils, as well as maintaining a range of habitat and landscape features which are characteristic of the English countryside. [450]

Pillar 2 of the CAP encompasses the Rural Development Programme for England (RDPE) which, amongst other things, looks to support farmers and foresters to deliver environmentally beneficial land management practices, which are not always supported by the market.[451] Under Pillar 2, farmers are essentially paid on an 'income foregone' basis for taking measures that protect and enhance the natural environment, for example planting hedges, digging drainage ditches, managing runoff, and taking care of field margins. The total budget available for AES under the RDPE for the seven-year programme period 2007–2013 is £3.1 billion.[452] As of August 2009, there were more than 58,000 AES agreements in place covering in excess of six million hectares in England, representing over 66% of English agricultural land and approaching the Government's target of 70% coverage.[453] The Environmental Stewardship scheme, one of two AES in England (the other being the English Woodland Grant Scheme) is arguably one of the world's largest PES schemes[454] and has delivered genuine environmental benefits. For example, 41% of hedgerows in England are actively managed under Environmental Stewardship and its predecessor schemes[455] and the schemes currently deliver greenhouse gas savings of 3.46 million tonnes of CO_2 equivalent per year.[456] AES and set-aside policies are thought to be responsible for the 5.4% increase in enclosed grassland

[446] See Defra web pages on CAP reform at: http://ww2.defra.gov.uk/food-farm/farm-manage/cap-reform/ (accessed 25 April 2011).
[447] See Defra web pages on the SCS at: http://ww2.defra.gov.uk/food-farm/farm-manage/single-pay/ (accessed 25 April 2011).
[448] These standards also apply to payments under certain rural development schemes.
[449] Tangermann, S. (2011). *Direct Payments in the CAP post 2013*. Briefing note for the European Parliament, January 2011 [online] available at: http://www.reformthecap.eu/sites/default/files/EP%20note%20direct%20payments_Tangermann.pdf [accessed 10 July 2011).
[450] See Defra web pages on cross-compliance at: http://www.defra.gov.uk/foodfarm/farmmanage/singlepay/furtherinfo/crosscomply/index.htm (accessed 31 January 2011).
[451] See Defra web pages on the RDPE available at: http://ww2.defra.gov.uk/rural/rdpe/ (accessed 31 January 2011).
[452] Natural England (2009). *Agri-environment schemes in England 2009: A review of results and effectiveness* [online] available at: http://www.naturalengland.org.uk/Images/AE-schemes09_tcm6-14969.pdf (accessed 31 January 2011).
[453] *Ibid.*
[454] Clarke, S., Waters, R., Hopkins, J. and Harlow, J. (2010). *How can we deliver and pay for multiple benefits? Experiences from the Natural England ecosystem services pilot projects*. Presentation at the CIWEM Valuing Water and the Environment in Practice conference 22 September 2010, School of Oriental and African Studies, University of London [online] available at: http://www.coastms.co.uk/conferences/437/show (accessed 31 January 2011).
[455] Environmentally Sensitive Areas (ESAs) and Countryside Stewardship (CSS) (although these are collectively referred to as 'classic schemes', there are still more than 19,000 existing agreements under these schemes).
[456] Natural England (2009). *Agri-environment schemes in England 2009: A review of results and effectiveness* [online] available at: http://www.naturalengland.org.uk/Images/AE-schemes09_tcm6-14969.pdf (accessed 31 January 2011).

between 1998 and 2007, restoring some diversity in arable landscapes.[457] **The economic value that people place on the environmental improvements associated with AES is significant.**[458] For example, a recent study indicated that the average household in England is willing to pay £26.09 per year for Environmental Stewardship as a whole.[459]

It is, however, worth noting that only a small proportion of agricultural land is under Environmental Stewardship. A report by Land Use Consultants (LUC)[460] estimated that, in 2008, only 11.3% of the agricultural area of England was under Environmental Stewardship 2008, of which 8.8% was under ELS and 2.5% under HLS management options. As noted by the LUC report, this suggests that to maximise ecosystem service delivery, there would need to be a combination of: single focus Environmental Stewardship options delivered through highly focused targeting; broad multi-objective options; and combinations of co-located options. The more focused targeting of ELS options might be achieved (subject to EU rules) by providing point bonuses in priority areas or by prioritising certain options in particular zones. Nevertheless, a balance will need to be struck between increasing the effectiveness of ELS through more focused targeting and avoiding increased complexity and administrative costs, which may also risk reducing clarity for farmers.

Intensive discussions are currently taking place on reform of the CAP in readiness for the next EU budget period 2014-2020. In November 2010, the European Commission published its 'Communication on the CAP towards 2020' which emphasises that *"the future CAP should contain a greener and more equitably distributed first pillar and a second pillar focussing more on competitiveness and innovation, climate change and the environment"*.[461] Furthermore, the Commission contends that *"Targeting support exclusively to active farmers and remunerating the collective services they provide to society would increase the effectiveness and efficiency of support and further legitimize the CAP"* (our emphasis).[462]

In relation to Pillar 1, the Commission argues that the CAP's environmental performance could be enhanced through a mandatory 'greening' of direct payments, which could take the form of actions that go beyond cross-compliance (e.g. permanent pasture, green cover, crop rotation and ecological set-aside). With regards to Pillar 2, the Commission maintains that a wide range of tools will remain useful, including PES. Moreover, **the Commission suggests that farmers in agricultural areas with specific natural constraints receive additional income support**, in the form of an area-based payment, as a complement to the support given under Pillar 2.

The Communication concludes with three broad options for the future of the CAP: gradual changes to the current policy framework (Option 1); a major overhaul of the policy framework to render it more sustainable (Option 2); and far-reaching reform with a strong focus on environmental and climate change objectives, while moving away gradually from income support and most market measures (Option 3). Defra's response to the Communication

[457] UK National Ecosystem Assessment (2011). *The UK National Ecosystem Assessment: Technical Report (Chapter 7: Enclosed Farmland)*. UNEP-WCMC, Cambridge [online] available at: http://uknea.unep-wcmc.org/Resources/tabid/82/Default.aspx (accessed 6 July 2011).
[458] UK National Ecosystem Assessment (2011). *The UK National Ecosystem Assessment: Technical Report (Chapter 7: Enclosed Farmland)*. UNEP-WCMC, Cambridge [online] available at: http://uknea.unep-wcmc.org/Resources/tabid/82/Default.aspx (accessed 6 July 2011).
[459] Boatman, N. and Willis, K. (2010). *Estimating the wildlife and landscape benefits of environmental stewardship* [online] available at: http://www.defra.gov.uk/evidence/economics/foodfarm/reports/documents/estimatingthewildlife.pdf (accessed 31 January 2011).
[460] Land Use Consultants (2009) *Provision of Ecosystem Services through the Environmental Stewardship Scheme*. Report prepared for Defra. Contract NR0121 [online] available at: http://randd.defra.gov.uk/Document.aspx?Document=NR0121_9136_FRA.pdf (accessed 18 July 2011).
[461] European Commission (2010). *Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions - The CAP towards 2020: Meeting the food, natural resources and territorial challenges of the future* [online] available at: http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2010:0672:FIN:en:PDF (accessed 31 January 2011).
[462] *Ibid*

emphasises that the UK favours a very substantially reduced CAP budget focused on enhanced Pillar 2 measures and the delivery of environmental public goods.[463] Although discussions on CAP reform are ongoing, it is nevertheless clear that the size of, and balance between, Pillar 1 and 2 funds in England could be significantly different in the future. In particular, a determined switch away from direct support payments to targeted payments for environmental public goods could mean more funding for AES in the longer term.

The Commission's Communication highlighted two strategic aims for the future CAP: to preserve food production potential throughout the EU so as to guarantee long-term food security; and contribute to growing world food demand, expected by the Food and Agricultural Organisation to increase by 70% by 2050.[464] A recent report from the Foresight Global Food and Farming Futures Project emphasises that global food supply will need to increase without the use of substantially more land and with diminishing impact on the environment and that sustainable intensification is a necessity.[465] **Should pressures to intensify food production in England increase in the coming years, measures to minimise ecosystem service degradation through mechanisms such as PES are likely to become increasingly important**.

By its nature, enclosed farmland offers financial reward from the sale of agricultural products, so that PES systems for this broad habitat must compete with, or at least not significantly reduce, these market incentives. Given that prices for arable land tend to be higher than for pasture (and much higher in eastern England, or compared to upland grazing)[466], payments for other types of ecosystem services face significant challenges. Moreover, as the NEA synthesis report[467] notes (p53): *"Responding to the pressures to provide food, water and energy security, while at the same time conserving biodiversity and adapting to rapid environmental change, will require getting the valuation right,* ***creating functioning markets for ecosystem services****, improving the use of our resources and adopting new ways of managing those resources"* [our emphasis].

Although a number of interactions between provisioning and other ecosystem services are currently negative, it is possible to generate mutually positive interactions by changing land management regimes and allocating land to different objectives across a range of scales[468]. The existence of a range of land management techniques with a demonstrable impact on ecosystem service provision within Enclosed Farmland can clearly assist with PES design.

Considerable work on better targeting of AES schemes is underway, both to make best use of scarce CAP Pillar 2 funds, and to maximise benefits. As regards the latter, there are choices to be made over the various objectives of AES schemes, e.g. biodiversity, key species protection, landscape enhancement, reduction in water pollution, etc. However, Natural England's target of 70% of total farmland to be in an agri-environment scheme by March 2011 means that targeting will be more in terms of specifying land and water management practices than which parts of the English countryside should be selected for AES funding. Moreover, there is

[463] Defra (2011). *UK response to the Commission communication and consultation "The CAP towards 2020: Meeting the food, natural resources and territorial challenges of the future"* [online] available at: http://www.defra.gov.uk/foodfarm/policy/capreform/documents/110128-uk-cap-response.pdf (accessed 31 January 2011).
[464] FAO (2009). *How to Feed the World in 2050* [online] available at: http://www.fao.org/fileadmin/templates/wsfs/docs/expert_paper/How_to_Feed_the_World_in_2050.pdf (accessed 31 January 2011).
[465] Foresight. The Future of Food and Farming (2011). Final Project Report. The Government Office for Science, London [online] available at: http://www.bis.gov.uk/assets/bispartners/foresight/docs/food-and-farming/11-546-future-of-food-and-farming-report.pdf (accessed 31 January 2011).
[466] Savills Research (2010). *Agricultural Land Market Survey 2009* [online} available at: http://docs.savills.co.uk/campaign/research/SavillsAgriculturalLandMarketSurvey2009.pdf (accessed 9 January 2011).
[467] UK National Ecosystem Assessment (2011). *The UK National Ecosystem Assessment: Synthesis of the Key Findings*. UNEP-WCMC, Cambridge [online] available at: http://uknea.unep-wcmc.org/Resources/tabid/82/Default.aspx (accessed 6 July 2011).
[468] *Ibid*

pressure to 'simplify' the CAP points to flat-rate payments and reduced monitoring, which again may not facilitate targeting.

Nevertheless, there is scope for improved targeting of AES in England, which has been assessed (on the basis of a North-East England case study) as having a "*less ambitious agri-environmental policy … where AESs mainly aim at maintaining existing practices*".[469] Such an aim is certainly justified where such practices have clear environmental and social benefits, e.g. the maintenance of extensive upland grazing by cattle, and the use of hay meadows. More ambitious projects would seek to restore lost habitats and their ecosystem services, particularly where these are in locations likely to be enjoyed by visitors (i.e. near towns and in popular tourist areas). Assessment of alternative land uses in Wales, taking account of the spatial pattern of shadow values of agricultural production and multi-purpose woodland (timber, carbon storage and recreation)[470], shows that a fairly detailed map of an 'optimal' land use can be achieved.

The 'greening' of the CAP proposed by the European Commission must involve increased attention to AES targeting, in one or more of the senses mentioned above. These include the continuation of management by 'active farmers'[471], which forms a major rationale for the current CAP itself. A recent House of Lords enquiry[472] concluded that "*the CAP post-2013 should target more of the available funding on incentivising sustainable farming. However, 'sustainable farming' should not be synonymous with simply 'not farming': it is essential that ways are found to farm more productively while minimising inputs and reducing negative impacts on the environment. We recommend that any 'greening' of the CAP should be directed at activities that promote sustainability alongside competitiveness*".

It has been recommended[473] that the advisory information accompanying AES awards should be further informed by Joint [Landscape] Character Areas, by measures of 'countryside quality', including futures modelling and scenarios, and, within a multi-year programming period, by assessment of initial awards before further awards are made.

Such approaches to spatial targeting should help to balance the interests of taxpayers and citizens as the ultimate 'buyers' of AES-type ecosystem services. The current system tends to focus on the 'needs' of farmers, especially those who are most interested and capable of making a viable application to the awarding authorities (who do not always clearly represent local interests or those of non-ecologists). Considerable academic work has been done on the efficiency of AES award systems in terms of information asymmetry, adverse selection and the principal-agent problem. In general, this work favours competitive or auction-type award

[469] Bonnieux , F, Dupraz, D. and Latouche, K. (2006). Experience with agri-environmental schemes in EU and non-EU members, *Notre Europe* [online] available at: www.notre-europe.eu/fileadmin/IMG/pdf/Bonnieux-EN.pdf (accessed 9 May 2011).

[470] Bateman, I.J., Mace, G.M., Fezzi, C., Atkinson, G. and Turner, K. (20210). Economic Analysis for Ecosystems Service Assessments. *Environmental & Resource Economics* 48: 177-218 [online] available at: http://www.springerlink.com/content/52751302216k1705/fulltext.pdf (accessed 9 May 2011).

[471] The definition of an 'active farmer' is problematic. There is no EU-wide definition of an 'active farmer'; the European Commission's 'Communication on the CAP towards 2020' intimates that a more exclusive definition is needed but gives no details on who might be excluded. In oral evidence taken before the Environment, Food and Rural Affairs Committee in January 2011, the Commissioner explained his thinking as "a farmer produces products for the market and a public good, and I think both objectives have to be covered by a farmer". This implies that farmers who are not actively producing agricultural goods should not receive payments. From 2010, Member States have been able to establish their own objective and non-discriminatory criteria to ensure that no direct payments are granted to those: (a) whose agricultural activities form only an insignificant part of its overall economic activities; or (b) whose principal business or company objects do not consist of exercising an agricultural activity. However, this provision is not compulsory and Member States can decide.

[472] House of Lords Environment, Food and Rural Affairs Committee (2011). *The Common Agricultural Policy after 2013*. Fifth report. [online] available at: http://www.publications.parliament.uk/pa/cm201011/cmselect/cmenvfru/671/67102.htm#evidence (accessed 9 May 2011).

[473] Haines-Young, R. and Langanke, R. (2005). Strategies for achieving landscape character objectives within the new Environmental Stewardship Scheme, final report to English Nature, Rural Development Service, and Countryside Agency [online] available at: http://webarchive.nationalarchives.gov.uk/20101219012433/countryside-quality-counts.org.uk//publications/ESS_Final_Report.pdf (accessed 9 May 2011).

processes but points out the implications for various types of farmer. For example, one conclusion is that *"more targeted schemes will only be efficient if the regulator is able to keep a direct control over the most efficient farmers", who are most likely to be negatively affected when... the principal [i.e. the regulator] obtains finer information"*[474].

In some parts of England, game sports such as partridge shooting already constitute a significant set of economic activities on enclosed farmland. For example in the East of England (whose agriculture is largely 'enclosed' farmland, though many field boundaries have been removed over past decades), a 2006 report[475] estimated that sport shooting involved habitat and wildlife management over 200,000 hectares at a cost of £27 million supporting 1600 full-time equivalent jobs, and that 1.6 million hectares of land (i.e. slightly more than the entire agricultural area of the region) were thus 'influenced'[476].

While conversion of grassland to arable has been responsible for significant releases of carbon, the reverse process (or conversion to woodland) offers the opposite benefit over a longer scale.

As the NEA synthesis report (p57) notes[477]:

"Greater demand is expected of multiple ecosystem services including food, bioenergy, greenhouse gas mitigation and cultural services, some of which can be delivered using current knowledge, while others could be met by novel approaches including spatial optimisation of land management. But there are major challenges and knowledge gaps regarding how such integrated land use could be determined and delivered given that the drivers of decision‐making (e.g. marked changes in weather, changes in the price of carbon, the desire for biodiversity conservation, the need for pest control, nutrient cycling and the control of diffuse pollution, etc.) are becoming more complex, and cross scales and ownership boundaries; that relationships between regulating services and food production are not clear; and that the values of different ecosystem services are not well defined".

4.2.4 Ecosystem service sellers

Actual and potential providers and sellers of ecosystem services from English EFL are shown in Table 9 overleaf.

[474] Canton, J., De Cara, S. and Jayet, P.-A. (2009). Agri-environmental schemes: Adverse selection, information structure and delegation. *Ecological Economics* 68: 2114–2121.
[475] PACEC Consulting (2006) *The Economic and Environmental Impact of Sporting Shooting* [online] available at: http://www.shootingfacts.co.uk/pdf/pacecmainreport.pdf (accessed 15 January 2011).
[476] Some of this activity involves water (e.g. duck shooting), rough grazing or forestry.
[477] UK National Ecosystem Assessment (2011). *The UK National Ecosystem Assessment: Synthesis of the Key Findings*. UNEP-WCMC, Cambridge [online] available at: http://uknea.unep-wcmc.org/Resources/tabid/82/Default.aspx (accessed 6 July 2011).

Table 9: Ecosystem service providers for EFL

Ecosystem Service	Sellers
Crops, livestock, water supply, hazard regulation, climate regulation (carbon sequestration), environmental settings (local places for amenity and landscape character), wild species diversity, water quality, pollination and biological pest control[478]	**Private land owners**, who may range from large-scale arable producers to small-scale 'hobby' farmers, or who may not farm the land themselves, but lease the land to **tenant land managers/farmers**[479]
Environmental settings (local places and landscapes), including opportunities for recreation, social cohesion, inspiration	**Individuals, companies, clubs or syndicates** who hold land-related (rather than farming) rights such as those over game sports, including access to water areas for e.g. fishing

4.2.5 Ecosystem service beneficiaries

Actual and potential beneficiaries of ecosystem services from English EFL are shown in the table below.

Table 10: Ecosystem service beneficiaries for EFL

Ecosystem Service	Beneficiaries
Crops, livestock	**Landowners and tenant farmers** who are able to benefit from crops produced and livestock raised within EFL.
Hazard regulation (flood, water and soil protection), environmental settings (local places and landscapes, including opportunities for recreation, social cohesion, inspiration), water quality, air quality, pollination and biological pest control	**Local residents** who are likely to be familiar with (if not always scientifically knowledgeable about) their neighbourhood EFL ecosystems, and may indeed have chosen their homes partly on the expectations of enjoying the relevant services. They are relatively well defined, and have little other ecosystem service alternative (other than moving house) so that they may organise themselves effectively to oppose - e.g. via social pressure on farmers and landowners - degradation of local views, water, established farming practices, etc. regarded as local public goods.
Environmental settings (local places and landscapes), including opportunities for recreation, social cohesion, inspiration, water quality, air quality	**Countryside visitors**, both general, e.g. tourists, and specialist, e.g. birdwatchers, orienteerers, educational groups. This group is less well defined except through clubs and societies of which some specialists - but probably not all - may be members. They may provide general support to local residents in defending local ecosystem services, but may also conflict with them through occasional overcrowding etc.
Water supply, hazard regulation (flood and water protection), climate regulation (carbon sequestration), water quality, pollination	**More distant consumers** who have no clear connection with EFL producers and landowners, such as urban users of water, and the global population in terms of climate change abatement

[478] Although, as the NEA notes, little is known of national trends in populations of biological control agents, nor the relationships between the various organisms providing regulating services, and crop yield.
[479] However, farming tenancies are more common in upland areas than in lowland regions of England.

4.2.6 Ecosystem service buyers and intermediaries

Actual and potential buyers and intermediaries of ecosystem services from English EFL are shown in the table below.

Table 11: Ecosystem service buyers and intermediaries for EFL

Ecosystem Service	Buyers and Intermediaries
Crops, livestock	**Consumers and retailers (on behalf of consumers)**
Water supply, wild species diversity, hazard regulation (flood and water protection), climate regulation, water and soil quality	**Government (on behalf of the public).** Government is the major buyer of non-marketed farmland ecosystem services, via agri-environmental schemes such as Entry and Higher Level Stewardship agreements.[480] As a key deliverer of schemes and services to local communities, Local Authorities are taking a lead role (primarily through local Public Service Agreement and Local Area Agreements and working closely with sub-regional and local partners) in 'pathfinder' projects to determine and test innovative mechanisms to better target resources to deal with social and economic issues in rural areas, linking into associated countryside access and environmental issues. Some of these projects may also be expected to include ecosystem services. The **European Commission** may also fund skills training and potentially other activities
Water supply, water quality	**Private businesses (usually on behalf of consumers)** – water and energy utilities may be willing to invest in improvements to upstream land management practices to prevent sedimentation of dams and pollution of water supplies[481]. The NEA notes, for example, that analysis of sediment cores in recent years has revealed that sedimentation of UK reservoirs has intensified in response to an increase in arable area and the adoption of field drains, thus contributing to reduced water storage capacity.
Environmental settings (local places and landscapes, including opportunities for amenity, education, inspiration)	Tourism concerns may – on behalf of their visitors – pay for preservation of iconic agricultural landscapes.
Hazard regulation (flood attenuation)	Insurers - who may wish to reduce liability with regards to flooding, dredging and water treatment costs
Wild species diversity, landscapes	**Charitable organisations** such as the RSPB and the National Trust (on behalf of their members) who may be interested in promoting farming practices that enhance farmland biodiversity or rare species such as farmland birds. For example, the RSPB is presently working with farmers to develop and promote farm management that supports bird species that are dependent on farmland[482]

[480] Natural England (2009). *Agri-environment schemes in England 2009: A review of results and effectiveness* [online] available at: http://www.naturalengland.org.uk/ourwork/farming/funding/aesiereport.aspx (accessed 16 January 2011).
[481] For example, Costa Rica's National Fund for Forest Financing (Fondo Nacional de Financiamento Forestal, FONAFIFO) has a successful history of negotiating agreements between hydropower producers and upstream land managers. See Pagiola, S. (2006). *Payments for Environmental Services in Costa Rica*. MPRA Paper No. 2010, Munich [online] available at: http://mpra.ub.uni-muenchen.de/2010/1/MPRA_paper_2010.pdf (accessed 11 July 2011).
[482] A recent 'Saving Species' BBC Radio 4 broadcast programme series revealed that the Blue Pimpernel (very small flower of arable land) and the six farmland birds in the England (the "Arable Six") are declining severely. In the programme, it was indicated that payments for Environmental Payments (PES) could induce farmers to adopt farming practices that help conserve important farmland wildlife.

Ecosystem Service	Buyers and Intermediaries
Crops, livestock, wild species diversity, climate regulation, soil quality, environmental settings (local places and landscapes)	**Producer and certification organisations (on behalf of consumers)** – e.g. the National Farmers Union, levy bodies, the Soil Association, and the Little Red Tractor scheme.

4.2.7 Case studies

Some case studies illustrating how PES schemes (other than European agri-environment schemes) have been applied to agricultural landscapes are described in Box 6 below.

Box 6: PES schemes in agricultural landscapes

United States Conservation Reserve Programme

The United States Conservation Reserve Programme is the largest payment scheme for environmental services in the world, providing annual rental payments and sharing the cost of conservation practices on farmland. See section 2.7.1 for more information.

Upstream Thinking

The Upstream Thinking project, jointly developed by the Westcountry Rivers Trust (WRT) and South West Water, aims to improve raw water quality in four catchments through a collaborative approach which sees landowners informed and assisted in the protection of river catchments as part of an integrated approach to good land management. The incentive for the water company is the effective decrease in the cost of water treatment before supply. Although, to-date, this cost-benefit has not been accepted by the Water Sector's regulating body, OFWAT, in late 2009 OFWAT approved all of the proposed catchment restoration work included within the Upstream Thinking Initiative proposal.

Tailored one-to-one advice and farm plans to the value of £3.26 million over three years are supported by a capital grant scheme funded by South West Water.

Source: *http://www.wrt.org.uk/projects/upstreamthinking/upstreamthinking.html*

Vittel, France

In France, a private water bottling company, Vittel, has invested €980 ha/yr to protect the quality of its water by paying farmers to adopt land-management practices to reduce nitrates in the water source. (Vittel is now owned by Nestlé Waters though the PES development started when it was in family ownership).

Practices adopted include extensive cattle ranching, and pasture management (switching from maize to hay and alfalfa), composting of animal waste and giving up synthetic agrochemicals. Farmers receive on average, about €200 per ha per year over five years. Of the €24.25 million invested in the first seven years: €9.14 million were spent on land acquisition, €3.81 million on investments in farm equipment, and €11.3 million in farm financial compensation.

Source: *Perrot-Maître, D (2006) The Vittel payments for ecosystem services: a "perfect" PES case? International Institute for Environment and Development, London, UK [online] available at: http://pubs.iied.org/pdfs/G00388.pdf (accessed 12 February 2011).*

4.2.8 Barriers to PES for enclosed farmland

The legal minimum for management of EFL in England has been raised over the years through increased regulation of land management, for example in relation to water, hedges and trees, and agri-chemicals, and, as explained above, cross-compliance requirements for Single Farm Payments have been introduced and strengthened. There seems limited scope for encouraging additional privately funded ecosystem services on enclosed farmland beyond the publicly funded cross-compliance Pillar 1 minima and Pillar 2 agri-environmental schemes, and the current voluntary activities by the National Trust and other NGOs. Nevertheless, with ever-increasing scale economies of, for example, machinery use, and new methods of crop management (e.g. plastic covering), there is constant pressure on the ecosystem services specific to EFL, and these pressures are likely to intensify with increased farm product prices. However, at the extensive margin of enclosed farmland, or where the prospect of urban development discourages further intensification of commercial farming, there may be scope for specific PES activity. The Upstream Thinking, WATER and SCaMP initiatives (see Boxes 6, 10 and 11), for example, clearly demonstrate the scope for securing additionality of ecosystem services in agricultural landscapes through appropriate targeting by a local broker and the existence of a willing 'buyer'.

4.2.9 Opportunities for PES for enclosed farmland

As noted above, the most significant scope for PES from EFL, at least on a wide scale, is likely to stem from CAP reform. Agricultural payments via the CAP are expected to decline post-2013, and remaining payments are anticipated to be more closely linked to the provision of ecosystem services from agricultural land.[483]

Importantly, PES may be able to help target policy incentives to areas where they can optimise the supply of services in places where they are most needed, and where they can be most efficiently delivered and function in harmony with other environmental objectives. More specifically, by rewarding land owners and managers on the basis of the services they provide, PES provides an explicit financial incentive for land owners and managers to provide public goods for which they are not currently paid (e.g. carbon sequestration and recreation).[484] There is evidence that spatial targeting of payments in this way enhances the economic efficiency of payment schemes[485], offering the possibility of providing better value for taxpayers' money. Moreover, facilitating land owners to collaborate across property boundaries when bidding competitively for funds is likely to further increase economic efficiency and deliver a number of important ecosystem services far more effectively.[486]

Current high farm commodity prices, and increased policy attention to 'food security' (however interpreted) present a significant challenge to establishing effective PES systems for enclosed

[483] European Commission (2010) *The CAP towards 2020: Meeting the food, natural resources and territorial challenges of the future*. Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions. COM(2010) 672 final [online] available at: http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2010:0672:FIN:en:PDF (accessed 23 May 2011)
[484] Engel, S., Pagiola, S., and Wunder, S. (2008). Designing payments for environmental services in theory and practice: an overview of the issues. *Ecological Economics* 65(4): 663–674.
[485] Wünscher, T., Engel, S. and Wunder, S. (2008). Spatial targeting of payments for environmental services: a tool for boosting conservation benefits. *Ecological Economics*, 65 (4): 822-33; Klimek S., Richter gen. Kemmermann A., Steinmann H.-H., Freese J., and Isselstein J. (2008). Rewarding farmers for delivering vascular plant diversity in managed grasslands: A transdisciplinary case-study approach. *Biological Conservation*, 141 (11): 2888-2897.
[486] Groth, M.J. (2005) *Auctions in an outcome-based payment scheme to reward ecological services in agriculture – Conception, implementation and results*. Paper prepared for the 45th Congress of the Regional Science Association in Amsterdam, 23-27th August 2005 [online] available at: http://www.feweb.vu.nl/ersa2005/final_papers/180.pdf (accessed 18 May 2011); Goldman R.L., Thompson B.H. and Daily, G.C. (2007). Institutional incentives for managing the landscape: Inducing cooperation for the production of ecosystem services. *Ecological Economics,* 64: 333-343; Wünscher, T., Engel, S. and Wunder, S. (2008). Spatial targeting of payments for environmental services: a tool for boosting conservation benefits. *Ecological Economics*, 65 (4): 822-33.

farmland. However, **a crop diversity option within a reformed CAP** after 2013 might contain potential for carbon storage, wildlife benefit (especially if long-term) and perhaps recreation. Set-aside contributes to the supply of a number of services through the provision of habitat for bird and invertebrate species, by connecting existing habitats, buffering watercourses and other habitats and by protecting soils from erosion.

Land retirement (where production is ceased and land is allowed to revert to its 'natural' state) has been identified as a possible mechanism to deal with the impact of the proposed abolition of set-aside land. However, as Rollett *et al.* (2008)[487] note, further research is needed to determine the desirability of including land retirement as an additional land management option in future agri-environment schemes. Despite apparent success in countries such as the USA, Canada and Australia, land retirement has received little attention in Europe, where the emphasis has been on reducing intensification and maintaining land in production. While current EU set-aside regulations do support temporary retirement from production, EU rural development policy, e.g. The Community Strategic Guidelines[488] focus on preserving farmed landscapes.

Outside of the CAP, farmland near major urban areas is under demand for **informal recreation** such as walking, running, riding, and cycling. Where these pressures are major, it may be attractive to both farmers and recreationalists (perhaps represented by Local Authorities or others) to agree on routes for these activities rather than coping with the impacts of unmanaged recreation. However, the problems of securing payment from the individuals involved are significant, and it may be simpler to arrange long-term purchase or leasing of land, for country parks or pathways.

Water and energy companies may also be willing to pay farmers to manage their land to enhance the supply of good quality water downstream. These opportunities are discussed in more detail in the sections on Freshwaters and Mountains, Moorlands and Heath.

4.3 Semi-natural grasslands (SNGLs)

4.3.1 Description

Grasslands are plant communities where grasses and herbaceous plants predominate in the absence of trees and shrubs and where vegetation height is normally less than one metre. In England, the majority of 'non-improved' grasslands (in this report, improved grassland is considered as part of enclosed farmland, discussed in the previous section) are managed to some extent through re-seeding, fertilisation or stocking, and thus may be described as semi-natural. These have been managed traditionally for livestock grazing and/or hay, making a significant contribution to national dairy, beef and lamb production. These habitats now tend to be associated with smaller farms or small areas on larger farms where intensification has been impractical for physical or financial reasons[489]. Small areas of unimproved grasslands (typically less than 0.5ha) may also persist as fragments within otherwise intensively managed landscapes. As such they may potentially serve as valuable residual wildlife refuges and are targeted by Countryside Survey for assessment of their botanical interest using 'Targeted

[487] Rollett, A., Haines-Young, R., Potschin, M. and Kumar, P. (2008). *Delivering environmental services through agri-environment programmes: a scoping study*. Land Use Policy Group [online] available at: http://www.nottingham.ac.uk/cem/pdf/Delivering%20Env%20Services%20through%20agri-env%20programmes-scoping%20study-31-10-08.pdf (accessed on 28 December 2010).
[488] European Commission (2005) Cohesion Policy in Support of Growth and Jobs: Community Strategic Guidelines, 2007-2013. COM(2005) 0299 [online] available at: http://ec.europa.eu/regional_policy/sources/docoffic/2007/osc/050706osc_en.pdf (accessed 23 May 2011).
[489] Countryside Survey (2008). *Countryside Survey: England Results from 2007* [online] available at: http://www.countrysidesurvey.org.uk/eng_reports2007.html (accessed 13 December 2010).

Plots'. Such areas may be too small to warrant protection or designation and may often be difficult to manage, vulnerable to intensive land-use or lack of management[490].

Semi-natural grasslands (SNGLs) may represent a spectrum of management intensity from semi-natural to semi-improved. At the semi-natural end of the scale are those which have not been agriculturally improved by ploughing, re-seeding, use of inorganic fertilisers or widespread application of herbicides, while semi-improved grasslands have typically been subject to improvement through fertiliser use and other intensive management but are typically not subject to regular reseeding[491].

Three broad types of SNGLs may be identified and are characteristic of soils with differing pH values: calcareous (mineral and calcium rich soils), neutral (deeper soils) and acid (mineral deficient) soils.[492] The 2007 Countryside Survey estimated 30,000ha of calcareous grassland, 1,453,000ha of neutral grassland, and 396,000ha of acid grassland in England, collectively amounting to 14.2% of England's land area.

SNGL historically exists predominantly as a result of human activity. However, human activities, primarily agriculture, are also responsible for the marked decline in their extent since World War II. In 1984, SNGL was estimated to cover only 3% of the area covered in 1930[493], although the rate and extent of loss varies according to the grassland type, with the greatest losses (2-10% per annum) sustained by neutral grassland.[494] Losses continued through the 1980s and 1990s as technological advances and government incentives drove the conversion of high diversity SNGLs to either 'improved grasslands' or arable land. Recognition of the scale of loss of semi-natural grasslands resulted in the development and delivery of policies to facilitate conservation of these habitats, including increased statutory protection and regulation, development of frameworks for facilitating and monitoring conservation action and provision of incentives for positive management of landscapes and habitats through agri-environment schemes with the result that there was no significant change in extent between 1998 and 2007.[495]

SNGL plant and animal communities can be easily damaged or destroyed, and maintenance of SNGL nature conservation value is dependent upon continuous management. 68% of England's SNGLs are now protected within Sites of Special Scientific Interest (SSSIs) [496] [497]. Conservation of these resources remains a high priority, as set out in the England Biodiversity Strategy and UK Biodiversity Action Plan (UKBAP). Statutory protection afforded to key semi-natural grassland habitats has been strengthened, in particular through the Wildlife and Countryside Act 1981 and the Countryside and Rights of Way (CRoW) Act 2000. These have been supported with specific targets to bring SSSIs into favourable or recovering condition.[498] However, inadequate management continues to cause declines in the quality of semi-natural

[490] Countryside Survey (2008). *Countryside Survey: England Results from 2007* [online] available at: http://www.countrysidesurvey.org.uk/eng_reports2007.html (accessed 13 December 2010).
[491] *Ibid*
[492] Natural England (1999) *Lowland Grassland Management Handbook* [online] available at: http://naturalengland.etraderstores.com/NaturalEnglandShop/Grassland (accessed 6 May 2011).
[493] Fuller, R.M. (1987). The changing extent and conservation interest of lowland grasslands in England and Wales: A review of grassland surveys 1930-1984. *Biological Conservation*, 40: 281-300.
[494] Jefferson and Robertson (1996) *Lowland grassland: wildlife value and conservation status*. Peterborough: English Nature Research Reports, No. 169.
[495] Countryside Survey (2008). *Countryside Survey: England Results from 2007* [online] available at: http://www.countrysidesurvey.org.uk/eng_reports2007.html (accessed 13 December 2010).
[496] SSSI's are legally protected under the Wildlife and Countryside Act 1981, as amended by the Countryside and Rights of Way (CROW) Act 2000 and the Natural Environment and Rural Communities (NERC) Act 2006.
[497] *Ibid*
[498] Countryside Survey (2008). *Countryside Survey: England Results from 2007* [online] available at: http://www.countrysidesurvey.org.uk/eng_reports2007.html (accessed 13 December 2010).

grasslands, e.g., in 2005 only 21% of English SNGLs were in favourable condition.[499] Other drivers continue to cause habitat and species loss: particularly climate change, nitrogen deposition, inadequate management and habitat fragmentation.[500] In addition, livestock productivity is low and relatively variable in SNGLs, and this leads to pressures on land use.

Incentives to improve the condition of SNGLs are primarily delivered through agri-environment schemes.[501] Alongside provision of incentives, the regulatory framework for conserving grassland habitats has been strengthened. Since 2006, local planning authorities have been required to protect and enhance BAP Priority Habitats through Planning Policy Statement 9 (PPS9). In October 2006 Section 40 of the Natural Environment and Rural Communities Act came into force which places a duty on all public authorities to have regard to the purpose of conserving biodiversity, including BAP Priority Habitats. These requirements represent extensions and strengthening of previous duties of care.

Alongside statutory designation and protection under the planning system, Defra has since 2002 implemented a regulatory framework to restrict the agricultural intensification of uncultivated and semi-natural land. The Environmental Impact Assessment Regulations (Agriculture) (England) (No.2) revised in October 2006 require the completion of a full EIA prior to undertaking any agricultural operation that might result in intensification and/or increased productivity of land meeting the criteria of semi-natural or uncultivated. However, since these regulations only apply to operations on land of 2ha of more in area, no protection from intensification is currently afforded to smaller areas of semi-natural grasslands[502].

4.3.2 Ecosystem Services from SNGLs

The key ecosystem services generated by SNGLs in England, as identified by the NEA, are outlined in the table below, together with an indication of the relative importance of SNGLs in delivering each of the listed ecosystem services.

Table 12: Main ecosystem services from SNGLs[503]

Provisioning		Cultural		Regulating	
Crops	L	Local places	M-H	Climate	M-H
Livestock / Aquaculture	M-L	Landscapes / seascapes	H	Hazard	M-H
Fish				Disease and pests	L
Trees, standing vegetation, peat	M-L			Pollination	H
Water supply				Noise	L
Wild species diversity	H	Wild species diversity	H	Water quality	H

[499] UK National Ecosystem Assessment (2011). *The UK National Ecosystem Assessment: Technical Report (Chapter 6: Semi-natural Grasslands)*. UNEP-WCMC, Cambridge [online] available at http://uknea.unep-wcmc.org/LinkClick.aspx?fileticket=IfVaZJDoV8c%3d&tabid=82 (accessed 6 July 2011).
[500] Countryside Survey (2008). *Countryside Survey: England Results from 2007* [online] available at: http://www.countrysidesurvey.org.uk/eng_reports2007.html (accessed 13 December 2010).
[501] *Ibid*
[502] Countryside Survey (2008). *Countryside Survey: England Results from 2007* [online] available at: http://www.countrysidesurvey.org.uk/eng_reports2007.html (accessed 13 December 2010).
[503] UK National Ecosystem Assessment (2011). *The UK National Ecosystem Assessment: Synthesis of the Key Findings*. UNEP-WCMC, Cambridge [online] available at http://uknea.unep-wcmc.org/Resources/tabid/82/Default.aspx (accessed 6 July 2011).

Provisioning	Cultural	Regulating	
		Soil quality	H
		Air quality	M-H

Key		
High	H	Blank cells represent services that are not applicable to the Broad Habitat
Medium – High	M-H	
Medium – Low	M–L	
Low	L	

SNGLs, although less intensively managed than improved grassland, retain an important **provisioning role**, especially for food (mainly beef, lamb and milk) and fibre (wool) production.[504]. SNGLs also contain valuable **genetic** resources (e.g. rare breeds of grazing animals and some scarce plant and invertebrate communities).

SNGLs – particularly acid grassland – present opportunities for **storing carbon**. It is estimated that average sequestration from European grasslands could be 0.52 mg C/ha per year.[505] Acid and neutral grasslands across England contain 293 Tg of the UK carbon store in the top 15 cm soil layer.[506] Other research has indicated that low–productivity SNGLs may be better able to capture and immobilise organic nitrogen compared to improved grasslands and as a consequence may confer benefits in reducing nitrate leaching to surface water systems[507],helping to improve the **water quality** of surface waters as required by the EU Nitrates and Water Framework Directive. SNGLs also allow greater water infiltration rates and enhanced storage which should aid **flood prevention**. SNGLs are also important for **soil retention** and **erosion control**. For example, Koulouri and Giourga (2007)[508] found that grassland abandonment resulted in increased soil erosion and landslides in mountainous areas.

Of the 1,150 species of conservation concern named in the UKBAP, lowland SNGLs are home to 206 UKBAP species (compared to 41 species in upland grassland Priority Habitats). **Biodiversity** is positively related to many ecosystem services provided by SNGLs, which have high invertebrate abundance and diversity. Grassland abandonment is, for example, a main cause of avian and mammal diversity decline.[509] SNGLs may also provide **pollination** and **pest control** services by spread of insects to agricultural areas, although the evidence for this effect is limited. There is, however, an established link between declines in bumblebees since

[504] Countryside Survey (2008). *Countryside Survey: England Results from 2007* [online] available at: http://www.countrysidesurvey.org.uk/eng_reports2007.html (accessed 13 December 2010).
[505] Vleeshouwers, L. M. and Verhagen, A. (2002). Carbon emission and sequestration by agricultural land use: a model study for Europe. *Global Change Biology*, 8: 519-530.
[506] Countryside Survey (2008). *Countryside Survey: England Results from 2007* [online] available at: http://www.countrysidesurvey.org.uk/eng_reports2007.html (accessed 13 December 2010).
[507] Bardgett, R. D. Streeter, T. C. and Bol, R. (2003). Soil microbes compete effectively with plants for organic-nitrogen inputs to temperate grasslands. *Ecology*, 84: 1277-1287.
[508] Koulouri, M. and Giourga, C. (2007). Land abandonment and slope gradient as key factors of soil erosion in Mediterranean terraced lands. *CATENA*, 69:274–281.
[509] Preiss, E., Martin, J.L. and Debussche, M. (1997). Rural depopulation and recent landscape changes in a Mediterranean region: Consequences to the breeding avifauna. *Landscape Ecology*, 12: 51–61; Stoate, C., Báldi, A., Beja, P., Boatman, N.D., Herzon, I., van Doorn, A., de Snoo, G.R., Rakosy, L. and Ramwell, C. (2009). Ecological impacts of early 21st century agricultural change in Europe - A review. *Journal of Environmental Management*, 91: 22–46.

the 1960s and declines in key SNGL plants[510] Pollination services to UK crops are estimated to be worth approximately £172 million p.a.[511] and reduced pollination rates known to deleteriously impact agricultural crop production.

SNGLs are also widely considered a vital part of **cultural landscape**, providing important wildlife habitat and generally supporting greater ecosystem services than improved grassland.[512] The UK National Parks, which are valued for **recreation**, **green spaces** and **education**, amongst other benefits, all contain significant areas of SNGL. Calcareous downland, for example, is the major habitat of the new South Downs National Park. A 2003 study showed that there were about 39 million visitor days per year to the South Downs. About £333 million was spent by these visitors and about 8,000 jobs were supported.[513]

SNGLs have also been considered as a potential source of **bio-energy feedstock.** However, whereas using land for bio-energy production could result in neutral or even beneficial outcomes in certain cases, for example where bio-energy crops replace intensive land uses or when native or ancient woodland is restored or brought back into appropriate management in certain areas, there is a high risk of loss of landscape and biodiversity on land with semi-natural characteristics, such as permanent pasture, semi-improved grassland, wet grassland, marshland and other marginal land.[514] The Renewable Energy Directive (2009/28/EC) does, however, afford some protection to SNGLs by stipulating sustainability criteria with which biofuels used to meet the EU renewable energy targets must comply.

4.3.3 Scope for PES from SNGLs

Almost by definition, SNGL has few inputs and a limited range of existing activities that can be altered to change the ecosystem services provided (e.g. changes to stocking density and type of livestock, fencing off watercourses). There may nevertheless be opportunities to introduce new activities for ecosystem service delivery. The introduction of an environmental scheme specifically targeting the uplands (the Uplands Entry Level Scheme) suggests that specific areas may be very vulnerable to inadequate service provision (e.g. both over- and under-grazing were identified as important issues). The retention of many low-productivity upland areas for water capture, initially by Victorian municipal managers and latterly transferred into water company ownership, emphasises the importance of these areas for services related to hydrology and water quality.

The farming systems that have produced SNGLs in England have done so by maintaining a stable (or sometimes decreasing) level of nutrients and a stable standing crop from year to year, while removing the annual net primary production. In other words, some sort of management that harvests the year's growth is essential. There are various management options, including grazing, cutting and burning, although burning is rarely used because of its deleterious impacts on invertebrates, ground-nesting birds and mammals. [515]

[510] UK National Ecosystem Assessment (2011). *The UK National Ecosystem Assessment: Technical Report (Chapter 6: Semi-natural Grasslands)*. UNEP-WCMC, Cambridge [online] available at: http://uknea.unep-wcmc.org/LinkClick.aspx?fileticket=IfVaZJDoV8c%3d&tabid=82 (accessed 6 July 2011).
[511] Carreck, N. and Williams, I. (1998). The economic value of bees in the UK. *Bee World*, 79: 115-123.
[512] UK National Ecosystem Assessment (2011). T*he UK National Ecosystem Assessment: Technical Report (Chapter 6: Semi-natural Grasslands)*. UNEP-WCMC, Cambridge [online] available at: http://uknea.unep-wcmc.org/Resources/tabid/82/Default.aspx (accessed 6 July 2011).
[513] Tourism South East (2003). *Economic Impact of Visits on the South Downs*.
[514] Wildlife and Countryside Link (undated) *Bioenergy in the UK: Turning Green Promises into Environmental Reality*. A policy paper by Wildlife and Countryside Link, Wales Environment Link, Northern Ireland Environment Link, Scottish Environment Link [online] available at: http://www.scotlink.org/files/publication/LINKReports/JointLINKReportBioenergyUK.pdf (accessed 23 May 2011).
[515] McIntosh, J. (1995). *The management of unimproved lowland grassland for nature conservation*. Information and Advisory Note Number 11, Scottish Natural Heritage [online] available at: http://www.snh.org.uk/publications/on-line/advisorynotes/11/11.htm (accessed 14 May 2011).

Agri-environment schemes have proved an effective means to enhancing biodiversity and ecosystem services in SNGLs. English grasslands are already addressed by several agri-environmental schemes, with the Entry Level Scheme and Organic Entry Level Scheme voluntary and open to all. They include a range of options from which the land manager can choose to meet a 'points target' needed to secure funding (based on amount of land in the scheme) over a five-year period. Options relevant to grasslands include reducing input use, maintenance of hedgerows and stone walls, and mixed stocking. As such, they can be expected to provide ecosystem services relating largely to habitat and biodiversity maintenance and enhancement, carbon sequestration, water management and erosion regulation.

Higher Level Stewardship (HLS) schemes are also voluntary, but are targeted towards high-priority situations and areas.[516] Natural England provides an interactive map detailing the target areas and the target themes or statements applying to each of these areas. The targeting map identifies 110 individually named, multi-objective target areas covering roughly a third of England. These represent the areas where Natural England wishes to focus delivery of HLS to maximise environmental outcomes and value for money.[517] The Dartmoor Target area, for example, includes landscape within the Dartmoor National Park, which is largely heather and grass moorlands comprising largely semi-natural grassland outside its heather areas. Requested actions for this area include: restoring habitats (largely grassland), maintaining historic and archaeological sites, minimising soil erosion/diffuse pollution, characteristic landscape features, new permissive access, and blanket bog for carbon stores. However, all of England's regions also have options identified for HLS outside of these target areas, organised under eight themes, most of which can be linked to ecosystem services generated by SNGLs:

- Theme 1: Improving the resilience of Nationally Important (UK Biodiversity Action Plan) habitats to climate change (typically grassland, but also coastal, wetland and woodland areas)
- Theme 2: Reversing the decline of farmland birds (specific species of arable and grassland birds)
- Theme 3: Securing the recovery of Nationally Important (UK Biodiversity Action Plan) Species (includes bees, pollinators and arable and wet grassland plant species)
- Theme 4: Improving the quality of nationally important water bodies and/or habitats adversely affected by diffuse water pollution from agriculture (largely soil erosion and run-off management etc)
- Theme 5: Reducing risk to nationally designated assets identified by the Heritage At Risk Survey
- Theme 6: Securing positive management of prioritised historic buildings.
- Theme 7: Reducing the damage caused to undesignated below-ground archaeological sites by cultivation and protecting and enhancing visible undesignated historic environment features
- Theme 8: Improving people's enjoyment and understanding of the farmed environment

Existing environmental schemes therefore provide a number of opportunities for grassland farmers to provide ecosystem services through existing environmental schemes. Additional forms of PES offer the potential for new buyers (and potentially new funding) to be included in

[516] Natural England (2010). *Higher Level Stewardship: Environmental Stewardship Handbook*. Third Edition [online] available at: http://naturalengland.etraderstores.com/NaturalEnglandShop/NE227 (accessed 15 July 2011).
[517] See http://www.naturalengland.org.uk/ourwork/farming/funding/es/hls/targeting/default.aspx.

negotiations of services provided. It may also offer the potential for new ecosystem services to be identified, and thus potentially new actions to be undertaken.

4.3.4 Ecosystem Service Sellers

Actual and potential providers and sellers of ecosystem services from English SNGLs are shown in the table below. Types of suppliers of ecosystem services from SNGLs can be considered on the basis of professional and non-professional, commercial and non-commercial, and at various scales. Land managers can be expected to exist at a wide range of scales – from estates, charities and public entities controlling many thousands of hectares, to small-scale 'hobby farms' of only a few hectares. Nevertheless, due to the extensive nature of most agricultural production from grasslands, a 'small' farm in terms of annual turnover and livestock numbers may still be several hundred hectares in size. Differences in tenure are also important to note – estates typically rent some if not all of their land to farmers; they may also lease gaming rights to separate parties. Thus, there may be three or more entities involved in land (and associated water) management.

Table 13: Ecosystem service providers for SNGLs

Ecosystem Service	Sellers
Livestock production, water supply, wild species diversity, environmental settings (local places for amenity carbon storage, water quality, water supply, soil quality, air quality, environmental settings (local places and landscapes), pollination and pest control, hazard regulation (flood and water protection)	**Private landowners and tenant land managers** – including farmers (tenant, owner-occupier, hobby, etc), community landowners
Water supply, wild species diversity, environmental settings (local places for amenity carbon storage, water quality, water supply, soil quality, air quality, environmental settings (local places and landscapes including recreation, archaeological heritage, ecological knowledge, religious and spiritual benefit, etc), pollination and pest control, hazard regulation (flood and water protection)	**Public landowners** including the Ministry of Defence, The Crown Estate, UK National Parks, English Natural Nature Reserves and the Church of England. • Substantial areas of SNGL are owned, leased and used for training by the Ministry of Defence. • The Church of England has over 12,000 churchyards in which biodiversity projects are taking place, including the National Living Churchyards and Cemeteries Scheme[518]
Wild species diversity, carbon storage, water quality, water supply, soil quality, air quality, environmental settings (local places and landscapes for recreation, cultural heritage, landscape aesthetics, etc)	**Private business** including commercial energy providers (wind power, also hydroelectric); whose interest is, by definition, in profitable use of their resources.
Wild species diversity, carbon storage, water quality, water supply, soil quality, air quality, cultural heritage, landscape aesthetics	**Individuals, companies, clubs, syndicates** who hold land-related rights

[518] UK National Ecosystem Assessment (2011). *The UK National Ecosystem Assessment: Technical Report (Chapter 6: Semi-natural Grasslands)*. UNEP-WCMC, Cambridge [online] available at: http://uknea.unep-wcmc.org/LinkClick.aspx?fileticket=IfVaZJDoV8c%3d&tabid=82 (accessed 6 July 2011).

4.3.5 Ecosystem Service Beneficiaries

Actual and potential beneficiaries of ecosystem services from English SNGLs are shown in the table below and are broadly similar to those who benefit from ecosystem services from EFLs.

Table 14: Ecosystem service beneficiaries for SNGLs

Ecosystem Service	Beneficiaries
Water supply, wild species diversity, environmental settings (local places for amenity carbon storage, water quality, water supply, soil quality, air quality, environmental settings (local places and landscapes including recreation, archaeological heritage, ecological knowledge, religious and spiritual benefit, etc), pollination and pest control, hazard regulation (flood and water protection)	**Local residents** who are likely to be familiar with (if not always scientifically knowledgeable about) the ecosystems from SNGLs, and may indeed have chosen their homes partly on the expectations of enjoying the relevant services. They are relatively well defined, and have little other ecosystem service alternative (other than moving house) so that they may organise themselves effectively to oppose - e.g. via social pressure on farmers and landowners - degradation of local views, water, established farming practices, etc. regarded as local public goods.
Air quality, water quality, wild species diversity, environmental settings (local places and landscapes including recreation, archaeological heritage, ecological knowledge, religious and spiritual benefit, etc	**Countryside visitors**, both general, e.g. tourists, and specialist, e.g. birdwatchers, orienteers, educational groups. This group is less well defined except through clubs and societies of which some specialists - but probably not all - may be members.
Standing vegetation (biomass for fuel), pollination	**Private business**, e.g. it has been suggested that hay from SNGLs might provide an alternative source of fuel which does not monopolise cropland. No studies relevant to SNGLs have taken place in the UK and so figures for costs or potential production are not available; but research in the USA has shown that high diversity prairie grassland could produce reasonable biomass for fuel with low fertiliser inputs.[519] Orchard owners may also benefit from pollination services provided by SNGLs.
Water flow regulation, water supply, water quality, climate regulation	**More distant consumers** such as urban users of water and power, and the global population in terms of climate change abatement who have no clear connection with SNGL landowners and managers.

4.3.6 Ecosystem Service Buyers and Intermediaries

Actual and potential providers and sellers of ecosystem services from English SNGLs are shown in Table 15 overleaf.

[519] UK National Ecosystem Assessment (2011). *The UK National Ecosystem Assessment: Technical Report (Chapter 6: Semi-natural Grasslands)*. UNEP-WCMC, Cambridge [online] available at: http://uknea.unep-wcmc.org/LinkClick.aspx?fileticket=IfVaZJDoV8c%3d&tabid=82 (accessed 6 July 2011).

Table 15: Ecosystem service buyers and intermediaries for SNGLs

Ecosystem Service	Buyers and Intermediaries
Wild species diversity; climate regulation (carbon storage), flood control	**National and Local Government (on behalf of the public)**. National government - Defra/Natural England currently regulate and fund agri-environmental activity through cross-compliance linked to the Single Farm Payment, Entry and High Level Stewardship schemes etc. Issues of carbon sequestration can also be expected to be addressed at national level, and are indeed already featuring in agri-environmental schemes. Local government - Local Authorities currently have Local Area Agreements set out in the Rural Strategy 2004[520], through which they can deliver projects which can be expected to include ecosystem services. For instance, local councils may be particularly interested in flood control, which can be facilitated through grassland management. The **European Commission** may also fund skills training, and potentially other actions
Wild species diversity, carbon storage, water quality, water supply, soil quality, air quality, environmental settings (local places and landscapes for recreation, cultural heritage, spiritual and religious benefit, etc)	**Advisory services as intermediaries (on behalf of government or private individuals)**. Among these are individuals and companies who currently assist with completing applications for environmental stewardship schemes. These are the most obvious candidates to provide the same service in relation to PES schemes. LEADER programmes may also be able to fund intermediary services
Landscapes, local places, wild species diversity	**Public Organisations (on behalf of the public),** e.g. UK National Parks who may develop and/or operate schemes to encourage beneficiaries to pay for the ecosystem services they enjoy (e.g. visitor payback schemes in National Parks) **Public Sector Partners** such as universities and colleges benefit from opportunities to do research, but are unlikely to have sufficient budgets to 'buy' this service on any kind of scale; the exception being research farms already established for this purpose.
Wild species diversity, landscapes	**Charitable Organisations** - Such as the Grasslands Trust, RSPB, the National Trust, and wildlife trusts might be interested in 'buying' grassland services, e.g. conservation of habitats for rare birds on behalf of their members. These charities typically have professional staff with existing connections to land managers. They may be considered themselves to be sellers of these services on the land they manage if entry charges are paid (even voluntarily) or to receive land use subsidies.). The Heritage Lottery Fund, for example, supports community and environmental regeneration projects.
Water supply, standing vegetation (hay for biofuel), water quality, soil retention, climate regulation, environmental settings	**Private businesses** – Energy utilities (particularly hydropower) may be willing to invest in SNGL conservation and/or improvement to maintain or improve soil retention (to prevent sedimentation of dams) while water utilities may be interested in protecting SNGLs to preserve or improve water supply and quality. Energy producers may be interested in the potential of SNGLs to provide source of plant biomass (hay) for fuel. Private companies required to compensate for the environmental

[520] See http://archive.defra.gov.uk/rural/documents/policy/strategy/rural_strategy_2004.pdf.

Ecosystem Service	Buyers and Intermediaries
	impacts of their activities (e.g. through carbon sequestration) or who invest in Corporate Social Responsibility could pay for carbon stored in SNGLs.
Landscapes, local places, wild species diversity	Tourism concerns may – on behalf of their visitors – pay for preservation of aesthetic landscapes.
Livestock, crops, wild species diversity, carbon storage, soil quality, local places, landscape	**Producer and certification organisations (on behalf of consumers)** – e.g. the National Farmers Union, levy bodies, the Soil Association, and the Little Red Tractor scheme. - Certifications like 'Little Red Tractor' could be more explicitly extended to grassland (i.e. extensive livestock production).
Environmental settings (local places and landscapes for recreation, spiritual and religious benefit, artistic inspiration, archaeological heritage, etc)	**Visitors**, e.g. tourists who benefit from aesthetic beauty etc provided by grassland areas may be willing to pay for their upkeep or for enhancement of cultural and regulating services. However, it may be difficult to convince them to pay for this service without joint marketing initiatives by tourist associations.

It is important to note that there may be other 'intermediaries' in the sense of organisations or bodies who have a management interest in the land, but are not the land managers or their agents. Sites under specific designations (e.g. Sites of Special Scientific Interest, national parks) may require approval by governmental organisations (e.g. Natural England) in order to make changes to how the land is managed.

4.3.7 Case Studies

Some case studies illustrating how PES schemes have been applied to SNGL landscapes are described in Box 7 below.

Box 7: PES schemes in SNGL landscapes

The Parish Grasslands Project, Wye Valley

The Parish Grasslands Project started in 2001 with the aims of raising interest in, and knowledge of, the grasslands on the former commons of St Briavels, Hewelsfield and Brockweir in the Wye Valley, and offering help and advice on grassland management. The project was started by a group of residents who recognised that the condition of the flower-rich meadows and pastures of the Hudnalls (central to the Parish) and adjacent areas was threatened by the downturn in income from cattle and sheep, and the difficulties associated with foot-and-mouth disease and who wanted to help landowners – most of whom are not farmers – to restore neglected fields and maintain them as attractive meadows and pastures. Several members entered the Environmental Stewardship Scheme and now enjoy financial support for management in return for limited undertakings on management. The project also works with the Monmouthshire Meadows Group, and has successfully bid for funds that have enabled its buy machinery with which it offers a management service (including disposal of hay) and provides information and advice to landowners.

Source: *http://www.parishgrasslandsproject.org.uk/index.html*

South African National Grasslands Biodiversity Programme

South Africa's temperate Grasslands are the second largest biome in the country, occupying 29 percent of the land territory. The biome is a repository of globally significant biodiversity – in particular a rich storehouse of floristic diversity – harbouring over 4,000 plant species, many of which are endemic. However, South Africa's grasslands, like others across the globe, are critically threatened. Human activities have already irreversibly transformed 30 percent of the area while less than two percent is included in the Protected Area estate, which itself is not representative of the biome's diversity.

The Grasslands provide essential ecosystem services, in particularly hydrological services that make a major contribution to South Africa's agriculture, forestry, mining, and industrial economy. The annual value of ecosystem services provided by the Grasslands is estimated at GBP0.88 billion (2006 prices).[521] Around 6.4 million cattle and 13 million sheep graze the biome. However, South Africa's largest urban and industrial centre – the conurbation of Johannesburg and Pretoria – and the country's main coal-producing region are also located within the biome. Plantation forestry in the Grasslands is worth GBP0.5 billion per year. However, these production activities also constitute the main threat to Grasslands, by stimulating habitat loss and degradation. These grasslands are also important for storing rainwater in either wetlands or as ground water which is gradually released throughout the year. This water is essential for cropping and animal production in and adjacent to catchments, for high density residential areas in Gauteng, and for the Highveld power stations which produce 70% of South Africa's electricity requirements. Other ecosystem services include pollination, soil production and conservation, flood amelioration, carbon storage (maintaining the earth's atmosphere), cultural heritage and recreational amenities; and support to subsistence livelihoods.

The Grassland Programme of the South African National Biodiversity Institute (SANBI) aims to safeguard both biodiversity and ecosystem services in response to the degradation of grasslands due to agriculture and other forms of land use. The programme identified spatial priority areas for ecosystem services, tested the effect of different target levels of ecosystem services used to identify priority areas, and evaluated whether biodiversity priority areas can be aligned with those for ecosystem services. Several of South Africa's priority river catchments occur in the grasslands biome, and it is believed that better management – such as appropriate burning systems, grazing at recommended stocking rates, and restoring degraded areas – could result in more water released back into various river catchment systems, significantly reducing water run-off, increasing infiltration, reducing summer storm flows, increasing winter base flows and securing additional ecosystem services such as sediment reduction, additional carbon sequestration and better water quality to the benefit of communities and landowners. Initial estimates for the Upper uThukela area suggested that almost 12.8 million cubic meters of additional winter river flows could be achieved, equivalent to a potential sales value of GBP0.3 million per annum and worth between GBP1.5 million and GBP7.76 million per year in terms of added value to the economy, in addition to curbing government expenditure on capital infrastructure costs.

The Grasslands Programme is working to find ways of ensuring that land owners in catchments, including rural communities and farmers who implement good land management practices, benefit from the value of the additional water produced off their land. There are over 100 public, private and civil society partners in the Grasslands Programme.

The Programme has also developed a banking system for impacts on wetlands mainly caused by the coal mining sector within the Mpumalanga Grassland Biome in South Africa. A designated government agency will generate credits in undertaking wetland rehabilitation and

[521] De Wit, M. P. and Blignaut, J.N. (2006) Monetary Valuation of the Grasslands in South Africa: Making the Case for the Value of Ecosystem Goods and Services in the Grassland Biome. Report prepared for the South African National Biodiversity Institute [online] available at http://www.grasslands.org.za/attachment_view.php?ia_id=31 (accessed 12 May 2011).

will thus act as the banker. As banker, it will also be responsible for the maintenance of the credits in the long-term. Other government departments will have key responsibilities at various stages in the model to ensure that such banks are established and operated within legal frameworks.

Sources:
South African National Grasslands Programme [online] available at: http://www.grasslands.org.za (accessed 27 February 2011).

De Wit, M. P. and Blignaut, J.N. (2006). Monetary Valuation of the Grasslands in South Africa: Making the Case for the Value of Ecosystem Goods and Services in the Grassland Biome. Report prepared for the South African National Biodiversity Institute [online] available at: http://www.grasslands.org.za/attachment_view.php?ia_id=31 (accessed 12 May 2011).

Grassland Extensification in Germany

The grassland extensification programme is a government-financed PES scheme in the federal state of Brandenburg in north-eastern Germany. The programme involves reducing fertilizer inputs, usage intensity and stocking rates in order to improve water quality, create and preserve habitats, reduce greenhouse gas emissions and increase the diversity and quality of the landscape through open space created. Participation in the programme is restricted to grazing livestock farms that have a livestock density between 0.3 to 1.4 livestock units per hectare forage area. The livestock density index provides the number of livestock units per area and allows for the aggregation of livestock from various species and ages. The programme prohibits the use of chemical-synthetic fertilizers and pesticides, and requires at least one usage per year (mowing, grazing or mulching).

The programme is implemented in the form of management agreements. Farmers commit themselves, for a five-year minimum period, to alter grassland management and livestock density. In return, they receive payments that compensate for additional costs and loss of income. The compensation payment is US$170 per hectare and year. The programme can be applied to the entire grassland area; no specific areas within the grassland area are targeted. The annual budget in Brandenburg for grassland extensification is US$ 20.9 million per year.

The funding comes from three different sources: the majority from the EU (between 50% and 75%), a small contribution from the national governments, and the remainder from regional governments.

Source: *Uthes, S., Li, F., Zhen, L., and Cao, X. (2010). Payments for Grassland Ecosystem Services: A Comparison of Two Examples in China and Germany. Journal of Resources and Ecology, 1(4), 319-330.*

4.3.8 Barriers to PES for SNGLs

The large-scale nature of many SNGL landholdings may alleviate some PES transaction costs, enabling negotiations to be undertaken with a single or small number of land managers. However, this may serve to disadvantage smaller land managers, and exacerbate existing power struggles in rural areas. The political sensitivities that this may raise, may therefore limit opportunities for PES in smaller swathes (which often provide valuable wildlife refuges within larger areas of more intensively managed land).

As noted above, SNGL has few inputs, and a limited range of activities that can be altered to change the ecosystem services provided (e.g. changes to stocking density and type of livestock, fencing off watercourses). The issue of whether ecosystem services would be

provided in any case without financial incentives is therefore particularly acute in grassland regions. Some practices that may enhance regulating and cultural ecosystem services require land managers to forego optimal harvest (e.g. reducing forage offtake), tolerate reduced yields (e.g. reduced stocking rates) or change land use (e.g. cessation of grazing of vulnerable soils). Others require investments in new equipment that could be substantial (e.g. for seeding, irrigation or fertilization). However, it can also be argued that the primary investments necessary for successful widespread adoption of many of the land management practices that enhance ecosystem services are knowledge, education and information. Most of the materials required for the implementation of many practices that support or enhance ecosystem services (e.g. improved species, legumes, grazing management, fire management, etc.) are often no different than those required for land-degrading management practices; they differ primarily in their implementation.[522]

Several studies have shown that grassland extensification programmes often produce an unintended slippage effect where farmers tend to enter less productive land into the programme while at the same time intensifying management of high potential areas.[523] Studies in the UK, for example, found that several farmers participating in grassland extensification programmes had enrolled already relatively extensive grassland areas. The lower opportunity costs associated with peripheral, marginal and difficult-to-farm areas mean that these are often entered first in such measures.[524] Conversely, several authors recommend the targeting of extensive areas (areas of low agronomic potential)[525] as the conservation benefits in such landscapes are usually higher, as species richness and nutrients loads have historically always been higher. In intensively managed regions, which are often larger parcels, habitats are often fragmented, soils contaminated and seed banks impoverished.[526] With these less favourable starting conditions, environmental effects are more difficult and costly to achieve than in extensive regions.

Perhaps one of the most significant issues for the implementation of PES in SNGLs is, however, how they may satisfy the 'additionality' criterion where many of the most obvious ecosystem services from SNGLs are already covered through Environmental Stewardship Schemes.

Cities tend to be built on arable land; remote areas are more likely to be grassland-based. SNGLs could therefore be expected to coincide in some cases with issues relating to remote areas, such as long distances to travel to meetings, and poorer quality infrastructure. Availability of intermediaries and non-governmental buyers may also be lower in some remote areas, particularly where these are not the focus of existing environmental research or monitoring programmes.

4.3.9 Opportunities for PES for SNGLs

Opportunities already exist for farm owners and managers to receive payments for activities that are beneficial to the environment through agri-environment schemes which are critical to the restoration and enhancement of SNGL biodiversity and ecosystem services. However,

[522] FAO (2010). Challenges and opportunities for carbon sequestration in grassland systems. A technical report on grassland management and climate change mitigation. *Integrated Crop Management* Vol. 9.
[523] Evans, N.J. and Morris, C. (1997). Towards a geography of agri-environmental policies in England and Wales. *Geoforum*, 28:189–204.
[524] *Ibid*
[525] Aviron, S., Burel, F., Baudry, J. and Schermann, N. (2005) Carabid assemblages in agricultural landscapes: impacts of habitat features, landscape context at different spatial scales and farming intensity. *Agric. Ecosyst. Environ*. 108: 205-217; Dahms H, Mayr,S., Birkhofer, K., Chauvat, M., Melnichnova, E., Wolters, V. and Dauber, J. (2010). Contrasting diversity patterns of epigeic arthropods between grasslands of high and low agronomic potential. *Basic and Applied Ecology*, 11: 6–14.
[526] Uthes, S., Li, F., Zhen, L., and Cao, X. (2010). Payments for Grassland Ecosystem Services: A Comparison of Two Examples in China and Germany. *Journal of Resources and Ecology*, 1(4): 319-330.

there is scope for the private sector to become more involved in financing the delivery of ecosystem services through for example:

- **Visitor payback schemes**. Many of the cultural ecosystem services provided by SNGLs focus around activities such as recreation, cultural heritage and landscape aesthetics. 'Visitor payback' schemes are now emerging that enable visitors to pay for environmental management that supports these services. Various National Park Authorities are already beginning to experiment with such schemes (see Table 27, Section 4.6.3). South Downs National Park, for example, which contains significant swathes of SNGL, is operating a scheme through the COLLABOR8 programme.[527] These schemes typically elicit payments by adding surcharges to tourist bookings and could be applied in regions where grasslands are a key feature or attraction;
- **Water utilities** may be interested in the ability of SNGLs to capture and immobilise organic nitrogen thereby reducing nitrate leaching to surface water systems and helping to improve the water quality of surface waters. Payments to SNGL land owners and managers for maintenance or improvement of surface water quality may be more cost-effective for utilities than conventional chemical treatment processes;
- **Crop farmers and horticultural enterprises** may be willing to pay for the pollination services supported by SNGLs. The NEA[528] notes the potential for pollination services to be delivered by the spread from SNGLs to farmed land of species which pollinate crops. Globally, there is some evidence of spillover of pollinators, [529] and in mainland Europe the abundance and species‐richness of bees, butterflies or hoverflies in arable fields has been shown to be related to the distance of the fields from SNGLs.[530] Ricketts *et al.* (2008) report a UK study which showed that the proximity of field bean (Vicia faba) crops to 'natural habitat' influenced pollination within the crops by native bees. The distance that the crops needed to be from natural habitat in order for the measures of pollination to decline by 50% was about 1.4 km for pollinator species ‐ richness and 900 m for visitation rate by pollinators to flowers.

[527] The Collabor8 project makes use of funding available from the EU's Interreg 4B programme. The nine partners include The South Downs National Park Authority (SDNPA), Brecon Beacons National Park Authority, Merthyr Tydfil County Borough Council and The West Country Rivers Trust together with others from Ireland, Belgium and the Netherlands. The idea for the project stemmed from the desire to make tourism and recreation more sustainable within the South Downs by encouraging visitors to help protect this special area. Based on an agreed set of criteria relating to quality assurance and eco-accreditation businesses will be encouraged to work together to develop locality or activity based 'products' linked to the sense of place. Businesses are supported through training, developing the business networks, product development and promotion.

[528] UK National Ecosystem Assessment (2011). *The UK National Ecosystem Assessment: Technical Report (Chapter 6: Semi-natural Grasslands)*. UNEP-WCMC, Cambridge [online] available at: http://uknea.unep-wcmc.org/LinkClick.aspx?fileticket=lfVaZJDoV8c%3d&tabid=82 (accessed 6 July 2011).

[529] Ricketts T.H., Regetz J., Steffan-Dewenter I., Cunningham S.A., Kremen C., Bogdanski A., Gemmill-Herren B., Greenleaf S.S., Klein A.M., Mayfield, M.M., Morandin, L.A., Ochieng, A., Potts S.G. and Viana, B.F. (2008). Landscape effects on crop pollination services: are there general patterns? *Ecology Letters*, 11: 499 ‐ 515.

[530] Ockinger, E. and Smith, H.G. (2007). Semi-natural grasslands as population sources for pollinating insects in agricultural landscapes. *Journal of Applied Ecology*, 44: 50 ‐ 59; Jauker, F., Diekotter, T., Schwarzbach, F. and Wolters, V. (2009). Pollinator dispersal in an agricultural matrix: opposing responses of wild bees and hoverflies to landscape structure and distance from main habitat. *Landscape Ecology*, 24: 547 ‐ 555.

4.4 Woodlands

4.4.1 Description

The area of woodland in England at March 2011 was estimated to be around 1.294 million hectares and represents around 9.8% of England's land area.[531] Woodland cover comprises 886,000ha of broadleaves and 411,000 ha of conifers.[532]

While there is no primary woodland in the UK, restoration in cover has resulted from afforestation (e.g. of marginal grazing land in the uplands) and re-growth of existing woodland from wartime felling.[533] The last two decades have seen increased rates of creation of new native woodlands on farmland and in old industrial areas.[534] While the initial driver for expansion was timber production (a provisioning service), which accounts for the substantial proportion (32%) of conifer species in current woodland cover in England, since the mid-1980s forestry policy has increasingly sought a basket of services (including biodiversity, cultural and regulating), resulting in increased planting of broadleaved tree species and a diversification of plantation structures.[535] As a result, there was a significant increase of 94,000ha (or 10.6%) in broadleaved, mixed and yew woodland between 1990 and 2007.[536] Expansion and restoration of broadleaved woodland is being implemented primarily through the actions of organisations such as the Forestry Commission, on its own estates, and through its grants to landowners, the Woodland Trust and other NGOs and at least 52 local biodiversity action partnerships.[537] About one quarter of priority species listed under the UK Biodiversity Action Plan are associated with trees and woods.

Coniferous woodland cover in England appears to be relatively stable in both its extent (a 1.4% decrease between 1998 and 2007) and composition. Though conifer restocking vastly exceeds that of broadleaves, accounting for around three quarters (73%) of the total area of restocking in 2010-2011[538], new planting is primarily of broadleaves (around 82% of the total area of new planting), and is, to some extent, being offset by clearance of stands to restore open habitats such as bog or lowland heath. In addition, an increase in temporary open ground within commercial forests is likely over the next 10 years, as the extensive areas planted between 1950 and 1980 reach felling age.[539]

Woodland is distributed unevenly across England and, similarly to grassland and agricultural habitats, contributes greatly to landscape value.[540] 117,000 hectares of woodland habitat (as defined under the UK Biodiversity Action Plan) is situated on SSSIs in England, constituting 86% of the total habitat as defined under the UK BAP. According to Natural England, the percentage of these SSSIs in target condition increased between 2003 and 2010 from 72% to

[531] Forestry Commission (2011). *Woodland Area, Planting and Restocking*. First Release, 9 June 2011 [online] available at: http://www.forestry.gov.uk/pdf/area2011.pdf/$FILE/area2011.pdf (accessed 16 September 2011).
[532] *Ibid*
[533] UK National Ecosystem Assessment (2011). *The UK National Ecosystem Assessment: Technical Report (Chapter 8: Woodlands)*. UNEP-WCMC, Cambridge [online] available at http://uknea.unep-wcmc.org/Resources/tabid/82/Default.aspx (accessed 6 July 2011).
[534] Forestry Commission (2005) *Keepers of Time: A Statement of Policy for England's Ancient & Native Woodland*. Forestry Commission, Cambridge.
[535] UK National Ecosystem Assessment (2011). *The UK National Ecosystem Assessment: Technical Report (Chapter 8: Woodlands)*. UNEP-WCMC, Cambridge [online] available at: http://uknea.unep-wcmc.org/Resources/tabid/82/Default.aspx (accessed 6 July 2011).
[536] Countryside Survey (2008*). Countryside Survey: England Results from 2007*. Chapter 6: Woodlands: Broadleaved, Mixed and Yew Woodland; and Coniferous Woodland Broad Habitats [online] available at: http://www.countrysidesurvey.org.uk/eng_reports2007.html (accessed 13 December 2010).
[537] See www.ukbap.org.uk
[538] Forestry Commission (2011). *Woodland Area, Planting and Restocking*. First Release, 9 June 2011 [online] available at: http://www.forestry.gov.uk/pdf/area2011.pdf/$FILE/area2011.pdf (accessed 16 September 2011).
[539] Countryside Survey (2008). *Countryside Survey: England Results from 2007* [online] available at: http://www.countrysidesurvey.org.uk/eng_reports2007.html (accessed 13 December 2010).
[540] *Ibid*

96%.[541] However, woodland ecosystems are affected by drivers of change, including climate change, pollution, government policy on land use, global trade, and the endogenous dynamics of ageing woodland.

4.4.2 Ecosystem Services from Woodlands

The key ecosystem services generated by woodlands in England, as identified by the NEA, are outlined in the table below, together with an indication of the relative importance of woodlands in delivering each of the listed ecosystem services.

Table 16: Main ecosystem services from woodlands[542]

Provisioning		Cultural		Regulating	
Crops		Local places	H	Climate	H
Livestock / Aquaculture	L	Landscapes / seascapes	M-H	Hazard	M-H
Fish				Disease and pests	M-L
Trees, standing vegetation, peat	H			Pollination	L
Water supply	M-L			Noise	M-H
Wild species diversity	H	Wild species diversity	H	Water quality	M-H
				Soil quality	H
				Air quality	H

Key

High	H	Blank cells represent services that are not applicable to the Broad Habitat
Medium – High	M-H	
Medium – Low	M–L	
Low	L	

Woodlands provide amongst the highest identified number of ecosystem services, including regulating climate, air quality and water flows, providing timber and other wood products, as well as a range of cultural benefits. A classification of the principal types of services considered important in UK woodlands/forestry is presented in Table 17 using the UK NEA typology.

[541] Natural England (2011) NE306 - Protecting England's natural treasures - Sites of Special Scientific Interest [online] available at: http://naturalengland.etraderstores.com/NaturalEnglandShop/ne306 (accessed 24 March 2011).
[542] UK National Ecosystem Assessment (2011). *The UK National Ecosystem Assessment: Synthesis of the Key Findings*. UNEP-WCMC, Cambridge [online] available at: http://uknea.unep-wcmc.org/Resources/tabid/82/Default.aspx (accessed 6 July 2011).

Table 17: Types of ecosystem services provided by woodlands[543]

Ecosystem service provided by woodlands	Examples of goods and benefits in the UK	Key references[544]
Provisioning services		
Crops, livestock and **fisheries**	Little tradition of agro-forestry other than grazing particularly as part of wood-pasture systems; non-timber forest products (NTFPs) for commercial and domestic use, e.g. meat (including from culled deer), berries, honey, fungi, medicinal derivatives and drugs.	Martin *et al*. (2006); Emery *et al.* (2006); Kirby *et al.* (1995)
Trees for timber	Provision of raw timber materials for use in commercial and domestic enterprises; provision of wood chips for boards and pulp for paper. Use of timber as an alternative for other building materials such as steel and concrete in order to reduce use of fossil fuels and enhance building standards.	Forestry Commission (2003a) Suttie *et al*. (2009)
Trees for bio/woodfuel	Timber products (e.g. harvesting residues, stumps and roots, recycled wood) as fuel for heat and power plants, as domestic firewood, for biochar and as raw material for processed hydrocarbon fuels.	Chapter 14 of the NEA Ireland *et al*. (2004)
Woodlands and **water supply**	Wooded catchments especially in the uplands provide important water supplies for major urban areas (e.g. Thirlmere and Manchester).	Ritvo (2009)
Regulating services		
Climate	Avoidance of climate stress. Tree cover can help dampen the climatic effects experienced in the open, thus protecting soils, animals and humans from extremes of temperature, strong winds and UV light.	Mason *et al.* (2009)
	Carbon sequestration. Woodlands and their soils are important reserves of terrestrial carbon, and timber products can also be considered.	Morison *et al*. (2009); Lorenz and Lal (2010)
Hazard	Soil protection. Tree cover can offer protection from soil erosion and slope failure. Forest management will reduce exposure to chemicals and pesticides and likelihood of soil compaction compared to agriculture.	Moffat (1991); Nisbet *et al*. (2008)
	Flood and water protection. Woodlands moderate	Nisbet *et al*. (in

[543] UK National Ecosystem Assessment (2011). *The UK National Ecosystem Assessment: Technical Report (Chapter 8: Woodlands)*, p23. UNEP-WCMC, Cambridge [online] available at: http://uknea.unep-wcmc.org/Resources/tabid/82/Default.aspx (accessed 6 July 2011).
[544] For full references see Chapter 8: Woodlands of UK National Ecosystem Assessment (2011). *The UK National Ecosystem Assessment: Technical Report*. UNEP-WCMC, Cambridge [online] available at: http://uknea.unep-wcmc.org/Resources/tabid/82/Default.aspx (accessed 6 July 2011).

Ecosystem service provided by woodlands	Examples of goods and benefits in the UK	Key references[544]
	rainfall events and river and stream hydrographs, delaying and reducing flood events.	press, 2011)
Disease and pests	Woodland dwelling organisms can help in regulating the incidence and spread of insect pests of crops and pathogens of importance to humans, livestock, crops and ecosystems.	Chapter 14 of the NEA
Detoxification and Purification	Water quality. Because of minimal use of pesticides and fertilisers, woodlands managed under sustainable principles also offer benefits of water quality.	Nisbet *et al*. (in press, 2011)
	Soil quality. Woodland cover can stabilise contaminated brownfield land and hinder the pathways between source and receptors.	Moffat and Hutchings (2007)
	Air quality. Capture of atmospheric pollutants in tree canopies can lead to consequent reduced exposure for humans, crops, buildings etc.	NEGTAP (2001)
	Noise reduction. Belts of trees between residences and transport routes can absorb sound.	Huddart (1990)
Pollination	Woodlands likely provide habitat for diverse wild pollinator communities of importance to trees, crops and other plants.	Devoto *et al*. (2011)
Cultural Services		
Wild species diversity	Biodiversity. UK forests, including plantations, provide habitat for a wide range of fauna and flora but a limited genetic resource (e.g. compared to tropical forests).	Humphrey *et al*. (2003)
Environmental settings	Trees and woodlands are valuable for personal enlightenment and as places or catalysts for social activity and cohesion.	O'Brien (2006); Lawrence *et al.* (2009)
	Forests are increasingly acknowledged for their educational value.	O'Brien and Murray (2007)
	Trees have been perpetual motifs in fine art, and influenced many other art forms.	Phythian (1907); Hohl (1998)
	Many forests are open to the public for the enjoyment of outdoor pursuits and recreational activities. Their access facilitates exercise and benefits human health and longevity.	Woodland Trust (2004); O'Brien and Morris (2009)

Ecosystem service provided by woodlands	Examples of goods and benefits in the UK	Key references[544]
	Trees and woodlands increase the diversity of landscape character; their existence provides a link with the past when man's existence was more closely linked to woodlands and their products; woodlands reduce the rate of, or eliminate the need for, cultivation, a significant cause of archaeological destruction.	Rackham (1976); Smout (2002); Crow (2004)
Supporting services		
Soil formation, nutrient cycling, water cycling, oxygen production	Forests facilitate soil formation and other biogeochemical processes essential to life.	Fisher and Binkley (2000)
Biodiversity	Little in way of unique species (endemism) at least amongst the well-know groups, but locally adapted provenances and distinctive assemblages associated with some species being at the edge of their range in Britain; a distinctive maritime climate; and historical differences. These include 'Atlantic' elements such as the abundance of bluebells, rich bryophyte communities in western oak woods, ash-hazel dominated woods (beyond range of beech), abundance of veteran trees with associated lichen and saproxylic associated species.	Rodwell (1991); Peterken (1996); Kirby *et al*. (2005)

The historical survival, and most planting, of woodlands in the past have been due to the provisioning services they provide. Since the Second World War, the expansion of woodland was driven by the need for **timber production**, and currently about 82% of UK wood and timber products are imported[545] (down from 96% in the 1940s).[546] UK-wide in 2009, 8.5 million tonnes of softwood and 0.5 million tonnes of hardwood were processed. An estimated 440 thousand green tonnes (mainly softwood) of **woodfuel** were supplied by UK sawmills and round fencing manufacturers in 2009, around 89% of which was sold to bioenergy.[547] Pulp and paper accounted for most exports, generating £1.4 billion out of a total of £1.5 billion for all wood product exports.[548] Non-timber forest products (e.g. elderflowers, sloes, damsons and bullaces, nettles, hazel fences and spars for thatching, fungi, moss and foliage) are often locally important but the quantities used are small. [549]

Woodlands also provide valuable regulating services. UK forests function as an important **carbon sink.** UK forest biomass (above- and below-ground) contains about 550 million tonnes

[545] Forestry Commission (2010). *Forestry Statistics 2010* [online] available at: http://www.forestry.gov.uk/website/forstats2010.nsf/LUContentsTop?openview&RestrictToCategory=1 (accessed 13 July 2011).
[546] UK National Ecosystem Assessment (2011). *The UK National Ecosystem Assessment: Synthesis of the Key Findings*. UNEP-WCMC, Cambridge [online] available at: http://uknea.unep-wcmc.org/Resources/tabid/82/Default.aspx (accessed 6 July 2011).
[547] Forestry Commission (2010). *Forestry Statistics 2010* [online] available at: http://www.forestry.gov.uk/website/forstats2010.nsf/LUContentsTop?openview&RestrictToCategory=1 (accessed 13 July 2011).
[548] *Ibid*
[549] UK National Ecosystem Assessment (2011). *The UK National Ecosystem Assessment: Technical Report (Chapter 8: Woodlands)*, p23. UNEP-WCMC, Cambridge [online] available at: http://uknea.unep-wcmc.org/Resources/tabid/82/Default.aspx (accessed 6 July 2011).

of CO_2, as much as the UK emits in a single year, and UK forest soils contain about 4 billion tonnes of CO_2[550] Together, UK forest biomass and soils are estimated to be removing around 10.7 million tonnes of CO_2 per year although this is expected to fall steadily to around 4.5 million tonnes per year by 2020.[551] Oak forests in England have been measured as removing around 15 tonnes of CO_2 per hectare per year during maximum growth phase, compared with 24 tonnes CO_2 per hectare per year in maximum growth phase for coniferous forest in southern Scotland.[552] The largest vegetation store of carbon in the UK is the woodland of southern England[553], although this is negligible in comparison with soil storage, particularly in heaths and blanket bogs. There have been various estimates of topsoil carbon concentrations. The NEA cites studies by Kirby *et al.* (2005),[554] who examined changes in woodlands in Great Britain between 1971 and 2000–2003 and found no significant change from 88 g C/kg, and Chamberlain *et al*. (2010)[555] who estimate that there has been a 0.5 Tg C increase in broadleaved woodland and a 9.2 Tg C decrease in the total topsoil carbon stocks between 1998 and 2007. Woodlands planted since 1990, with a woodland creation programme of 23,000 ha per year, are removing about 2.5 million tonnes of CO_2 annually[556] and could, by 2050, sequester 10% of UK carbon emissions.[557]

In addition, trees and woodlands generate a **cooling** effect which can reduce local temperatures by 3-4˚C.[558] Shading of rivers streams and other water bodies by trees can deliver similar cooling, with beneficial effects for fisheries and wildlife, and street trees can have a similar effect in urban areas.[559]

Woodlands can also provide important **soil** and **water** protective and **hydrological** functions when carefully managed. They can, however, reduce water yield, which can be an issue of consequence in maintaining good ecological status of water bodies. Riparian woodlands are a means of reducing flood peaks and may provide a soft engineering solution that is more cost-effective than 'hard' engineering solutions to flood mitigation. Forests also contribute significantly to the maintenance of good **water quality**.[560] They achieve this through minimising soil erosion on site, thus reducing sediment in water bodies (wetlands, ponds and lakes, streams and rivers), and through trapping or filtering other water pollutants. Woodlands

[550] Broadmeadow, M. (2009). *Carbon: Payments for carbon sequestration and substitution by UK forests*, presentation at ecosystem services seminar, Institute of Chartered Foresters South East Region Annual General Meeting [online] available at: http://www.forestry.gov.uk/pdf/icfagm2009_carbon_broadmeadow.pdf.pdf/$FILE/icfagm2009_carbon_broadmeadow.pdf.pdf (accessed 23 February 2011).
[551] Forestry Commission (2010). *Forestry Statistics 2010* [online] available at: http://www.forestry.gov.uk/website/forstats2010.nsf/LUContentsTop?openview&RestrictToCategory=1 (accessed 13 July 2011).
[552] UK National Ecosystem Assessment (2011). *The UK National Ecosystem Assessment: Technical Report (Chapter 17: Country Synthesis - England)*, UNEP-WCMC, Cambridge [online] available at: http://uknea.unep-wcmc.org/Resources/tabid/82/Default.aspx (accessed 6 July 2011).
[553] Milne, R. & Brown, T.A. (1997). Carbon in the vegetation and soils of Great Britain. Journal of Environmental Management, 49, 413 - 433.
[554] Kirby, K.J., Smart, S.M., Black, H.I.J., Bunce, R.G.H., Corney, P.M., & Smithers, R.J. (2005). Long term ecological change in British woodlands (1971–2001), *English Nature*, Peterborough.
[555] Chamberlain, P.M., Emmett, B.A., Scott, W.A., Black, H.I.J., Hornung, M. & Frogbrook, Z.L. (2010). No change in topsoil carbon levels of Great Britain, 1978–2007. *Biogeosciences Discuss*, 7: 2267 - 2311.
[556] *Ibid*
[557] UK National Ecosystem Assessment (2011) *The UK National Ecosystem Assessment: Technical Report (Chapter 17: Country Synthesis - England)*, UNEP-WCMC, Cambridge [online] available at: http://uknea.unep-wcmc.org/Resources/tabid/82/Default.aspx (accessed 6 July 2011).
[558] Morecroft, M.D., Taylor, M.E. and Oliver, H.R. (1998). Air and soil microclimates of deciduous woodland compared to an open site. *Agricultural and Forest Meteorology*, 90: 141 - 156.
[559] Handley, J. and Gill (2009) Combating climate change - a role for UK forests. An assessment of the potential of UK's trees and woodlands to mitigate and adapt to climate change. In Read, D.J., Freer- Smith, P.H., Morison, J.I.L., Hanley, N., West, C.C. and Snowdon, P. (eds.) (2009) *Combating climate change – a role for UK forests. An assessment of the potential of the UK's trees and woodlands to mitigate and adapt to climate change. The synthesis report*. The Stationery Office, Edinburgh.
[560] FAO (2004). *Forests and water quality* [online] available at: ftp://ftp.fao.org/docrep/fao/011/i0410e/i0410e04.pdf (accessed 15 December 2010).

and trees also play a role in **air quality**, with a *"measurable impact in reducing air pollution, absorbing polluting gases, intercepting particulates, and releasing oxygen"*.[561]

Many forests in England, especially semi-natural woodlands, are associated with particularly high levels of **biodiversity**. It is estimated that broadleaved woodland contains twice as many species of conservation concern as any other habitat.[562] The complex structure of woodland provides a multitude of niches for different species, and while trees take years to reach maturity, a new native wood provides a range of interesting transitional and temporary habitats as it develops.[563] Woodland biodiversity is valued for its existence by many different people from casual walkers to wildlife enthusiasts; the opportunities that woodlands provide for viewing wildlife is a major motivation for woodland visits. Willis *et al.* (2003)[564] have provided one of the most comprehensive assessments of the value of ecosystem services from woodlands and forests in Great Britain. They estimate, for example, that the biodiversity value alone is worth $476 million per year (2010 prices).[565]

According to the Woodland Trust, *"All green space offers opportunities for health and well-being but woodland has special qualities"*. The Trust's 2010 report cites that woodlands, in particular, provide an important environment for outdoor relaxation and play, environmental education and outdoor child development, with their complex structure offering opportunities for imaginative play and encouraging independence. Other **health and cultural** benefits include screening out noise and absorbing large numbers of visitors without seeming overcrowded. The report also refers to the 'special meaning' that woods and trees can hold for people.[566]

The **recreation** value of forests is well known and has been well studied.[567] In 2009, 49% of UK woodland was assessed as being accessible to the public. In 2007, there were an estimated 317 million visits to English woodland and 63% of the English population has access to 20ha or more wood within 4km of their home (increasing from 55.2% in 2004).[568]

4.4.3 Scope for PES from Woodlands

About 16.5% of England's woodland resource is owned and managed by the Forestry Commission.[569] The remaining 83.4% is owned by individuals, family trusts, charitable trusts or companies, local authorities or public bodies other than the Forestry Commission.[570] In the

[561] The Woodland Trust (2010). *Space for People: Targeting action for woodland access* [online] available at: www.woodlandtrust.org.uk/publications (accessed 24 March 2011).
[562] Biodiversity: the UK Steering Group Report (1995) Volume 1: Meeting the Rio challenge HMSO.
[563] The Woodland Trust (2010). *Space for People: Targeting action for woodland access* [online] available at: http://www.woodlandtrust.org.uk/en/about-us/publications/Documents/space-for-people-new.pdf (accessed 24 March 2011).
[564] Willis, K.G., Garrod, G., Scarpa, R., Powe, N., Lovett, A., Bateman, I.J., Hanley, N. and Macmillan, D.C. (2003). *The social and environmental benefits of forests in Great Britain*. Forestry Commission, Edinburgh.
[565] This value was estimated on the basis of an evaluation of the relative importance and value of biodiversity in different types of forest (e.g. upland native broadleaved woodland; lowland conifer forest; lowland ancient semi-natural broadleaved woodland) and the value of additions to these forests.
[566] The Woodland Trust (2010). *Space for People: Targeting action for woodland access* [online] available at: http://www.woodlandtrust.org.uk/en/about-us/publications/Documents/space-for-people-new.pdf (accessed 24 March 2011).
[567] See, for example, Scarpa, R. (2003). *The Recreation Value of Woodlands*. Report to the Forestry Commission Edinburgh [online available at: http://www.forestry.gov.uk/pdf/nmbrecrep.pdf/$FILE/nmbrecrep.pdf (accessed 28 December 2010); Willis, K.G., Garrod, G., Scarpa, R., Powe, N., Lovett, A., Bateman, I.J., Hanley, N. and Macmillan, D.C. (2003). *The social and environmental benefits of forests in Great Britain*. Report to Forestry Commission, Edinburgh. Centre for Research in Environmental Appraisal and Management, University of Newcastle upon Tyne; Edwards, D., Elliott, A., Hislop, M., Martin, S., Morris, J., O'Brien, L., Peace, A., Sarajevs, V., Serrand, M. and Valatin, G. (2009*). A valuation of the economic and social contribution of Forestry for People in Scotland*. Research Report for Forestry Commission Scotland by Forest Research, Edinburgh.
[568] Forestry Commission (2010). *Forestry Statistics 2010* and *Forestry Facts & Figures 2010* [online] available at: http://www.forestry.gov.uk/forestry/infd-88qdfk (accessed 13 December 2010).
[569] Forestry Commission (2011). *Woodland Area, Planting and Restocking*. First Release, 9 June 2011 [online] available at: http://www.forestry.gov.uk/pdf/area2011.pdf/$FILE/area2011.pdf (accessed 16 September 2011)
[570] *Ibid*

period 1995-1999, around 70% of England's woodland area was privately owned.[571] While there are many thousands of small farm woodlands, there is very little ownership with more than 1,000 hectares of woodland[572]. Whilst this is a potentially critical issue for future PES schemes, many of these small woodlands exist in recognition of beneficial services, including regulating wind speeds and providing cover for sporting activities, particularly shooting, but from which a range of biodiversity, landscape, hydrological, carbon sequestration and other services may come 'free' and so providing a basis for bundling within a PES scheme.

The remaining proportion of woodland is owned publicly, the bulk of it managed by the Forestry Commission. These are often 'new' forests established in the 20th century in areas of low agricultural value, particularly in the uplands, using mainly conifer species.[573] The Government recently halted a consultation on the future of the Public Forest Estate (PFE) in England, which proposed reducing the level of Government ownership or management of woodland, following public concern. The Secretary of State for Environment, Food and Rural Affairs has announced that an independent panel of experts will advise on the future direction of woodland policy in England and on the role of the Forestry Commission and the PFE and report back in spring 2012.

Forestry policy and woodland management have changed over time, as different combinations of ecosystem services have been sought, the delivery of which depend on the specific characteristics of trees and woodlands (e.g. growth rate and species composition) and management practices.[574] For example, the diversification of forest structure for biodiversity benefits may improve cultural services while increases in forest cover may benefit carbon and flood regulation. However, maximising provisioning services through the use of highly productive species and intensive site treatments may have negative effects upon the value of woodland for biodiversity and cultural services.[575]

Efforts to protect and enhance the range of ecosystem services (and most particularly carbon sequestration) provided by woodlands are supported by a number of policy drivers including:

- The Climate Change Act, which requires an 80% reduction in greenhouse gas emissions by 2050;
- The Renewable Energy Strategy which sets a target for the UK to source 15% of energy from renewable sources (including biomass/woodfuel) by 2020;
- The Rural Development Programme for England (which supports the English Woodland Grant Scheme – see below);
- The UK Low Carbon Transition Plan (LCTP);
- Departmental Carbon Reduction Delivery Plans; and
- The Natural Environment White Paper, which recognises the important role of forests and woodlands in achieving a resilient and coherent ecological network across England, and their contribution to human well-being and prosperity.

[571] Forestry Commission (2010). *Forestry Statistics 2010* and *Forestry Facts & Figures 2010* [online] available at: http://www.forestry.gov.uk/forestry/infd-88qdfk (accessed 13 December 2010).
[572] *Ibid*
[573] *Ibid*
[574] UK National Ecosystem Assessment (2011). *The UK National Ecosystem Assessment: Technical Report (Chapter 8: Woodlands)*. UNEP-WCMC, Cambridge [online] available at: http://uknea.unep-wcmc.org/Resources/tabid/82/Default.aspx (accessed 6 July 2011).
[575] *Ibid*

The LCTP in particular notes that "*The Government will support a new drive to encourage private funding for woodland creation.... This will allow businesses and individuals to help the UK meet its carbon budgets, whilst delivering the other benefits that woodlands can bring*"[576].

The Woodland Trust advocates the creation of more woodland in England to meet the Woodland Access Standard, which it claims will improve health and wellbeing and provide other benefits[577]:

"Creating new native woodland can improve water quality by reducing sediment, nitrate, phosphate and pesticide concentrations through lower inputs and decreased run-off. In urban areas, where trees are used as part of sustainable urban drainage systems, they can reduce surface run-off and retain pollutants on brownfield sites".

The Forestry Commission has compiled a substantial evidence base highlighting the range of social and cultural benefits derived from woodland ecosystem services, focusing particularly on health, well-being, quality of place and learning opportunities. It has also identified various mechanisms for capturing the value of these ecosystem services through, for example[578]:

- Grants to deliver key services (i.e. through the English Woodland Grant Scheme);
- Contracts for delivering services (e.g. Hill Holt Wood in Lincolnshire has established contracts with the Learning Skills Council and Local Education Authorities to work with young people who have been excluded from school or who are unemployed and teach them basic conservation and craft skills);
- Charging for services delivered (e.g. entry fees to woodland parks and facilities); and
- Adding to a body of evidence of how services and benefits contribute to key government policies.

There is growing interest in the use of payments for ecosystem services from woodlands. The Forestry Commission and Forest Research, an agency of the Forestry Commission, have explored the application of PES in a woodland context, drawing on evidence from the USA, and concluded that, if well designed and implemented, PES offers considerable potential for ecosystem protection.[579] In particular, the research recognised the importance of regulation as a driver for PES schemes[580] (arguing that mitigation banking in the US, for example, is driven principally by requirements under the Clean Water and Endangered Species Acts). The research also concluded that the scope for water quality trading should be further explored as a means to meet requirements under the Water Framework Directive.

The Forestry Commission administers the English Woodland Grant Scheme (EWGS) which consists of a series of grants designed to create and enhance woodlands for environmental and social benefit (in some instances support for woodlands is also available through

[576] HM Government (2009). *The UK Low Carbon Transition Plan: National Strategy for Climate and Energy*, p160 [online] available at: http://www.decc.gov.uk/assets/decc/White%20Papers/UK%20Low%20Carbon%20Transition%20Plan%20WP09/1_20090724153238_e_@@_lowcarbontransitionplan.pdf (accessed 28 December 2010).
[577] The Woodland Trust (2010). *Space for People: Targeting action for woodland access* [online] available at: www.woodlandtrust.org.uk/publications (accessed 24 March 2011).
[578] Forest Research (2009). Payments for health and well-being and the cultural services provided by woodlands. Presentation, November 2009 [online] available at: http://www.forestry.gov.uk/pdf/icfagm2009_health_obrien.pdf/$FILE/icfagm2009_health_obrien.pdf (accessed on 6 May 2011).
[579] Coull, J. and Valatin, G. (2008). *Payments for Ecosystems Services: Findings and Perceptions from the USA* [online] available at: http://www.forestry.gov.uk/pdf/PES_policy_summary_Jan08.pdf/$FILE/PES_policy_summary_Jan08.pdf (accessed 23 February 2011).
[580] It is worth noting here that the Forestry Commission uses a broader definition of PES than that adopted for the purposes of this report. The Forestry Commission defines PES as "any mechanism involving paying for an ecosystem service", including 'cap-and-trade' systems, offsets, public payments to land owners and self-organised voluntary deals. (See http://www.forestry.gov.uk/pdf/PES_policy_summary_Jan08.pdf/$FILE/PES_policy_summary_Jan08.pdf).

Environmental Stewardship).[581] The six grants cover woodland management plans; evidence gathering to improve woodland management decisions; woodland restocking following tree felling; ongoing work that maintains or enhances the environmental value of woodlands or provides access; capital works for environmental or social improvement; and the creation of new woodland.[582] As such, the EWGS can act to compensate landowners for the provision of ecosystem services of value to people and thus constitutes a PES scheme[583].

The UK Forestry Standard (UKFS) represents the Government's approach to sustainable forestry.[584] It sets out criteria and standards for sustainable woodland management and is the centrepiece of a system to guide and monitor forestry. The Standard is linked to the developing international protocols for sustainable forestry. It is used in the UK as a basis for the development of forest monitoring and is the basis from which the UK Woodland Assurance Standard was developed. Following consultation in 2009/10, a revised version of the UKFS and associated guidelines (covering biodiversity, climate change, historic environment, landscape, people, soil and water) is set to be launched in 2011. The new versions will have more explicit requirements and will again emphasise that compliance with the UKFS is a condition for all woodland grant aid.[585] Both the UK Forestry Standard and the Woodland Assurance Standard underlie the UK Certification Scheme for Sustainable Forest Management under the Programme for the Endorsement of Forest Certification (PEFC) and Forest Stewardship Council (FSC) schemes.[586]

The existence of carbon markets as part of both formal emission trading schemes and voluntary offset schemes demonstrates the potential for a **forest carbon sequestration** PES. These payments can occur either for carbon sequestration (deriving from the net absorption of carbon dioxide in planted trees) or by protecting carbon stocks – which would otherwise be emitted – in natural forests. Debate is ongoing in the EU about the extent to which forestry credits may be included in the EU Emissions Trading Scheme. The view has been that forestry offsets (like any offset) are undesirable because attention is diverted away from the real effort needed towards 'prevention' (i.e. energy saving, renewable, etc). The UK government has, however, accepted that high quality forestry carbon sinks can make an important contribution to offsetting UK emissions. In 2009, The Stationery Office published the 'Read Report' – an independent assessment of the potential of the UK's trees and woodlands to mitigate and adapt to our changing climate – which concluded that increasing tree cover and increased use of sustainably-produced UK timber would not only enhance the carbon store but also offer a range of other benefits including flood mitigation, water run-off and temperature control.[587]

[581] See Forestry Commission web pages on the EWGS available at: http://www.forestry.gov.uk/ewgs (accessed 23 February 2011).
[582] The EWGS Woodfuel Woodland Improvement Grant is set to be launched in spring 2011 and will support woodland management for woodfuel and timber production
[583] Payments are typically conditional on adherence to management prescriptions rather than actual outcomes and therefore the EWGS does not fully satisfy the definition of a PES developed by Wunder (2005).
[584] Forestry Commission (2004). *The UK Forestry Standard: The Government's Approach to Sustainable Forestry*. Forestry Commission: Edinburgh [online] available at: http://www.forestry.gov.uk/pdf/fcfc001.pdf/$FILE/fcfc001.pdf (accessed 6 July 2011).
[585] Richard Howe, Forestry Commission, personal communication, 23 February 2011
[586] PEFC UK Ltd was established in 2000 and is the member of PEFC International, an international non-profit, non-governmental organisation dedicated to promoting Sustainable Forest Management (SFM) through independent third-party certification. PEFC International is an umbrella organisation that endorses national forest certification systems developed through multi-stakeholder processes and tailored to local priorities and conditions. It works throughout the forest supply chain to promote good practice in the forest and to ensure that timber and non-timber forest products are produced with respect for ecological, social and ethical standards.
[587] National Assessment of UK Forestry and Climate Change Steering Group (2009) *Combating Climate Change – A Role for UK Forests. An Assessment of the Potential of the UK's Trees and Woodlands to Mitigate and Adapt to Climate Change. The Synthesis Report*. Forestry Commission [online] available at: http://www.tsoshop.co.uk/gempdf/Climate_Change_Synthesis_Report.pdf (accessed 21 May 2011).

The Forestry Commission has recently developed and launched a Woodland Carbon Code[588] that sets out the requirements for voluntary carbon sequestration projects that incorporate core principles of good carbon management as part of modern sustainable forest management.

The launch of the Code is one of several milestones under a project being undertaken by the Woodland Carbon Task Force (WCTF) to develop standards and clarify how to report carbon savings from woodland creation. The WCTF was brought together by the Forestry Commission with leading roles for business, landowners and civil society organisations. The principal objectives of the WCTF are to[589]:

- Establish the conditions for more woodland creation via significant private sector investment to complement public funding; and
- Increase the supply and demand of woodfuel leading to greater uptake of Sustainable Forest Management practices.[590]

All these initiatives support the case for allowing companies, organisations and individuals to compensate for their unavoidable emissions through payments for carbon sequestration.[591] The Woodland Carbon Code in particular will have benefits for both carbon companies and landowners who will be able to:

- Demonstrate compliance with government-backed standards for woodland carbon projects; and
- Provide reassurance to investors that the projects they are investing in meet transparent criteria and standards through access to forest carbon measurement protocols and a system of independent quality assurance to ensure that real carbon benefits are delivered.

There is potentially also scope to implement PES in SSSIs, whether managed by Forest Enterprise or privately. However, SSSI classification does not extend to measuring delivery of services and therefore any payment system is likely to have to cover a bundle of potential services (i.e. those delivered by an SSSI in 'favourable' condition). Other private woodland owners may also potentially elicit payments for management actions that preserve areas of woodland that deliver valuable ecosystem services that might not otherwise be realised.

In addition to the climate regulating services of woodlands, a number of other ecosystem services may be enhanced through the introduction of PES schemes that support changes in management practices. For example, faster growing species or the use of better quality sites will not only fix carbon quicker, but also produce timber of an utilisable size quicker. Felling may take place sooner and, provided that the carbon is then stored (e.g. through embedding in construction), another rotation can be established to further sequester carbon. Such synergies have already attracted policy support through new woodland expansion targets for England.[592]

[588] See http://www.forestry.gov.uk/forestry/INFD-863ffl.
[589] See http://www.forestry.gov.uk/england-wctf.
[590] With a target for increasing the amount of wood harvested for fuel from England's woods by 60%, the Forestry Commission's Woodfuel Strategy is supporting the installation of lower-carbon wood-fuelled boilers and bringing currently uneconomic woodland into productive sustainable management.
[591] Note, however, that the Woodland Carbon Code is not a carbon offsetting scheme. While Carbon sequestration resulting from certified projects will contribute directly to the UK's national targets for reducing emissions of greenhouse gases, the Code does not provide a route to conformance with regulatory carbon 'offsetting' schemes (e.g. the Carbon Reduction Scheme or EU Emissions Trading Scheme); or the generation of internationally tradable carbon credits linked to either the compliance or voluntary markets. So, while not a tradable commodity, recent guidance issued by DECC on measuring and reporting greenhouse gas emissions, allows organisations that invest in or are directly associated with projects certified to the Code, to report those carbon savings as part of their net greenhouse gas emissions. This reporting is currently voluntary but could become mandatory for some businesses in 2012.
[592] Forestry Commission (2007). *England Forestry Strategy. A New Focus for England's Woodlands: Strategic Priorities and Programmes*. Forestry Commission [online] available at: http://www.forestry.gov.uk/pdf/fcefs.pdf/$FILE/fcefs.pdf (accessed 14 July 2011).

The NEA[593] identifies a number of other potential synergies between provisioning, regulating and cultural services:

- Stand management, in the form of thinning, can harvest some of the production (provisioning). In doing so, it will increase the light levels within the stand, leading to improved conditions for ground and shrub layers (and those organisms, such as woodland birds, that depend upon them), and improved access for recreational activities (including the gathering of non-timber forest products);
- Reinstatement of a coppice regime could foster crafts and traditional skills, maintain a supply of niche products and woodfuel, and bring biodiversity benefits;
- Restoration of riparian/floodplain woodland may delay and reduce flood peaks. Such restoration would also lead to the reinstatement of habitats that have been lost over large parts of Europe, favouring a range of aquatic and terrestrial organisms, providing wildlife corridors and making a significant contribution to landscape quality and diversity.

Similarly with other broad habitat types, there are, nevertheless, also a number of potential conflicts to be considered:

- The harvesting of trees to make fibre available for use in timber products, construction, paper-making, or fuel removes the carbon store in the aboveground parts of the tree, and may lead to increased rates of soil carbon loss as a result of changes in the microclimate and soil. The magnitude of this trade-off depends upon the end use of the tree products (including the extent to which these products become an off-site store), and the rate of restoration of forest conditions after felling;
- There are potential conflicts between harvesting operations (particularly where these are mechanised) and recreational use as access may be restricted to prevent accidents, and the resulting change of character may influence the perceived attractiveness of the area. Heavy machinery may also disturb wildlife and reduce opportunities to view charismatic species, at least in the short-term (in the medium-term, the habitat manipulation may be beneficial);
- The use of fast-growing species, particularly eucalyptus, as a source of biomass for biofuel has benefits for carbon sequestration but there are concerns over its relatively high water use, increased fire hazard, potential invasiveness, impact on ground flora and uncertain impacts on landscape aesthetics. Furthermore, the optimal stand structure for fuel production is unlikely to be compatible with extensive recreational use; and
- Recreationalists (e.g. mountain-bikers and 4x4 drivers) may enjoy 'wild terrain', yet their activities erode the structure and tranquillity upon which many other ecologically-meditated and publicly-valued services derive.

There is therefore a need, across all habitat types, to recognise the possibility of antagonistic effects and to reflect this in measures and incentives to protect or restore service including their profitable enjoyment. The Forestry Commission, for example, is working closely with bikers to 'legalise' biking tracks and jumps to make them safer and socially acceptable, thus boosting their value and the social cohesion of the site. The potential for PES schemes to help realise synergies and address the trade-offs does, however, depend on them being able to satisfy the additionality criterion.

[593] UK National Ecosystem Assessment (2011). *The UK National Ecosystem Assessment: Technical Report (Chapter 8: Woodlands)*. UNEP-WCMC, Cambridge [online] available at: http://uknea.unep-wcmc.org/Resources/tabid/82/Default.aspx (accessed 6 July 2011).

A PES-type approach is already in operation through the National Forest Company's Changing Landscapes and Freewoods Schemes. The National Forest Company[594], a non-departmental public body established in 1995 and sponsored by Defra, is leading the creation of The National Forest, a new, wooded landscape for the nation across 200 square miles of central England. The Company is operating a range of funding schemes designed to encourage tree planting and the creation of wildlife habitats within the Forest's 200 square miles:

- **The Changing Landscapes Scheme** (CLS) (for sites > 1ha within the National Forest) offers funding to any landowner for the creation of new woodlands and associated habitats. It is unique to The National Forest and pays 100% of costs for woodland and habitat creation and its management for 10 years. Land entered into the CLS may incorporate other habitats including parkland, meadows, unimproved grassland, orchards, hedgerows and wetlands. The CLS requires competitive bids from landowners, with the elements of the schemes drawn from a standard and publicised costs menu. For each item there is a prescribed maximum price which will be paid. A CLS application will be judged according to design and content and upon the overall contribution which it will make to National Forest objectives, (as described in the National Forest Strategy 2004 - 2014 and Delivery Plan 2009 - 2014).
- **The Freewoods Scheme** (for sites < 1ha within the National Forest) has been developed as a means of creating small woodland to fit in with all landscape types, around continued farming activity, and other land uses. The National Forest Company will pay all costs for a professional consultant to design, apply, plant and establish the scheme for the first three years. After this, the landowner agrees to the on-going care and management of the woodland. Landowners can choose to create primarily environmental/commercial, conservation/landscape or amenity woods.
- **The Programme Development Fund** (for smaller projects) which provides grants for up to 50% of the costs of site improvement (access, conservation, orchards and hedgerows) and heritage, community and management projects within the National Forest and which directly benefit the National Forest.

4.4.4 Ecosystem Service Sellers

Actual and potential providers and sellers of ecosystem services from English woodlands are shown in the table[595] below.

Table 18: Ecosystem service providers for woodlands

Ecosystem Service	Sellers
Trees for timber and bio/woodfuel, water supply, carbon sequestration, flood and water protection, soil protection, water and soil quality, pollination, wild species diversity, environmental settings (local places and landscapes for recreation, personal enlightenment and	**Public and private landowners and tenant land managers** with substantial areas of forested land or land that may be converted to woodland, e.g. the Forestry Commission, the Crown Estate and private land owners. Private land owners may include: • **Private businesses** (commercial interests / investors) - Financially-oriented and likely to carry out timber production or other profit-making activity. May be interested in selling carbon

[594] See http://www.nationalforest.org/about_us/.
[595] Forest Research (2009). *Public benefits from private forests and woodland in England: classifying private woodland owners*. Research summary [online] available at: http://www.forestresearch.gov.uk/pdf/SERG_Classifying_private_woodland_owners.pdf/$FILE/SERG_Classifying_private_woodland_owners.pdf (accessed 18 May 2011).

Ecosystem Service	Sellers
education, artistic inspiration, spiritual benefit, etc)	and biodiversity credits. • **Conservationists** - Main motivation to conserve woodland for wildlife, resulting in personal enjoyment. Least motivated by financial return and unlikely to encourage public access due to risk of disturbance to wildlife. • **Amenity owners** (individuals, companies, clubs or syndicates) with small or very large woodlands used for recreation

4.4.5 Ecosystem Service Beneficiaries

Actual and potential beneficiaries of ecosystem services from English woodlands are shown in the table below.

Table 19: Ecosystem service beneficiaries for woodlands

Ecosystem Service	Beneficiaries
Trees (for timber and/or bio/woodfuel)	**Forest estate owners; producers and consumers of wood and wood-based products; investors** who may benefit from the consumption and/or sale of wood
Non-timber forest products, climate regulation (avoidance of climate stress), wild species diversity, hazard regulation (water and flood protection), water quality, air quality, environmental settings (local places and landscapes for recreation, spiritual benefit, artistic inspiration, etc)	**Local residents** who gain personal enjoyment from woodlands and may also benefit from regulating services. Local residents may also benefit from access to woodlands to collect non-timber forest products e.g. berries, honey, fungi, medicinal derivatives, etc.
Climate regulation	**Local communities,** particularly in urban and peri-urban areas, may benefit from the cooling effects of tree cover. **The global population** benefits from carbon sequestration
Flood and water protection; soil protection	**Downstream businesses and residents** may benefit from woodlands' ability to delay and reduce flood events, as well as protection from soil erosion and slope failure and reduced exposure to chemicals and pesticides compared to agriculture.
Non-timber forest products, wild species diversity, climate regulation (avoidance of climate stress), environmental settings, air quality	**Woodland visitors** who benefit from woodland amenity and who may also collect non-timber forest products.

4.4.6 Ecosystem Service Buyers and Intermediaries

Actual and potential buyers and intermediaries of ecosystem services from English woodlands are shown in Table 20.

Table 20: Ecosystem service buyers and intermediaries for woodlands

Ecosystem Service	Buyers and Intermediaries
Trees for timber, bio/fuelwood, climate regulation (carbon sequestration); hazard regulation (water and flood protection; soil protection)	**Private businesses**, including: • Industrial and commercial entities who benefit from the use or sale of timber and non-timber forest products • Those wishing to reduce their carbon footprint while also potentially delivering a range of social and environmental benefits. Businesses may invest (on behalf of customers) as part of a Corporate Social Responsibility initiative; and • Downstream businesses who benefit from the flow regulation and soil retention services provided by upland forests; local authorities wishing to improve local air quality • Tourism operators (on behalf of visitors)
Local settings (for amenity), trees for woodfuel, climate regulation (avoidance of climate stress)	**Government and public agencies** (on behalf of the public), e.g. through the Woodland Grants Scheme, the Changing Landscapes and Freewoods schemes and the Public Forest Estate Local authorities, especially in peri-urban areas who may be interested in expanding the cultural (including amenity, social regeneration, and educational opportunities) and regulating services (climate cooling) that woodlands can provide, e.g. under the Community Forest Programme.
Local settings and landscapes (for recreation, artistic inspiration, spiritual benefit, education, etc)	**Visitors to woodlands**, e.g. visitors to Woodland Trust and Forestry Commission properties, private estates, etc)
Wild species diversity, environmental settings (landscapes and local places)	**Conservation organisations** (on behalf of their members), e.g. Woodland Trust, RSPB, etc.

4.4.7 Case Studies

Payments for ecosystem services from watersheds have received much attention in the literature and therefore there are a number of well-documented case studies from around the world. Two examples that focus specifically on securing ecosystem services from forested areas are provided in Box 8.

Box 8: Examples of payments for ecosystem services from forests

Costa Rica National PES programme

A financial mechanism for the recuperation and conservation of forest cover in Costa Rica has contributed to reverse forest loss by paying forest owners for four bundled environmental services (watershed protection, carbon sequestration, landscape beauty and biodiversity protection) their forests provide. While the scheme relies heavily on state funds derived from a fuel tax, it also counts with contributions from the private sector (hydropower producers and water bottling companies).

In nine years, it covered over 500,000ha of forest, mainly under protection, corresponding to over 6,000 contracts with landowners and invested over US$110 million into the protection of the country's forests and its environmental services.

Further information:
FONAFIFO (2005) The Environmental Services Program: A success story of sustainable development implementation in Costa Rica. FONAFIFO, over a decade of action. Edited by J.M. Rodríguez, Costa Rica National Forestry Fund (FONAFIFO).

IIED (2006) San José Watershed Markets. Technical trip report: active learning from Costa Rica's PES Programme. IIED [online] available at: http://pubs.iied.org/pdfs/G00298.pdf (accessed 12 May 2011).

Tasmanian Forest Conservation Fund

As noted in Section 3.4.1, the Tasmanian Forest Conservation Fund (FCF) was established to protect up to 45,600 hectares of forested private land in Tasmania, targeting old growth forest and under-reserved forest communities. The FCF was developed to address several issues including insufficient private incentives to protect high value biodiversity and the high variability in environmental benefits and opportunity costs for different parcels of native vegetation.

The FCF comprises a suite of market-based approaches to secure the protection and management of high conservation value forests on private land in Tasmania. The Fund includes:

- PES mechanisms: inverse auction, differentiated take-it-or-leave-it offers, and direct negotiation approaches; and
- The establishment of a revolving fund for the purchase, protection and resale of high conservation properties in the existing property market.

Key elements of the Fund are summarised below:

Issue	Key design element
Mechanisms	Inverse auction. Several rounds were conducted. Rounds 1a to 1c from the initial pool of participants and Round 2 from a later pool of participants. Following round 1c of inverse auction, differentiated take-it-or-leave-it offers were made to landholders. Direct approaches through a third party service provider.
Price	For inverse auction: landholder paid their own winning offer prices. For differentiated take-it-or-leave-it, prices based on modelled values of equivalent successful bids from inverse auction rounds 1a to 1c. For direct approach, price was that agreed by both parties.
Bids	Sealed bids.
Rounds	Multiple auctions conducted until available budget was exhausted and/or targets achieved.
Assessment of conservation values	Specific assessment metric created – the Conservation Values Index (CVI).
Bid selection	Based on unit cost of conservation benefits from individual bids (AUD/CVI).
Securing property rights	Two mechanisms used: a covenant attached to the land title that binds current and future owners; and a management agreement that outlines agreed management actions to enhance forest condition and extent.
Selection cut-off	No formal price cap used, but cut-off for each round established at natural point of inflections in aggregate cost curve from that round.
Decision-making	Fund Assessment Panel, supported by technical experts considers all bids and recommends to Minister for the Environment for funding approval.
Payments	Ex-ante (20% on signing agreement and 80% on registration of covenant).

Ongoing monitoring, reporting and evaluation	Requirements on landholder to report on management actions. Ongoing monitoring and evaluation undertaken by Tasmanian Government.
On-ground delivery of Fund	A third party delivery model was adopted to ensure local presence and on-ground capacity in Tasmania.

Source: OECD, 2010

The results achieved through the Fund have made a measurable contribution to the protection of native forest communities in Tasmania and provided a strong basis for designing and implementing future PES schemes in Australia. Opportunities for widening the scope for PES schemes to enable efficient payments for 'bundles of ecosystem services' that will enhance the extent and condition of multiple environmental assets (e.g. biodiversity, carbon, water, soil) are currently being explored in more depth in Australia.

Sources:
See http://www.environment.gov.au/land/forestpolicy/fcf/index.html.

OECD (2010). Paying for Biodiversity. Enhancing the Cost-Effectiveness of Payments for Ecosystem Services. OECD.

4.4.8 Barriers to PES for woodlands

Despite the importance of woodlands to the environment and to local people, woodland PES face a particular challenge – in addition to opportunities for bundling, etc. - as a result of the multiple values that woodlands offer. One particular hurdle is the relatively high economic returns available from provisioning activities, particularly timber and biofuel production, which may, under certain management regimes, undermine some of the supporting, regulating and cultural services, many of which have public good characteristics and are valued differently by different stakeholder interests (see discussion in Section 4.4.3). [596] Any scheme designed to reward the delivery of non-provisioning services must therefore ensure that payments are set high enough to compensate land managers and owners for the opportunity costs, and that these payments do not exceed the relevant ecosystem service values.

With respect to cultural services, their value is often contingent on their location in relation to the source of demand. Consequently, for example, the use values of an accessible forest are likely to exceed those of a similar forest in a remote location. Such use values inevitably create distributions of non-market benefits that are shaped by the distribution of population. Thus the value of a forest recreational attraction is often (although not necessarily) more a function of where it is than the landscape aesthetics of the site. This implies that woodland PES schemes are likely to be more attractive and successful where amenity is the main ecosystem service targeted, or accompanies other ecosystem services.

There are a number of specific issues relating to the implementation of woodland carbon schemes including:

- Demonstrating additionality. it is necessary to show that forest carbon offset projects are additional i.e. that the carbon wouldn't have been saved without the project. For example, new forests may have been planted anyway.
- Difficulties in ensuring that carbon is stored in forests permanently. The Woodland Carbon Code addresses this issue through a requirement for project owners to transfer a proportion

[596] Slee, W. (2009). Re-imagining forests as multifunctional and sustainable resources for a low carbon rural economy: the potential for forest-based rural development. OECD Conference on Developing rural policies to meet the needs of a changing world. Quebec October 13-15th 2009 [online] available at: http://www.oecd.org/dataoecd/41/23/44272665.pdf (accessed 4 May 2011).

of the carbon dioxide sequestered to a 'pooled buffer', in case of woodland loss by fire, wind, pest or disease outbreaks. Furthermore, under the UK Forestry Act 1967, licences are required to fell trees (with certain exceptions, such as for development permitted through the planning system). Project owners are required to take steps to ensure that the woodland is not removed or replaced by current or future land owners; placing on them a duty to carry out compensatory planting should an area be felled for development. Moreover, any woodland carbon project will result in a permanent land use change from open ground to woodland.

4.4.9 Opportunities for PES in woodlands

Similarly to water catchment areas, forests provide (to a certain extent) an identifiable spatial boundary, which may assist in the process of identifying key stakeholders, services, inputs and outputs on a local level (with the acceptance of exogenous services and supply chain impacts), thus providing more scope for PES design and management. For example, to a large degree, the ownership of forest resources can be mapped, and the PEFC UK Certification Scheme for Sustainable Forest Management (based on the UK Forestry Standard and the UK Woodland Assurance Scheme) both contribute towards a better understanding and more rigorous monitoring of forest resource user chains. Conceivably, there is considerable scope to apply knowledge of forest governance towards setting up PES-like schemes.

The multifunctional role of forests and woodlands is increasingly recognised and, facing falling prices for timber and other wood products until recent years, many forest managers have been looking for alternative sources of income.[597] Over recent decades, therefore, English forestry – with policy incentives – has seen a shift from predominantly production-focused land use to one build around multi-functionality. Recent rises in timber prices may alter this rebalancing of priorities, although the rises have not yet been to the levels seen in the late 1980s and mid-1990s, even in nominal terms.[598]

Woodlands often make a substantial contribution to the economic development of rural areas. Research by Slee *et al.* (2004)[599] for the Forestry Commission revealed that over 90% of the regional impact of forestry in two heavily wooded areas in the South and South East of England came from non-timber activities associated with the forest, even though one of the areas, Breckland, is seen as a significant timber producing region. This demonstrates that, when properly managed, timber production and other ecosystem services can co-exist.

In an area with relatively modest forest cover, forests are an attractive place to live, to visit for recreation, as well as a highly attractive place to locate tourism and recreational businesses. For example, studies undertaken to assess the economic impact of mountain biking facilities in Coed-y-Brenin forest in a remote part of Wales revealed a visitor spend in the region of between £3 and 5 million per year.[600] The problem is that this value is not captured by forest owners but rather by the myriad of firms associated with tourism and recreation. The challenge is therefore to provide some reward system to forest owners, to reward them directly for the services that they provide. There is some evidence in other countries (see, for example,

[597] Slee, W. (2009). Re-imagining forests as multifunctional and sustainable resources for a low carbon rural economy: the potential for forest-based rural development. OECD Conference on Developing rural policies to meet the needs of a changing world. Quebec October 13-15th 2009 [online] available at: http://www.oecd.org/dataoecd/41/23/44272665.pdf (accessed 4 May 2011).
[598] See http://www.forestry.gov.uk/forestry/infd-7m2djr.
[599] Slee, B., Evans, R. and Roberts, D. (2004). Forestry in the rural economy: a new approach to assessing the impact of forestry on rural development, *Forestry* 77(5): 441-453.
[600] Slee, W. (2009). Re-imagining forests as multifunctional and sustainable resources for a low carbon rural economy: the potential for forest-based rural development. OECD Conference on Developing rural policies to meet the needs of a changing world. Quebec October 13-15th 2009 [online] available at: http://www.oecd.org/dataoecd/41/23/44272665.pdf (accessed 4 May 2011).

Kouplevatskaya-Buttoud *et al*., 2009)[601] of agreements being reached between forest owners and mountain bikers on payment for access to Austrian private forests.

Specific opportunities for developing PES schemes in woodlands in England include:

- Enhancing the use of, and efficiency with which, payments under the English Woodland Grant Scheme are used to deliver ecosystem services. The mid-term evaluation of the RDPE (p.5)[602] notes that "[*T]he forestry measures (221-223-225-227) delivered under the EWGS are largely on target and have been effective in the creation of new woodland as well as managing existing woodland for biodiversity and access. The evaluators judge that woodland creation makes a measurable contribution to climate change mitigation but note that better targeting of woodland creation could make a more substantial impact on improving water quality.*" It goes on to recommend that the targeting of woodland creation is strengthened to deliver greater benefits to water and soil quality and to fully achieve the multi-objective potential of woodland creation and also that the demand for activities relating to the economic value of forests (Measure 122) is assessed and promoted amongst forest holders along with other woodland-related Measures under the EWGS banner. This may be through better targeting of eligible woodland areas or through payments linked to specific outcomes (rather than for the management activities expected to deliver those outcomes). In some cases, there is a long time lag between changes in management practices and the appearance of measureable results, but rapid effects can be achieved in others, albeit sometimes in habitat and potential rather than observed service utilisation, .e.g. particular species or access use.
- Developing mechanisms that more directly reward forest owners for the cultural, regulating and supporting services they provide to private users through, for example, user fees;
- Encouraging businesses to abate unavoidable emissions through investment in the Woodland Carbon Code (or similarly accredited schemes);
- Targeting woodland owners and managers of woodlands in suitable locations as providers for flood management services; and
- Encouraging woodlands as an important component of 'green infrastructure' in urban and peri-urban locations.

4.5 Freshwaters - openwaters, wetlands and floodplains

4.5.1 Description

The UK NEA classification of freshwaters includes lakes, rivers, ponds, groundwaters, riparian zones, wetlands, floodplains and marshes and estuaries. For the purposes of the NEA, and therefore of this report, bogs and upland fen, marsh and swamp are covered as part of mountains, moors and heaths.

In 2007, rivers and streams (over 5m wide) covered around 29,000ha in England, equivalent to 0.2% of the land area, and standing water open water and canals 97,000ha (0.7%).[603] The area of standing open water and canals increased by 5.3% (6,000ha) and the number of ponds

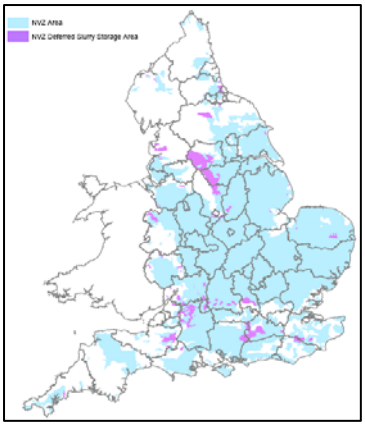
[601] Kouplevatskaya-Buttoud, I., Buttoud, G., Slee, W., and Weiss G. (2009). Barriers to Institutional Learning and Innovation in the Forest Sector in Europe: Markets, Policies and Stakeholders, paper presented to conference on Change in governance as collective learning process: management politics and ethics in forestry.
[602] Hyder Consulting (2010). *Defra Rural Development Programme for England 2007-2013. Mid-Term Evaluation* [online] available at: http://rdpenetwork.defra.gov.uk/assets/files/Mid-Term%20Evaluation/RDPE%20PMC%2011-7a%20MTE%20of%20RDPE%20Exec%20Sum.pdf (accessed 14 July 2011).
[603] Countryside Survey (2008). *Countryside Survey: England Results from 2007* [online] available at: http://www.countrysidesurvey.org.uk/eng_reports2007.html (accessed 13 December 2010).

by 18% (37,000ha) between 1998 and 2007. This period also saw an improvement in the physical habitat quality of headwater streams and an increase in the number of natural features. According to the Countryside Survey, headwater streams represent the majority of all watercourses in England and their status can greatly affect the quality of water flowing in to downstream watercourses.[604] However, almost 80% of ponds were in poor ecological condition in 2007, and plant species richness alongside the watercourse of streams has continued to decrease since 1978.

The legislative driver for improvement in the water environment in rivers is primarily the EU Water Framework Directive (WFD). The WFD was adopted in 2000 in order to establish a framework for the protection of inland surface waters (rivers and lakes), transitional waters (estuaries), coastal waters (to one nautical mile) and groundwater. Using the WFD classification system, results for assessed rivers in England and Wales show that for overall ecological classification, 26 per cent of rivers are of 'good or better' quality, 60 per cent are of 'moderate' quality, 12 per cent are of 'poor' quality and 2 per cent are in 'bad' condition.[605] Approximately 50% of the rivers in England and Wales have been subject to historical physical intervention and morphological change. Wetlands and floodplains ecosystems have also been subject to intervention, and in England over 1 million hectares of wetlands are now in agricultural use.

The Environment Agency has classified over 21 different types of river environment, based on catchment size, altitude and geology in England and Wales. Water quality in those rivers has improved substantially over the last two decades primarily through better control of point source discharges and improvements in sewage treatment. According to Natural England, almost 29,000 hectares of open water habitat lies within SSSIs in England[606], and the percentage in target condition (i.e. in 'favourable' or 'recovering favourable' condition)[607] increased from 56 per cent in 2003 to 80 per cent in 2010.

In accordance with the EC Nitrates Directive, Defra has designated areas of England as Nitrate Vulnerable Zones (NVZs), in order to reduce nitrogen loss from agriculture to water. Farmers within NVZs are required to comply with measures in the Nitrates Action Programme. NVZs now cover approximately 70% of England.[608]



4.5.2 Ecosystem Services from Freshwaters

The key ecosystem services generated by Freshwaters in England, as identified by the NEA, are outlined in Table 21, together with an indication of the relative importance of Freshwater habitats in delivering each of the listed ecosystem services.

[604] Countryside Survey (2008). *Countryside Survey: England Results from 2007* [online] available at: http://www.countrysidesurvey.org.uk/eng_reports2007.html (accessed 13 December 2010).
[605] Environment Agency (2010). *Water resources in England and Wales – current state and future pressures* [online] available at: http://www.environment-agency.gov.uk/research/library/publications/100582.aspx.
[606] Natural England (2008). *State of the Natural Environment 2008* [online] available at: http://www.naturalengland.org.uk/publications/sone/default.aspx (accessed 14 March 2011).
[607] 'Favourable condition means that special habitat and species features are in a healthy state and are being conserved for the future by appropriate management. Unfavourable recovering condition means that all necessary management measures are in place to address reasons for unfavourable condition. Special habitat and species features will 'recover' to a healthy state, but in many cases this takes time.
[608] Defra (2008). *Implementation of the Nitrates Directive (91/676/EEC). Description of the methodology applied in identifying waters and designating Nitrates Vulnerable Zones in England (2008)* [online] available at: http://archive.defra.gov.uk/environment/quality/water/waterquality/diffuse/nitrate/documents/methodology-summary.pdf (accessed 29 March 2011).

Table 21: Main ecosystem services from Freshwaters[609]

Provisioning		Cultural		Regulating	
Crops	L	Local places	H	Climate	M-L
Livestock / Aquaculture	L	Landscapes / seascapes	H	Hazard	H
Fish	M-H			Disease and pests	M-H
Trees, standing vegetation, peat	M-H			Pollination	
Water supply	H			Noise	M-L
Wild species diversity	H	Wild species diversity	H	Water quality	H
				Soil quality	M-H
				Air quality	L

Key		
High	H	Blank cells represent services that are not applicable to the Broad Habitat
Medium – High	M-H	
Medium – Low	M–L	
Low	L	

According to the NEA, freshwater ecosystems are crucial for the supply of fresh water, regulation of flooding, erosion, sedimentation and local climates. They also provide characteristic landscape to the English countryside and cultural services including nature and heritage conservation, recreation, tourism, education and inspiration for arts and religion. However, the multitude of services and associated benefits that they provide are largely overlooked, poorly valued, and degraded or lost as a result of human activity.[610]

Open water, wetlands and floodplains (OWWFs) are considered to be integral to many English **landscapes**, and highly connected to each other and their catchments. They provide a number of **social** and **economic** benefits associated with their unique place in the English countryside. For example, over eight million people from around the world visit the Lake District National Park each year, and tourism is the area's major industry. The unique waterscape provides a central component of the Park's attraction and setting; for scenery, ecological and geological features, cultural and social roots, and for water-based activities such as sailing, kayaking, fishing, windsurfing and boat cruises. However, the local authority, community and tourism industry also face challenges associated with maintenance of the lakeland, such as flood risk, road congestion and ecological damage from the high volume of tourists, and the issue of housing affordability as prices rise in association with the location's popularity.[611]

[609] UK National Ecosystem Assessment (2011). *The UK National Ecosystem Assessment: Synthesis of the Key Findings*. UNEP-WCMC, Cambridge [online] available at: http://uknea.unep-wcmc.org/Resources/tabid/82/Default.aspx (accessed 6 July 2011).
[610] UK National Ecosystem Assessment (2011). T*he UK National Ecosystem Assessment: Technical Report (Chapter 9: Freshwaters – Openwaters, wetlands and floodplains)*. UNEP-WCMC, Cambridge [online] available at: http://uknea.unep-wcmc.org/Resources/tabid/82/Default.aspx (accessed 6 July 2011).
[611] Lake District National Park Authority (2010). *Lake District National Park: Core Strategy* [online] available at: http://www.lakedistrict.gov.uk/lake_district_docs95/core_strategy_oct_2010.pdf (accessed 29 March 2011).

Freshwaters provide key regulatory services for flooding, erosion, sedimentation, flow, local climate and water quality. Wet grassland and flood meadows are now perceived as an important mechanism for the protection of water courses from diffuse **pollution**, the attenuation of **flood** discharge peaks and the enhancement of riparian **habitat** with concomitant beneficial consequences for both terrestrial and aquatic ecosystems. Multi-functional river restoration strategies are now looking to decrease the amount of riparian margin under intensive use, and to alter water table profiles to encourage inundation and the temporal establishment of wetland and wet grass areas[612]. There are also potential carbon savings associated with renewable energy and transport e.g. canal boats and commuter ferries relieving congestion[613].

Ponds in particular are effective at storing water, removing and storing sediments and pollutants, and alleviating flooding. Streams, in comparison to ponds, have a natural flow that creates greater variation along their length and allows a range of physical, chemical and biological processes to operate that affect **water quality**.[614] Although water quality in England's streams and ponds has been improving in general, there are concerns surrounding nutrients, faecal organisms and sediments from farming, urban runoff and deficiencies in sewage treatment. Moreover, climate change brings as added threat to the UK hydrological cycle, placing further stress on catchments, and increasing the risk and severity of flooding.[615] Freshwaters also have various supporting services for biodiversity, biogeochemical cycling, pollution dilution, delta formation and material fluxes to coastal environments.

Historically in the UK, large areas of floodplain meadows were managed for **hay production** and **grazing**, but over a 40-year period up to the 1990s over 90% of these areas were lost. Most of the remaining 10% are now subject to a variety of nature conservation measures[616]. Other provisioning services include **food** (e.g. fish, plant products) and **fibre** (e.g., reeds, thatch). Annual sales of Environment Agency rod licences for England and Wales have increased by 35%, from 1.09 million in 2000/1 to 1.47 million in 2009/10. Rod licence sales were up by 12% in 2009/10 compared to the previous year to set a record high of 1.47 million licences sold. The income received as a result was £25.4 million, contributing towards the Environment Agency's Fisheries service.[617]

Inland waterways, through the creation of canals and the modification of naturally occurring waterways, have traditionally provided a **navigation** function for commercial transport; although this commercial use has increasingly been replaced with leisure use. The conservation and enhancement of these inland waterways may be associated with benefits to include health and wellbeing, improved physical and mental health (e.g. recreation, sustainable commuting, volunteering and community / civic pride benefits), tourism, job creation, urban and rural regeneration, drainage services and benefits to the environment.[618]

[612] Ferrier, R.C. and Jenkins, A. (2010). *Handbook of Catchment Management*. Wiley: London.
[613] Jacobs (2010). *The Benefits of Inland Waterways*. Final Report [online] available at: http://www.iwac.org.uk/downloads/research/OGorman_et_al_2010_The_Benefits_of_Inland_Waterways_Phase_1_2nd_Edition_March2010.pdf (accessed 28 March 2011).
[614] Countryside Survey (2008). *Countryside Survey: England Results from 2*007 [online] available at: http://www.countrysidesurvey.org.uk/eng_reports2007.html (accessed 13 December 2010).
[615] Rural Economy and Land Use Programme (RELU) (2010). Innovative Market-Based Mechanisms and Networks for Long Term Protection of Water Resources. See http://www.soas.ac.uk/water/research/wces/.
[616] Acreman, M.C. and Mountford, J.O. (2010). Ecologically acceptable flows in chalk rivers. Wallingford, Centre for Ecology and Hydrology, 27pp. (CEH Project No: C03774) (unpublished).
[617] Environment Agency (2010). *Where your money goes. How we spend your money to improve fish stocks and fisheries* [online] available at: http://www.environment-agency.gov.uk/homeandleisure/recreation/fishing/106684.aspx (accessed 28 March 2011).
[618] Jacobs (2010). *The Benefits of Inland Waterways*. Final Report [online] available at: http://www.iwac.org.uk/downloads/research/OGorman_et_al_2010_The_Benefits_of_Inland_Waterways_Phase_1_2nd_Edition_March2010.pdf (accessed 28 March 2011).

4.5.3 Scope for PES from Freshwaters

The UK NEA[619] indicates that many of the services from the Freshwaters broad habitat have been degraded or lost through human activities such as wetland drainage, flow modification for flood defence, habitat degradation and exploitation and introduction of exotic species. Water quality has been improving but pollution with nutrients, faecal organisms and sediments from farming remains a concern. Urban runoff and remaining deficiencies in sewage treatment are also problems. The risk and severity of flooding seems to be increasing and the impacts of climate change on the hydrological cycle, and particularly those catchments already under stress from high demands for water, are likely to be significant.

There are many factors that influence the quality of freshwaters, the condition of associated habitats and biodiversity, and the way that aquatic ecosystems function. Ponds in particular are effective at storing water, removing and storing sediments and pollutants, and alleviating flooding. The flowing nature of streams make them more varied along their length than ponds and allows a range of physical, chemical and biological processes to operate that affect the water quality. Both habitats are highly dynamic and sensitive to environmental change, especially in quantity and quality of water.

Pollution arising from a range of sources, including effluents, agriculture and road run-off are known to have significant effects on the quality of freshwaters and the biodiversity it supports.[620] Abstraction, low flows and climate change can also affect the hydrology, water quality and biodiversity of freshwaters.[621] The physical management of freshwater habitats is also a critical determinant of the quality of freshwater habitats for characteristic flora and fauna.[622]

The English landscape supports an array of diverse catchments where agricultural land use is prevalent and likely to be a major contributing factor in the changes observed in freshwaters streams and ponds. However, the Countryside Survey notes the difficulties in trying to attribute the effects of agriculture on these habitats using national-level data. A study by Brown *et al.* (2006) classified the freshwater habitats of the agricultural landscape into 12 cultivated landscape types and one non-cultivated class (mountain and moorland areas, and urban landscapes)[623] and demonstrated significant differences in the physical structure of the freshwater environment and the composition of biotic assemblages in each of these landscape types.

The effects of agricultural policies such as cross-compliance (Good Agricultural and Environmental Condition (GAEC)) and the development in England over time of agri-environment schemes, including incentives to protect and enhance the freshwater environment, are often difficult to distinguish from other possible drivers of change, such as climate change or abstraction and low flows, but further research is ongoing.[624]

[619] UK National Ecosystem Assessment (2011). *The UK National Ecosystem Assessment: Technical Report (Chapter 9: Freshwaters – Openwaters, wetlands and floodplains)*. UNEP-WCMC, Cambridge [online] available at: http://uknea.unep-wcmc.org/Resources/tabid/82/Default.aspx (accessed 6 July 2011).
[620] Mainstone C. P.; Wils, R.M.; and Withers, P.J.A. (2008). Controlling sediment and phosphorous transfer to receiving waters – a strategic management perspective for England and Wales. *Journal of Hydrology*, 350: 131-143.
[621] Mainstone, C.P. and Clarke, S.J. (2008). Managing multiple stressors on sites with special protection for freshwater wildlife – the concept of Limits of Liability. *Freshwater Reviews* (2008) 1: 175-187.
[622] Mainstone, C.P. and Holmes, N. T. H. (2009). Embedding a strategic approach to river restoration in operational management processes – experiences in England. *Aquatic Conservation: marine and freshwater ecosystems*.
[623] Brown, C.D., Turner, N., Hollis, J., Bellamy, P., Biggs, J., Williams, P., Arnold, D., Pepper, T. and Maund, S. (2006). Morphological and physico-chemical properties of British aquatic habitats potentially exposed to pesticides. *Agriculture Ecosystems & Environment*, 113: 307-319, and Biggs, J., Williams, P., Whitfield, M., Nicolet, P., Brown, C. Hollis, J., Arnold, D., and Pepper, T. (2007). The freshwater biota of British agricultural landscapes. *Agriculture Ecosystems & Environment,* 122: 137-148.
[624] Countryside Survey (2008) *Countryside Survey: England Results from 2007* [online] available at: http://www.countrysidesurvey.org.uk/eng_reports2007.html (accessed 13 December 2010).

Bankside fencing is being promoted strongly as part of work to buffer the river network against bankside erosion, direct pollution by livestock, and enriched/sediment-laden run-off. Increased bankside fencing and associated control of bank erosion induced by livestock leads to development of tall and woody vegetation along river banks, increased encroachment of marginal vegetation into the channel, and an increase in submerged vegetation that is freed from the effects of livestock trampling. Agricultural policy mechanisms have contributed substantially to the trend to fence off river banks. The Environmental Stewardship Scheme, cross-compliance measures and the Catchment Sensitive Farming Initiative all promote the creation of riparian buffer zones involving the exclusion of livestock through fencing. With reduced funding available for publicly-funded incentive schemes, there may be opportunities for private payment schemes to fill the gap.

During the last ten years, **water quality and more recently water quantity** have become major drivers for intensive localised catchment-based restoration work (see, for example, the SCaMP described in Box 11). The majority of this work has been driven by water companies in an effort to reduce the costs of treating raw drinking water quality in an environment where Dissolved Organic Carbon (DOC) levels were rising steadily.[625]

The existence of many environmental regulations (at local, national, and international levels) – for example the Water Framework Directive, NVZs in accordance with the EC Nitrates Directive, Habitats Directive and CAP reform – suggest starting points with respect to measuring improvements and building PES against a regulatory framework background, that has established stakeholders and actors.

Water companies are also a major private sector stakeholder in maintaining water quality. A large amount of investment is already undertaken for treating and cleaning water to ensure that it is fit for consumption. Water companies are also major land holders in England, with a particular stake in SSSIs (6%)[626], and control of other water resources such as reservoirs. They have a unique dependence upon other land users within the water catchment that they operate within. These factors imply a considerable opportunity for setting up PES agreements with water companies and other land managers. Farmers/land managers in England have already had good experience of providing various environmental services via a number of schemes so PES is not a new concept needing promotion in England.

As a key recreational resource, there is generally high public awareness about, and support for, efforts towards cleaning and maintaining rivers, lakes and canals. The **recreational use** of Freshwaters may provide an opportunity for direct payments (PES-like schemes), for example, payments though the tourism sector such as hotels at popular destinations (e.g. lakeside at Lake Windermere), through park entrance (e.g. sailors entering the Lake District National Park) or canal boat river tolls.

Jacobs developed a valuation tool for Defra and the Inland Waters Advisory Council (IWAC) to assess the benefits of inland waterways in England and Wales, with benefits categorised using an ecosystem services approach. The study identified key gaps in our attempts to understand and quantify the value of inland waterways, including lack of information and understanding of how to quantify some benefits (e.g. community, drainage and water conveyance services etc), insufficient scientific evidence of the bio-physical relationships between the ecosystem service and related benefit provided, and non-availability of suitable monetary valuation data available (e.g. for well-being benefits from volunteering). Nevertheless, the study demonstrates the multiple benefits derived from inland waterways and provides a useful framework for placing

[625] Lund, M. (2009). Peatlands at a Threshold. Unpublished Ph.D. thesis, Lund University, Lund Sweden, 163pp.
[626] Natural England, 2011. NE306 - Protecting England's natural treasures - Sites of Special Scientific Interest [online] available at: http://naturalengland.etraderstores.com/NaturalEnglandShop/ne306 (accessed 24 March 2011).

monetary values on these benefits. As noted in the report "[T]*he effort applied to complete the valuation can be targeted and varied depending on the scale of the site and the resources available*"[627] and provides a useful starting point for investigating the potential for PES.

The Environment Agency already generates significant revenue (£24 million in 2009/10) through rod licences.[628] This income is fed back into the management of freshwaters through fish passages, addressing WFD issues, improving the environment, maintaining flood defences, development of canoe trails and passages, improving and developing fisheries, and increasing fish stocks. The Agency works closely with recreational users and partners to ensure that different uses are managed without adversely impacting on each other or the environment. Working in collaboration with partners increases the total spend on environmental improvements, and in 2009/10 total benefits to fisheries from project work in England and Wales amounted to over £19 million.[629] As an example of these shared outcomes, the Environment Agency has installed new fish and canoe passes on the River Medway. In addition, the monetary potential of this area is emphasised by the investment by water companies of £4.4 billion to improve water quality over 5 years.[630]

Of particular promise is the Angling Passport Scheme which has already been introduced in a number of catchment areas by various Rivers Trusts (see Table 22 and Box 10). The schemes have the common principle of exchanging tokens purchased from the issuing rivers trust for the right to fish beats within its scheme on a day-ticket basis. The requisite tokens are posted in a box at the beginning of the day and are subsequently collected for reconciliation and payment to the fishery owner at a later date. The advantage for the angler is that it is a flexible day ticket opportunity to fish many different and generally under-fished beats. The advantage for the fishery owner is that it is co-operative marketing approach, with low costs and minimal administration burden.

Table 22: Angling Passport Schemes

Scheme	Rivers Trust	Location
Westcountry Angling Passport	Westcountry Rivers Trust	Cornwall and Devon
Peak Passport	Trent Rivers Trust	Derbyshire and Staffordshire (Peak District)
Wye & Usk Passport	Wye & Usk Foundation	Mid-Wales, Monmouthshire and Herefordshire
Go-Wild	Eden Rivers Trust (Go-Wild)	Cumbria

[627] Jacobs (2010). *The Benefits of Inland Waterways*. Final Report [online] available at: http://www.iwac.org.uk/downloads/research/OGorman_et_al_2010_The_Benefits_of_Inland_Waterways_Phase_1_2nd_Edition_March2010.pdf (accessed 28 March 2011).
[628] Environment Agency (n.d.). *Where your money goes. Our work to improve fisheries in England and Wales* [online] available at: http://www.environment-agency.gov.uk/static/documents/Leisure/Annual_report_summary_-_final_-_combined.pdf (accessed 14 July 2011).
[629] Environment Agency (2010). *Where your money goes. How we spend your money to improve fish stocks and fisheries* [online] available at: http://www.environment-agency.gov.uk/homeandleisure/recreation/fishing/106684.aspx (accessed 28 March 2011).
[630] *Ibid*

Scheme	Rivers Trust	Location
Ribble Catchment Conservation Trust Angling Passport	The Ribble Catchment Conservation Trust	Lancashire

Payment mechanisms in OWWF may take various forms:

- Direct cash payment or compensation for lost farm income.
- Tax holidays or tax breaks, for instance for farmers in Nitrate Vulnerable Zones (NVZs) to compensate the income foregone. The new NVZ regulations introduced in England and Wales affect the majority of farmers in England, and will have a significant financial impact, especially on dairy farmers.
- Farm subsidies over and above those currently available through the CAP.
- Formal contractual agreements.

Ongoing research by SOAS[631] is investigating whether PES schemes can provide the necessary incentives to landowners to go further in protecting water by setting aside the limited areas of land with most beneficial effect.

4.5.4 Ecosystem Service Sellers

Actual and potential providers and sellers of ecosystem services from Freshwaters in England are shown in the table below.

Table 23: Ecosystem service providers for Freshwaters

Ecosystem Service	Sellers
Fisheries, water supply, wild species diversity, environmental settings, hazard regulation (water and flood protection), water and soil quality	**Private landowners and tenant land managers** who own riparian rights, wetlands (including SSSIs), etc
Fisheries, environmental settings (local places and landscapes for recreation)	**Individuals, companies, clubs or syndicates** who hold riparian rights, including access to water areas for recreation

4.5.5 Ecosystem Service Beneficiaries

Actual and potential beneficiaries of ecosystem services from Freshwaters in England are shown in Table 24 overleaf.

[631] Research conducted by SOAS Water Group in partnership with the Rural Economy Land Use Programme, ESRC and Tamar Consulting on Innovative Market-Based Mechanisms and Networks for Long Term Protection of Water Resources (2010-2012). See http://www.soas.ac.uk/water/research/wces/.

Table 24: Ecosystem service beneficiaries for Freshwaters

Ecosystem Service	Beneficiaries
Fisheries, water supply; water quality, hazard regulation, (water, flood and soil protection)	**Downstream residents and businesses** including farmers (water for irrigation); commercial and recreational fisheries, domestic and industrial users (water for production and consumption); hydropower providers; water utilities (high quality raw supplies reduce treatment costs which ultimately benefit consumers); commercial and recreational fisheries
Wild species diversity, water quality, environmental settings (local places and landscapes for recreation, artistic inspiration, spiritual benefit, etc)	**Local residents** who are likely to be familiar with (if not scientifically knowledgeable about) nearby freshwater ecosystems, and may have chosen their homes partly on the expectations of enjoying the relevant services, particularly amenity. Housing along or on rivers and canals is in high demand, and often priced at a premium.
Wild species diversity, water quality, environmental settings (local places and landscapes for recreation, artistic inspiration, spiritual benefit, education, etc)	**Visitors**, both general, e.g. tourists, recreationalists (sailing, swimming, fishing, towpath users, etc) and specialist .e.g. birdwatchers, educational groups, etc.

The principal beneficiaries of ecosystem services provided by OWWF include farmers (water for irrigation), domestic and industrial users (water for production and consumption), commercial fisheries, recreationalists and the general public (landscape aesthetics, biodiversity, etc).

4.5.6 Ecosystem Service Buyers and Intermediaries

Actual and potential buyers and intermediaries of ecosystem services from Freshwaters in England are shown in the table below.

Table 25: Ecosystem service buyers and intermediaries for Freshwaters

Ecosystem Service	Buyers and Intermediaries
Water supply, water quality, wild species diversity, hazard regulation, environmental settings (local places and landscapes)	**Government and its associated agencies** (on behalf of the public), primarily to satisfy the provisions of the Water Framework and Nitrates Directives through River Basin and Catchment Flood Management planning, etc. Local authorities in particular may be willing to pay upstream land managers for practices that enhance the hazard regulating services provided by Freshwaters
Fisheries Water supply, water quality, hazard regulation (water, flood and soil protection)	**Private business**, including: • Commercial fisheries • Downstream beneficiaries via private or mediated negotiations with upstream providers, for potable water supply (piped and bottled), energy, and flood mitigation. • Insurers (on behalf of premium holders) for flood protection Utilities may buy on behalf of customers; intermediaries such as River Trusts may facilitate transactions

Ecosystem Service	Buyers and Intermediaries
Hazard (flood) regulation	**Downstream residents** via private or mediated negotiations with upstream providers and where not already 'bought' by local authorities.
Wild species diversity, water quality, environmental settings (local places and landscapes for recreation, artistic inspiration, spiritual benefit, education, etc)	**Visitors and water recreation groups,** including special interest groups (e.g. birdwatchers) and sports clubs (e.g. boating clubs, etc). For example, • Recreational fishers (e.g. through Angling Passport Schemes) • Boating and rowing clubs (for use of canals, lakes, rivers, etc) • Towpath users (e.g. through visitor payback schemes)
Wild species diversity, water quality, environmental settings (local places and landscapes for recreation, artistic inspiration, spiritual benefit, education, etc)	**Conservation organizations/groups** (e.g. RSPB; River Trusts, New Waterways Charity[632]) for improvements in habitats for birds, salmonid fisheries and other protected species and to enhance environmental settings (e.g. canal heritage, access to, and use of towpaths, etc)

4.5.7 Case Studies

Box 9 below describes two examples from the Thames River Basin where, by offering appropriate incentives to upstream land managers, adverse environmental impacts may be mitigated more cost-effectively.

Box 9: Examples of potential PES schemes in the Thames River Basin

River Lee Navigation

In 2009, British Waterways (on behalf of the Environment Agency) funded a dredging programme to remove sediment in the canalised River Lee Navigation in order to improve water quality. The sediment was found to be contaminated with heavy metals and oils which reduced the dissolved oxygen content of the water and caused unsightly duckweed and pennywort in the summer season. In addition the working area was within a source protection zone for a drinking water supply borehole.

The task to remove urban sediment and other matter from the canal over a distance of 3.2kms was completed at a cost of £2 million. As part of the overall aims of the programme, sediment was used to create bankside enhancement by depositing material behind wooden piling to form soft vegetated margins. Over time, the improved bankside habitat should help to improve biodiversity and aesthetics along the canal.

It is possible that, in future, by providing incentives for landholders along the riverbank to undertake riverbank management activities, sedimentation problems in the River Lee Navigation could be mitigated whilst simultaneously providing enhanced bankside habitat. Incentives may be provided by beneficiaries including recreationalists (primarily waterway users), water abstractors and potentially the Environment Agency who may buy ecosystem services on behalf of water users in general.

[632] A merger between the Waterways Trust and British Waterways which is expected to launch in April 2012. See http://www.britishwaterways.co.uk/newsroom/all-press-releases/display/id/3123

Loddon Farm Advice Project

The Environment Agency is working in partnership with the Hampshire and Isle of Wight Wildlife Trust to support the Loddon Farm Advice Project. The upper Loddon has a number of sensitive chalk streams, such as the Rivers Lyde, Whitewater and Hart. They are classified as salmonid rivers and protected under the Freshwater Fish Rivers Directive 78/659/EEC. Many of the water bodies within the Loddon catchment have been classified as poor ecological status under WFD, with agriculture being one sector assessed as contributing to the pollution problem. The Loddon Farm Advice Project offers land owners free best farming practice advice to help reduce diffuse sediment and diffuse phosphate pollution. Again, in addition to free advice, if farmers undertake activities the reduce water pollution, the Environment Agency or the Wildlife Trust could be potential buyers of this ES.

Source: *Environment Agency (2009) Water for life and livelihoods. River Basin Management Plan Thames River Basin District. Environment Agency: Bristol [online] available at: http://publications.environment-agency.gov.uk/PDF/GETH0910BSWA-E-E.pdf (accessed 16 September 2011).*

There are numerous examples in the UK and abroad relating to PES for watershed services, including rivers and estuaries. Many of these examples are shared with those classified under the woodlands and mountains, moorland and heaths broad habitats, as it is most often the topography and upstream land cover that give rise to the ecosystem services derived from rivers.

A selection of case studies relating to open waters, floodplains and wetlands is provided in Box 10 below.

Box 10: Case studies for PES in Freshwaters

Westcountry Rivers Trust WATER Project

Project rationale
Water quality within the English Channel and the Integrated Coastal Zone Management (ICZM) areas is dominated by the water quality of the numerous rivers that discharge into the Cross Border area on both the English and French sides. Water quality (and availability) within these rivers has significantly deteriorated over recent years due to management practices within their catchments and the large-scale loss of wetted land (including wetlands, reedbeds, wet woodlands and floodplains), which buffer the river from the land.

Poor management practices across the Channel area have many important social, economic and environmental implications including direct negative effects such as increases in flooding; reduced biodiversity and ecosystem function; increased freshwater and marine eutrophication; and reductions in the resilience of river catchment to the effects of climate change. These implications in turn have indirect negative effects on bathing water quality and tourism; fisheries and aquaculture; water treatment costs and drinking water availability; navigation in ports; increased flood and drought risk; and marine water quality deterioration on the continental shelf. The WATER project recognises that these issues cannot be treated in isolation and require channel-wide cooperation through integrated water resource management.

Objectives
The Wetted Land: the Assessment, Techniques and Economics of Restoration (WATER)

project is developing a market-based catchment restoration scheme which will be based on a Payments for Ecosystem Services (PES) model and aims to identify both delivery and funding mechanisms to lever private investment for catchment restoration by:

- Developing a substantive Channel-wide cooperation network that identifies and addressed common issues and can deliver environmental restoration of wetted land within a river catchment, together with its beneficial functions, in a cost-effective way.
- Developing a set of five robust cost/benefit guides that demonstrate how investment from private companies in catchment restoration can make a long-term impact on their profitability and competitiveness, in line with the Lisbon agenda[633], and ensure the sustainable development of the environment, in accordance with the Göthenburg agenda[634].
- Simply put, WATER will develop mechanisms whereby the people and businesses that benefit from protected or enhanced ecosystem services will pay directly the people who deliver good ecosystem functioning. They will do this because they have a clear understanding of the economic, social and environmental benefits as demonstrated by the WATER project.

Activities

The two objectives of the WATER project will be delivered through four main activities:

- Assessing former distribution of wetted land within six river catchments, sub-catchments and local areas (the Rivers Exe and Axe in Devon; the Rivers Ouse and Adur in Sussex; Cousenon in the Ille et Vilaine; and Oust in Morbihan) and several smaller test catchments.
- Restoring and managing areas of wetted land and integrating it with economic research studies.
- Evaluating the economic costs and benefits of restoring wetted land aimed at five private interest groups (those benefiting from improved water purification, flood mitigation, carbon sequestration, biodiversity enhancement and potential catchment food branding).
- Dissemination and transfer of knowledge through the project partnership and extension of the project approach through the development of a wider Channel network.

In England, the project is being led by the WRT with support from the Environment Agency, South West Water and the Association of River Trusts (ART).

Source: *http://www.wrt.org.uk/projects/water/water.html*

Wetland Example of Payments for Ecosystem Services (WPES)

The Wetland Example of Payments for Ecosystem Services is a novel research and development project, part funded by the Natural England Wetland Vision Fund, based on a section of historic floodplain on the river Fal in West Cornwall. The two-year project has been underway since late 2009. It is led by the Westcountry Rivers Trust (WRT), and involves monetisation of the costs and benefits of a wide range of ecosystem goods and services that are or could be generated from the study area. It also involves identifying organisations, groups or individuals willing to pay for ecosystem goods and service benefits.

A crucial feature is that the site, which is currently set out in different land parcels each

[633] Also known as the Lisbon Strategy or the Lisbon Process, the Lisbon Agenda was an action and development plan for the economy of the European Union between 2000 and 2010. Its aim was to make the EU "the most competitive and dynamic knowledge-based economy in the world capable of sustainable economic growth with more and better jobs and greater social cohesion" by 2010. It was set out by the European Council in Lisbon in March 2000.

[634] The Gothenburg Agenda, which provided the foundation for the EU Sustainable Development Strategy (adopted 2006), sets out the European level vision for implementation sustainable development principles across the EU member states. See http://ec.europa.eu/environment/eussd/

currently under a different management regime, represents a microcosm of the whole catchment. This will allow changes in management regimes of different degrees and qualities to be tested in their capacity to deliver different end target wetland habitats and long-term protection mechanisms. This will generate variations in the economic benefits and therefore the likely investment achievable per parcel and will be vital in establishing what funding potential there is on a catchment scale.

More specifically, the project aims to:

- Reconnect and rewet 21ha of extensively grazed and cultivated disconnected floodplain reinstating it as a series of lowland wetland BAP habitats.
- Economically evaluate the direct and indirect ecosystem services benefits including carbon sequestration, flood mitigation, nutrient stripping, biodiversity and extensive management (limited grazing, shooting, fishing).
- Identify and sell the most economically beneficial services to local investors.
- Establish with the landowner and pay for mechanisms to remove land from long-term intensive production to light touch extensive management agreements or 1000-year covenants.
- Evaluate the projects applicability in terms of developing a Payments for Ecosystem Services based scheme that ensures long-term protection of other hydrologically important areas within the rest of the Fal catchment.

Source: *http://embed.org.uk/case-studies/wetland-example-of-payments-for-ecosystem-services-river-fal/*

US Wetland Reserve Program

Similar to the Conservation Reserve Program described in Box 6, the US Wetland Reserve Program (WRP) is a voluntary program offering landowners the opportunity to protect, restore, and enhance wetlands on their property. The USDA Natural Resources Conservation Service (NRCS) administers the program with funding from the Commodity Credit Corporation.

Producers enrolling in the program must agree to implement approved wetland restoration and protection plans. In return, participating producers receive payments based on the difference in the value of their land caused by placing an easement on a portion of it.

Ripon Multi-Objective Pilot Project

The Ripon Multi-Objective Project (MOP) was set up to help reduce the risk of flooding in Ripon, North Yorkshire, following stakeholder concerns that the joint benefits of land use and flood management were not being adequately considered or realised. Defra therefore agreed to promote a catchment scale pilot project focusing on these issues. The project was funded through a grant from the Environment Agency for capital works by farmers (incentivised by targeted grant aid) on the Rivers Skell, Laver and Kex Beck, and their tributaries. The aim of the project was to slow the passage of water from the land through land management projects and to help prevent soil and nutrient loss and create habitats to conserve biodiversity.

The MOP made some progress in influencing changes within the catchment but many of these changes could not be implemented because of a lack of available funding streams

within the pilot project timeframe.

Source: *http://www.forestry.gov.uk/pdf/urgp_case_study_019_Ripon_MOP.pdf/$FILE/urgp_case_study_019_Ripon_MOP.pdf*

The Westcountry Rivers Trust Angling Passport Scheme

A number of River Trusts have introduced Angling Passport Schemes (see Table 22). These are not-for-profit schemes that offer a means of privately financing the conservation and enhancement of open water habitats on privately-owned land, such as farms and properties.

The Westcountry Angling Passport – the first angling initiative of its kind in the UK – encourages farmers and landowners to manage the quality and accessibility of their river courses in exchange for financial incentives provided by anglers. It not only improves the river course habitat and water quality, thus enhancing the diversity and richness of fish and other river-dependent species (aquatic and terrestrial), but also secures a controlled recreational service.

Two payment methods are offered: a token scheme, which provides users with a more flexible access to less frequented waters; and a booking office, which caters for better established river fishing areas. Payment can be made online on the dedicated website, which also provides a user friendly guide to the fishing resources of Dartmoor and encourages comments and feedback from scheme participants. Payment can also be made over the phone, by cheque via the Westcountry Rivers Trust, in person at the Trust's offices, or at participating hotels, pubs and tackle shops. Tokens cost £2.50 each and are supplied in books of five or ten. The tokens are valid for any fishery 'beat' but can only be used once and have an expiry date of 31st December. Beats are rated according to their quality, ease of fishing and species of fish and cost between two and five tokens. A token box is provided at the 'beat' - directions to which are given in the Token Fishery Guide - and the angler posts the required number of tokens for the beat. The scheme also requires a catch return to be posted in the token box; this data is used for monitoring the health of the river and provides information for other anglers. In addition, the fishery owners and Trust staff carry out checks to ensure participants' fishing is not disturbed by others abusing the scheme.

Scheme participants can access the fishery without the need to contact the landholder for consent, and register the sites accessed with the Trust, who pass on payment to the landowner and in doing so act as a scheme broker and as an intermediary in advising the owner on appropriate investment of the revenue. Broadly speaking, a healthier river and associated fishery correlates with greater numbers of anglers visiting the resource and thus more payments to the resource owner as a management incentive.

Source: *http://www.westcountryangling.com/homepage.php*

4.5.8 Barriers to PES in Freshwaters

In many aspects, the OWWF habitat is the most suited to PES as the link between ecosystem service providers (mainly terrestrial) and beneficiaries (especially along water courses) is often quite obvious. However, some of the specific challenges that may arise in implementing PES in Freshwater habitats include:

- Not all freshwater habitats perform all processes, functions and services to the same degree, with the production of many services varying according to position in the

catchment.[635] As noted by the NEA[636], there is therefore increasing recognition of the need to understand better the interactions of various different freshwater and land types within a catchment to assess how their processes and functions combine to deliver ecosystem services. In addition to spatial heterogeneity, services from Freshwaters depend on catchment and temporal hydrological dynamics. Moreover, while many of the final ecosystem services provided by the UK's Freshwaters are well‐documented few studies are available that: i) explicitly quantify the value of the services provided; ii) develop quantitative understanding of interactions among the provision of goods and services, their exploitation and ecological functions; or iii) give an indication of the specific area and/or condition necessary to maintain or enhance particular services. While not all these interactions need to be fully understood to implement simple PES schemes where cause-effect relationships are clear, the potential for more elaborate 'bundling' schemes may be limited until more detailed functional analyses are performed at various scales across river catchments.

- Regulatory barriers may limit the scope for investment in PES schemes. For example, Ofwat, the economic regulator for the water and sewerage industry in England and Wales, needs to approve any investment water companies make in order to ensure that the companies provide household and business consumers with a good quality service and value for money. In a recent case, Ofwat rejected a case for investment in an unconventional solution to water quality issues in the Peak District (see the Sustainable Catchment Management Project described in Box 11), largely because there was insufficient evidence to demonstrate that the investment would be the most cost-efficient way of addressing the water quality problem. The water company – United Utilities – therefore needed to create the case for government support, as well as the business case, to its own board for the investment. Further funding was secured from Defra, through its agri-environment schemes, following successful lobbying by number of influential organisations (RSPB, English Nature and the National Park Authorities).
- The scale and integrated nature of Freshwater systems requires co-operative action amongst land managers to deliver benefits across a catchment or along a floodplain. Given the voluntary nature of PES, it may be difficult to obtain the necessary co-operation from all land managers.

4.5.9 Opportunities for PES in Freshwaters

Recognition of the breadth of benefits arising from sensitive ecosystem management is likely to stimulate opportunities for the implementation of PES schemes including for benefits such as improvements in water supply and quality, local air quality and health through habitat regeneration, flood risk management and navigation.

The impacts of climate change include rising sea levels and more extreme weather leading to floods, heatwaves, droughts, and intense rainfall.[637] According to the Environment Agency, 5.2 million properties in England are at risk from flooding with 2.4 million of these at risk from river or coastal flooding, 3.8 million from surface water flooding, and 1 million from river, coastal and

[635] Maltby, E. (1986). *Waterlogged wealth*. Earthscan, London; Dugan, P.J. (1993). *Wetland conservation – a review of current issues and required action*. IUCN, Gland; Switzerland; Bullock, A. and Acreman, M.C. (2003). The role of wetlands in the hydrological cycle. *Hydrology and Earth System Sciences*, 7(3): 75‐86.
[636] UK National Ecosystem Assessment (2011). *The UK National Ecosystem Assessment: Technical Report (Chapter 9: Freshwaters*). UNEP-WCMC, Cambridge [online] available at: http://uknea.unep-wcmc.org/Resources/tabid/82/Default.aspx (accessed 6 July 2011).
[637] Environment Agency (2009). *Climate change, adapting for tomorrow* [online] available at: http://publications.environment-agency.gov.uk/pdf/GEHO0709BQBW-e-e.pdf (accessed 25 February 2011).

surface water flooding.[638] The Agency estimates that the average annual cost of damage from flooding in England exceeds £1 billion with these costs borne by householders, businesses, central and local government and others including insurance companies.[639] The Agency maintains that, on average, every £1 invested in new and improved flood risk management assets reduces the long-term cost of flooding and coastal erosion damages by around £8.[640] The Government has recently completed a consultation on future funding for flood and coastal erosion risk management which argues that since costs currently fall almost entirely to the general taxpayer, this artificially constrains how much can be achieved, as well as creating potential for inequity in the system.[641] As such, the consultation emphasised that the Government would like to encourage additional local investment in flood and coastal erosion risk management, and give areas at risk a bigger say in the action taken. The consultation proposes a new 'payment for outcomes' approach to determining funding for all capital maintenance and defence projects from 1 April 2012. According to the Government, this would lead to greater local choice and discretion over what projects can proceed, and when, based on local willingness to contribute towards the benefits that would be delivered. This could potentially increase the scope for locally designed PES schemes to emerge whereby local beneficiaries (households, businesses) paid upstream landowners to employ certain land management techniques, e.g. re-flooding wetlands to improve water carrying capacity. Defra's short introduction to PES also argues that buyers might also include insurance groups interested in reduced flooding.[642]

In England, many of the most obvious opportunities for PES in Freshwaters have already been identified and include, for example:

- Payments by water utilities to upstream land managers to deliver good quality water resources;
- Payments by anglers for recreational fishing rights;
- Payments by various ecosystem service beneficiaries for catchment and wetland restoration activities to improve water quality, reduce sedimentation and manage flood risk;
- Investment in wetland construction for water treatment as a more cost-effective alternative to engineering solutions. Constructed treatment wetlands can also provide a range of secondary benefits such as habitat provision and production of reeds for thatching; and
- Payments for improved navigation

The reform of the CAP is likely to stimulate more payments for maintaining ecosystem services.

The challenge now is to reproduce and upscale successful examples of existing PES schemes in Freshwater habitats. Awareness-raising and dissemination of examples showcasing the benefits of PES schemes (i.e. cost-effectiveness, locally mediated solutions, etc) will play an important role in this.

Considering both land and water protection at a landscape‐scale could hold major benefits in terms of safeguarding water‐related ecosystem services and biodiversity simultaneously,

[638] Environment Agency (2009). *Investing for the future - Flood and coastal risk management in England: A long-term investment strategy* [online] available at: http://publications.environment-agency.gov.uk/pdf/GEHO0609BQDF-E-E.pdf (accessed 25 February 2011).
[639] *Ibid*
[640] *Ibid*
[641] Defra (2010). Future funding for flood and coastal erosion risk management: Consultation on the future Capital Grant-In-Aid allocation process in England [online] available at: http://www.defra.gov.uk/corporate/consult/flood-coastal-erosion/101124-flood-coastal-erosion-condoc.pdf (accessed 25 February 2011).
[642] Defra (2010). *Payments for ecosystem services: a short introduction* [online] available at: http://www.defra.gov.uk/environment/policy/natural-environ/documents/payments-ecosystem.pdf (accessed 25 February 2011).

while allowing the integrated management of catchments, riparian zones and Floodplains at a reduced cost. Enhancing stakeholder and community involvement, for example, through the current Government's 'Big Society' thinking, are key to this approach, and a range of stakeholder groups are already expressing interest in taking on these roles.

4.6 Mountains, moorlands and heaths

4.6.1 Description

The NEA states that mountains, moorlands and heaths (MMH) cover 18% of the UK but only around 5% of England's land surface area.[643] In 2007, dwarf shrub heath amounted to 331,000ha or 2.5% of land area in England, bog habitats 140,000ha (1.1% of land), fen, marsh and swamp 117,000ha (0.9%) and bracken 91,000ha (0.7%).[644] This habitat is usually considered poor-quality agricultural land due to soil conditions, water logging and topography, and so is mainly used for livestock grazing (mainly sheep, but some cattle at lower altitudes). Some areas have been limed and fertilised to create improved grassland.

The extent, condition and use of MMH changed substantially in the period between World War II and approximately 20 years ago. In England, dwarf shrub heath has shown a significant increase of 15.1% between 1998 and 2007 (converted mainly from acid grassland), bog increased by 1.2%, bracken decreased by 16.5% and fen, marsh and swamp decreased by 5.5%. Dwarf shrub heath is an assemblage of plants able to tolerate extreme conditions. The terrain for this ecosystem is largely located on low-value, marginal land, located in the harsh conditions of the uplands. Pressures include afforestation, agricultural development, high grazing pressures, airborne pollution, recreational use and, to a lesser extent, climatic changes.[645] [646]

There is a degree of dynamism between dwarf shrub heath, bog and acid grassland, responding to environmental pressures such as grazing and burning; but for the purposes of this report acid grassland is covered under semi-natural grasslands.

4.6.2 Ecosystem Services from MMH

The key ecosystem services generated by MMH in England, as identified by the NEA, are outlined in Table 26, together with an indication of the relative importance of MMH in delivering each of the listed ecosystem services.

[643] UK National Ecosystem Assessment (2011). *The UK National Ecosystem Assessment: Technical Report (Chapter 5: Mountains, moorlands and heaths)*. UNEP-WCMC, Cambridge [online] available at: http://uknea.unep-wcmc.org/Resources/tabid/82/Default.aspx (accessed 6 July 2011).
[644] Countryside Survey (2008). *Countryside Survey: England Results from 2007* [online] available at: http://www.countrysidesurvey.org.uk/eng_reports2007.html (accessed 13 December 2010).
[645] UK National Ecosystem Assessment (2011). *The UK National Ecosystem Assessment: Technical Report (Chapter 5: Mountains, moorlands and heaths)*. UNEP-WCMC, Cambridge [online] available at: http://uknea.unep-wcmc.org/Resources/tabid/82/Default.aspx (accessed 6 July 2011).
[646] Countryside Survey (2008). *Countryside Survey: England Results from 2007* [online] available at: http://www.countrysidesurvey.org.uk/eng_reports2007.html (accessed 13 December 2010)

Table 26: Main ecosystem services from MMH[647]

Provisioning		Cultural		Regulating	
Crops		Local places	M-H	Climate	H
Livestock / Aquaculture	M-L	Landscapes / seascapes	H	Hazard	H
Fish				Disease and pests	L
Trees, standing vegetation, peat	M-H			Pollination	M-L
Water supply	H			Noise	L
Wild species diversity	H	Wild species diversity	H	Water quality	H
				Soil quality	H
				Air quality	M-L

Key		
High	H	Blank cells represent services that are not applicable to the Broad Habitat
Medium – High	M-H	
Medium – Low	M–L	
Low	L	

MMH act as a source for approximately 70% of UK **drinking water**[648], mostly from the uplands. In addition, MMH also provides a key regulating service, by **buffering water quality** against the effects of atmospheric, diffuse and point source pollution. Appropriate management of MMH habitats (e.g. grip and gully blocking, re-vegetation of bare and eroding peats, sustainable grazing levels) can regulate water quality by reducing the concentration of Dissolved Organic Carbon and Particulate Organic Carbon (from erosion) reaching streamwater, with benefits for water treatment and reduced sedimentation of rivers and reservoirs. **Wildfire risk** can also be reduced on appropriately managed MMH habitats (controlled burning, fire breaks, and re-vegetating or raising the water table on degraded peat soils).

There is limited evidence about whether MMH habitats attenuate or exacerbate downstream **flooding**. There is evidence that restoration of degraded MMH can reduce stream peakflow and hence may reduce downstream flood risk at relatively small spatial and temporal scales, but more research is needed to provide evidence about the effect of restoration in the longer term and at a landscape scale. Although there is evidence that restoration of MMH habitats via grip and gully blocking reduces stream peakflow and hence may reduce downstream flood

[647] UK National Ecosystem Assessment (2011). *The UK National Ecosystem Assessment: Synthesis of the Key Findings*. UNEP-WCMC, Cambridge [online] available at: http://uknea.unep-wcmc.org/Resources/tabid/82/Default.aspx (accessed 6 July 2011).
[648] DWI (2008). *Annual report of the Drinking Water Inspectorate* [online] available at: http://www.dwi.gov.uk/about/annual-report/2008/index.htm (accessed 6 July 2011); DWQR (2008). Annual report of the Drinking Water Quality Regulator for Scotland [online] available at: http://www.dwqr.org.uk/technical/annual-report (accessed 6 July 2011).

risk[649], this effect is short-lived, and once the capacity of the soil to store water has been reached (e.g. following a heavy storm), restoration has little effect on flood risk[650].

This habitat is usually considered poor-quality agricultural land due to soil conditions, water logging and topography, and so is mainly used for **livestock** grazing (mainly sheep, but some cattle at lower altitudes). Some areas have been limed and fertilised to create improved grassland. Sporting estates provide **game**, mainly grouse in England, but also venison. **Wool** is a by-product of sheep production and has little commercial value, though it may become increasingly important as insulation material. MMH also provide **lifestyle** and other related products; for example bog myrtle acts as an ingredient for midge repellent, and heather for honey, heather tea and heather cutting for mulch or restoration of bare peat.

Many MMH habitats occur on peat soils, which represent the UK's largest terrestrial **carbon store**. In an active, peat-forming state, these soils are carbon sinks. The soils of heaths and bog (and acid grassland) contain considerable carbon stocks in comparison to other habitats, and MMHs contain about 40% of the UK's soil carbon, mainly in upland peaty soils. This presents opportunities for short-term reductions in UK carbon dioxide emissions, both through ongoing losses of soil carbon and further sequestration.[651] Moreover, the high altitude of many MMH areas makes them suitable for the generation of **wind energy**.

MMH are home to some of the UK's rarest species and communities, comprising a unique mixture of temperate, alpine and arctic species.[652] In addition to containing unique and internationally important habitats and species (supporting important **biodiversity**), MMH also provide **geodiversity**, some of which is protected in SSSIs. The UK holds 20% of the world's lowland heaths, and this habitat supports a range of protected species, with 90% of heathland habitats protected under national and international legislation as SSSIs, Special Protection Areas (SPAs) or Special Areas for Conservation (SACs). In terms of cultural heritage and aesthetics, peat soils help preserve archaeological records in the form of artefacts and pollen. Farm buildings and boundaries also have cultural heritage value, and their remote, bleak, open and biodiverse nature means they are also valued aesthetically.

Dwarf shrub heath contributes to the characteristic appearance of the uplands and the **cultural** and **historical** importance of areas – preserving palaeo-environmental and archaeological evidence in the peat and organic soils – that has, in some cases, resulted in national or international **landscape** designation. Related to this, MMH are considered to contribute towards national identity, social cohesion and community development. MMH also provides opportunities for **spiritual** and **religious** reflection through their wild and beautiful terrain and uninterrupted views, containing historic sacred places, e.g. stone circles, and with some pilgrimages passing through the landscape (e.g. St Cuthbert's Way in Northumbria). Other benefits include **education**, with opportunities to learn about the natural environment and cultural heritage, and health benefits associated with recreational activities and passive benefits to mental and emotional **health** associated with wild and open spaces for reflection. The NEA (chapter 5, p3) states that the 'non-use' or existence value of MMH is very high, and

[649] United Utilities (2010) SCaMP Sustainable Catchment Management Programme. Monitoring Progress Report Year 4. Penny Anderson Associates Ltd [online] available at: http://www.unitedutilities.com/SCaMPdatalibrary.aspx (accessed 8 December 2010).
[650] Evans, M.G., Burt, T.P., Holden, J. and Adamson, J.K. (1999). Runoff generation and water table fluctuations in blanket peat: evidence from UK data spanning the dry summer of 1995. *Journal of Hydrology* 221: 141-160; Holden, J. and Burt, T.P. (2003). Runoff production in blanket peat covered catchments. *Water Resources Research* 39(7): 1191. O'Brien, H.E, Labadz, J.C. and Butcher, D.P. (2007). Review of management and restoration options for blanket bog. . DEFRA project BD1241.
[651] UK National Ecosystem Assessment (2011). *The UK National Ecosystem Assessment: Technical Report (Chapter 5: Mountains, moorlands and heaths)*. UNEP-WCMC, Cambridge [online] available at: http://uknea.unep-wcmc.org/Resources/tabid/82/Default.aspx (accessed 6 July 2011).
[652] *Ibid*

that they are: *"nationally treasured landscapes, providing breathing spaces for people"* [653] *"Steeped in history, MMH are important cultural landscapes. …Mountain landscapes are often part of iconic imagery that is used to convey a national or regional sense of identity."*[654]

MMH are important for tourism and recreation. The majority of UK National Parks are located within MMH habitat; in England alone, these receive 69.4 million visitor days per year.[655] They are also widely used for grouse shooting and stalking red deer.

Although MMH contribute to soil formation, many areas of upland blanket bog and wet heath are degraded and actively eroding. Estimates of the affected area vary between 10 - 30% of peatlands.[656] Causes include a range of cumulative anthropogenic impacts over the last millennium including fire, overgrazing, acid deposition and climatic changes. While erosion is a natural process, increased soil erosion has a number of negative environmental consequences including the degradation of perceived landscape quality, a reduction in water quality due to release of heavy metals and POPs, and the loss of water storage capacity in reservoirs due to sedimentation of aquatically transported particulate matter.[657]

4.6.3 Scope for PES from MMH

Mountains, moorlands and heaths play a unique and important role in providing regulating services, and support internationally important sites for biodiversity conservation. Payments are already made for many of these services through the Upland Entry Level Scheme (UELS) (see Box 11) and, in some cases, through the private sector. However, there may be opportunities to elicit further engagement with the private sector to pay for some services.

4.6.3.1 Regulation of water quality

In many MMH habitats, land management practices have been blamed for poor water quality, in particular discoloured water with high concentrations of Dissolved Organic Carbon (DOC)[658]. This creates problems for raw water treatment where colour has to be removed not only to satisfy consumers, but also to prevent trihalomethanes (which can be carcinogenic) getting into drinking supplies when DOC reacts with chlorine[659]. DOC loss also contributes towards the loss of carbon from peat soils, and its transmission into more reactive riverine, marine and ultimately atmospheric carbon pools. Although the exact causes of increased DOC export from MMH catchments is unclear, there is evidence from some areas that blocking drainage ditches and gullies and revegetating bare and eroding peats can reduce DOC inputs to stream water approximately 3-4 years post-intervention[660]. It is predicted that the majority of this carbon

[653] UK National Ecosystem Assessment (2011). *The UK National Ecosystem Assessment: Technical Report (Chapter 5: Mountains, moorlands and heaths)*. UNEP-WCMC, Cambridge [online] available at: http://uknea.unep-wcmc.org/Resources/tabid/82/Default.aspx (accessed 6 July 2011).
[654] *Ibid*
[655] *Ibid*
[656] Evans, M. and Warburton, J. (2007). *The Geomorphology of Upland Peat: Pattern, Process, Form*. Blackwells: Oxford, 262pp.
[657] UK National Ecosystem Assessment (2011). *The UK National Ecosystem Assessment: Technical Report (Chapter 5: Mountains, moorlands and heaths)*. UNEP-WCMC, Cambridge [online] available at http://uknea.unep-wcmc.org/Resources/tabid/82/Default.aspx (accessed 6 July 2011).
[658] Driscoll, C.T., Driscoll, K.M., Roy, K.M. and Mitchell, M.J. (2003). Chemical response of lakes in the Adirondack Region of New York to declines in acidic deposition. *Environmental Science & Technology* 37: 2036-2042; Wallage, Z.E., Holden. J. and McDonald, A.T. (2006). Drain blocking: An effective treatment for reducing dissolved organic carbon loss and water discolouration in a drained peatland. *Science of the Total Environment* 367: 811-821.
[659] Kneale, P.T., and McDonald, A.T. (1999). Bridging the gap between science and management in upland catchments. In: Trudgill, S.T.,Walling, D.E., Webb, B.W. (Eds.), *Water Quality: Processes and Policy*. John Wiley & Sons, Chichester, pp.121–133.
[660] Wallage, Z.E., Holden, J. and McDonald, A.T. (2006). Drain blocking: An effective treatment for reducing dissolved organic carbon loss and water discolouration in a drained peatland. *Science of the Total Environment* 367: 811-821; Lunt, P.H., Allot, T.E.H., Anderson, P, Buckler, M., Coupar, A, Jones, P.S., Labadz, J.C A. and Worrall, P. (2010). *IUCN Technical Review of the Impacts of Peatland Restoration (rewetting, revegetation and vegetation management)* [online] available at: http://iucn-uk-peatlandprogramme.org/commission/restoration (accessed 3 June 2011).

ends up in the atmosphere as CO_2, but work is ongoing to corroborate this with empirical measurements.[661]

Since these same management activities also contribute towards carbon sequestration in MMH and are associated with the restoration of internationally important habitats, there is a potential for packaging PES for water, carbon and biodiversity together. Although market research for BRE (2009) suggests that UK companies are interested in investing in carbon offsets that have multiple benefits[662], serious consideration has not yet been given to the marketing of payments for multiple ecosystem services.

Interest in PES for water quality in MMH varies within the water industry. In part, levels of interest reflect the cost of treating DOC contaminated water, which in turn is linked to the proportion of catchments dominated by peat soils from which a company collects water. Some water companies own significant land-holdings in MMH, on which they may be able to pay for restoration or changes in management that can deliver water treatment cost savings. Others who use water from peat catchments own little of their own land, which may act as an additional barrier to PES for water quality. OFWAT have allowed water companies to pay for clean water via changes in peatland management through United Utilities' Sustainable Catchment Management Programme (SCaMP) in Bowland and the Peak District. This has included large-scale blocking of drainage ditches (grips) and re-vegetation of bare peat (both on blanket bog), cessation of burning and the introduction of more sustainable grazing regimes. Early findings of SCaMP monitoring of blanket bog SSSIs suggest: movers towards favourable condition; reduced water colour (DOC) four years after grip blocking; reduced sedimentation of streams two years after re-vegetation of bare and eroding peat; and reduced peak streamflow following grip blocking, which may have benefits for downstream flood risk.

However, there is uncertainty over the implications of Water Framework Directive (WFD) implementation for such schemes. Liabilities are likely to arise under Article 7 of the WFD if water quality targets are not met by 2015, and it is not yet clear who will take responsibility for these. Water companies are likely to try and avoid incurring these liabilities themselves, and one option for doing this may be to pass these on to land owners or agencies, such as Natural England, that approve land management plans that compromise water quality. Many water companies may be reticent about investing in PES that are effectively paying land managers to do something they should be doing anyway under the WFD, especially given that SFP and GAEC mechanisms are already in force.

4.6.3.2 Climate regulation

Peatlands, the majority of which are found in MMH, represent the single largest terrestrial carbon store in the UK.[663] The dynamics of carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O) depend on the condition of the peatland. Intact peatlands, with vegetation including bog mosses (*Sphagnum spp.*), are generally considered to be a carbon sink, albeit a slow one. As vegetation dies and becomes incorporated in the peat layer, the wet and acidic conditions

[661] Worrall, F., Davies, H., Bhogal, A., Lilly, A., Evans, M.G., Turner, K., Burt, T.P., Barraclough, D., Smith, P., and Merrington, G. (forthcoming). The flux of DOC from the UK – predicting the role of soils, land use and in-stream losses. *Global Biogeochemical Cycles* (accepted pending revisions).
[662] Rabinowitz, R. and Este d'Hoare, J. (2009). The Feasibility of Creating a Funding Mechanism for UK Carbon Reduction Projects: Key Findings from a BRE Research Project. BRE, unpublished report.
[663] Cannell, M.G.R., Dewar, R.C. and Pyatt, D.G. (1993). Conifer plantations on drained peatlands in Britain: a net gain or loss of carbon? *Forestry* 66: 353–369.

inhibit decomposition, leading to an increase in the volume of peat and an accumulation of soil carbon.[664]

However, Natural England[665] estimates that 70% of England's peatlands are degraded in some way. This generates emissions of greenhouse gases, primarily CO_2 via the oxidation of peat as water tables drop due to drainage via gullies or grips. This also leads to water stress in the surface vegetation and reduces rates of carbon sequestration[666]. The effects of this on the climate system are offset in the short term by reduced CH_4 production as the water table is lowered (CH_4 has a global warming potential of 23).

Restoration may take the form of rewetting drained peats, revegetation, reduced grazing, and/or reduced burning. The majority of restoration to date has focused on blocking drainage ditches and gullies to raise water tables and rewet peat soils, mainly on blanket peats, but this has so far been on a relatively small scale (it is estimated that around 20,000 hectares have been restored to date across the UK).[667]

While rewetting tends to reduce CO_2 emissions to the atmosphere[668] and aqueous carbon losses[669], it may increase CH_4 emissions in the short term[670]. However, Kaat and Joosten (2008), Lindsay (2010), Worrall *et al*. (2010) and Lunt *et al*. (2010)[671] emphasise that the increase in CH_4 is usually of short duration, and that rewetting peatlands leads to a net GHG benefit over the longer term. Given the range of site conditions and complex interactions among processes, it is difficult to generalize about N_2O emissions, but these represent a relatively small contribution to the overall GHG budget of peatlands.

The GHG benefit of restoration can be significantly enhanced by targeting restoration methods to locations where they can provide greatest benefit and avoiding locations that are likely to most exacerbate CH_4 emissions.[672] In this way, it is possible for restoration to provide significant GHG benefits; indeed, Worrall *et al*. (2010)[673] cite an example where restoration doubled the size of the present carbon sink. When appropriately targeted, restoration can also

[664] Worrall, F, Bell, M.J. and Bhogal, A. (2010). Assessing the probability of carbon and greenhouse gas benefit from the management of peat soils. *Science of the Total Environment* 408(13): 2657-2666.; Worrall, F., P. Chapman, J. Holden, C. Evans, R. Artz, P. Smith and R. Grayson (In press) *A review of current evidence on carbon fluxes and greenhouse gas emissions from UK peatlands*, Joint Nature Conservancy Council, Peterborough.
[665] Natural England (2010). *England's peatlands - carbon storage and greenhouse gases*. Natural England Report NE257, Peterborough [online] available at: http://naturalengland.etraderstores.com/NaturalEnglandShop/NE257 (accessed 9 May 2011).
[666] Byrne, K.A., Chjnicki, B., Christensen, T.R., Drösler, M., Freibauer, A., Friborg, T., Frolking, S., Lindroth, A., Mailhammer, J., Malmer, N., Selin, P., Turunen, J., Valentini, R., Zetterberg, L. (2004). *EU Peatlands: Current Carbon Stocks and Trace Gas Fluxes*, CarboEurope.
[667] Holden, J., Walker, J. Evans, M.G., Worrall, F., Davison, S. and Bonn, A. (2008). A compendium of UK peat restoration and management projects. Final report to DEFRA. DEFRA published report SP0556.
[668] For example, Tuittila, E.S., Komulainen, V.M., Vasander, H. and Laine, J. (1999). Restored cut-away peatland as a sink for atmospheric CO2. *Oecologia*, 120: 563–574.
[669] For example, Waddington, J.M., Tóth, K. and Bourbonniere, R. (2008). Dissolved organic carbon export from a cutover and restored peatland. *Hydrol Process* 22: 2215–2224; Holden, J., Shotbolt, L., Bonn, A., Burt, T.P., Chapman, P.J., Dougill, A.J., Fraser, E.D.G., Hubacek, K., Irvine, B., Kirkby, M.J., Reed, M.S., Prell, C., Stagl, S,, Stringer, L.C., Turner, A. and Worrall, F. (2007). Environmental change in moorland landscapes. *Earth-Science Reviews* 82: 75-100
[670] Waddington, J.M. and Day, S.M. (2007). Methane emissions for a peatland following restoration. *J. Geophys. Res*. 112.
[671] Kaat & Joosten (2008). *Factbook for UNFCCC policies on peat carbon emissions*. Ede, W.I. and Lindsay, R. (2010) *Peatbogs and Carbon*, RSPB [online] available at: http://www.uel.ac.uk/erg/PeatandCarbonReport.htm (accessed 9 May 2011); Worrall, F., Bell, M.J. and Bhogal, A. (2010). Assessing the probability of carbon and greenhouse gas benefit from the management of peat soils. *Science of the Total Environment*, 408(13): 2657-2666 and Lunt, P.H., Allot, T.E.H., Anderson, P, Buckler, M., Coupar, A, Jones, P.S., Labadz, J.C A. and Worrall, P. (2010). IUCN Technical Review of the Impacts of Peatland Restoration (rewetting, revegetation and vegetation management) [online] available at: http://iucn-uk-peatlandprogramme.org/commission/restoration (accessed 3 June 2011).
[672] Worrall F, Evans, M.G., Bonn, A., Reed, M.S., Chapman, D. and Holden, J. (2009) Can carbon offsetting pay for upland ecological restoration? *Science Of The Total Environment* 408: 26-36
[673] Worrall, F, Bell, M.J. and Bhogal, A. (2010) Assessing the probability of carbon and greenhouse gas benefit from the management of peat soils. *Science of the Total Environment* 408(13): 2657-2666.

offer considerable resilience in the face of ongoing and future climate change, potentially offering 60 years of additional GHG storage.[674]

Degraded peatlands are also blamed for discolouring drinking water, reducing reservoir capacity and altering species composition.[675] Hence, restoration of these habitats has the potential to generate multiple benefits including mitigating climate change, improving habitat for biodiversity, and improving water quality.

4.6.3.3 Regulation of natural hazards

Although there is evidence that restoration of MMH habitats via grip and gully blocking reduces stream peakflow and hence may reduce downstream flood risk[676], this effect is short-lived and once the capacity of the soil to store water has been reached (e.g. following a heavy storm), restoration has little effect on flood risk.[677] However, restoration activities in MMH that raise the water table (such as grip and gully blocking) have the potential to reduce the risk of wildfires burning deep into peat soils, with consequent carbon and habitat loss. There is currently no market for wildfire risk regulation. However, such benefits may contribute towards the attractiveness of PES schemes based on carbon or water, by increasing the range of co-benefits. By enabling sellers to add a premium for such co-benefits, it may be possible to indirectly pay for reducing wildfire risk.

4.6.3.4 Cultural ecosystem services

Many of the cultural ecosystem services provided by MMH focus around activities and values that are hard to monetise, such as recreation, cultural heritage, aesthetics and spirituality. However, "visitor payback" schemes are now emerging that enable visitors to pay for environmental management that supports these services. Where these schemes provide payments for specific projects that provide measurable improvements in ecosystem services e.g. access to recreation via footpath creation or maintenance, these can be considered PES. For example the "Our Man at the Top" scheme in the Lake District secures £50k per year for such work by adding a £2 surcharge to every week booked by tourists.[678] [679] See Table 27 for a list of current visitor payback schemes operating across the UK National Park network. Alternatively, there are a range of mechanisms which can broadly be considered under "spatial planning" approaches, and help to broker arrangements between developers, landowners and planning authorities to create and enhance the management of habitats at a landscape scale. These include habitat banking, Section 106 Agreements and the Community Infrastructure Levy.

[674] Worrall, F, Bell, M.J. and Bhogal, A. (2010) Assessing the probability of carbon and greenhouse gas benefit from the management of peat soils. *Science of the Total Environment* 408(13): 2657-2666.
[675] Holden J, Shotbolt, L., Bonn, A., Burt, T.P., Chapman, P.J., Dougill, A.J., Fraser, E.D.G., Hubacek, K., Irvine, B., Kirkby, M.J., Reed, M.S., Prell, C., Stagl, S., Stringer, L.C., Turner, A. and Worrall, F. (2007). Environmental change in moorland landscapes. *Earth-Science Reviews* 82: 75-100; Lunt, P.H., Allot, T.E.H., Anderson, P, Buckler, M., Coupar, A, Jones, P.S., Labadz, J.C A. and Worrall, P. (2010). *IUCN Technical Review of the Impacts of Peatland Restoration (rewetting, revegetation and vegetation management)* [online] available at: http://iucn-uk-peatlandprogramme.org/commission/restoration (accessed 3 June 2011).
[676] United Utilities (2010). SCaMP Sustainable Catchment Management Programme. Monitoring Progress Report Year 4. Penny Anderson Associates Ltd [online] available at: http://www.unitedutilities.com/SCaMPdatalibrary.aspx (accessed 8 December 2010).
[677] Evans, M.G., Burt, T.P., Holden, J. and Adamson, J.K. (1999) Runoff generation and water table fluctuations in blanket peat: evidence from UK data spanning the dry summer of 1995. *Journal of Hydrology* 221: 141-160; Holden, J. and Burt, T.P. (2003) Runoff production in blanket peat covered catchments. *Water Resources Research* 39 (7): 1191; O'Brien, H.E, Labadz, J.C. and Butcher, D.P. (2007). Review of management and restoration options for blanket bog. . Defra project BD1241.
[678] See http://www.insights.org.uk/articleitem.aspx?title=Lake+District+Tourism+and+Conservation+Partnership.
[679] See http://www.heartofthelakes.co.uk/conservation.html.

Table 27: Visitor Payback Schemes in UK National Parks

National Park	Name of scheme	Further information
Brecon Beacons	-	Developing one as part of the COLLABOR8 project
Broads	-	Developing scheme as part of the STEP (Sustainable Tourism in Estuary Parks) Interreg project, and in association with the Broads Charitable Trust and the Broads Tourism Forum.
Cairngorms	-	Scoping study 2007-8. No plans for developing a scheme.
Dartmoor	-	Nothing currently in place but is being actively considered
Exmoor	CareMoor	http://www.exmoor-nationalpark.gov.uk/index/visiting/keeping-exmoor-special/caremoor.htm Approx. £5,000 a year raised - a third of this is from Exmoor NPA walks / events programme. Currently looking at new options for the fund
Lake District	Nurture Lakeland	Nurture Lakeland is a registered charity not part of LDNPA http://www.nurturelakeland.org/
Loch Lomond and the Trossachs	-	Managed by Friends of Loch Lomond and the Trossachs (no other info on-line)
New Forest	New Forest Trust	New Forest visitor payback scheme is administered by the Hampshire and Isle of Wight Community Foundation on behalf of the New Forest Trust. See http://www.hantscf.org.uk/default.aspx?id=174 and www.newforesttrust.org.uk The scheme is independent of the New Forest NPA.
Northumberland	Good Nature Fund	http://www.northumberlandnationalpark.org.uk/grantsandsupportgoodnaturefund
North York Moors	-	NYMNPA looking at options for small scale scheme to start in April 2011
Peak District	Peak Pound Partnership	Run by Friends of the Peak District. Established 18 months ago. http://www.friendsofthepeak.org.uk/Support_us/Corporate_Support/Peak_Pound_Partnership/
Pembrokeshire Coast	-	No NPA run payback scheme but a local cottage letting agency has set one up to put funds into conservation and access projects
Snowdonia	-	Considering options and researching good practice with a view to starting a scheme in partnership
South Downs	-	Developing one as part of the COLLABOR8 project
Yorkshire Dales	Donate to the Dales Three Peaks Project	Administered by the Yorkshire Dales Millennium Trust http://www.yorkshiredalesandharrogate.com/donate.html

National Park	Name of scheme	Further information
		Operated in House by YDNPA staff. http://www.yorkshiredales.org.uk/index/looking after/projectwork/threepeaksproject.htm

4.6.3.5 Wild species diversity

Markets are also emerging to pay for biodiversity. Habitat banking can be used purchase biodiversity credits that offset the impacts of development on biodiversity by creating or enhancing habitats elsewhere. Many countries include some sort of biodiversity compensation scheme in the Environmental Impact Assessment laws. Madsen *et al*. (2010)[680] identified 39 operational schemes, with another 25 being planned, and estimated the global annual market to be worth around $1.8-$2.9 billion. In Europe, this is partly already enforced through the Habitats Directive and the Bird Directive, which demands like-for-like compensation where development that is of over-riding public interest damages important sites for conservation. It may be possible to generate biodiversity credits from the restoration of degraded MMH habitats that could be traded to offset damage from development. Given the relatively high proportion of MMH protected by conservation designations and that offsets must be like-for-like, it is unlikely that there would ever be a large market for credits generated for this purpose. However, some of the organisations that develop standards to accredit projects for international carbon markets now also have standards for evaluating the effects of these projects on biodiversity (e.g. the Climate, Community and Biodiversity Alliance). In this way, it may be possible to package the carbon and biodiversity benefits of MMH restoration to access payments for both.

4.6.4 Ecosystem Service Sellers

Actual and potential providers and sellers of ecosystem services from English MMH are shown in the table below.

Table 28: Ecosystem service providers for MMH

Ecosystem Service	Sellers
Trees, standing vegetation, peat , wild species diversity climate regulation (carbon storage), water quality, soil quality, , landscape aesthetics, recreation	**Private landowners and tenant land managers**.
Climate regulation, wild species diversity, livestock, game, wool, natural products, peat	**Non-governmental organisations** such as RSPB, Wildlife Trusts, The National Trust – several such organisations have expressed an interest in selling carbon to finance peatland restoration on land owned by them or those they represent. The Country Land and Business Association has expressed an interest in selling carbon to finance peatland restoration on land owned by those they represent

[680] Madsen, B., Carroll, N. and Moore Brands, K. (2010). State of Biodiversity Markets Report: Offset and Compensation Programs Worldwide [online] available at: http://www.thegef.org/gef/sites/thegef.org/files/publication/sbdmr.pdf (accessed 16 September 2011).

Ecosystem Service	Sellers
Environmental settings (local places and landscapes of cultural and historical significance, tourism and recreation), wild species diversity	National Park Authorities and Area of Outstanding National Beauty Partnerships[681]

4.6.5 Ecosystem Service Beneficiaries

Actual and potential beneficiaries of ecosystem services from English MMH are shown in Table 29. The ultimate beneficiaries from MMH ecosystem services are widespread in both type and location, reflecting the wide range of ecosystem services available from this type of broad habitat.

Table 29: Ecosystem service beneficiaries for MMH

Ecosystem Service	Beneficiaries
Environmental settings (local places and landscapes for recreation, cultural and historical services), wild species diversity, crops (natural products)	Locally, **recreational visitors** to MMH not only gain personally in enjoyment, cultural and health terms, but bring economic benefits to farms, shops, accommodation providers, tourist guides, etc.
Air quality, water quality, environmental settings (local places and landscapes for recreation, cultural and historical services), wild species diversity, crops (natural products)	**Local residents** in houses, villages and towns in or near MMH gain amenity benefits in terms of landscape, air quality, etc.
Water supply, water quality, natural hazard regulation, climate regulation	**Downstream household and commercial consumers** of water benefit from higher-quality (and therefore cheaper) supplies, and the ecosystem service of water entrapment benefits downstream communities and councils liable to flooding (and perhaps a wider population due to a lower need for cross-insurance). Carbon sequestration benefits the global population (present and future).

4.6.6 Ecosystem Service Buyers and Intermediaries

Actual and potential buyers and intermediaries of ecosystem services from English MMH are shown in the table below.

Table 30: Ecosystem service buyers and intermediaries for MMH

Ecosystem Service	Buyers
Biodiversity and landscape protection, maintenance and enhancement; flood alleviation;	**Government** (on behalf of the public). Mainly central government and its agencies, e.g. Natural England. Local authorities (supported by national government) may also

[681] See http://www.northpennines.org.uk/index.cfm?articleid=13043.

Ecosystem Service	Buyers
carbon sequestration	implement spatial planning approaches to facilitate developer contributions.
Water supply, water quality	**Downstream buyers** including water utilities and hydropower companies (on behalf of consumers)
Wild species diversity, landscape aesthetics	**Conservation organizations/groups** such as the National Trust and wildlife trusts
Wild species diversity, carbon storage	**Private companies** investing in Corporate Social Responsibility or developers fulfilling obligations under the CIL, Section 106 Agreements and Environmental Liability Directive. Other companies/organisations such as the Carbon Neutral Company and the World Land Trust may channel payments from those wishing to invest in peatland restoration projects to those wishing to sell carbon to finance their restoration activities.

A range of intermediaries exist (e.g. the Carbon Neutral Company and the World Land Trust in the UK), that could channel payments from those wishing to invest in peatland restoration projects to those wishing to sell carbon to finance their restoration activities. A number of such intermediaries have informally expressed an interest in working with peatland restoration projects, providing cost-effective verification of carbon reductions can be provided. Currently there are two approaches being developed for verification. The first relies on mathematical models of carbon dynamics, which use proxies such as water table depth to infer carbon budgets, which can be validated through spot checks, replacing the need for more costly monitoring (e.g. Worrall *et al*., 2007[682]). Alternatively, the UK's IUCN Peatland Programme are currently developing an approach that may be more cost-effective, using remotely sensed data on peatland vegetation assemblages as a proxy for hydrological function and carbon budgets.

4.6.7 Case Studies

Some case studies illustrating how PES schemes have been applied to MMH landscapes are described in Box 11 below.

Box 11: Examples of PES schemes applied to mountains, moorland and heaths

Sustainable Catchment Management Programme (SCaMP)

United Utilities (UU) supplies water to around 7 million people in the North West of England, a large proportion of which comes from upland surface water sources. UU is a major landowner in the north west of England, with 56,000 ha of catchment land, historically acquired to provide a degree of control in protecting both water quality and flows. Much of this land is also of high conservation importance. The Sustainable Catchment Management Programme (SCaMP) is aimed at securing management of two key areas of land: UU's Bowland and Southern (Longdendale, Goyt and Peak District) Estates. It will help restore important habitats and enhance biodiversity, protect and improve raw water quality, and enable a sustainable future for the company's agricultural tenants. UU has been allowed to fund this programme of work by its financial regulator, OFWAT, as part of its five-year investment programme for 2005-2010 (PRO9).

[682] Worrall, F., Armstrong, A. and Adamson J.K. (2007) The effects of burning and sheep-grazing on water table depth and soil water quality in a upland peat. Journal of Hydrology 339:1-14

SCaMP has been developed in association with the Royal Society for the Protection of Birds (RSPB), a key partner with UU in defining and delivering the work.
The programme's aim is to develop an integrated approach to catchment management incorporating sustainable upland farming that delivers:

- Government targets for SSSIs
- Biodiversity plans for priority habitats and species
- Improved raw water quality

This will be achieved by entering into long-term agreements with tenant farmers which will define farming plans compatible with the above objectives. Whole-farm plans will be produced which will identify specific land management techniques to be applied on all catchment and SSSSI land within the funded areas. The plans are based upon giving the tenant the best chance of accessing higher-level agri-environmental support grants to ensure that the plans are both environmentally and economic sustainable. As a result, the plans have been developed in consultation with English Nature, the RSPB and the Rural Development Service.

A key part of the programme is to monitor and evaluation the effect of any land management changes that UU agree and implement with tenants. UU has established a monitoring programme that looks at the effects of land management change on vegetation, hydrology and water quality.

For more information, see http://www.hydrology.org.uk/Publications/durham/bhs_14.pdf

The Uplands Entry Level Stewardship (Uplands ELS)

The Uplands Entry Level Stewardship (Uplands ELS) is a new strand of Environmental Stewardship which has recently replaced the Hill Farm Allowance with new agreements starting from 1 July 2010. It is designed to support and reward farmers in looking after some of England's most iconic upland landscapes including Dartmoor, Exmoor and Bodmin Moor.

Uplands ELS is a Defra scheme administered by Natural England and was drawn up after consultation with the NFU, CLA and other partners. Through the scheme, hill farmers will be rewarded for looking after local wildlife and watercourses, and for maintaining traditional features of the landscape such as dry stone walls and barns. Up to £31 million from the Rural Development Programme for England will be made available to fund all farmers who qualify for the scheme. Their payments will be more than double those for standard Entry Level Stewardship in recognition of the harsh conditions in which they farm.

To qualify for the Uplands ELS, farmers will have to farm in designated areas and meet a points threshold, with points based on a wide variety of beneficial land management practices including maintaining a minimum level of grazing stock on the moorlands, dry stone wall maintenance, and appropriate use of fertiliser or supplementary feed near a watercourse.

Source: *http://www.naturalengland.org.uk/regions/south_west/press_releases/2010/090210.aspx*

Other (non-upland) examples of higher level agri-environment options for MMH

The examples below describe some of the management options that may be included within an HLS agreement for the MMH habitat. Options under the HLS scheme are funded by the UK

[683] Natural England (2010) Higher Level Stewardship: Environmental Stewardship Handbook. Third edition, February 2010 [online] available at http://naturalengland.etraderstores.com/NaturalEnglandShop/NE227 (accessed 12 July 2011); Scottish Government (2010) Scotland Rural Development Programme - Rural Priorities - List of Options available under Axis 2 (options 23, 26, 28, 30 and 31) [online] available at http://www.scotland.gov.uk/Topics/farmingrural/SRDP/RuralPriorities/Options#a2(accessed 30 July 2010)

Government and the European Union.

Maintenance of restoration of moorland £40/ha

Objective: to maintain or restore moorland habitats to benefit upland wildlife, retain historic features and strengthen the landscape character. In addition, in the right situation they may provide an area of flood containment and some benefits to flood risk management. The options are targeted at grazing units that are predominantly in the SDA, above the Moorland Line and characterised by the presence of upland habitats and species.

Requirements: Management will include grazing the moorland following an agreed stocking calendar. This calendar will reflect the different habitats within the moorland unit and their present condition. It will indicate how many and what type of livestock will be allowed to graze the moorland in each month of the year. Restoration may also include grip blocking or temporary fencing, in order to reduce or exclude grazing.

Additional payments: £7/ha for management of heather, gorse and grass by burning, cutting or swiping; £10/ha for moorland rewetting

Capital payments: Fencing and grip blocking

Creation of upland heathland £60/ha

Objective: to create dwarf-shrub communities in upland moorland areas where heathland plants are rare or absent and their seedbanks are depleted. To enhance the diverse vegetation mosaic characteristic of upland landscapes and will be targeted at areas adjacent or close to existing dwarf-shrub heath.

Requirements: Management must include site preparation using a combination of topping, scarification, ploughing, burning and/or herbicide treatment; establishment of heathland vegetation by sowing or spreading heather or heathland seed or cuttings; and control of grass and weed species by an agreed method.The methodology will be influenced by existing environmental values, such as the presence of archaeology or landscape considerations.

Capital payments: Grip blocking and temporary fencing

Wildlife Management on Upland and Peatland Sites £0.70/ha (Scotland)

Objective: conserve soils and restore special wildlife features to favourable condition (aimed at managers of wild deer and red grouse, with priority for SSSI/Natura land).

Requirements: application supported by a Moorland Management Plan, identifying suitable grazing regimes, other management and any ditch blocking needed; manage deer to avoid trampling the most sensitive ground; minimise vehicle usage away from tracks, and then use only low ground pressure vehicles on dry, hard ground; have approved muirburn plan for SSSI/Natura sites (on other sites follow Muirburn Code); existing peat cutting by hand permitted, replacing turf carefully.

Additional payments: in SSSI/Natura sites only, for management of moorland grazings on upland and peatlands £2 ha/year (implement plan for changes in shepherding, managing livestock and feeding practices that will benefit the environment and wildlife) and extra shepherding £7.82 per hour (where this is most effective way to deal with localized grazing problems identified in the management plan). In all areas, if required for habitat management, away-wintering or off-wintering of sheep £21 and £9 ha/year respectively.

Capital payments: eradication of scrub/woody vegetation; ditch blocking with plastic piling or peat dams; fencing, gates and fence removal; renewable energy powered pumps for water troughs; works required for Sites of Special Scientific Interest (SSSI) and Natura features.

Sources: *Natural England (2010); Scottish Government (2010)*[683]

New York Catskills PES Scheme

From the beginning of the twentieth century, the burgeoning New York City looked north for its water supply, initially to the Catskill Mountains and then to Delaware, relying on the low population and extensive farming in these landscapes to provide the service for fresh water supply. By the 1990s, the Catskill Mountains and Delaware were providing 90% of the water to

New York City. This was untreated, though issues of contamination surfaced in the early 1980s due to intensification of the catchments in conjunction with increasingly stringent federal standards governing the use of unfiltered water (the Safe Drinking Water Act, 1986 and the Surface Water Drinking Rule 1989).

Faced with a substantial potential bill for a water filtration plant (between US$4 billion and US$6 billion capital costs with annual operational costs of US$250 million), with its associated chemical and energy inputs and ongoing operational costs, City water authorities explored alternatives. Working with the New York State Department of Agriculture a favoured option emerged of investment in a rural-urban partnership with the aim of water user charges being used under a PES scheme to promote measures to preserve drinking water quality at source. Improvement of land use in the watershed proved substantially more cost-effective, requiring an initial investment of US$1.5 billion though the social negotiation and targeting of farm advice and payments for relevant upgrades to farm infrastructure was far from trivial.

The programme was voluntary and administered by the farming community through the 'Watershed Agricultural Council'. Some 85 per cent of the farmers were required to sign up. This was the 'deal-maker' for New York authorities: the threshold level deemed necessary to effectively reduce non-point source pollution. Between 1990 and 1993, 93 per cent of landholders signed up to the programme at a cost to New York City of the equivalent of about 11 per cent of the proposed filtration plant. Farms that opt to participate in the Watershed Agricultural Program receive technical assistance in developing a 'whole farm plan', incorporating farm business viability but also designing a strategy for controlling potential sources of pollution on the farm. New York City covers all costs associated with the implementation, and participating farms become eligible for other forms of compensation for specific environmental services.

The New York City water system provides 9 million people with 4.5 billion litres of freshwater daily, around 90 per cent of it drawn from the Catskills-Delaware system. It is today the largest unfiltered urban water supply system in the world.

Sources:

Appleton, A. F. (2002). How New York City Used an Ecosystem Services Strategy Carried out Through an Urban-Rural Partnership to Preserve the Pristine Quality of Its Drinking Water and Save Billions of Dollars. A Paper for Forest Trends -Tokyo, November 2002

Bond, I. and Mayers, J. (2010). Fair deals for watershed services: Lessons from a multi-country action-learning project, Natural Resource Issues No. 13. IIED, London [online] available at: http://pubs.iied.org/pdfs/13535IIED.pdf (accessed 28 December 2010).

South Africa's Working for Water Programme

Most of South Africa's surface water originates from high altitude grassland areas. In these areas, seepage wetlands act as sponges that catch much of the summer rainfall. The slow subsequent release of the infiltrated water serves to maintain base flows in the catchments during the dry season. The functionality of these grassland wetlands is compromised by bad management practices such as overgrazing and inappropriate burning regimes, as well as by damming and reclamation of wetlands. More serious is the increasing (albeit controlled) tendency for conversion of grassland by afforestation with alien Pinus and Eucalyptus species, which negatively affects the quantity of catchment runoff. These plantations intercept stream flow, especially when close to watercourses. In addition, base flows are also intercepted by alien vegetation that has invaded stream courses.

The Working for Water (WfW) Programme is a public sector funded programme, launched in 1995 and administered by the Department of Water Affairs (DWA), which supports rural employment programmes that involve the removal of alien invasive species from riparian

zones, as well as mountainous areas in order to restore natural fire regimes, the productive potential of land, biodiversity, and hydrological functioning. What is particularly unusual about the programme is that it was initiated and is funded primarily as a poverty relief public works programme. This is reflected in its goal of sustainably controlling invasive alien species by 2020 "in order to contribute to economic empowerment, social equity and ecological integrity" (DWAF, 2004). The control of invasive alien plants involves both manual clearing and the release of biological control agents. Ongoing research and releases of organisms address the latter, but will not replace the need for physical clearing (which is also the most costly form of restoration) until all the most important species are under biological control and are in significant decline. While much of the early work was done exclusively within national and provincial parks, most (66%) of WfW's activities since 2001 have been outside of these conservation enclaves, contributing greatly to conservation and ecosystem health on unprotected land.

The DWA includes a water resource management fee, which includes a charge for the control of invasive alien plants as well as charges for activities such as planning and implementation, pollution control, demand management, water allocation and water use control, in the water tariff charged to consumers.

Certain municipalities and water utilities have also entered into voluntary payment agreements with WfW to alleviate localised water shortages. In 1996 the municipality of Hermanus, a coastal resort town in the Western Cape, responded to critical water shortages by introducing a block rate tariff system for water that effectively raised water prices for users above other areas. Its main motivation was water demand management, since increasing demand was outstripping supply. A significant percentage of the revenues collected were paid to WfW for clearing invasive alien plants in the catchment areas from which Hermanus derives its water. Water consumers participated in developing this arrangement. Also in the Western Cape, the George municipality implemented an augmentation scheme to supplement the capacity of the Garden Route Dam. After studying the impacts of invasive alien plants on water supply, George concluded that investing in a clearing programme to enhance water supply was economically viable. Water utilities are financially autonomous and publicly owned companies that supply water to urban users in South Africa. Some of these utilities (e.g. Umgeni Water, the largest bulk water supplier in KwaZulu-Natal province) have established contracts with WfW to ensure the continuity of their water supplies. The future prospects for expansion of PES for hydrological services are further strengthened by the legal requirement for Catchment Management Agencies. These authorities will have an incentive to purchase hydrological services through organisations such as WfW so as to be able to supply more water to their users.

In most PES systems, the sellers are landowners, whether state, private, or communal. In this case, the 'sellers' are roving service providers in the form of small-scale contractors who perform restoration work on land under any type of ownership. The seller selection criterion is that contractor staff must have been previously unemployed. Like some PES systems, where landowners bid to participate as service providers, potential contractors tender to win contracts. Contracts specify how invasive alien plants in a defined area are to be treated, either chemically, mechanically, or both, depending on the species and maturity of the stand. The landowners involved in the transaction include private landowners, communal landowners, and the state (in the case of protected areas). Private and communal landowners are mainly farmers, and typically use the affected areas as rangelands and to harvest natural resources, such as wild flowers and thatch for either commercial or subsistence purposes. Private and communal landowners benefit from having their land cleared through increased productivity, where the cost of clearing is too high to make it worthwhile from a private perspective, even though they are obliged to do so by law. Most WfW projects are on public lands, but some projects are on communal or private lands, usually in important conservation areas. In the latter cases the landowners do not bear any costs.

Another unique feature of this programme is that the cost of intervention is relatively low. This is unlike most other PES systems where conservation action carries a significant and on-going opportunity cost, typically as a result of decreased agricultural or forestry production from the lands in question. In this case, total costs are low because (1) no land use is displaced, and in fact treated land (if used for agriculture or natural resource harvesting) is likely to be more productive, so the opportunity cost portion of the total cost is low or even negative; and (2) labour costs are low from society's perspective as the labour employed has few alternative formal sector employment opportunities. This leaves materials costs (equipment, travel to sites, etc) as the major costs.

While many PES programmes include the objective of poverty alleviation as a side objective, it is the one of the primary objectives of WfW. Indeed, the continued political support of the programme has hinged on its being primarily a poverty-relief programme. The programme has created thousands of jobs, with a strong emphasis on gender equity, and provides considerable benefits such as skills training and health and HIV/ AIDS awareness programmes. It also generates further income through the development of value adding industries, such as furniture, fuel wood, and charcoal that use alien vegetation as inputs.

Sources: *Turpie, J., Marais, C. and Blignaut, J. (2008) The working for water programme: Evolution of a payments for ecosystem services mechanism that addresses both poverty and ecosystem service delivery in South Africa. Ecological Economics, 65(4), pp788-798.*

DWAF (2004). The Working for Water Programme: Annual Report 2002/3. Department of Water Affairs and Forestry, Pretoria.

http://www.dwaf.gov.za/wfw/

http://moderncms.ecosystemmarketplace.com/repository/moderncms_documents/Working_for_Water_final2.pdf

China Sloping Land Conversion

One of the largest national PES, the Chinese Sloping Lands Conversion Programme (SLCP) had US$ 43 million assigned to it, each year to compensate tens of millions of rural households for converting erosion-prone farm land into forest to reduce flood risk in the Yangtze and Yellow rivers. The SLCP has been described previously in Section 2.7.3.

Source: *Bennett, M. and Xu, J. (2008). China's Sloping Land Conversion Program: Institutional Innovation or Business as Usual? [online] available at: http://www.cifor.cgiar.org/pes/publications/pdf_files/China_paper.pdf (accessed 28 December 2010)*

4.6.8 Overcoming barriers to payments for carbon in MMH

Investment in the restoration of degraded peatlands appears to represent a win-win scenario that could help meet conservation targets whilst increasing the resilience of peatlands to climate change and mitigating further climate change by reducing greenhouse gas emissions (see Section 4.6.3). It also protects or enhances the hydrology of catchments. Peatland restoration is a target of the UK Habitat Action Plan. The Scottish Government has expressed an intention to include carbon emission reductions from peatland restoration in meeting national climate change targets.[684] At COP15 of the UN Framework Convention on Climate

[684] Reed, M.S., Buckmaster, S., Moxey, A.P, Keenleyside C, Fazey I, Scott I, Thomson K, Thorp S, Anderson R, Bateman I, Bryce R, Christie M, Glass J, Hubacek K, Quinn C, Maffey G, Midgely A, Robinson G, Stringer LC, Lowe P, and Slee, R. (2010). *Policy Options for Sustainable Management of UK Peatlands*, IUCN Technical Review 12, IUCN UK Peatland Programme, Edinburgh.

Change (UNFCCC) in Copenhagen, draft rules were agreed, which could come into force from 2012, which specifically include rewetting of drained peatlands within national reporting.[685] However, a number of policy barriers currently exist, which are also a barrier to private investment in peatland restoration, whether for carbon or other associated ecosystem services.

4.6.8.1 Compliance Markets

The Kyoto Protocol established a number of 'flexibility mechanisms' that could, in theory, enable peatland restoration to be financed via international carbon markets. However, to generate carbon credits that could be traded on international markets, all peatlands would need to be included in the UK's Greenhouse Gas Inventory, and changes would be necessary to: i) UK legislation (to allow projects to become part of the Joint Implementation scheme under the UNFCCC); ii) the EU's Emissions Trading Scheme (if peatland restoration were to become part of a compliance programme where credits were generated and counted under the Kyoto Protocol); and iii) DECC's Greenhouse Gas Accounting Guidelines (to enable carbon credits from restoration to be traded on voluntary carbon markets).

4.6.8.2 Voluntary markets

Changes i) and ii) above are highly unlikely at the present time. However, if all peatlands could be included in the UK's GHG Inventory and a registry were created to prevent carbon sold on the voluntary market entering national accounting under the Kyoto Protocol, it may be possible to establish a voluntary carbon market for peatland restoration in the UK.

While a number of voluntary crediting programs have emerged over the past few years, the Verified Carbon Standard (VCS) is the leading crediting program for offset projects in the voluntary market.[686] The VCS allows crediting for a number of different land use and forestry activities, and has recently issued draft guidance that would expand the list of permissible activities to include peatland rewetting and conservation activities.[687]

In its general guidance for all offset projects, the VCS requires that projects provide evidence that emission reductions generated by the project will not be used to demonstrate compliance within a program that places binding limits on greenhouse gas emissions in that jurisdiction or sector. The intent of this provision is to avoid double-counting of emission reductions.[688]

Therefore, in the context of a UK peatland restoration project, a project developer would need to provide evidence that emissions from peatlands are not included in the UK's national GHG Inventory reported under the Kyoto Protocol or, if they were included, the equivalent amount of reductions were cancelled from the UK's reported GHG emissions. While the UK does not currently report emissions from non-forested peatlands in its GHG Inventory, potential changes to accounting in future commitment periods (post-2012) of the Kyoto Protocol could require Annex I countries (including the UK) to account for emissions and removals on all peatlands in future commitment periods (post-2012)[689] [690].

[685] UNFCCC (2010). *Report of the Ad Hoc Working Group on Further Commitments for Annex I Parties under the Kyoto Protocol on its tenth session*, held in Copenhagen from 7 to 15 December 2009 [online] available at: http://unfccc.int/resource/docs/2009/awg10/eng/17.pdf (accessed 9 May 2011).
[686] See http://ecosystemmarketplace.com/documents/cms_documents/StateOfTheVoluntaryCarbonMarkets_2009.pdf
[687] See http://www.v-c-s.org/docs/VCS-Program-PRC-Public-Consultation-Document.pdf
[688] Verified Carbon Standard (2011). *VCS Program Guide. Requirements Document*. Version 3, March 2011 [online] available at: http://www.v-c-s.org/sites/v-c-s.org/files/VCS%20Program%20Guide%2C%20v3.0_2.pdf (accessed 12 July 2011).
[689] Discussed within the Ad Hoc Working Group on Further Commitments for Annex I Parties under the Kyoto Protocol (AWG-KP) (http://unfccc.int/resource/docs/2010/awg12/eng/06a02.pdf).
[690] Settelmyer, S. and Eaton, J. (2010). Feasibility Assessment: Program Design for Carbon Based Restoration of UK Peatlands. Unpublished report commissioned from Terracarbon by University of Aberdeen.

It may also be difficult to prove additionality under the VCS, given that peatland restoration is included in agri-environmental schemes and so (it could be argued) would happen in the absence of voluntary carbon markets. On the other hand, given the relatively small pot of money available for this in agri-environmental schemes compared to the area that could be restored, it may be possible to argue that carbon payments would generate additional work that would not otherwise have taken place.

4.6.8.3 A Government-backed Corporate Social Responsibility Scheme

Alternatively, the Government may consider backing a Corporate Social Responsibility scheme to channel private investment into peatland restoration (possibly co-ordinated with existing peatland agri-environment schemes e.g. under UELS and SRDP). Assuming that all peatlands were included in the UK's GHG Inventory, this would have the added advantage of allowing the Government to count carbon emission reductions from peatland restoration towards its targets under national and international law. The main barrier to inclusion in the GHG Inventory is cost-effective verification of changes in peatland carbon stocks. However, new work commissioned by IUCN's UK Peatland Programme is developing a way to use remotely sensed data, assessing peatland vegetation assemblages, as a proxy for changes in carbon stocks. The method has already been used successfully in other European peatlands[691], and is hoped to be ready for use in the UK later in 2011.

Peatland restoration activities would need to meet a range of specific standards under DECC's Greenhouse Gas Reporting Guidelines. These guidelines were introduced in 2009 as a precursor to mandatory carbon reporting which will be required for all UK corporations by 2012. They do not currently allow companies to use peatland restoration to offset their emissions. Standards would ideally need to be set out in a new UK Peatland Carbon Code as part of DECC's Reporting Guidelines. UK companies who have done everything possible to reduce their emissions at source and who want to offset their remaining emissions to become carbon-neutral would then be able to invest in peatland restoration, facilitating private investment in this important work.

Defra has consulted on the potential for including the UK Forest Carbon Code (developed by the Forestry Commission in conjunction with Defra and the Woodlands Trust) in the GHG Accounting Guidelines, and Settelmyer and Eaton (2010)[692] have outlined the technical, legal, financial and organisational design that could form an initial basis for a future UK Peatland Carbon Code, and would be consistent with the demands of the VCS (so leaving the option of voluntary markets open at a later date).

It may be possible to develop standards as part of this Code to avoid the transaction costs associated with analysing peatland restoration projects on a case-by-case basis to determine the emission reductions and carbon mitigation values that can be achieved relative to implementation costs. A financial analysis by Settlemeyer and Eaton (2010)[693] can be used to compare various restoration techniques in both upland and lowland peats. This analysis indicates that, in many circumstances, carbon mitigation values can contribute to a significant portion of implementation costs.

The analysis considers a range of restoration costs (£1-6,000/ha for grip blocking; £2-3,000/ha for gully blocking; £1-900/ha for reseeding or reprofiling; £600-1,400/ha for ceasing grazing;

[691] Couwenberg, J., Thiele, A., Tanneberger, F., Augustin, J., Bärisch, S., Dubovik, D., Liashchynskaya, N., Michaelis, D., Minke, M., Skuratovich, A. and Joosten, H. (in press). Assessing greenhouse gas emissions from peatlands using vegetation as a proxy. *Hydrobiologia*
[692] Settelmyer, S. and Eaton, J. (2010). Feasibility Assessment: Program Design for Carbon Based Restoration of UK Peatlands. Unpublished report commissioned from Terracarbon by University of Aberdeen.
[693] *Ibid*

and £6-16,000/ha for rewetting cultivated peat), carbon sequestration rates (2-4 mt CO_2e/ha/yr for upland blanket and raised bogs; and 15-25 mt CO_2e/ha/yr for lowland fen), carbon prices (£5-10 per tonne), discount rates (2.5-7.5%), crediting period (10-40 years), and includes monitoring and verification costs (£20,000 per year) and development and validation costs (£30,000 up front). Settlemeyer and Eatons' (2010) conclusions are shown in Box 12. Similarly Natural England conducted a Cost-Benefit Analysis of 11 peatland restoration options and concluded that two options (re-wetting cultivated deep peat and re-wetting improved grassland deep peat) yielded a positive per hectare net present value over a forty year time period.[694]

These analyses show how the economic viability of such a scheme may be highly dependent on carbon prices, which are volatile. However a CSR scheme would not have to use carbon prices and may instead choose to seek investment to cover the costs of restoration.

It may be possible to reduce the transaction costs associated with introducing such a scheme by integrating it with existing agri-environment schemes, for example using PES to introduce new options to UELS or to subsidise existing options. This would need careful scrutiny in relation to EU rules about the way money from the Common Agricultural Policy is distributed.

Box 12: Cost-Benefit Analysis of Peatland Restoration for Carbon[695]

Under the most optimistic assumptions, carbon payments have the potential to fully pay for some forms of peatland restoration, and in some cases generate profits. Under the least optimistic assumptions, the contribution that payments for carbon could make to peatland restoration are more modest, but not negligible. Given that it is widely assumed that carbon prices will increase over the long-term, carbon payments may be able to make a more significant contribution to the cost of restoration in future. More specifically, Settelmyer and Eaton (2010) make the following observations with respect to restoration of blanket and raised bogs:

- Grip blocking – Carbon benefits are valued at >20% of the estimated implementation costs *only in the high NPV scenario*; however, using the low end of the range for estimated costs, carbon benefits in the high NPV scenario may actually exceed costs
- Gully blocking - Carbon benefits are valued >20% of the estimated implementation costs *only in the high NPV scenario*; even using the low end of the range for estimated costs, carbon benefits in the high NPV scenario are valued at only 60% of costs
- Reseeding or reprofiling – Carbon benefits are valued >20% of the estimated implementation costs *in the high and central NPV scenarios*, although if these two activities are undertaken together, or in conjunction with grip blocking or gully blocking, then the carbon benefits would likely be valued at less than 20% of the implementation costs
- Stop-grazing - Carbon benefits are valued >20% of the estimated implementation costs *in the high and central NPV scenarios*; however, carbon benefits are valued at significantly less than 20% of estimated implementation costs in the low NPV scenario (where gross emission reduction estimates are closest to those that would be expected for stop grazing)

The following observations can be made with respect to restoration of lowland fens:

Rewetting lowland cultivated and grasslands - Carbon benefits are valued >20% of the estimated implementation costs *only in the high NPV scenario*; however, these benefits may

[694] Natural England (n.d.) A Cost-Benefit Analysis of Peatland Restoration Options.
[695] Settelmyer, S. and Eaton, J. (2010). Feasibility Assessment: Program Design for Carbon Based Restoration of UK Peatlands. Unpublished report commissioned from Terracarbon by University of Aberdeen.

be less than 20% of estimated costs if actual opportunity cost are higher than the assumed £400/ha/yr.

4.6.9 Opportunities for PES from MMH

Despite their scarcity in England (5% cover), MMH make a major contribution to certain ecosystem services, notably the provision of drinking water, climate regulation through carbon storage in peat soils, and a range of cultural services including recreation and internationally important species and habitats. There may be scope to expand the range of services currently supported by the Uplands Entry Level Scheme and increase engagement with the private sector in payments for ecosystem services from MMH.

In particular, there may be potential to package payments for clean water, carbon sequestration and biodiversity together in schemes designed to restore degraded peatlands (similar in some respect to the Costa Rican 'bundling' model discussed in Box 8). Market research suggests that there is substantial interest among UK-based companies in making payments for carbon sequestration that have associated co-benefits. Interest in PES for water quality varies geographically within the water industry, depending on the proportion of peat soils in company catchments (and hence the cost of removing Dissolved Organic Carbon) and attitudes towards whether liability for non-compliance with the Water Framework Directive is likely to lie primarily with water companies or land managers (where these differ).

A growing number of 'visitor payback' schemes (such as those described in Section 4.6.3.4) are attempting to monetise cultural ecosystem services. Currently these are all local schemes, and there is interest from the English National Parks Association in developing a pilot national scheme across the National Parks network. A number of spatial planning approaches could also be managed to facilitate payments from developers to finance habitat creation, restoration and management e.g. habitat banking, biodiversity offsetting, Section 106 Agreements and the Community Infrastructure Levy.

There is a range of potential buyers, sellers and intermediaries who have expressed an interest in facilitating PES in MMH habitats. Many of the sellers are primarily interested in covering the costs of peatland restoration, and hence prices will depend on restoration costs, which in turn often reflect the accessibility of locations to be restored. Market research suggests potential buyers are more interested in well regulated, UK-based PES with multiple co-benefits that can be used for Corporate Social Responsibility purposes, than they are in purchasing tradable carbon, water or biodiversity credits. However, there are a number of legislative and regulatory hurdles that need to be overcome before this can be realised.

If it were possible to include all degraded peatlands in DECC's Greenhouse Gas Inventory (which may shortly be facilitated by the development of remotely sensed vegetation proxies that can rapidly and cost-effectively determine changes in peat carbon stocks back to 1990), then any net carbon gains resulting from PES schemes could count towards the Government's targets under international and domestic climate change policies. As interest in PES associated with peatland restoration grows amongst potential buyers and sellers, there is an increasingly urgent need to regulate these transactions. Given ongoing controversy over carbon markets, there is likely to be considerable scrutiny of any such transactions. If not effectively regulated, early adopters could bring this sort of PES into disrepute. Given the motives of most potential buyers (focusing on Corporate Social Responsibility), this could significantly suppress any future PES market in MMH. For this reason, it may be necessary to consider the development of a 'peatland carbon code' as part of DECC's Greenhouse Accounting Guidelines. Such a code could ensure companies wishing to engage in PES have done everything possible to reduce GHG emissions at source before opting for carbon offsets to become carbon neutral,

while ensuring restoration is done in a way that ensures climate benefits. This could also provide potential buyers with the level of transparent and independent verification they need to make peatland restoration a viable CSR investment.

In conclusion, there are currently opportunities for some water companies to make payments for water quality regulation services through the management of MMH, and it may soon be possible to overcome barriers to payments for carbon sequestration and storage in MMH. Markets for cultural ecosystems are at a relatively early stage of development, and there are no foreseeable markets for wildfire regulation. However, by packaging these other co-benefits with carbon and/or water, it may be possible to increase the attractiveness of payments for carbon and water, and so indirectly obtain payments for these other ecosystem services.

4.7 Coastal Margins

4.7.1 Description

The English coastline is about 8,982km long, or 10,077km taking into account the Isle of Wight, Lundy and the Scilly Isles.[696] The English coastline encompasses a diverse number of habitats, including sand dunes, saltmarsh, shingle, sea cliffs and coastal lagoons. Coastal areas in the UK are the focus of important economic, environmental and social activities. They directly provide ecosystem services to the terrestrial and the marine habitats on either side and to a broad cross-section of the UK population willing to travel to experience the coast.

Coastal Margin habitats are naturally dynamic and have responded to climate change and long-term geomorphological trends as the coast has adjusted to the higher sea levels of the Holocene Period. Human influences, such as land-claim, harbour construction and the expansion of coastal towns, have also been shaping the coast for the last 2,000 years. Since the 1960s, protective legislation has reduced many of the direct human pressures on Coastal Margin habitats. However, important drivers of change remain, and some, such as climate change and sea-level rise, are expected to intensify significantly during the coming decades.

Climate change is expected to have several significant impacts on coastal margin habitats including a rise in sea level, shifts in the distributions of coastal species, changes in erosion rates and the quantity and frequency of exchanges between habitats.[697] Sea-level rise alone threatens to flood low-lying land, accelerate coastal erosion, and encourage saltwater intrusion into freshwater aquifers.[698] Of the 4,500 km of coast in England, approximately 1,800 km is at risk of coastal erosion (approximately 340 km of which is defended). It is estimated that approximately 200 properties are currently vulnerable to coastal erosion but by 2029, up to 2,000 residential properties, and 15 km of major road and railway may become vulnerable.[699]

Coastal margin habitats have already declined in extent by about 10% since World War II due to development and coastal squeeze[700] but there are ongoing efforts to reclaim intertidal habitats through a series of managed realignment schemes (see Box 13)[701].

[696] Darkes (2008). *The British Cartographic Society: How long is the UK coastline?* [online] available at: http://www.cartography.org.uk/default.asp?contentID=749 (accessed 13 December 2010).
[697] UK National Ecosystem Assessment (2011) *The UK National Ecosystem Assessment: Technical Report (Chapter 11: Coastal Margins)*. UNEP-WCMC, Cambridge [online] available at: http://uknea.unep-wcmc.org/Resources/tabid/82/Default.aspx (accessed 6 July 2011).
[698] UKCIP. Coastal issues [online] available at: http://www.ukcip.org.uk/index.php?option=com_content&task=view&id=409 (accessed 13 December 2010).
[699] Halcrow Group Ltd (2009). Receptors vulnerable to coastal erosion. Report for the Environment Agency.
[700] Coastal squeeze is the reduction of the area of land near a coast or the loss of its former use because of its position between rising sea levels and fixed sea defences or high ground.
[701] See also http://www.abpmer.net/omreg/default.aspx.

4.7.2 Ecosystem Services from Coastal Margins

The key ecosystem services generated by coastal margin habitats in England, as identified by the NEA, are outlined in the table below, together with an indication of the relative importance of coastal margin habitats in delivering each of the listed ecosystem services.

Table 31: Main ecosystem services from coastal margins[702]

Provisioning		Cultural		Regulating	
Crops	L	Local places	H	Climate	M-H
Livestock / Aquaculture	M-L	Landscapes / seascapes	H	Hazard	H
Fish	M-H			Disease and pests	L
Trees, standing vegetation, peat	M-L			Pollination	M-L
Water supply	L			Noise	M-H
Wild species diversity	H	Wild species diversity	H	Water quality	H
				Soil quality	M-L
				Air quality	L
Key					
High	H	Blank cells represent services that are not applicable to the Broad Habitat			
Medium – High	M-H				
Medium – Low	M–L				
Low	L				

According to the NEA, **coastal defence** is the most important regulating service provided by Coastal Margins. All habitats contribute to coastal defence either directly by dissipating or attenuating wave energy or indirectly through regulating sediment. It is estimated that the soft coasts provide an estimated £3.1–£33.2 billion worth of capital cost savings and annual maintenance cost savings of around £0.3 billion for sea defence in England alone.[703]

Coastlines support a highly varied set of habitats including internationally significant wetlands and sites for major bird populations, and 10% of notified nature reserves are located near the coast.[704] The wide range of rare species and **biodiverse** nature of coastal margins supports a number of other ecosystems services, including related to cultural benefits. Provisioning benefits related to species diversity and richness include **fisheries** (there are around 280 ports,

[702] UK National Ecosystem Assessment (2011) *The UK National Ecosystem Assessment: Synthesis of the Key Findings*. UNEP-WCMC, Cambridge [online] available at: http://uknea.unep-wcmc.org/Resources/tabid/82/Default.aspx (accessed 6 July 2011).
[703] [703] UK National Ecosystem Assessment (2011) *The UK National Ecosystem Assessment: Technical Report (Chapter 11: Coastal Margins)*. UNEP-WCMC, Cambridge [online] available at: http://uknea.unep-wcmc.org/Resources/tabid/82/Default.aspx (accessed 6 July 2011).
[704] UKCIP. Coastal issues [online] available at: http://www.ukcip.org.uk/index.php?option=com_content&task=view&id=409 (accessed 13 December 2010).

harbours and creeks around the UK where fish is landed[705]), possible **medicines**, **ornamental** goods; and regulating services such as **pollination** and **disease and pest control**.

Coastal margins also support a diverse range of cultural services including **living space** for coastal communities, for **social cohesion and identity** (e.g. fishing communities), for **rest and relaxation**, and **recreation** and **tourism** activities including sunbathing, walking, birdwatching, boating, swimming and outdoor sports, in addition to enjoyment for characteristic wildlife and scenery.[706] Leisure activities generate large revenues associated with hotels, pubs and restaurants, located on the shoreline or close by. There are a number of **cultural heritage** activities on coastal sites that are managed by large organisations such as the National Trust. For example, it has been estimated that the South West Coast Path brings over £300m per year spending into the regional economy[707].

The results of a 2005 Leisure Visits Survey[708] showed that 37% of the adult population (14.8 million people) visited the English coast in 2005 (a total of 70 million visits), and 62% (47 million people) visited a seaside town or city (a total of 174 million visits). The survey placed a value of leisure visits to the coast and seaside towns and cities as £1.4bn and £4.7bn, respectively. According to Defra, the single most popular activity along the coast for recreation is walking, although there are issues of inaccessibility facing parts of the coastline.[709]

4.7.3 Scope for PES from Coastal Margin Habitats

Coastal margin habitats clearly provide a number of important ecosystem services. Many of these are threatened by 'coastal squeeze' and development within the coastal zone, while flooding and coastal erosion present a major risk to homes and businesses located along the coast. There are a number of policies to address these issues including:

- Shoreline Management Plans (SMPs). The emphasis of SMPs is on reducing the risk of flood and coastal erosion through an integrated portfolio of measures which work more closely with natural processes and include a move from hard defences to soft protection, beach nourishment and managed realignment.
- Conservation Policy which affects the degree of statutory protection for coastal sites, how that protection is enforced and, at a local scale, how individual sites are managed. The statutory protection of sites of biological, geological or other interest has been found to be a major factor in slowing land-claim or agricultural intensification of Coastal Margin habitats.[710]
- Coastal and marine access. The Marine and Coastal Access Act 2009 creates a new legal right of access to all the coast of England. This will provide a linear route along the coast, with access from this route to the water or cliff edge allowing people direct access to many coastal habitats that were previously out of bounds. The Act also created the Marine Management Organisation (MMO) with responsibility for preparing marine plans on behalf of the marine planning authorities in UK territorial waters, and be the regulator of most activities in the marine environment including those of relevance to coastal margins such as coastal dredging, aggregate extraction and the laying of submarine cables.

[705] Seafish (n.d.) Seafood facts [online] available at:: http://www.seafish.org/plate/facts.asp (accessed 13 December 2010).
[706] UK National Ecosystem Assessment (2011*) The UK National Ecosystem Assessment: Synthesis of the Key Findings*. UNEP-WCMC, Cambridge [online] available at: http://uknea.unep-wcmc.org/Resources/tabid/82/Default.aspx (accessed 6 July 2011).
[707] Defra (n.d.). Accessing the English Coast – FAQ [online] available at: http://www.defra.gov.uk/rural/countryside/coastfaq.htm#q22 (accessed 13 December 2010).
[708] Natural England (2006). *England Leisure Visits: report of the 2005 survey* [online] available at: http://naturalengland.etraderstores.com/NaturalEnglandShop/NE13 (accessed 29 March 2011).
[709] Defra (n.d.) Accessing the English Coast – FAQ [online] available at: http://www.defra.gov.uk/rural/countryside/coastfaq.htm#q22 (accessed 13 December 2010).
[710] Everard, M., Jones, M.L.M. and Watts, B. (2010). Have we neglected the societal importance of sand dunes? An ecosystem services perspective. *Aquatic Conservation: Marine and Freshwater Ecosystems*, 20: 476–487.

4.7.3.1 Managing flood and coastal erosion risk

In May 2011, the Environment Agency submitted its national flood and coastal erosion risk management strategy for England to Parliament. The strategy builds on existing approaches to flood and coastal risk management and promotes the use of a wide range of measures to manage risk, highlighting the need for risk to be managed in a co-ordinated way within catchments and along the coast and balance the needs of communities, the economy and the environment.[711] One of the key guiding principles of the strategy is the implementation of a coastal 'cell'-based approach that recognises the impacts of local actions to manage coastal risk on other parts of the coast. More specifically;

"Activities must seek to avoid passing risk on to others within the catchment or along the coast without prior agreement. This agreement ***could, potentially, include the provision of funding by upstream communities for actions and measures carried out by others to manage downstream risks****. The catchment or coastal cell approach is also key to managing risks at source and achieving wider benefits through more integrated water management and increasing the opportunity for developing new sources of funding as well as pooling resources and expertise"*[712].

Moreover, the strategy encourages beneficiaries to invest in risk management as a way of ensuring that local (or private) benefits can be delivered, particularly in cases where public funding of localised activities would not represent good value-for-money to the taxpayer at large. In his review of the summer 2007 flooding, Sir Michael Pitt suggested that better aligning beneficiaries with those that pay would create a more efficient and responsive system. To do this he recommended that 'Government should develop a scheme that allows and encourages local communities to invest in flood risk management measures'. He also said that developers, in potentially increasing local flood risk, should 'make a full contribution towards both the costs of building and maintaining the necessary defences.' In taking this recommendation forward, the Government has made clear that "we cannot continue all of the work that the Environment Agency has historically done at the taxpayer's expense. Government investment in flood and coastal erosion risk management is significant, but we need to ensure that we get best value for money".[713]

Historically, the response to flooding and erosion has been sea defence and coastal protection respectively. While these measures deal with the immediate and local problem, they often have adverse consequences down-drift, and into the future, as they may export problems of erosion and hence degrade natural defences. They may also reduce the natural capacity of the coast to respond to changing conditions.

Managed realignment is becoming a key tool in coastal management, providing sustainable flood risk management, potential long-term economic benefits and possible climate change mitigation (see Box 13). This process can be used to protect areas of land further inland rather than that near the coast by relying on natural defences to absorb or dampen the force of

[711] Environment Agency (2011). *Understanding the risks, empowering communities, building resilience. The national flood and coastal erosion risk strategy for England and Wales*. Presented to Parliament pursuant to Section 7 of the Flood and Water Management Act 2010 [online] available at: http://www.official-documents.gov.uk/document/other/9780108510366/9780108510366.pdf (accessed 2 June 2011).
[712] Environment Agency (2011) *Understanding the risks, empowering communities, building resilience. The national flood and coastal erosion risk strategy for England and Wales*. Presented to Parliament pursuant to Section 7 of the Flood and Water Management Act 2010 [online] available at: http://www.official-documents.gov.uk/document/other/9780108510366/9780108510366.pdf (accessed 2 June 2011), p15.
[713] Cited in Environment Agency (2011) *Understanding the risks, empowering communities, building resilience. The national flood and coastal erosion risk strategy for England and Wales*. Presented to Parliament pursuant to Section 7 of the Flood and Water Management Act 2010 [online] available at: http://www.official-documents.gov.uk/document/other/9780108510366/9780108510366.pdf (accessed 2 June 2011).

waves.[714] It also enables the creation of new wildlife habitats and provides valuable fish nurseries.

Managed retreat essentially allows an area that was not previously exposed to flooding by the sea to become flooded by removing coastal protection. This process is usually in low lying estuarine areas and typically involves flooding of land that has at some point in the past been claimed from the sea and has been entered into productive use (e.g. for agriculture).

Arrangements to buy land for intertidal habitat creation have proved popular in some locations, but in others, property owners have not wanted to relocate and have considered that such disturbance to their existing way of life should be compensated over and above market value. The Environment Agency, via Defra, provides most of the funding for land purchase, providing the managed realignment fulfils certain conditions. There would be no funding, for example, if compensatory habitat is required due to changes caused by private development. Where there is a legal obligation to create compensatory habitat, it is expected that the developer will fund the associated costs, whether this is a flood defence operating authority supported by Defra funding or a private company reliant on its own resources. Saltmarsh creation may also be eligible for payments under English agri-environmental schemes or European Union LIFE funding, but again not where the purpose of defence realignment is to deliver statutory compensatory habitat.

Sand Dunes and Shingle also provide direct protection, often replacing the need for artificial sea defence structures providing the dune or shingle system is wide enough, or the primary dune ridge is large enough. Sand and shingle beaches are dissipaters of energy, absorbing, rather than reflecting, wave attack. Shingle provides important natural defence structures, such as those at Chesil Beach, Hurst Spit and Pevensey in England.[715] Several local authorities (e.g. Sefton, Blackpool and Fylde) have been investing in the restoration/reinforcement and management of sand dunes as an effective way or reducing vulnerability to storm surges and coastal flooding.

4.7.3.2 Tourism and leisure

The English coastline has significant tourism value, underpinning a number of jobs in leisure and hospitality, and local sense of identity. As a result, there is a reliance on the maintenance on the coastline, coupled with an increasing interest in sustainable tourism. The coast is also an outlet for rivers in to the sea and for treated wastewater from water companies; meaning that the quality of services is linked to upstream activities by land mangers (e.g. farmers and water companies) in other broad habitats by land managers. Poor water quality can result in degradation to the coastline, with consequences such as the loss of a coveted 'blue flag' status and impacts on health and wellbeing, and the tourism economy. As a result, there is a vested interest for local authorities, tourism operators and hoteliers, to work with upstream land managers; and thus potential for PES.

Cultural heritage-related activities on coastal sites that are managed by large organisations such as the National Trust can provide significant in-kind financial support to activities in support of achieving Marine Protected Area (MPA) objectives. Furthermore, leisure activities least directly related to MPA objectives and functions potentially generate the largest revenues – for example, hotels, pubs and restaurants located on the shoreline or close by. In some parts

[714] Luisetti, T., Turner, R. K., Bateman I. J., *et al*. (2011) Coastal and marine ecosystem services valuation for policy and management: Managed realignment case studies in England. *Ocean & Coastal Management*. 54: 212-224 [online] available at: http://ec.europa.eu/environment/integration/research/newsalert/pdf/235na2.pdf (accessed 6 July 2011).
[715] [715] UK National Ecosystem Assessment (2011) *The UK National Ecosystem Assessment: Technical Report (Chapter 11: Coastal Margins)*. UNEP-WCMC, Cambridge [online] available at: http://uknea.unep-wcmc.org/Resources/tabid/82/Default.aspx (accessed 6 July 2011).

of the world, these services have been targeted to raise revenues, such as levies on overnight stays. This is partly because the MPA supports the landscape that attracts customers, underpinning a willingness to contribute to it – though this may also be supported by other conservation priorities in the area, such as Areas of Outstanding Natural Beauty (AONB) – and partly because of scale of revenue involved, making collecting it worthwhile.

In many cases, coastal and marine ecosystems provide valuable on-site benefits in addition to whatever off-site benefits they might generate. In such cases, the most practical solution is to seek to generate revenues from those on-site benefits through mandatory direct user fees rather than through voluntary PES. On-site benefits are generally much easier to charge for, because direct access to the site is necessary to enjoy on-site benefits. However, this is only viable where access can be controlled.

4.7.4 Ecosystem Service Sellers

Actual and potential providers and sellers of ecosystem services from English coastal margin habitats are shown in the table below.

Table 32: Ecosystem service providers from coastal margins

Ecosystem Service	Sellers
Fisheries, wild species diversity, environmental settings (local places and landscapes/seascapes)	**Government** and its associated agencies (i.e. Natural England) for Marine Protected Areas),
Crops, trees for timber and woodfuel, hazard regulation (flood and water control), water quality, climate regulation (carbon sequestration from mangroves), environmental settings (local places and landscapes/seascapes)	**Private landowners and tenant land managers**, specifically lowland farmers and landowners with land in intertidal zones to be set back as part of managed realignment schemes

4.7.5 Ecosystem Service Beneficiaries

Actual and potential beneficiaries of ecosystem services from English coastal margin habitats are shown in the table below.

Table 33: Ecosystem service beneficiaries from coastal margins

Ecosystem Service	Beneficiaries
Hazard regulation (coastal defence)	**Local Authorities** and taxpayers (reduced costs associated with maintenance and repair of sea defences);
Fisheries, standing vegetation, wild species diversity, water quality, hazard regulation (water, flood and soil protection)	**Private business**, e.g. water companies (through reduced effluent treatment costs), producers of natural products, commercial fisheries
Climate regulation	The global population
Water quality, soil quality, hazard regulation (coastal defence)	**Local residents and businesses**, who benefit from coastal protection and enjoyment of living in a coastal location. Port owners and power station owners may benefit from reduced sedimentation.

Ecosystem Service	Beneficiaries
Environmental settings (local places and landscapes/seascapes for recreation, heritage, artistic inspiration, education, etc), wild species diversity	**Visitors**, including tourists (and tourism-based businesses), recreationalists, sporting clubs, special interest groups (e.g. birdwatchers)
Fisheries, crops and standing vegetation (including natural products)	**Consumers** of fish and natural products

The beneficiaries of ecosystem services provided by coastal margin habitats are primarily tourists (and tourism-based businesses), recreationalists, and fishers.

4.7.6 Ecosystem Service Buyers and Intermediaries

Actual and potential buyers and intermediaries of ecosystem services from English coastal margin habitats are shown in the table below.

Table 34: Ecosystem service buyers and intermediaries from coastal margins

Ecosystem Service	Buyers and Intermediaries
Fisheries and wild species diversity Hazard regulation (coastal defence)	**Government** and associated agencies (on behalf of the public), for example: • The Joint Nature Conservation Committee (JNCC) (on behalf of the public); • Local Authorities (on behalf of the public). Local Authorities may, for example, compensate riparian or coastal landowners for land acquired for the construction or maintenance of defences, or for damage arising expressly from such operations. Also, in some circumstances where land seaward of justifiable new defences can be shown to contribute to effective defence, whether locally or remotely, landowners may be eligible for payment for depreciation or loss of land. Finally, if a defence is realigned landward, land currently in agricultural use may be considered for payments under agri-environment schemes if a long-term return to inter-tidal habitat fulfils the relevant objectives. [716]
Fisheries, water and soil quality, hazard regulation (coastal defence)	**Private business**, e.g. water companies, commercial fishers and fishing organisations (on behalf of consumers), insurers (on behalf of policy holders), port owners
Wild species diversity	**Conservation organizations/groups** (e.g. RSPB) for improvements in habitat for biodiversity, especially birds and coastal fisheries Special interest groups (e.g. birdwatchers)
Environmental settings (local places and landscapes/seascapes for recreation, heritage, artistic inspiration, education, etc)	**Visitors**, e.g. tourists, or tourist associations on behalf of tourists

[716] 1998 Agriculture Select Committee report 0-10-5548073.

4.7.7 Case Studies

Few documented genuine PES case studies in coastal habitats were identified. Defra and Natural England have jointly promoted a number of managed realignment projects in England that make use of an ecosystem approach (see Box 13) and illustrate the potential for PES, while several coastal local authorities are investing in management of sand dunes as a coastal defence strategy. These have demonstrated the value (albeit sometimes uncertain) of the range of ecosystem services that managed realignment can deliver (including protection from floods and storm surges, prevention of saline intrusion, provision of grazing marsh), yet relatively few have gone beyond valuation to elicit payment from service beneficiaries. Typically, private landowners are eligible for compensation where land is acquired (for the purpose of constructing or maintaining coastal defences) through Compulsory Purchase Order, or where damage is incurred as a result of construction or maintenance activities. Farmers may also seek compensation through agri-environment schemes where productive land is foregone as a result of managed realignment.

Box 13: Enhancement of ecosystem services in coastal margins

Humber Estuary Mudflats

Associated British Ports (ABP) - the UK's largest ports owner and operation - has agreed to work with the RSPB, the Environment Agency and the Yorkshire and Lincolnshire Wildlife Trusts to compensate for the loss of 31 ha of mudflats arising from two projects including the building of Immingham Outer Harbour at its Port of Immingham on the Humber Estuary. The mudflats provide a vital habitat for around 160,000 birds that use the Humber Estuary on their migrations and contribute to the Environment Agency's long-term plans for flood defence on the estuary. The project is worth £3.5 million.

Source:.*http://www.rspb.org.uk/news/265683-abp-and-rspb-work-together-for-a-prosperous-future-on-the-humber*

Alkborough Flats Managed Realignment Scheme

Since 2000, the RSPB has been championing the need to create new intertidal habitat around the Humber Estuary, to offset habitat loss from coastal squeeze through future climate change and flood protection schemes. Managed realignment - an actively controlled process including defence retreat to higher ground, moving defences inland, widening flood plains or other types of shortening or lowering defences – creates space for new intertidal habitats, including tidal mud flats and saltmarshes that provide a number of ecosystem services including coastal protection and flood defence. These areas provide productive habitats for plants, invertebrates and molluscs, and they are also important fish nursery areas[717] and feeding, breeding and roosting areas for birds.

The Alkborough Flats site, located on the south bank of the inner Humber Estuary at the confluence of the River Ouse and the River Trent, is the location of a coastal setback scheme in the Humber Estuary. It is one of the largest managed retreat sites and also one of the largest flood storage schemes in Europe. The scheme was designed to designed to deliver flood risk management and biodiversity benefits as well as social and economic benefits to the local community while maintaining the viability of local farms affected by the change of land use and the navigability of the Humber Estuary. It constitutes part of a wider Humber Estuary Strategy that aims to protect the homes and businesses of over 400,000 people. Allowing the

[717] Colclough, S., Fonseca, L., Watts, W. and Dixon, M. (undated) High Tidal Flats, Saltmarshes and Managed Realignments as Habitats for Fish.

Alkborough Flats to flood helps to safeguard land throughout the Humber Trade Zone (HTZ) by reducing high water levels elsewhere within the Humber Estuary and its tidal tributaries. At the same time, the Alkborough Flats scheme has direct longer-term wildlife conservation benefits through 440 hectares of re-created habitat, but also indirectly as it allows the wider estuary to change and adapt to sea level rise.

The scheme is a partnership between the Environment Agency, Natural England, Associated British Ports (ABP) and North Lincolnshire Council. Under the scheme, ABP has purchased a small area of the Alkborough Flats site. The Environment Agency and Natural England have jointly purchased the remaining area of the 400ha site, with the total land area controlled through a management group.

An evaluation of the impact of the Scheme has shown a net positive impact on ecosystem services. The loss of area suitable for food production was more than offset by the gains to fibre and fuel production, regulating and cultural services.

Sources:
http://www.rspb.org.uk/ourwork/conservation/sites/england/alkborough.aspx

Everard, M. (2009). Ecosystem services case studies. Environment Agency: Bristol [online] available at: http://publications.environment-agency.gov.uk/pdf/SCHO0409BPVM-E-E.pdf (accessed 17 July 2011).

4.7.8 Barriers to PES in Coastal Margin Habitats

To date, there are very few (if any) examples of genuine PES schemes in coastal margin habitats. This is possibly, at least partly, attributable to the open access nature of many coastal resources. Ecosystem degradation in coastal and marine habitats is not so much a problem of externalities as of open access.

Coastal ecosystems are highly complex and exist at the interface of terrestrial and marine systems and thus often suffer from the classic 'tragedy of the commons' dilemma. Like marine habitats, they are generally less well understood, undervalued, and largely at risk from coastal development and the indirect impacts that arise from land use in connected watersheds. Lack of clear ownership and blurred jurisdictions of management authorities have restrained the sorts of market solutions that have been successfully applied in terrestrial conservation.

4.7.9 Opportunities for PES in Coastal Margin Habitats

Payment for ecosystem services (PES) systems (together with market offsets) have the potential to achieve better and more cost-effective conservation outcomes than result from projects which seek to isolate and protect coastal areas from human encroachment. Given the lack of available evidence around the practicability and effectiveness of PES in coastal habitats, it is difficult to identify specific PES opportunities in England. Nevertheless, the scope for PES is significant:

- Commercial interests, such as private landowners, port operators, power station owners, the tourism sector, and the insurance industry, all have much to gain by investing in and protecting coastal habitats to reduce their exposure to flood and coastal erosion risk;
- There is potential to target private sector (commercial fishery) as well as government (specifically EU MARE) investment in the protection of fish nursery habitat, as well as to consider this service in mitigation measures requires from developers in the coastal zone;

- Commercial shipping and port owners may benefit from actions to manage coastal erosion and reduce siltation of ports and channels; and
- The tourism sector and special interest groups (e.g. birdwatchers, etc) may be willing to pay (e.g. through visitor payback schemes) for management activities (e.g. wetland creation through managed realignment) that enhance the attractiveness of coastal areas.

The Marine Initiative of the Natural Capital Project has developed an ecosystem service model (Marine inVEST) that can be applied to assess the value and trade-offs of ecosystem services in marine and coastal habitats.[718] The model can be used to identify the providers and beneficiaries of ecosystem services and the impacts of resource management decisions on the environment, the economy and human well-being. The tool may also be applied to support the design and implementation of PES schemes by identifying how payments may be used to achieve multiple goals, how payments may be distributed and how the efficiency of investments may be improved.

4.8 Marine

4.8.1 Introduction

The UK NEA report highlights the wide range of services provided by **marine** ecosystems, including: food (fish, shellfish, and aquaculture); avoidance of climate stress (carbon and other biogas regulation); energy (wave, tidal, biofuels); genetic resources (e.g. for aquaculture); industrial inputs (biocatalysts and natural medicines); fertiliser (seaweed); coastal protection including erosion and flood control; waste breakdown and detoxification leading to pollution control, waste removal and waste degradation; disease and pest control; tourism, leisure and recreation opportunities; a focus for engagement with the natural environment; physical and mental health benefits; cultural heritage; and learning experiences.[719]

Climate change and increasing activity in several economic sectors in the Marine environment is putting significant pressure on all sea shelf, coastal and estuarine habitats.[720] These sectors include marine renewable energy development, expansion in recreation and leisure activities, and port activities. Their impacts vary in spatial extent and importance, but are compounded by climate change. Human contamination of marine waters with a range of hazardous substances has been reduced through reductions in industrial effluent and improvements in sewage treatment infrastructure; however, there are now concerns about more recently introduced chemicals, such as nanoparticles and pharmaceuticals, which pass through sewage treatment plants. Furthermore, the sustainability of food provision from Marine Habitats is threatened by overexploitation of fisheries; and fishing is also damaging other Marine ecosystem services.

Currently protection of the marine environment falls short of that on land. For example, only two Special Protection Areas designated under the Birds Directive (1979) are entirely marine (the Outer Thames Estuary and Liverpool Bay). Although there are a small number of ASSIs/SSSIs below the low water mark, for example The Wash and Morecombe Bay, many coastal ASSIs/SSSIs do not offer protection to subtidal marine life[721] (JNCC 2010a). The sea around Lundy Island was designated as England's first, and currently only, Marine Conservation Zone in January 2010, which includes a no‐take zone of 3.3 km2 in which all fishing is prohibited.

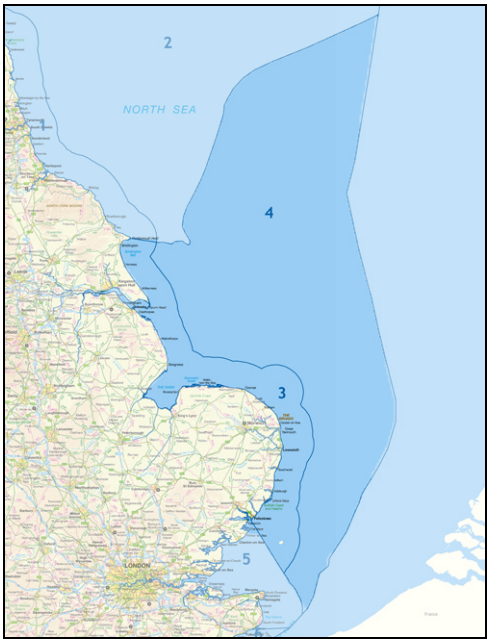
[718] See http://www.naturalcapitalproject.org/InVEST.html.
[719] UK National Ecosystem Assessment (2011). *The UK National Ecosystem Assessment: Technical Report (Chapter 12: Marine)*. UNEP-WCMC, Cambridge [online] available at: http://uknea.unep-wcmc.org/Resources/tabid/82/Default.aspx (accessed 6 July 2011).
[720] *Ibid.*
[721] JNCC (2010). *Different Types of Marine Protected Areas*. [online] available at: http://www.jncc.gov.uk/PDF/MPAsInfoDoc_v2_1.pdf (accessed 18 July 2011).

The Government is currently developing a system of marine planning as provided for in the Marine and Coastal Access Act (2009). The marine planning system involves, firstly, the development of a Marine Policy Statement (MPS) and, secondly, the production of Marine Plans. The MPS will provide the framework for preparing Marine Plans and taking decisions that affect the marine environment.[722] The Government published a draft MPS for consultation in July 2010 which emphasised that marine planning will, amongst other things, manage competing demands on the marine area, taking an ecosystem-based approach, and integrate with terrestrial planning.[723] The draft MPS emphasises that Marine Plans will provide detailed policy and spatial guidance for an area and help ensure that decisions within a plan area contribute to the delivery of UK, national and any area specific policy objectives.[724] The Marine Management Organisation (MMO) is authorised to carry out planning functions for English waters (having been delegated most of the Secretary of State's functions as marine plan authority[725]) and has embarked on preparing the first two Marine Plans, for the East Inshore and East Offshore areas - see Figure 10.

Similar to terrestrial planning, all public authorities taking authorisation or enforcement decisions that affect or might affect the UK marine area must do so in accordance with marine policy documents (the MPS and Marine Plans) unless relevant considerations indicate otherwise.[726] In terms of integration with terrestrial planning, Defra emphasise that the MMO should take all reasonable steps to ensure that Marine Plans for the English inshore region are compatible with relevant development plans, including the Wales Spatial Plan.[727] Like territorial development plans, emerging Marine Plans should also undergo Strategic Environmental Assessment (SEA) under EU legislation and this assessment can form part of a wider Sustainability Appraisal (SA) (a statutory requirement under the Marine and Coastal Access Act 2009).[728]

[722] HM Government in association with Northern Ireland Executive, the Scottish Government and the Welsh Assembly Government (2010). *Pre-Consultation on the Draft UK Marine Policy Statement: A paper for discussion* [online] available at: http://www.defra.gov.uk/environment/marine/documents/legislation/mps-discussion.pdf (accessed 28 February 2011).
[723] HM Government (2010). *UK Marine Policy Statement: A draft for consultation* [online] available at: http://www.defra.gov.uk/corporate/consult/marine-policy/100721-marine-policy-statement.pdf (accessed 28 February 2011).
[724] *Ibid*
[725] Defra (2010). *Consultation on a marine planning system for England* [online] available at: http://www.defra.gov.uk/corporate/consult/marine-planning/100721-marine-planning-condoc.pdf (accessed 28 February 2011).
[726] *Ibid*
[727] *Ibid*
[728] *Ibid*

Figure 10: The East Inshore and East Offshore Marine Plan Areas



Marine Plans should contribute to meeting the UK's obligations under the Marine Strategy Framework Directive[729] which entered into force in July 2008 and aims to achieve Good Environmental Status in Europe's seas by 2020. Its key requirements include: an assessment of the current state of UK seas by July 2012; a detailed description of what Good Environmental Status means for UK waters, and associated targets and indicators by July 2012; establishment of a monitoring programme to measure progress toward Good Environmental Status by July 2014; and establishment of a programme of measures for achieving Good Environmental Status by 2016.[730] Marine Plans will also need to take account of the network of Marine Protected Area (MPAs), established primarily to help conserve marine biodiversity.[731] The Government aims to have an ecologically coherent network of MPAs substantially in place by the end of 2012.[732] The main types of MPA in the UK are Special Areas of Conservation (SACs) under the Habitats Directive, Special Protection Areas (SPAs) under the Birds Directive, and Marine Conservation Zones (MCZs) for nationally important habitats and species.[733] Over 24% of English inshore waters are now under European protection.[734] Meanwhile, Lundy Island, a former Marine Nature Reserve, became the first MCZ in January 2010. Natural England and the Joint Nature Conservation Committee (JNCC) have established four regional projects covering the South West, Irish Sea, North Sea and Eastern Channel to deliver recommendations on potential MCZ sites.[735]

[729] Defra (2010). *Consultation on a marine planning system for England* [online] available at: http://www.defra.gov.uk/corporate/consult/marine-planning/100721-marine-planning-condoc.pdf (accessed 28 February 2011).
[730] See Defra's web page on the Marine Strategy Framework Directive at: http://ww2.defra.gov.uk/environment/marine/msfd/ (accessed 28 February 2011).
[731] See Defra's web pages on Marine Protected Areas at: http://ww2.defra.gov.uk/environment/marine/protect/mpa/ (accessed 28 February 2011).
[732] *Ibid*
[733] *Ibid*
[734] *Ibid*
[735] See Natural England's web pages on Marine Conservation Zones at: http://www.naturalengland.org.uk/ourwork/marine/protectandmanage/mpa/mcz/default.aspx (accessed 28 February 2011).

In terms of ownership, the Crown Estate owns extensive marine assets throughout the UK. The Marine Estate – of the four estates managed by the Crown Estate – includes virtually the entire UK seabed out to the 12 nautical mile territorial limit, as well as the rights vested in the Crown to explore and utilise the natural resources of the UK Continental Shelf which extends to 200 miles from the coast, including rights in respect of renewable energy generation and the right to lease undersea storage of gas and carbon dioxide.[736] Following an earlier scoping study[737], the Crown Estate has commenced an ecosystem valuation study of the Marine Estate and the activities that occur within it.[738]

The UK claims jurisdiction over the continental shelf, an exclusive fishing zone of 200 nautical miles, and 'territorial sea' of 12 nautical miles. Wild fish capture for food generates employment both for fishermen and in secondary services associated with fishing. The fishing industry is dependent upon boat builders and repairers, gear merchants, and suppliers of boxes and ice, amongst other items. At the same time, the industry supplies numerous fish processors and food industries, and the UK has around 480 fish processing sites that employ around 15,000 people (Seafish 2009). Furthermore, the seafood service sector covers a range of outlets including fish and chips shops, and hotels and restaurants, and hence, is beneficial to millions of workers and consumers. There are also around 280 ports, harbours and creeks around the UK where finfish and shellfish are landed. In 2005, the combined employment level in the catching, processing and aquaculture sector in the UK was 31,633 people, representing 3.5% of the total employment in all maritime industries in the UK, including leisure and recreation.[739] Although the three largest UK fish landing ports (in terms of value of fish landed) are in Scotland, the fishing industry is also an important employer in England. In 2009, the English fishing fleet consisted of 3,169 vessels with the number of small vessels greatly exceeding that of larger vessels, although the catching power of the latter fleet (indicated by engine power) is considerably greater.[740]

4.8.2 Ecosystem Services from Marine Habitats

The key ecosystem services generated by marine habitats in England, as identified by the NEA, are outlined in the table below, together with an indication of the relative importance of marine habitats in delivering each of the listed ecosystem services.

Table 35: Main ecosystem services from marine habitat[741]

Provisioning		Cultural		Regulating	
Crops		Local places	M-L	Climate	H
Livestock / Aquaculture	H	Landscapes / seascapes	H	Hazard	M-H

[736] The Crown Estate and the Marine Management Organisation (2011). Memorandum of Understanding between the Marine Management Organisation and the Crown Estate [online] available at: http://www.thecrownestate.co.uk/mmo_mou.pdf (accessed 28 February 2011).
[737] Saunders, J., Tinch, R., and Hull, S. (2010). *Valuing the Marine Estate and UK Seas: An Ecosystem Services Framework*. The Crown Estate, 54pp, March 2010 [online] available at: http://www.thecrownestate.co.uk/valuing_marine_estate_uk_seas.pdf (accessed 28 February 2011).
[738] See the Crown Estate's web pages on its Sustainability Report 2010 at: http://www.thecrownestate.co.uk/sustainability-report/driving-environmental-value/biodiversity.html (accessed 28 February 2011).
[739] Pugh, D. (2008). *Socio-economic indicators of marine-related activities in the UK economy*. The Crown Estate, 68pp.
[740] UK National Ecosystem Assessment (2011). *The UK National Ecosystem Assessment: Technical Report (Chapter 17: Status and Changes in the UK's Ecosystems and their Services to Society: a Synthesis for England)*. UNEP-WCMC, Cambridge [online] available at: http://uknea.unep-wcmc.org/Resources/tabid/82/Default.aspx (accessed 6 July 2011).
[741] UK National Ecosystem Assessment (2011). *The UK National Ecosystem Assessment: Synthesis of the Key Findings*. UNEP-WCMC, Cambridge [online] available at http://uknea.unep-wcmc.org/Resources/tabid/82/Default.aspx (accessed 6 July 2011).

Provisioning		Cultural		Regulating	
Fish	H			Disease and pests	M-H
Trees, standing vegetation, peat				Pollination	
Water supply				Noise	
Wild species diversity	H	Wild species diversity	H	Water quality	M-L
				Soil quality	
				Air quality	H

Key		
High	H	Blank cells represent services that are not applicable to the Broad Habitat
Medium – High	M-H	
Medium – Low	M–L	
Low	L	

According to the Natural Capital Project, marine ecosystem services are "poorly understood, scarcely monitored, and often only appreciated after they are lost"[742]. It is nevertheless recognised[743] that marine ecosystems provide an important range of ecosystem services and benefits, including:

- Provisioning services include **food** (fish, shellfish, aquaculture); **genetic** resources (e.g. for aquaculture); **industrial** inputs (biocatalysts, natural medicines); **commercial** sand and gravel extraction; **fertiliser** (seaweed). Furthermore, the technology for energy extraction from the physical component of marine habitats as wave and tidal power is being developed and biofuels from macro and microalgae are likely to be provided by their biomass in the near future.
- Regulating services include **climate regulation** (carbon and other biogas regulation); **coastal protection** including erosion and flood control; waste breakdown and detoxification leading to **pollution** control, **waste** removal and waste degradation; **disease** and **pest** control.
- Cultural services include **tourism**, **leisure** and **recreation** opportunities; a focus for engagement with the natural environment; physical and mental **health** benefits; cultural **heritage** and **learning** experiences.

Provisioning services are often under pressure off the English coast and are subject to national, European and global policy intervention. There are issues relating to commercial fishing regarding the use of a common pool resource, including commercial pressure for short-term profit, large catches and national and international competition that can drastically impact upon the sustainability of fish stocks. Measures to resolve such issues include fishing no-take zones. Evidence from the Lundy Island Marine Nature Reserve's 2004/05 monitoring

[742] Natural Capital Project (2010) Marine InVEST [online] available at: http://www.naturalcapitalproject.org/marine/MarineInVEST_Apr2010.pdf (accessed 29 March 2011).
[743] UK National Ecosystem Assessment (2011). *The UK National Ecosystem Assessment: Technical Report (Chapter 12: Marine)*. UNEP-WCMC, Cambridge [online] available at: http://uknea.unep-wcmc.org/Resources/tabid/82/Default.aspx (accessed 6 July 2011).

programme[744] suggests that other marine wildlife also benefits from no-take zones: lobsters in the zone are reported to have increased in size and doubled in abundance.

Users of services such as leisure and recreation activities in marine areas include leisure companies offering boat trips etc., and consumers of these services using their own private craft. The sustainability of provisioning services therefore has potential implications for the maintenance of cultural services (recreation, health, learning, wild species diversity, charismatic seascapes, cultural heritage etc).

The services outlined above exclude the abiotic features of the marine environment which includes space for transport, for sea-bed pipelines and for cables for telecommunications, as well as aggregates and minerals, and oil and gas reserves. Space for storing wastes has been important in the past, although international treaties now prevent most direct dumping at sea. Recently, there has been increasing interest in using marine areas for storage of carbon dioxide, whether through direct injection into the water column (currently not legal) or through long-term storage in depleted oil and gas reservoirs or saline aquifers. Less obvious instances include the scientific importance of areas of the sea bed as a record of past climates.

Although these are not directly ecosystem services, they are uses of the space in ecosystems, and can compete with alternative uses and services. Also, there tends to be significant interest from business, management and policy communities in taking the values of these abiotic resources into account, and indeed in resisting a focus that is exclusively on biodiversity and services provided by the natural world.[745]

4.8.3 Scope for PES from Marine Habitats

Funding indirect use and non-use benefits relating to natural regulation and supporting mechanisms in marine areas has presented many difficulties for governments, since these services are long-term, and have a considerable degree of uncertainty attached – for example, in relation to climate change, although the degree of uncertainty here is decreasing – as well as limited public appreciation.

Throughout the world, coastal and marine ecosystems and the valuable environmental services they provide are under severe threat. The causes of this degradation are often very similar to those facing terrestrial ecosystems: many of the benefits of coastal and marine ecosystems are not received by those who manage them, but by others. Both mangroves and coral reefs, for example, play very important roles in the lifecycles of many commercially important fish. These fish, however, are often caught at some distance from the mangroves and reefs, and the benefits of these ecosystems are enjoyed by faraway fishers, not by those who directly manage them. The latter thus have limited incentives to protect these ecosystems.[746]

In principle, it seems that PES could help protect these ecosystems. To date, however, very few PES programmes have been implemented for marine ecosystems. This may be due to uncertainties in the underlying science (i.e. the role of the ocean in regulating the earth's climate is a subject of ongoing research), difficulties in identifying service providers and defining service beneficiaries for non-marketed ecosystem services, and the fact that some of the problems associated with the marine environment (e.g. over-fishing) are not primarily ones of externalities, but rather of open access — the so-called 'tragedy of the commons'.

[744] See www.defra.gov.uk/news/2006/060824a.htm.
[745] Saunders, J., Tinch, R., and Hull, S. (2010). *Valuing the Marine Estate and UK Seas: An Ecosystem Services Framework*. The Crown Estate, 54pp, March 2010. [online] available at: http://www.thecrownestate.co.uk/valuing_marine_estate_uk_seas.pdf (accessed 28 December 2010).
[746] Pagiola, S. (2008). Can Payments for Environmental Services Help Protect Coastal and Marine Areas? *Environment Matters*. Annual Review July 2007 – June 2008 [online] available at: http://siteresources.worldbank.org/INTENVMAT/Resources/3011340-1238620444756/5980735-1238620476358/8CanPayments.pdf (accessed 20 December 2010).

Furthermore, due to the fluid nature of the marine environment, resources can quickly travel across a variety governance systems and effectively "change hands" with zero financial transaction costs. This makes it difficult to identify a "seller", whose change in behaviour due to a payment, will positively the impact a service of interest, because, fish for example, may depend upon a network of habitats distributed across a large geographic area. Thus, for effective PES markets to develop in the marine context, it will be critical to have clear, legally recognised and functional governance regimes over resources that are somehow constrained to a given area (i.e. restricted range or sedentary), so, that the conservation of a service can be directly linked to specific natural resource practices undertaken by someone/entity who is being compensated for their stewardship. This does not seem to be an insurmountable obstacle where restricted access can be legally formalised.

In many cases, coastal and marine ecosystems provide valuable on-site benefits in addition to whatever off-site benefits they might generate. In such cases, the most practical solution is to seek to generate revenues from those on-site benefits through direct user fees rather than through PES. On-site benefits are generally much easier to charge for, because direct access to the site is necessary to enjoy on-site benefits. This makes entry fees for marine protected areas, for example, a viable financing mechanism whenever access can be controlled. Voluntary entry fees have sometimes proved successful. The revenue generated by a voluntary fee program instituted by the Cancun Marine Park, for example, was enough to double its operating budget. This approach has already been applied successfully in many reef areas but success is limited largely to those reefs that can attract a sufficient number of tourists[747]. Moreover, such direct uses must be carefully managed to avoid damaging the very asset they depend on. Some leisure and recreation activities ('cultural services') may be subject to levies such as green tourist taxes to pay for conservation linked to the activity. However, such levies vary considerably in their potential to support the objectives and functions of Marine Planning Authorities (MPAs), particularly where these are not directly aligned with the activities themselves, as in the case of general tourism.

Leisure activities that are most directly related to MPA objectives and functions include recreational diving and snorkelling, angling, beach-related leisure activities, wildfowl and seabird watching and marine wildlife watching. Some of these activities take place through commercial ventures in whose interest it is to cooperate with the MPA. For example, it is clearly in a dive centre's interest to maintain and protect the marine environment on which its business depends. Financial support is effectively 'in kind' as far as the MPA management organisation is concerned. The potential for direct financial contributions from such directly related and sympathetic commercial activities is limited by the scale of the enterprises concerned; the direct benefits of MPAs are generally experienced by a relatively small number of consumers, compared to those that experience indirect benefits.

It is also important to note that some activities that take place on land can have a significant impact on the marine environment and *vice versa*. This makes considered management of coastal areas particularly important. Some sectors are also active both on land and at sea, and developments can have both marine and land-based elements. Systems for protecting the marine environment must therefore also accommodate the complex interrelationships in coastal areas.

Moreover, a more detailed understanding of the interconnectivity between marine and terrestrial ecosystem services needs to be supplemented by a better understanding of how and where benefits may be enjoyed remotely from where the services are 'consumed' (e.g. fish

[747] Pagiola, S. (2008). Can Payments for Environmental Services Help Protect Coastal and Marine Areas? *Environment Matters*. Annual Review July 2007 – June 2008 [online] available at: http://siteresources.worldbank.org/INTENVMAT/Resources/3011340-1238620444756/5980735-1238620476358/8CanPayments.pdf (accessed 20 December 2010).

harvesting, sand-eel beds supporting coastal bird colonies, areas suitable for energy harvesting and transmission onto land, etc). This information could potentially support the emergence of markets that would improve the targeting of activities to protect or enhance Marine ecosystem services.

An example of a tool that may help in this regard, is the Marine InVEST (Integrated Valuation of Ecosystem Services and Trade-offs) model developed by the Marine Initiative of the Natural Capital Project which has been using the framework of ecosystem services to inform ecosystem-based management of marine and coastal waters. The model is designed to be flexible and accommodate application across multiple scales in coastal and marine regions with diverse habitats, policy questions, and stakeholders. It can assist in identifying decision-making boundaries, by mapping where ecosystem services are provided and where they are consumed. It can also reveal how resource management decisions will affect multiple aspects of the economy, human wellbeing and the environment. With regards to PES, the tool can support the design and implementation of PES programs by identifying how payments can meet multiple goals, where to distribute payments or establish new programs, and how to improve efficiency of investments.[748]

4.8.4 Ecosystem Service Sellers

Actual and potential providers and sellers of ecosystem services from the English Marine habitat are shown in the table below.

Table 36: Ecosystem service providers for marine habitat

Ecosystem Service	Sellers
Fisheries, crops, standing vegetation (e.g. seaweed and other marine products for pharmaceuticals and biofuel)	The Marine Management Organisation (MMO), the Crown Estate
Wild species diversity	RSPB and Wildlife Trusts who own a number of reserves around the coast
Climate regulation, water quality, hazard regulation (coastal protection), detoxification and purification	The Marine Management Organisation, the Marine Planning Authorities
Environmental settings (local places and seascapes for recreation, artistic inspiration, education)	Tourism and leisure operators (through voluntary conservation contributions)

The likely sellers of ecosystem services from England's marine habitat are the Marine Management Organisation (MMO), the Crown Estate (which owns and licenses a number of marine activities) the Marine Planning Authority and, potentially tourism and leisure operators (through voluntary conservation contributions).

4.8.5 Ecosystem Service Beneficiaries

Actual and potential beneficiaries of ecosystem services from English marine habitats are shown in the table overleaf.

[748] Natural Capital Project (2010) Marine InVEST [online] available at: http://www.naturalcapitalproject.org/marine/MarineInVEST_Apr2010.pdf (accessed 29 March 2011).

Table 37: Ecosystem service beneficiaries for marine habitat

Ecosystem Service	Beneficiaries
Fisheries, standing vegetation (e.g. algae and seedweed), hazard regulation (coastal defence), local places and seascapes (for recreation, cultural and archaeological heritage, education, artistic inspiration, etc)	**Private businesses**, particularly those who benefit directly or indirectly from the sale of marine produce, including: • Commercial fishers and the raft of secondary industries that support the marine fishing industry (e.g. boat-making and maintenance, gear supply and repair, processing, etc) • Pharmaceutical companies (bio-prospectors) • Renewable energy producers • Industries that benefit from sand/gravel extraction • Tourism and leisure companies including recreational diving, angling and sailing operations • Owners of business properties located along the coast may benefit from natural coastal defence.
Wild species diversity, hazard regulation (coastal defence), environmental settings (local places and seascapes for recreation, aesthetics, artistic inspiration, etc)	**Local residents** who are likely to be familiar with (if not scientifically knowledgeable about) local marine ecosystems, and may have chosen their homes partly on the expectations of enjoying the relevant services. Marine ecosystem services also support social cohesion and enfranchisement among local residents e.g. amongst fishing communities and special interest groups such as Surfers Against Sewage.
Fisheries, wild species diversity, water quality, local places and seascapes (for recreation, cultural and archaeological heritage, education, artistic inspiration, etc)	**Visitors,** both general .e.g. tourists and specialist .e.g. birdwatchers, sailors, anglers, students and researchers, artists who draw inspiration from seascapes, etc.
Fisheries, standing vegetation (e.g. algae and seedweed), local places and seascapes (cultural and archaeological heritage, education, artistic inspiration, etc)	More distant **consumers** of marine goods ,e,g seafood, marine products, renewable energy
Climate regulation, water quality, pollution control and waste removal	Global population

The marine environment provides many different services to many different users including fishers (both provisioning and cultural services), seafood consumers, recreational divers, shippers, power producers and bio-prospectors. While the beneficiaries of provisioning and cultural services are relatively easy to identify (primarily through supply chains), the beneficiaries of regulating services (particularly carbon storage and climate control) are global in nature.

4.8.6 Ecosystem Service Buyers and Intermediaries

Actual and potential buyers and intermediaries of ecosystem services from English marine habitats are shown in Table 38.

Table 38: Ecosystem service buyers and intermediaries for marine habitat

Ecosystem Service	Buyers and Intermediaries
Hazard regulation (coastal defence), climate regulation (carbon sequestration), detoxification and purification, wild species diversity, local places and seascapes (for recreation, health, cultural heritage, etc).	**Government,** particularly Local Authorities (on behalf of the public)
Fisheries, standing vegetation (e.g. algae and seedweed), hazard regulation (coastal defence), local places and seascapes (for recreation, cultural and archaeological heritage, education, artistic inspiration, etc)	**Private businesses**, particularly those who benefit directly or indirectly from the sale of marine produce, including: • Commercial fishers and the raft of secondary industries that support the marine fishing industry (e.g. boat-making and maintenance, gear supply and repair, processing, etc) • Pharmaceutical companies (bio-prospectors) • Renewable energy producers • Industries that benefit from sand/gravel extraction • Tourism and leisure companies including recreational diving, angling and sailing operations • Owners of business properties located along the coast may benefit from natural coastal defence and the detoxification and purification services provided by marine waters.
Wild species diversity, hazard regulation (coastal defence), environmental settings (local places and seascapes for recreation, aesthetics, artistic inspiration, etc)	**Local residents** who are likely to be familiar with (if not scientifically knowledgeable about) local marine ecosystems, and may have chosen their homes partly on the expectations of enjoying the relevant services. Marine ecosystem services also support social cohesion and enfranchisement among local residents e.g. amongst fishing communities and special interest groups such as Surfers Against Sewage.
Fisheries, wild species diversity, water quality, local places and seascapes (for recreation, cultural and archaeological heritage, education, artistic inspiration, etc)	**Visitors,** both general .e.g. tourists and specialist .e.g. birdwatchers, sailors, anglers, students and researchers, artists who draw inspiration from seascapes, etc.
Fisheries, standing vegetation (e.g. algae and seedweed), local places and seascapes (cultural and archaeological heritage, education, artistic inspiration, etc)	More distant **consumers** of marine goods ,e,g seafood, marine products, renewable energy
Wild species diversity, local places and seascapes	**Charitable organisations**, e.g. the Marine Conservation Society, RSPB and Wildlife Trusts who have an interest in protecting seabirds and other marine wildlife;

The likely buyers of ecosystem services include government, conservation organisations and, potentially, pharmaceutical companies interested in bioprospecting opportunities. Tourists and visitors to marine protected areas may also be encouraged to make voluntary contributions to marine conservation initiatives.

4.8.7 Case Studies

There are few examples of genuine operational PES schemes in marine habitats. To date, the most comprehensive assessment of the potential for implementing marine PES has emanated

from the Marine Ecosystem Services (MARES) Program established by Forest Trends.[749] The aim of the MARES initiative is to protect crucial marine ecosystem services by harnessing markets and private sector investment, in order to complement conventional coastal and marine management and safeguard human well-being.

MARES targets the following four main objectives in promoting its overall goal of protecting marine ecosystem services:

- developing a solid foundation of understanding of marine ecosystem services and their economic value;
- elaborating best practices for the conservation of those services;
- communicating information about ecosystem services and the potential to effectively and efficiently protect them, in order to raise awareness and generate political will; and
- helping to build a community of practice for marine payment of ecosystem services (PES) and other innovative financing mechanisms.

In meeting these objectives, MARES uses analyses, assessments, pilot projects, and other tools to derive lessons learned from PES initiatives and to build capacity for marine ecosystem services protection.

A recent report[750] by MARES examines a range of potential mechanisms for financing the protection of valuable marine ecosystem services, with a specific focus on water quality, marine biodiversity, coastline and beach stabilisation and fish nurseries. Although the definition of PES used by MARES is broader than that employed for the purposes of this report, the examples provided nevertheless demonstrate the potential for the concept of marine PES. These include:

- Expanding the concept of payments for ecosystem services in watersheds to encompass the marine environment, where runoff from land spills directly into the sea or where rivers and streams dump their cumulative runoff into the ocean. The report cites the example of the Great Miami Watershed Project, an inland water quality scheme that could be expanded to include beneficiaries in marine and coastal areas. This is supported by evidence from the US Geological Survey (USGS) which found that reduced emissions into watershed streams as a result of the Miami Watershed Project were likely a significant factor in revitalising a 'dead zone' in the Gulf of Mexico which had threatened to wipe out shrimp fishing in the Gulf. The USGS in mid-2009 noted that the spring delivery of nitrogen from the Mississippi and Atchafalaya Rivers to the Gulf of Mexico that year was 23% lower than the figure for 2008. The potential also exists for large coastal polluters like oil drillers and refiners to participate in the Great Miami Watershed Project by purchasing offset credits for their Gulf-water emissions.
- Marine biodiversity offsets for marine and coastal development, e.g. using a levy on fisheries bycatch to fund conservation actions.
- Catch shares, or Individual Transferable Quotas (ITQs) whereby fishers can trade fishing rights within an overall total catch allowance.
- Payments by tourists for marine ecosystem services. For example, Ecuador's Galapagos Islands National Park collects a $100 park entry fee from each of its annual 80,000 foreign tourists. Australia charges commercial tourism operators $4 per tourist per day to explore its

[749] See http://forest-trends.org/program.php?id=135.
[750] Forest Trends (2010). *Paying Poseidon: Financing the Protection of Valuable Ecosystem Services* [online] available at: http://www.forest-trends.org/documents/files/doc_2375.pdf (accessed 18 July 2011).

Great Barrier Reef. The Caribbean island of Bonaire gets a $10 annual flat fee from scuba divers to protect its coral reefs and coastal environment.

4.8.8 Barriers to PES in marine habitats

Perhaps the most significant barrier to the use of PES in marine habitats relates to the open access nature of marine resources. Property rights are poorly defined for many of the provisioning (outside of fisheries) and regulating services generated by marine habitats.

Furthermore, the linkages between marine processes and human well-being are poorly understood making it difficult to quantify and value the benefits. Valuing the services of any marine ecosystem faces challenges that terrestrial-based schemes do not. With the possible exceptions of commercial fish and seafood, and the carbon sinks of mangroves and sea grasses, the benefits of many marine ecosystem services are often felt far from the ecosystem that generates them. Further research is needed on the scales at which underlying marine ecosystem processes occur, how these relate to the scale at which the services are delivered and what the linkages are between them.

One approach to overcoming this problem, and which is gaining ground internationally, is ocean zoning. Several countries have set aside a few marine protected areas, but to make a difference zoning would have to be enacted on a far grander scale. Ocean zoning could play a role in the development of markets for marine ecosystem services by helping to establish clear rights and responsibilities which provide reassurance to potential investors. A comprehensive zoning approach could include “trading zones” where payments for ecosystem services transactions could be established.

4.8.9 Opportunities for PES in marine habitats

Opportunities for PES in marine habitats may include:

- Direct payments by bioprospectors for protection and maintenance of marine areas known to harbour rich species diversity. For example, marine biotechnology forms a significant part of research activities in the European Centre for Marine Biotechnology at the Scottish Association for Marine Science (SAMS) at Aberdeen University and at Plymouth Marine Laboratory (PML) within its trading subsidiary PML Applications.
- Payments by recreational users (divers, snorkelers and sailors) for the enhancement of areas suitable for such activities.
- Payments by marine and coastal fishers for upstream land management to reduce the volume of pollutants entering the marine environment
- Commercial resource exploiters and retailers paying for sustainably sourced seafood. Companies such as Marks & Spencer through its Forever Fish initiative[751] and Selfridges through Project Ocean[752] have recently demonstrated an increased interest in purchasing “sustainable” seafood products. MPAs are one clear manner to ensure the long term protection of reef associated products such as groupers, conch and spiny lobster. Financial transfers could emerge from seafood buyers to fisherman to protect a certain area of reef or coastal ecosystem for reasons of stock sustainability, food quality and ecosystem intactness. This market could emerge either out of profits, or direct proceeds from the added value of certification schemes.

[751] See http://plana.marksandspencer.com/we-are-doing/sustainable-raw-materials/forever-fish/our-partners.
[752] See http://www.selfridges.com/en/StaticPage/ProjectOcean/#/.

- The possibility for carbon markets in marine systems has been relatively unexplored. Seagrass meadows have been estimated to contain approximately 12% of the carbon stored in marine systems and in open water, planktonic coccolithophores make a major contribution to the global carbon sink.[753] Payments for carbon storage may have the potential to develop in these contexts, if ownership and governance issues over these ecosystems are clear, and if carbon payments are a sufficient incentive to conserve these ecosystems in the face of other market opportunities.

Innovation may be necessary in the marine environment to deal with overlapping jurisdictions and the potential of multiple owners of a resource.

4.9 Urban

4.9.1 Introduction

Urban ecosystems cover around 10% of England. According to the Countryside Survey, there are 1,038,000ha of built-up areas and gardens but a further 428,000ha of urban land has not been surveyed.[754] The amount of developed land and land converted to urban use will undoubtedly increase with time. The recent Foresight report on land use futures argues that the underlying trend in economic growth in the UK suggests a continuing increase in the demand for land for development, with pressures on land use in the South East in particular expected to intensify.[755] At the same time, the report emphasises that there has been an upsurge in concern for green space in and around urban areas, including the development of green infrastructure.[756] According to the report, two-thirds of the general public think it is important to have green space nearby and the majority think parks and public spaces improve quality of life,[757] an attitude supported by the inclusion of access to green spaces as measure of wellbeing within the UK Sustainable Development Indicators.[758]

Government guidance for local authorities on spatial planning defines green infrastructure as *"a network of multi-functional green space, both new and existing, both rural and urban, which supports the natural and ecological processes and is integral to the health and quality of life of sustainable communities"*.[759] Natural England argues that 'multifunctionality' is central to the concept of green infrastructure and defines this to mean its capacity to encompass a range of functions and to deliver a broad range of ecosystem services.[760] The authors of the Foresight report argue that greater pressure on land will increase the requirement for land to deliver multiple benefits.[761] Green infrastructure is also increasingly being recognised for its

[753] UK National Ecosystem Assessment (2011). *The UK National Ecosystem Assessment: Technical Report (Chapter 12: Marine)*. UNEP-WCMC, Cambridge [online] available at: http://uknea.unep-wcmc.org/Resources/tabid/82/Default.aspx (accessed 6 July 2011).
[754] Countryside Survey (2008). *Countryside Survey: England Results from 2007* [online] available at: http://www.countrysidesurvey.org.uk/eng_reports2007.html (accessed 13 December 2010).
[755] Foresight Land Use Futures Project (2010). Final Project Report. The Government Office for Science, London [online] available at: http://webarchive.nationalarchives.gov.uk/+/http://www.bis.gov.uk/foresight/our-work/projects/current-projects/land-use-futures (accessed 3 June 2011).
[756] *Ibid*
[757] *Ibid*
[758] Defra (2010). *Measuring Progress: Sustainable Development Indicators 2010* [online] available at: http://sd.defra.gov.uk/documents/SDI2010_001.pdf (accessed 18 July 2011).
[759] Communities and Local Government (2008). *Planning Policy Statement 12: Creating Strong Safe and ProsperousCommunities through Local Spatial Planning* [online] available at: http://www.communities.gov.uk/documents/planningandbuilding/pdf/pps12lsp.pdf (accessed 27 February 2011).
[760] Natural England (2009). *Green Infrastructure Guidance* [online] available at: http://naturalengland.etraderstores.com/NaturalEnglandShop/NE176 (accessed 27 February 2011).
[761] Foresight Land Use Futures Project (2010). Final Project Report. The Government Office for Science, London [online] available at: http://webarchive.nationalarchives.gov.uk/+/http://www.bis.gov.uk/foresight/our-work/projects/current-projects/land-use-futures (accessed 3 June 2011).

importance in relation to improving air quality[762], climate change[763], biodiversity[764] and sustainable urban drainage.[765] The UK Climate Impacts Programme (UKCIP) notes *"The significance of ecosystem services"* as part of this increased awareness of the *"multiple benefits of green infrastructure"*.[766] Similarly, the Foresight report argues that the importance of green space in and near towns and cities is likely to increase for a variety of reasons. In particular, climate change will mean that parks, gardens and other green areas will have a crucial role to play in helping urban areas to adapt to higher temperatures by mitigating the urban heat island effect and providing cooler places for urban dwellers.[767] However, the report cautions that there is likely to be competition for land to accommodate green spaces in the fringes around towns and cities, which are also likely to be the target for the development of housing and employment opportunities.[768] Here, the way strategic planning deals with the complex issue of the future of green belts as well as 'green wedges/fingers' will be particularly significant. Indeed current proposals under the Natural Environment White Paper for the creation of non-statutory community designations to protect valued greenspace offers improved protection, at least in theory.[769] Worcestershire County Council, within their green infrastructure partnership[770], has developed environmental character areas[771] which could provide a valuable planning tool.

Whilst allotments have attracted attention, there is also the advent of 'guerrilla gardening' where the use of residual urban space is turned over to local food production. In some instances this has led to large-scale adoption and acceptance by local authorities, such as in the Todmorden example.[772] This is an example of what can be characterised as 'forgotten space' in cities; spaces that have escaped significant research and policy attention but clearly have the potential to deliver significant ecosystem service benefits.[773]

4.9.2 Ecosystem Services from Urban Habitats

The key ecosystem services generated by urban habitats in England, as identified by the NEA, are outlined in Table 39, together with an indication of the relative importance of urban habitats in delivering each of the listed ecosystem services.

[762] Nowak, D.J.; Crane, D.E, and Stevens, J.C. (2006). Air pollution removal by urban trees and shrubs in the United States. *Urban Forestry and Urban Greening* 4:115-123; Tiwary, A., Sinnett, D., Peachey, C., Chalabi, Z., Vardoulakis, S., Fletcher, T., Leonardi, G., Grundy, C., Azapagic, A. and Hutchings, T.R. (2009). An integrated tool to assess the role of new planting in PM10 capture and the human health benefits: A case study in London. *Environmental Pollution*, 157(10): 2645-2653.
[763] London Climate Change Impact Partnership (2002) London's warming: The impacts of climate change on London [online] available at: http://www.london.gov.uk/lccp/publications/impacts.jsp (accessed 18 July 2011).
[764] CLG (2010) *Draft Policy Planning Statement: Planning for a Natural and Healthy Environment* [online] available at http://www.communities.gov.uk/documents/planningandbuilding/pdf/1498981.pdf (accessed 25 July 2011).
[765] Gill, S., Handley, J., Ennos, A. & Pauleit, S. (2007) Adapting cities for climate change: the role of the greenspace. *Built Environment*, 33(1): 115-133.
[766] UKCIP (n.d.) *Green Infrastructure* [online] available at: http://www.ukcip.org.uk/government/local-authorities/service-areas/green-infrastructure/ (accessed 13 December 2010).
[767] Foresight Land Use Futures Project (2010). Final Project Report. The Government Office for Science, London [online] available at: http://webarchive.nationalarchives.gov.uk/+/http://www.bis.gov.uk/foresight/our-work/projects/current-projects/land-use-futures (accessed 3 June 2011).
[768] *Ibid*
[769] Scott, A. and Shannon, P. (2007). Local landscape designations in Scotland: Opportunity or barrier to effective landscape management? *Landscape and Urban Planning*, 81(3): 257-269.
[770] The Strategic Planning team within Worcester County Council is working with partners including The Environment Agency, Natural England, Forestry Commission, English Heritage and Worcestershire Wildlife Trust to develop a sub-regional green infrastructure framework
[771] See Worcester County Council, Forestry Commission England and Natural England (2008). *Planning for Landscape, Biodiversity and the Historic Environment in the Development of Green Infrastructure Strategies in Worcestershire*. Technical Research Paper, Version 1 [online] available at http://www.worcestershire.gov.uk/cms/pdf/Green%20Infrastructure1%20PV%20editsv3%20_2_.pdf (accessed 17 September 2011).
[772] See http://www.incredible-edible-todmorden.co.uk/.
[773] Scott, A.J. and Carter, C. (2011). The Rural Urban Fringe Forgotten Opportunity Space? *Town and Country Planning*. May/June 2011: 231-234.

Table 39: Main ecosystem services from urban habitat[774]

Provisioning		Cultural		Regulating	
Crops	M-L	Local places	H	Climate	H
Livestock / Aquaculture	M-L	Landscapes / seascapes	M-H	Hazard	M-H
Fish	M-L			Disease and pests	M-L
Trees, standing vegetation, peat	M-H			Pollination	M-H
Water supply	M-H			Noise	H
Wild species diversity	M-L	Wild species diversity	M-L	Water quality	M-H
				Soil quality	M-H
				Air quality	H

Key		
High	H	Blank cells represent services that are not applicable to the Broad Habitat
Medium – High	M-H	
Medium – Low	M–L	
Low	L	

The NEA notes that the ecosystem goods and services that could potentially be derived from urban greenspace are substantial. While they currently provide relatively limited provisioning services, changing attitudes to urban food production, the revival of allotment gardening and a growing movement to link environmental benefits with deprived urban areas[775] has resulted in a substantial increase in domestic food production in built up areas.

Urban green infrastructure also plays an important role in flood control, urban cooling, providing shade and removing pollutant particles and so contributing to improved air quality.[776] Elmqvist, for example, states that parks may reduce air pollution by up to 85% and that vegetation significantly reduces urban heat island effects[777]. Urban areas may have a role to play in carbon storage; for example, in New York, trees currently store about 1.35 million tons of carbon valued at $24.9 million.[778] The NEA emphasises the importance of the cultural services arising from access to good quality greenspace and through public parks and private gardens, which contribute to positive mental health, childhood development, physical health and social cohesion.[779] In New York, research suggests that doubling the number of street trees results in

[774] UK National Ecosystem Assessment (2011). *The UK National Ecosystem Assessment: Synthesis of the Key Findings*. UNEP-WCMC, Cambridge [online] available at: http://uknea.unep-wcmc.org/Resources/tabid/82/Default.aspx (accessed 6 July 2011).
[775] See, for example, projects run by Groundwork UK at http://www.groundwork.org.uk/our-services/communities.aspx.
[776] UK National Ecosystem Assessment (2011). *The UK National Ecosystem Assessment: Technical Report (Chapter 10: Urban)*. UNEP-WCMC, Cambridge [online] available at http://uknea.unep-wcmc.org/Resources/tabid/82/Default.aspx (accessed 6 July 2011).
[777] Elmqvist, T.(2010). Ecosystem Services in Urban Landscapes. Presentation [online] available at: http://www.els.salford.ac.uk/urbannature/news/events/argumenta/4.Elmqvist-Ecosystem%20services%20in%20cities-what%20and%20why.pdf (accessed 13 December 2010).
[778] *Ibid*
[779] UK National Ecosystem Assessment (2011). *The UK National Ecosystem Assessment: Technical Report (Chapter 10: Urban)*. UNEP-WCMC, Cambridge [online] available at: http://uknea.unep-wcmc.org/Resources/tabid/82/Default.aspx (accessed 6 July 2011).

a 25% reduction of asthma among children. Moreover, green area accessibility is strongly linked to reduced obesity and increase in indicators of health in the UK and USA.[780]

About 80% of the population of England lives in urban areas[781] and although access to greenspace increases the health and happiness of residents[782], it is inevitably limited in cities, because of restricted space and high land prices. Green patches in the urban environments may act as valuable corridors into and through cities, especially if the pathways are targeted toward and designed for a specific species or group of species. [783] In this way urban greenspaces may be able to fill a number of niches, supplying habitat to species within cities and increasing the value of that space to urban residents. The NEA notes that brownfield sites have also contributed to urban wildlife conservation, along with providing open space and accessible educational opportunities for urban residents. For example, Canvey Wick, Essex was an oil refinery and is now a post-industrial SSSI and has become home to a number of Red Data Book and UK BAP priority species, including herb-rich grassland, early successional habitat and scrub edge and brackish habitats, and provides habitat for the nationally important shrill carder bee (*Bombus sylvarum*), as well as a wide array of plants.[784]

Some examples of local authorities around the world where an ecosystems approach to planning has been adopted have been identified in TEEB[785]:

- The replacement value of the South African municipality of Durban's ecosystem goods and services supplied by Durban's 2002 Open Space system was conservatively estimated at US$ 0.41 billion per annum. This figure does not include the tourism sector which is valued at an additional US$ 0.44 billion per annum. The Municipality is now investigating how to value municipally owned spaces and include them on its asset register in order to make better provision for ongoing management.
- Local authorities in Canberra, Australia, have enhanced urban quality of life by planting 400,000 trees. Besides making the city greener, the trees are expected to regulate the microclimate, reduce pollution and thereby improve urban air quality, reduce energy costs for air conditioning, sequester and store carbon. Combined, these benefits are expected to amount to the equivalent of US$ 20–67 million to the city for the period 2008–2012 in terms of the value generated or savings incurred.

4.9.3 Scope for PES from Urban Habitat

The Foresight report on land use futures argues that the importance of green space in and near towns and cities is likely to increase. Rising demand coupled with an increased understanding of the benefits associated with green infrastructure may provide an opportunity to promote PES in the context of urban green space.

[780] Elmqvist, T. (2010). Ecosystem services in urban landscapes. Presentation [online] available at: http://www.els.salford.ac.uk/urbannature/news/events/argumenta/4.Elmqvist-Ecosystem%20services%20in%20cities-what%20and%20why.pdf (accessed 13 December 2010).
[781] CABE (2010). *Urban green nation: Building the evidence base*. CABE, London [online] available at: http://webarchive.nationalarchives.gov.uk/20110118095356/http:/www.cabe.org.uk/files/urban-green-nation.pdf (accessed 16 September 2011).
[782] Fuller, R.A., Irvine, K.A., Devine-Wright, P., Warren, P.H. and Gaston, K.J. (2007). Psychological benefits of greenspace increase with biodiversity. *Biology Letters*, 3: 390 - 394.
[783] Angold, P.G., Sadler, J.P., Hill, M.O., Pullin, A., Rushton, S., Austin, K., Small, E., Wood, B., Wadsworth, R., Sanderson, R. and Thompson, K. (2006). Biodiversity in Urban Habitat Patches. *Science of the Total Environment*, 360(1-3): 196 - 204.
[784] English Nature (2005). *Canvey Wick SSSI*, Essex. [online] available at: http://www.englishnature.org.uk/special/sssi/images/uploaded_files/2000497.pdf (accessed 18 July 2011).
[785] TEEB (2010). *The Economics of Ecosystems and Biodiversity: Mainstreaming the Economics of Nature: A synthesis of the approach, conclusions and recommendations of TEEB* [online] available at: http://www.teebweb.org/LinkClick.aspx?fileticket=bYhDohL_TuM%3d&tabid=1278&mid=2357 (accessed 16 September 2011).

In England, green space managed by local authorities is usually funded from the authority's general revenue budget, which is financed from local taxation and/or government transfers. Green space is one of many services funded from this budget, and parks departments have to compete for the money. The decision about how the general revenue budget is distributed among competing services is made by councillors. Funding may also be accessed through a range of government departments and agencies for the delivery of projects that meet cross-cutting targets, for instance targets for public health, young people, crime or sustainable development. Often this money could be used to fund urban green spaces. Section 106 planning agreements can also ensure funding for the provision and management of urban green space in, and around, new residential and commercial developments.

A key mechanism in relation to PES for urban habitats could be the new Community Infrastructure Levy (CIL) which allows local authorities in England to apply a charge on most new types of development in order to cover infrastructure costs. The levy will take the form of a fixed standard charge, applying in pounds per square metre on the net additional increase in floor space.[786] The levy can be used to fund a wide range of infrastructure, including green infrastructure, flood defences, healthcare facilities, schools and transport[787] that councils, local communities and neighbourhoods consider priorities. At present it is unclear what the mechanisms for determining these priorities will be. However, if green infrastructure is considered a priority, then developers will be effectively contributing funds for the supply of ecosystem services of value to local people. However, it may be that green infrastructure is not necessarily perceived as a priority in a given area and that CIL funds are largely channelled elsewhere. In discussing green infrastructure, it is important to bear in mind that open space may not necessarily be of high quality and/or multifunctional and, therefore, provide a range of ecosystem services. For example, while green infrastructure represents a bridge between planning and biodiversity there is significant unrealised potential from its current urban forms[788].

A recent report entitled 'Open space: an asset without a champion', cited a survey which *"…reveals that the private sector is more than willing to invest in open spaces if the right vehicle for investment is made available, and their investment is managed properly"*.[789] In particular, 95% of respondents not only believed that good open space adds value to commercial property, but are prepared to pay at least 3% more to be in close proximity to it. The report states that, in London, this could equate to an additional £1.3 billion of additional capital that could be invested in open spaces. Given a demand among the private sector for access to open space, it may be possible to conceive of PES-like schemes whereby businesses contribute to a funding pot which, in turn, is used to create or enhance green infrastructure. This could draw on the example of Crossrail whereby the Mayor of London has introduced a levy of 2p on non-domestic properties with a rateable value of over £55,000 in London to help pay for Crossrail.

In considering the scope for PES in relation to green infrastructure, it is important to bear in mind the emerging localism agenda. The Government is committed to promoting decentralisation and democratic engagement and giving new powers to local councils, communities, neighbourhoods and individuals.[790] According to Government, decentralisation is

[786] Communities and Local Government (2010). *The Community Infrastructure Levy: An overview* [online] available at: http://www.communities.gov.uk/documents/planningandbuilding/pdf/1772940.pdf (accessed 1 February 2011).
[787] *Ibid*
[788] Kambites C. and Owen S. (2006). Renewed prospects for green infrastructure planning in the UK. *Planning Practice and Research*, 21: 483-497.
[789] Gensler and Urban Land Institute (2011). *Open space: an asset without a champion?* [online] available at: http://www.gensler.com/uploads/documents/Open_Space_03_08_2011.pdf (accessed 3 June 2011).
[790] HM Government (2010). *The Coalition: our programme for government* [online] available at: http://www.cabinetoffice.gov.uk/sites/default/files/resources/coalition_programme_for_government.pdf (accessed 1 February 2011).

the most significant contribution it can make to building the 'Big Society'.[791] In relation to planning, the new Localism Bill will introduce a new right for communities to draw up a 'neighbourhood development plan'.[792] According to CLG, provided a neighbourhood development plan is in line with national planning policy, with the strategic vision for the wider area set by the local authority via its development plan, and with other legal requirements, local people will be able to vote on it in a referendum; if the plan is approved by a majority, then the local authority will bring it into force.[793] CLG estimate that almost 2,000 neighbourhood plans will be created across England in the five years after the Localism Bill becomes law.[794] In relation to development management, the Localism Bill will provide for 'neighbourhood development orders' to allow communities to approve development without requiring normal planning consent.[795] Furthermore, in the absence of statutory development plans, the presumption in favour of sustainable development proposed in the draft National Planning Policy Framework (NPPF) will provide the decision making context and could have implications for greenspace provision.[796]

As an aside, Defra's Business Plan 2011-2015 included a commitment to assess the scope for actions to offset the impact of development on biodiversity by April 2011.[797] Biodiversity offsetting involves compensating society for biodiversity lost as a result of development. Although offsetting is currently required where development of overriding public interest has significant impacts on European sites or sites occupied by European protected species, Defra argue that it might be possible to implement the approach more widely.[798] For example, if a site with biodiversity value was necessary for development and there was no alternative site available, on-site mitigation was considered insufficient to remedy adverse effects and the planning process determined that the development should nonetheless go ahead, then the developer could pay to restore an area of habitat with the potential to become at least the same quality as the habitat which would be lost.[799] The Lawton Review emphasises that biodiversity offsetting must not become a 'licence to destroy' or damage existing habitat of recognised value (i.e. it must only be used to compensate for genuinely unavoidable damage) and where developers propose to create replacement habitat there needs to be some certainty that the habitat type can be (re-)created.[800] Defra have raised the possibility of using Section 106 Agreements as a means to deliver biodiversity offsets.[801]

4.9.4 Ecosystem Service Sellers

Actual and potential providers and sellers of ecosystem services from English urban habitats are shown in the table below.

[791] HM Government (2010). *Decentralisation and the Localism Bill: an essential guide* [online] available at: http://www.communities.gov.uk/documents/localgovernment/pdf/1793908.pdf (accessed 1 February 2011).
[792] Communities and Local Government (2011*). A plain English guide to the Localism Bill* [online] available at: http://www.communities.gov.uk/documents/localgovernment/pdf/1818597.pdf (accessed 1 February 2011)
[793] *Ibid*
[794] Donnelly, M. (2011). CLG predicts nearly 2,000 neighbourhood plans. *Planning* 1 February 2011 [online] available at: http://www.planningresource.co.uk/planningdaily/login/1052467/ (accessed 1 February 2011).
[795] See http://services.parliament.uk/bills/2010-11/localism.html (accessed 1 February 2011).
[796] At the time of writing, there was still a consultation process to go through on this.
[797] Defra (2010). *Business Plan 2011-2015* [online] available at: http://www.defra.gov.uk/corporate/about/what/documents/defra-businessplan-101108.pdf (accessed 23 February 2011).
[798] See Defra's web pages on biodiversity offsetting at: http://www.defra.gov.uk/environment/biodiversity/offsetting/index.htm (accessed 25 February 2011).
[799] *Ibid*
[800] Lawton, J.H., Brotherton, P.N.M., Brown, V.K., Elphick, C., Fitter, A.H., Forshaw, J., Haddow, R.W., Hilborne, S., Leafe, R.N., Mace, G.M., Southgate, M.P., Sutherland, W.A., Tew, T.E., Varley, J., and Wynne, G.R. (2010). *Making Space for Nature: a review of England's wildlife sites and ecological network*. Report to Defra [online] available at: http://www.defra.gov.uk/environment/biodiversity/documents/201009space-for-nature.pdf (accessed 25 February 2011).
[801] See Defra's web pages on biodiversity offsetting at: http://www.defra.gov.uk/environment/biodiversity/offsetting/index.htm (accessed 25 February 2011).

Table 40: Ecosystem service providers for urban habitat

Ecosystem Service	Sellers
Crops (e.g. from allotments), wild species diversity, noise regulation, detoxification and purification services, climate regulation, pollination	**Private land owners and tenant land managers** including allotment owners.
Regulating services such as climate regulation, flood regulation and disease and pest control, soil quality, air quality and noise	**Local Authorities** who manage green spaces and urban parks
Environmental settings (local places for recreation, stress relief, psychological restoration, creativity and inspiration, etc), climate regulation, hazard regulation (water and flood control), detoxification and purification (air quality, water quality, soil quality), noise regulation, pollination	**Authorities and charitable organisations** responsible for managing green spaces and urban parks, e.g. Parks Foundations (Royal Parks), Groundwork UK, etc

4.9.5 Ecosystem Service Beneficiaries

Actual and potential beneficiaries of ecosystem services from English urban habitats are shown in the table below.

Table 41: Ecosystem services beneficiaries from urban habitat

Ecosystem Service	Beneficiaries
Crops, standing vegetation (e.g. in allotments), carbon regulation, noise regulation, hazard regulation (flood and water control), air quality, water quality, environmental settings (local places and landscapes for amenity, inspiration, health, etc)	**Local residents** who have access to the fresh produce from gardens and allotments and who benefit from the regulating services provided by urban green spaces. Those living closest to urban areas may have specifically chosen their homes on the expectation of being able to enjoy the relevant services.
Environmental settings (local places and landscapes for amenity, recreation, inspiration, recovery, etc), climate regulation (relief from climate stress), noise regulation, air quality.	**Visitors**, including workers who visit green spaces for exercise, relaxation, stress-relief and escape from 'hustle and bustle'; property owners who enjoy premiums on property values as a result of living in close proximity to a green space; businesses who see benefits from proximity to green space (e.g. greater productivity, reduced absenteeism)

Urban ecosystem services are of benefit to those who live and work in urban areas. The benefits are therefore usually highly localised in nature.

4.9.6 Ecosystem Service Buyers and Intermediaries

Actual and potential buyers and intermediaries of ecosystem services from English urban habitats are shown in the table below.

Table 42: Ecosystem service buyers and intermediaries for urban habitat

Ecosystem Service	Buyers and Intermediaries
Crops, standing vegetation (e.g. in allotments), carbon regulation, noise regulation, hazard regulation (flood and water control), air quality, water quality, environmental settings (local places and landscapes for amenity, inspiration, health, etc)	**Local residents** who have access to the fresh produce from gardens and allotments and who benefit from the regulating services provided by urban green spaces. Those living closest to urban areas may have specifically chosen their homes on the expectation of being able to enjoy the relevant services. They may be willing to pay (and often already do) for access to allotments.
Regulating services such as climate regulation, hazard regulation (flood and water control), detoxification and purification (particularly air quality), noise regulation	**Local Authorities** (on behalf of the public); who may be interested in the regulating services provided by urban greenspaces.
Environmental settings (local places and landscapes for amenity, health, social cohesion, etc)	**Charitable organisations and community groups**, e.g. Heritage Lottery Fund, Parks Foundations, sporting associations or clubs (e.g. for access to green spaces that are suitable for recreation activities), community groups that support conservation work and community development (e.g. Friends of Richmond Park, Groundwork UK), Rivers Trusts (on behalf of the public).
Hazard regulation (flood and water control), climate regulation, pollination, local places	**Private businesses**, e.g. insurers (on behalf of premium holders) who may be interested in reduced flood risk), peri-urban horticulturalists who may benefit from pollination from urban gardens, businesses who are 'preferred employers' because of their location near to greenspaces.

4.9.7 Case Studies

There are few examples of operational PES schemes for ecosystem services provided by urban habitats. The example provided in Box 14, while not a PES scheme at the moment, clearly demonstrates the relationships between ecosystem service suppliers and beneficiaries and explores the potential for eliciting funding and investment from private beneficiaries of green infrastructure.

Box 14: Example of a potential PES schemes in an urban habitat

Mayesbrook Park Project, Barking, East London

The Thames Rivers Restoration Trust has brought together a partnership of the Environment Agency, GLA, Natural England, London Wildlife Trust, Design for London and the London Borough of Barking and Dagenham to restore 2km of the Mayes Brook in Mayesbrook Park; a 45 ha underused public park in Barking, East London. The funding partners include RSA insurance group and the SITA Trust.

The £1m first phase of work has started and includes restoring the river and creating a new one hectare floodplain to store the increased flows expected in this catchment in future due to climate change. However, the project has grown into a broader environmental regeneration project with multiple ecosystem services, health and other benefits for people and wildlife, called the Mayesbrook Climate Change Park. Those broad ecosystem services benefits have attracted the broad range of partners and funders into a project that each one could not afford to do alone.

A study published by the Environment Agency (EA)[802] explored some of the key benefits of the planned river restoration and the wider park 'greenspace' improvements, in terms of their impact on ecosystem services. The study shows that the restoration and improvements will contribute to 'regulatory services' (regulation of air and water quality, microclimate and flood risk) affecting the local community. Enhanced recreation and tourism (cultural services) are also likely to bring benefits. The benefits for 'supporting services', which are hard to quantify but important in maintaining ecosystem functions, are significant in terms of nutrient cycling and providing habitats for wildlife. Many of the more important benefits of the Mayesbrook Park restoration can be seen in social and health aspects, enhancing the quality of life in the borough and the wellbeing of local communities. The overall benefits are substantial relative to the planned investment. The lifetime value of restoring the site across the four ecosystem service categories (provisioning, regulatory, cultural and supporting) produces a significant lifetime benefit-to-cost ratio of £7 of benefits for every £1 invested. The EA study found that urban river restoration would therefore be of major public value, fully justifying the planned investment and providing firm evidence that investment in urban 'green infrastructure' is highly favourable for the health and wellbeing of local people and the economic improvement of deprived wards.

Sources: *Thames Rivers Restoration Trust (n.d.) Restoration For All [online]: http://www.trrt.org.uk/index.aspx?articleid=15955 (accessed 27 February 2011).*

Personal Communication, Robert Oates, Executive Director, Thames Rivers Restoration Trust, May 2011.

4.9.8 Barriers to PES in urban habitats

Although the Community Infrastructure Levy (CIL) could channel development monies into local and neighbourhood priorities, these may not necessarily involve green infrastructure or the provision of multifunctional green infrastructure which provides a range of benefits. Although private PES schemes are conceivable with businesses paying for the provision of green infrastructure given benefits in terms of productivity, staff retention etc., in most cases this would involve contributing to a common pot with corresponding potential for free riders, particularly in areas with large concentrations of businesses.

4.9.9 Opportunities for PES in urban habitats

As discussed above, the Community Infrastructure Levy (CIL) provides a potential PES-like mechanism for channelling private sector money into the provision of green infrastructure and there is also scope for private PES schemes involving businesses funding green space where they see commercial benefits. In order to capitalise on the opportunity for private schemes, it will be important to better demonstrate some of the links between green infrastructure and commercial benefits in terms of enhanced employee productivity etc. Very small scale PES schemes in urban areas can also be envisaged. For example, following the provision of green

[802] Everard, M. (2010) *The Mayes Brook restoration in Mayesbrook Park, East London: an ecosystem services assessment*. The Environment Agency: Bristol.

space in a new housing development, residents might choose to collectively fund a warden or an environmental NGO to manage the land with flood risk attenuation or biodiversity in mind, thus providing additional ecosystem service benefits.

5 Conclusions and suggested next steps

5.1 Introduction

This section sets out our conclusions and suggestions for next steps in relation to future development of PES in England.

5.2 Conclusions

5.2.1 Defining PES

The term Payments for Ecosystem Services (PES) is often used to describe a variety of schemes in which the beneficiaries, or users, of ecosystem services provide payment to the stewards, or providers, of ecosystem services. A review of the literature suggests that, at a minimum, the following five principles should underpin any arrangement labelled PES:

- stakeholders enter into a PES agreement on a **voluntary** basis;
- payment is made by the **beneficiaries** of ecosystem services (individuals, communities and businesses or governments acting on their behalf);
- payments are made **directly** to ecosystem service providers;
- ecosystem service benefits are **additional** or over-and-above business-as-usual (i.e. land managers must go beyond regulatory compliance) or, if current benefits are demonstrably threatened, then the status quo is at least maintained and continued service provision therefore guaranteed (either way an agreed baseline is a prerequisite); and
- payment is **conditional** on the delivery of ecosystem service benefits (although these may be assumed to occur with the implementation of certain proxy land use practices).

Since PES is based on the 'beneficiary-pays' principle, the research did not address 'trading' systems designed to compensate for damage in one place through improvements elsewhere (such as biodiversity offsets) as these invoke the polluter-pays principle. The research also excluded consideration of certification (e.g. eco-labelling) schemes although these may technically constitute PES and like biodiversity offsets are certainty PES-like. Generally speaking, given the specific principles which underpin PES, we take the view that PES is best considered separately from broader 'ecosystem markets', which include the full array of economic tools used to reward the conservation of ecosystem services.

5.2.2 Scale of PES

PES programmes can be developed at a wide variety of spatial scales. National schemes, for example Environmental Stewardship, which pays about £400 million a year to farmers and land managers in return for more environmentally sensitive farming, tend to be government-financed (whereby government buys ecosystem services on behalf of users, in this case the public). Smaller schemes, in particular those at the scale of individual catchments, are more likely to be user-financed (whereby the buyers are the direct beneficiaries of the services in question). Very small scale PES schemes can also be envisaged. For example, following the provision of green space in a new housing development, residents might choose to collectively fund a warden or an environmental NGO to manage the land with flood risk attenuation or biodiversity in mind, thus providing additional ecosystem service benefits.

5.2.3 Ecosystem services provided

The majority of PES programmes globally focus on four broad types of ecosystem service: watershed protection (including erosion management); carbon sequestration; biodiversity conservation; and landscape aesthetics. Others services that sometimes form part of PES include public access (i.e. recreation or cultural services). While some services lend themselves to user-financed PES programmes, others tend to feature in government-financed schemes. For example, watershed protection often forms the basis for user-financed schemes in which the beneficiaries of downstream ecosystem services such as water quality contract directly with service providers such as upstream watershed managers via localised exchange arrangements ('self organised private deals'). These schemes tend to arise because many water-related services are club goods, i.e. only those located in the watershed benefit and, as such, it is possible to exclude 'free riders'. In contrast, biodiversity conservation often figures strongly in government-financed schemes in which the government contracts with ecosystem service providers on behalf of the public. Government-financed schemes tend to include a focus on wildlife enhancement because public goods such as biodiversity are widely enjoyed by diffuse beneficiaries and, as such, a market is unlikely to spontaneously arise in the absence of government intervention.

5.2.4 Challenges to the use of PES

The research identified a series of key barriers or challenges to the use of PES – see the table below.

Table 43: Barriers to the use of PES

Category	Challenges
Informational	• Lack of awareness among beneficiaries and providers
Technical	• Scientific uncertainty • Establishing baselines • Diffuseness • Appropriate programme size • Avoiding leakage • Ecosystem valuation • Excludability and free riding • Shortage of skills and experience
Spatial	• Spatial variability
Temporal	• Permanence • Time lags • Differing time horizons
Financial	• Perceived risks • High start-up costs • High transaction costs
Institutional	• Collective action problems • Perverse incentives

Category	Challenges
	• Complex policy environment
Legal	• Property rights and other issues
Cultural	• Aversion to paying for ecosystem services • Lack of trust among land managers • Terminology
Equity considerations	• Perceived unfairness

While there are numerous challenges in establishing PES programmes, none of these necessarily represent insurmountable barriers to implementation and this report includes a series of suggested next steps for overcoming the challenges identified. Generally speaking, a considered choice of the services to be provided together with careful programme design can address many of the challenges involved in delivering PES schemes.

5.2.5 Opportunities for PES

The table below sets out the opportunities for establishing PES across England in relation to key ecosystem services. Existing UK and widespread international experience suggests that the promise for new PES schemes appears to be greatest in relation to **water quality** and **water quantity** (including both water resource supply and flood risk attenuation); in particular, it is relatively straightforward to identify providers and beneficiaries and there are numerous examples globally on which programme designers can draw.

The Natural Environment White Paper includes a Government commitment to publish an action plan in 2012 to expand PES schemes in which the provider of nature's services is paid by the beneficiaries.[803] In addition, the White Paper includes a Government commitment to publish a best practice guide for designing PES programmes and states that the Government will also encourage pilots to develop across a broad spectrum of nature's services and beneficiaries.

While there are clear opportunities to promote the emergence of further PES schemes in England, PES remains only one environmental policy instrument among many and is unlikely to represent a universally applicable solution to ecosystem degradation. Rather than revolutionising environmental protection, PES is more likely to promote enhancements in the delivery of existing ecosystem service provision.

[803] HM Government (2011). *The Natural Choice: securing the value of nature* [online] available at: http://www.official-documents.gov.uk/document/cm80/8082/8082.pdf (accessed 11 July 2011).

Opportunities for PES in England

Ecosystem Service	Habitat*	Providers / Sellers	Beneficiaries	Buyers	Opportunities
Regulating					
Climate	Mountains, Moorlands & Heath, Enclosed Farmland; Semi-Natural Grasslands; Woodlands; Freshwaters; **Urban**; Coastal Margins; **Marine**	• Farmers and tenant land managers (Enclosed Farmland; Semi-Natural Grasslands) • Woodland owners and managers • Communities, local authorities, private landholders (Urban)	• **Local residents** (relief from climate stress) • **Global population** (carbon sequestration)	**Government (on behalf of the public), for example** • Payments to farmers under Environmental Stewardship Schemes **Private businesses (on behalf of investors):** • Investment in woodland planting schemes (as a Corporate Social Responsibility initiative) that allows companies to report carbon reduction activities and achieve 'carbon neutrality' where this investment meets the requirements of the UK Woodland Carbon Code under DECC's Greenhouse Gas Monitoring and Reporting Guidelines. **Charitable organisations (on behalf of their members), for example:** • RSPB, Wildlife Trusts, Rivers Trusts; Wildfowl and Wetlands Trust; Woodlands Trust; Marine Conservation Society	• Better targeting of existing AES schemes • Business investment in woodland carbon as a means of abating (but not 'offsetting') unavoidable emissions, e.g. through the Woodland Carbon Code or similarly accredited schemes. . • The Country Land and Business Association has expressed an interest in selling carbon to finance peatland restoration on land owned by those they represent. • There may be opportunities in future (through a Peatland Carbon Code similar to the Woodland Carbon Code) to reduce emissions / sequester carbon through peatland restoration on non-forested land (e.g. through grip/gully blocking and/or revegetation of bare/eroding peat).
Hazard	**Mountains, Moorlands & Heath**, **Enclosed Farmland**; Semi-natural Grasslands; Woodlands; **Freshwaters**; **Urban**; Coastal Margins; **Marine**	• Farmers and tenant land managers (Enclosed Farmland) • Woodland owners and managers	**Government:** • Local Authorities (reduced spending on flood, coastal defence and erosion control measures and/or clean-up costs) **Private businesses:** • Water and energy companies (reduced water treatment and dredging costs) • Port owners and shipping companies (reduced dredging costs) • Insurers (reductions in claims) • Businesses located in river floodplains or at risk of coastal flooding **Local residents:** • Residents located in areas	**Government (on behalf of the public), for example:** • Local Authorities (on behalf of residents and visitors) **Private businesses:** • Water and energy companies • Coastal businesses and businesses located in properties at risk of flooding • Port owners and operators • Insurers (on behalf of premium holders) **Local residents**	• Payments by port-owners and operators and possibly recreational waterway users (e.g. canal boats) to upstream land managers to prevent siltation of navigation channels • Payments by water companies to upstream land managers to prevent sedimentation of reservoirs • Insurers may be interested in opportunities to reduce liability with regards to flooding, dredging and water treatment costs. • Targeting woodland owners and managers of woodlands in suitable locations as providers for flood management services

Ecosystem Service	Habitat*	Providers / Sellers	Beneficiaries	Buyers	Opportunities
			vulnerable to flooding (reduced vulnerability to flooding)		
Disease and pests	**Enclosed Farmland**; **Freshwaters; Marine**	• Farmers and tenant land managers (Enclosed Farmland)	Crop and livestock farmers Timber producers Water companies (where, for example, alien vegetation affects water supplies) Visitors to cultural landscapes	**Government (on behalf of the public), for example:** • Payments to farmers under Environmental Stewardship Schemes **Private businesses:** • Agri-business • Commercial and recreational fisheries • Timber and woodfuel producers • Water companies **Charitable organisations (on behalf of their members), for example:** • RSPB, Wildlife Trusts, Rivers Trusts; Wildfowl and Wetlands Trust; Woodlands Trust; Marine Conservation Society	Payments to land managers (not already enrolled in agri-environment schemes) to clear alien vegetation.
Pollination	**Semi-natural Grasslands; Enclosed Farmland;** Urban	Farmers and tenant land managers (Enclosed Farmland)	**Private businesses:** • Crop farmers and horticultural enterprises	**Private businesses:** • Crop farmers and horticultural enterprises	• Crop farmers and horticultural enterprises (including orchards and flower-growers) may be willing to pay for pollination services supported by SNGLs and EFLs
Noise	Woodlands; **Urban**, Coastal Margins	Land owners and managers with tracts of land / woodland that acts as a noise screen	Local residents, workers, local business	**Government (on behalf of the public):** • Local authorities (on behalf of residents and visitors)	• National government and Local Authorities may be interested in investing in woodlands, urban greenspace and coastal margins to mitigate the adverse impacts of noise on human health, productivity and amenity. • Local businesses may be willing to invest in the noise regulating services provided by ecosystems in order to provide a more conducive working environment and/or opportunities for workers to relieve stress, etc.
Water quality	Mountains, Moorlands & Heath, **Enclosed Farmland**; Semi-natural Grasslands; Woodlands; **Freshwaters; Urban**; Coastal Margins	Farmers and tenant land managers (Enclosed Farmland)	**Local residents** **Private businesses:** • Water companies • Producers /retailers of bottled water • Tourism & leisure industry	**Government (on behalf of the public)** • Environment Agency • Local Authorities **Private businesses:** • Water companies • Producers /retailers of bottled water • Tourism & leisure industry	• Water companies may be interested in paying farmers and land managers in SNGLs to capture and immobilise organic nitrogen, thereby reducing nitrate leaching to surface water systems. Payments to SNGL land owners and managers for maintenance or improvement of surface water quality may be more cost-effective for

Ecosystem Service	Habitat*	Providers / Sellers	Beneficiaries	Buyers	Opportunities
			More distant consumers: • Consumers of piped water supplies and bottled water		utilities than conventional chemical treatment processes • Promoting investment in wetland construction for water treatment as a more cost-effective alternative to engineering solutions.
Soil quality	Mountains, Moorlands & Heath, **Enclosed Farmland**; **Semi-natural Grasslands**; Woodlands; **Freshwaters; Urban**	• Farmers and tenant land managers (Enclosed Farmland and Semi-Natural Grasslands) • Woodland owners and managers • Upland farmers and land managers (mountains, moorlands and heath)	• Farmers (particularly producers of organic crops) • Market gardeners / allotment gardeners in urban and peri-urban settings	**Private businesses:** • Agricultural producers (particularly those supplying organic goods) **Charitable organisations (on behalf of their members), for example:** • RSPB, Wildlife Trusts, Rivers Trusts; Wildfowl and Wetlands Trust; Woodlands Trust; Marine Conservation Society	
Air quality	Enclosed Farmland; Semi-natural Grasslands; Woodlands; Urban; Marine	Farmers and tenant land managers (Enclosed Farmland)	**Local residents** who gain amenity value and health benefits from good air quality **Visitors** (including workers) who obtain amenity and health benefits from good air quality **Private businesses** who may benefit from increased productivity where workers do not suffer from the effects of poor air quality	**Government (on behalf of the public)** • Local Authorities (on behalf of residents and visitors)	• Local Authorities may be interested in investing in woodlands in urban and peri-urban areas to provide a screen for noise and improve local air quality.
Cultural					
Wild species diversity	Mountains, Moorlands & Heath, **Semi-natural Grasslands**; Woodlands; **Freshwaters**; Urban; **Coastal Margins; Marine**	Farmers and tenant land managers (Enclosed Farmland)	**Local residents** who may have chosen their homes partly on the expectation of enjoying local biodiversity. **Private businesses** who benefit from tourism to areas containing high species diversity **Tourists and visitors,** including special interest groups (e.g. birdwatchers) who may be attracted to particular sites simply because of their biodiversity.	**Government (on behalf of the public):** • Payments to farmers under Environmental Stewardship Schemes **Private businesses:** • Developers who may wish to voluntarily offset impacts on habitats and biodiversity **Charitable organisations (on behalf of their members), for example:** • RSPB, Wildlife Trusts, Rivers Trusts; Wildfowl and Wetlands Trust; Woodlands Trust; Marine Conservation Society **Local residents**	• Developers (e.g. house-builders) may be interested in voluntary biodiversity offsetting schemes • Visitor Payback Schemes in National Parks and Nature Reserves

Ecosystem Service	Habitat*	Providers / Sellers	Beneficiaries	Buyers	Opportunities
				• Payments to developers to provide or safeguard habitat for wild species that might not otherwise be provided. **Visitors** • Special interest groups (e.g. birdwatchers; researchers, etc) • Tourists	
Environmental settings: local places	Mountains, Moorlands & Heath, Enclosed Farmland; Semi-natural Grasslands; Woodlands; Freshwaters; Urban; Coastal Margins	Farmers and tenant land managers (Enclosed Farmland) Individuals, companies, clubs or syndicates who hold land-related rights such as those over game sports, including access to water areas for, e.g. fishing or recreation, or forests for, e.g. walking, mountain-biking.	**Local residents** who may have chosen their homes partly on the expectation of being able to enjoy the local setting. **Visitors,** including tourists and specialist groups, who are attracted to local places because of their cultural, historical or spiritual significance, or for recreational purposes. **Private businesses** who benefit from tourism to local places.	**Government (on behalf of the public):** • Payments to farmers near urban areas for recreational opportunities • Local authorities (for amenity) • National Park Authorities **Private businesses:** • Payments to farmers near urban areas for recreational opportunities • Tourism and leisure operators (on behalf of tourists and visitors) may pay for maintenance of places with cultural or archaeological heritage **Charitable organisations (on behalf of their members), for example:** • RSPB, Wildlife Trusts, Rivers Trusts; Wildfowl and Wetlands Trust; Woodlands Trust; Marine Conservation Society • Community organisations, e.g. Groundwork UK, Community Forests, etc	• Farmland near major urban areas is under demand for informal recreation such as walking, running, riding, and cycling. Where these pressures are major, it may be attractive to both farmers and recreationalists (perhaps represented by Local Authorities or others) to agree on routes for these activities rather than coping with the impacts of unmanaged recreation. However, the problems of securing payment from the individuals involved are significant, and it may be simpler to arrange long-term purchase or leasing of land, for country parks or pathways. • Payments by anglers for recreational fishing rights through, for example, more widespread uptake by Rivers Trusts of the Angling Passport Scheme.
Environmental settings: landscapes/seascapes	Mountains, Moorlands & Heath, Enclosed Farmland; Semi-natural Grasslands; Woodlands; Freshwaters; Urban; Coastal Margins; Marine	Farmers and tenant land managers (Enclosed Farmland)	**Local residents** who may have chosen their homes partly on the expectation of being able to enjoy the local setting and because of the health benefits that certain designations or landscape features may provide. **Visitors** who derive enjoyment or inspiration from the aesthetic experience of a landscape/seascape, or who benefit from recreational and educational opportunities.	**Government (on behalf of the public):** • National Park Authorities and National Nature Reserves **Private businesses:** • Tourism and leisure operators (on behalf of tourists and visitors) may pay for preservation of iconic English landscapes **Charitable organisations (on behalf of their members), for example:** • RSPB, Wildlife Trusts, Rivers Trusts; Wildfowl and Wetlands Trust; Woodlands Trust; Marine Conservation Society	• Visitor payback schemes emerging that enable visitors to pay for environmental management that supports cultural services such as recreation, cultural heritage and landscape aesthetics. • Payments to forest owners / managers to reward them for the cultural services they provide.

Ecosystem Service	Habitat*	Providers / Sellers	Beneficiaries	Buyers	Opportunities
			Private businesses who benefit from tourism to local places.	**Visitors:** • Tourists • Special interest groups, e.g. hikers, orienteerers • Educational groups and researchers • Religious / spiritual groups	
Provisioning					
Crops	Enclosed Farmland; Urban	Farmers and tenant land managers; market gardeners and allotment managers	**Farmers and tenant land managers** who benefit from consumption and sale of crops produced within EFL. **Secondary industries** supported by the crop-farming industry **Retailers** **Consumers**	**Private businesses:** • Retailers • Energy companies (biomass for biofuel) **Consumers** **Producer and certification organisations** (on behalf of consumers)	Markets for crops produced on Enclosed Farmlands and urban / peri-urban market gardens are already well-established
Livestock / Aquaculture	Enclosed Farmland; Marine	Farmers and tenant land managers	**Farmers and tenant land managers** who benefit from consumption and sale of livestock / aquatic species **Secondary industries** supported by the livestock and aquaculture industries **Retailers** **Consumers**	**Private businesses:** • Retailers **Consumers** **Producer and certification organisations** on behalf of consumers	Markets for livestock and aquaculture are already well-established
Fish	**Freshwaters**, **Coastal Margins**, **Marine**	**Farmers and tenant land managers** (riverine fisheries); **Clubs and syndicates** who hold land-related rights, including access to water areas for fishing, etc. **Government and associated agencies:** • Environment Agency (riverine fisheries); • Marine Management Organisation (marine fisheries)	Commercial fishers; secondary industries supported by the fishing industry, recreational anglers	**Government (on behalf of the public):** • Environment Agency **Private businesses:** • Commercial fisheries **Visitors:** • Recreational anglers • Sports clubs and special interest groups (e.g. Angling Associations, Wild Trout Association) **Conservation organisations, for example:** • Rivers Trusts, Marine Conservation	Markets for commercial fisheries are already well-established but there may be opportunities to expand existing payment schemes in riverine fisheries, i.e. the Angling Passport Scheme

Ecosystem Service	Habitat*	Providers / Sellers	Beneficiaries	Buyers	Opportunities
				Society Consumers and retailers	
Trees, standing vegetation, peat	**Mountains, Moorlands & Heaths**, Enclosed Farmland; Woodlands, **Freshwaters**; Urban	**Government and associated agencies:** • Forestry Commission • The Crown Estate • The Ministry of Defence **Private landowners and tenant managers:** • Farmers and tenant land managers (Enclosed Farmland) • Forestry estate owners		**Private businesses:** • Timber and bio/woodfuel producers • Wood-products industry including manufacturing, construction and paper)	Markets for timber and non-timber forest products are already well established.
Water supply	Mountains, Moorlands & Heath; **Enclosed Farmland**; **Freshwaters**; Urban	**Government and associated agencies** • The Crown Estate • Forestry Commission • Ministry of Defence • Farmers and tenant land managers (Enclosed Farmland) **Private companies** with significant land holdings (e.g. water, mining and energy companies.	Intermediate and end-consumers of water supplies	**Government (on behalf of the public):** • Payments to farmers under Environmental Stewardship Schemes • Local authorities **Private businesses:** • Water and energy companies (on behalf of consumers) • Water-dependent enterprises (e.g. producers of bottled water) • Farmers (for irrigation) **Charitable organisations (on behalf of their members), for example:** • RSPB, Wildlife Trusts, Rivers Trusts; Wildfowl and Wetlands Trust; Woodlands Trust; Marine Conservation Society	• Water and energy companies may also be willing to pay upland land managers to manage their land to enhance the supply of good quality water downstream.

* The Broad Habitat types listed in this column are those assessed by the UK NEA having High or Medium-High for delivering the ecosystem service. Those demarcated in bold are where these has been a deterioration of the ecosystem service in that habitat since 1990. Note, however, that this assessment represents a UK-wide overview and will vary nationally, regionally and locally.
† Provisioning services are shown in faded text to reflect the fact that these are already largely traded in private markets and are therefore not the subject of PES.

5.3 Potential next steps

Following on from the research, this section sets out a range of potential next steps for promoting the development of PES schemes across England. The emphasis here is on facilitating the emergence of user-financed schemes but modifications to government-financed schemes to enhance their efficiency and effectiveness should also be explored (for example, through the use of 'inverse auctions'). In order to implement the next steps suggested here, a wide range of stakeholders will need to be proactively engaged including Government, the Environment Agency, Natural England, local authorities, environmental NGOs as well as landowners and managers.

5.3.1 Planning for ecosystem services

The identification of prospects for private, user-financed PES programmes to emerge together with opportunities to enhance the efficiency and effectiveness of existing government-financed schemes (e.g. Environmental Stewardship) are likely to be facilitated through planning for ecosystem services on a spatial basis (referred to by one workshop attendee as 'bioregional planning'). Planning for ecosystem services on a spatial basis (note we are consciously avoiding the term 'spatial planning' as this has an accepted meaning in the context of local authority development planning) would involve undertaking a range of activities within a defined area (for example, a catchment) including: gathering evidence to identify geographical variations in ecosystem service provision; identifying areas at risk of seeing services lost or degraded; establishing the spatial variation in opportunity costs associated with enhanced service provision; and determining the land uses and land management techniques likely to deliver improved provision. Armed with this knowledge, those responsible – including perhaps local authorities, the Environment Agency, Natural England and other stakeholders including local landowners – could begin the process of targeting areas with the greatest potential for service enhancement and start to bring together potential buyers and sellers, establish baselines and so on and ultimately develop appropriate PES schemes. The OECD has argued that *"…biodiversity and ecosystem benefits tend to vary from one location to another… The greater the spatial variation in costs and benefits, the larger the potential cost-effectiveness gains are when PES programmes are designed to take these differences into account"*.[804] Planning for ecosystem services on a spatial basis could also assist in identifying areas for potential habitat creation/restoration into which Section 106 or Community Infrastructure Levy (CIL) monies secured from developers for the purposes of biodiversity offsetting could be most effectively channelled. Planning for ecosystem service provision in this way could also help to bring together the policies and proposals contained in a wide range of relevant plans and strategies including Local Plans, River Basin Management Plans/Programmes of Measures, Catchment Flood Management Plans, Catchment Abstraction Management Strategies, and local authority green infrastructure strategies. The Natural Environment White Paper includes a Government commitment to support the creation of Nature Improvement Areas (NIAs) and Natural England is tasked with establishing a competition to identify 12 initial areas.805 These areas could provide a valuable opportunity to pilot the concept of planning for ecosystem services on a spatial basis.

5.3.2 Further develop the evidence base

Designing a PES programme requires evidence. For example, for a PES scheme to be feasible it will be necessary to identify cause-and-effect, i.e. will a certain land use or

[804] OECD (2010). *Paying for biodiversity: enhancing the cost-effectiveness of payments for ecosystem services*. OECD: Paris.
[805] HM Government (2011). *The Natural Choice: securing the value of nature* [online] available at: http://www.official-documents.gov.uk/document/cm80/8082/8082.pdf (accessed 11 July 2011).

management practice yield an increase in the desired service and can the basic terms for payment therefore be established? In some cases, the evidence will be clear cut; for example, hedgerows may have an established role in promoting biodiversity. In other cases, the evidence may be less conclusive; for example, downstream communities may be uncertain as to which areas of land are currently or could be best placed to alleviate flood risk through changes in land management. For regulated issues such as water quality a wide range of stakeholders may need to be convinced by the evidence (including Ofwat and the Drinking Water Inspectorate). In light of this, a concerted effort will be needed to further develop the evidence around ecosystem service provision but also, in particular, to disseminate this among key stakeholders (e.g. utilities, statutory consultees). In particular, further evidence will need to be assembled and communicated in relation to:

- the links between biodiversity, ecosystem function and ecosystem services;
- the values people attach to the benefits derived from ecosystems;
- links between land management practices and ecosystem service outcomes; and
- metrics to measure service provision (e.g. carbon stores under different management regimes or biodiversity indices).

Several recent initiatives should serve to strengthen the general evidence base around ecosystem services. These include the Valuing Nature Network, sponsored by the Natural Environment Research Council (NERC) and NERC's Biodiversity & Ecosystem Service Sustainability (BESS) research programme. Further research could potentially include the development of rapid biophysical assessment methods to reduce the cost of establishing baselines and so promote cost-effectiveness and scalability.[806] Establishing the links between land management practices and ecosystem service outcomes (i.e. cause-and-effect) will be particularly important for PES. As an illustration, the RSPB has observed that *"when scientific understanding of the causes of the loss of bees is further advanced, it is possible to envisage a private PES where landholders that rely on pollination pay for a reduction in damaging actions elsewhere"*.[807] The existing evidence surrounding land management and ecosystem service provision could be usefully included in the Government's proposed best practice guide for designing PES programmes or perhaps in a compendium accompanying it.

5.3.3 Promote open source databases

The scientific and economic evidence required to develop PES programmes and undertake wider spatial planning for ecosystem services needs to be easily accessible to a wide range of potential PES actors including providers, beneficiaries and brokers or intermediaries. An open source approach to data provision facilitated by the Government could be very helpful. Related to this, the Natural Environment White Paper includes a Government commitment to bring together web-based Government information on the natural environment and make this available through a single 'My Environment' web portal, including facilities to search by post code for environmental features.[808]

[806] Wunder (2008) cited in WWF (2010). *Payments for Ecosystem Services: Literature Review* [online] available at: http://www.planvivo.org/wp-content/uploads/Framework-for-PES-feasibility_WWF_MorrisonAubrey_2010.pdf (accessed 21 July 2011).
[807] RSPB (2010). *Financing nature in an age of austerity* [online] available at: http://www.rspb.org.uk/Images/Financingnature_tcm9-262166.pdf (accessed 26 April 2011).
[808] HM Government (2011). *The Natural Choice: securing the value of nature* [online] available at: http://www.official-documents.gov.uk/document/cm80/8082/8082.pdf (accessed 11 July 2011).

5.3.4 Establish a PES Capacity Building Group

Forest Trends, the Katoomba Group, and UNEP (2008) have argued that *"Due to the amount of specialized information needed to get PES deals off the ground, support institutions may be a cost-effective – and perhaps unavoidable – investment"*.[809] Although a new body would be arguably inappropriate, the capacity building necessary to promote PES will need to be coordinated and, as such, we would recommend establishing a dedicated PES Capacity Building Group. The Group's objectives could include contributing to the Government's proposed best practice guide to designing PES programmes; running awareness raising and training events for key stakeholders (utilities, local authorities, statutory consultees, environmental NGOs etc.); providing capacity building for brokers or intermediaries; assembling case studies and disseminating relevant research; and overseeing pilots and the Government's proposed PES seed fund (see below).

Case studies for dissemination will include Defra 'multi-objective demonstrator projects' (which seek to apply the ecosystem services approach to three flood risk management schemes, Pickering, Honicote and the Derwent); Natural England's ecosystem approach pilots (Bassenthwaite Lake catchment, Cumbria; South Pennines National Character Area, Yorkshire; and Dartmoor and Exmoor, South West); and WATER (a partnership including various Rivers Trusts, the Environment Agency and South West Water to take forward a market-based catchment restoration scheme based on a PES model). Engel *et al.* (2008) point out that, despite considerable interest in the use of PES worldwide, few PES mechanisms have been carefully documented and discussion of PES mechanisms has remained largely confined to the grey literature (in which, moreover, proposals for PES mechanisms are more common than assessments of actual working mechanisms).[810] Formal evaluations of user-financed PES programmes in the UK and subsequent journal papers would therefore be helpful.

5.3.5 Identify and develop 'honest brokers'

The PES literature consistently emphasises the importance of **'honest brokers'** in developing PES programmes and the identification and development of independent and credible brokers will be key to developing user-financed schemes. Brokers can undertake a wide range of activities, including:

- help sellers assess an ecosystem service 'product' and its value to prospective buyers;
- assist sellers with establishing relationships and rapport with potential buyers;
- enable sellers get to know potential buyer(s);
- assist with proposal development; and
- administering PES programmes.

Jack *et al.* (2008) point out that PES schemes are often focused on many individual landowners whose collective activities alter the levels of a given ecosystem service and this feature will increase costs. However, they argue that working with a third-party intermediary such as an NGO or a community could reduce the costs of working with a large number of providers.[811] In addition, as Perrot-Maître (2006) argues, the primary reasons for the success of most PES schemes are not financial. Instead, the fundamental conditions of success

[809] Forest Trends, the Katoomba Group, and UNEP (2008). *Payments for Ecosystem Services: Getting Started – A Primer* [online] available at: http://www.katoombagroup.org/documents/publications/GettingStarted.pdf (accessed 30 April 2011).
[810] Engel, S., Pagiola, S., and Wunder, S. (2008). Designing payments for environmental services in theory and practice: an overview of the issues. *Ecological Economics* 65(4): 663–674.
[811] Jack, B.K., Kouskya, C. and Simsa, K.R.E. (2008). Designing payments for ecosystem services: Lessons from previous experience with incentive-based mechanisms. *PNAS* 105(28): 9465-9470.

include trust-building through the creation of an intermediary institution (locally based and led by a "champion" sympathetic to the providers' cause); the development of a long-term participatory process to identify alternative practices and a mutually acceptable set of incentives; the ability to link incentives to land tenure and debt cycle issues; and to substitute the old technical and social support networks with new ones.

5.3.6 Learn by doing

Given the challenges inherent in establishing PES programmes, a significant element of 'learning by doing' will be inevitable and key stakeholders including utilities, statutory consultees and environmental groups will need to adopt a pragmatic approach to programme development which allows flexibility for modifications in light of practical experience.

5.3.7 Establish a PES seed fund

In order to promote the emergence of user-financed PES programmes, Defra could consider establishing a seed fund and invite applications for small scale grants to kick off the development of PES programmes. Grants could contribute to start-up costs, initial workshops between buyers and sellers, buying in expert assistance (e.g. facilitation) etc. In order to evaluate applications, it will be important to consider what constitutes a PES programme and reference to the five principles outlined above could be helpful in this regard. The Natural Environment White Paper includes a Government commitment to introduce a new research fund targeted at PES schemes.[812]

5.3.8 Mobilising PES finance

The OECD argues that there is considerable scope for scaling-up private sector financing in PES programmes, especially as business becomes more aware of the opportunities that investment in ecosystem services can provide.[813] Private sector engagement in PES involving water quality and quantity and carbon sequestration should be actively explored and encouraged. In particular, there may be potential to package payments for clean water, carbon sequestration and biodiversity together in schemes designed to restore degraded peatlands. Indeed, market research suggests that there is substantial interest among UK-based companies in making payments for carbon sequestration that have associated co-benefits.[814] The Natural Environment White Paper includes a Government commitment set up a business-led Ecosystem Markets Task Force to review the opportunities for UK business from expanding the trade in green goods and the market for sustainable natural services.[815] This could provide a useful forum for discussing sources of PES finance and how to best to engage the private sector. Other sources of PES finance might include the Government's proposed Green Investment Bank, which is set to play a vital role in addressing market failures and unlock significant new private investment in 'green infrastructure' projects.[816]

5.3.9 Evaluate the effectiveness of PES

In order to promote PES it will be crucial to monitor and evaluate the effectiveness of existing programmes in satisfying key objectives, particularly the degree of additionality secured and

[812] HM Government (2011). *The Natural Choice: securing the value of nature* [online] available at: http://www.official-documents.gov.uk/document/cm80/8082/8082.pdf (accessed 11 July 2011).
[813] OECD (2010). *Paying for biodiversity: enhancing the cost-effectiveness of payments for ecosystem services*. OECD: Paris.
[814] Rabinowitz, R. and Este d'Hoare, J. (2009). *The Feasibility of Creating a Funding Mechanism for UK Carbon Reduction Projects: Key Findings from a BRE Research Project*. BRE, unpublished report.
[815] HM Government (2011). *The Natural Choice: securing the value of nature* [online] available at: http://www.official-documents.gov.uk/document/cm80/8082/8082.pdf (accessed 11 July 2011).
[816] For further information, see http://www.bis.gov.uk/greeninvestmentbank (accessed 29 July 2011).

any equity implications. In particular, evaluations of any instances in the use of inverse auctions would be particularly beneficial since these are viewed by the OECD as a key means for promoting efficiency in PES schemes.[817]

5.3.10 Pursue a different approach for biodiversity in PES

The OECD argues that in cases where the ecosystem services in question are public goods, such as biodiversity, the incentives to free-ride may preclude the establishment of direct user-financed PES programmes.[818] One approach may be for biodiversity conservation organisations help to cover the significant start-up costs of a PES scheme in return for not having to pay the recurrent future costs. Another approach might be for the Government to provide part funding for benefits that do not accrue to business.[819]

[817] Inverse auctions require potential ecosystem service sellers to submit bids indicating the minimum payment they are willing to accept for the provision of an ecosystem service).
[818] OECD (2010). *Paying for biodiversity: enhancing the cost-effectiveness of payments for ecosystem services*. OECD: Paris.
[819] RSPB (2010). *Financing nature in an age of austerity* [online] available at: http://www.rspb.org.uk/Images/Financingnature_tcm9-262166.pdf (accessed 26 April 2011).

Appendix 1 – Workshops

Regional Workshop

Date:

Wednesday 9th February 2011, 10.30 – 16.30

Location:

Exeter Conference Centre, Exeter

Attendance List:

Surname	Name	Organisation
Baker	Martin	Ofwat
Barden	Ruth	Wessex Water
Beatty	Matilda	Severn Trent Water
Clarke	Liz	URS/Scott Wilson
Couldrick	Laurence	Westcountry Rivers Trust
Crowe	Eamon	Natural England
Dunn	Helen	Defra
Everard	Mark	Environment Agency
Inman	Alex	Freelance Environmental Management Consultant
McGarvey	Cathy	South West Water
Mitchell	Diane	NFU
Molloy	Dominic	RSPB
Oates	Robert	Thames Rivers Restoration Trust
Rickard	Arlin	Association of Rivers Trusts
Rowcroft	Petrina	URS/Scott Wilson
Scott	Alex	Yorkshire Water
Smith	Laurie	SOAS

Surname	Name	Organisation
Smith	Steve	URS/Scott Wilson
Toms	Simon	Environment Agency
Ulf-Hansen	Flemming	Natural England
Watts	Bill	Environment Agency
White	Janine	United Utilities

Agenda:

10.00	**Registration** Tea and coffee
10.30	**Welcome and overview** *Petrina Rowcroft (Principal Environmental Economist, URS/Scott Wilson)*
10.40	**Understanding PES in the context of Defra's Natural Value Programme and the National Environment White Paper** *Helen Dunn (Study Lead, Defra)*
10.50	**Introduction to the research – where are we now?** *Dr Steve Smith (Associate, Climate Change and Policy, URS/Scott Wilson)*
11.10	**The work of WATER in the Westcountry** *Dr Laurence Couldrick (Westcountry Rivers Trust)*
11.40	**Questions and answers**
11.50	**Coffee break**
12.05	**Breakout session 1** What are the key challenges for water-related PES schemes?
12.55	**Breakout session 1** Feedback
13.05	**Lunch**
13.45	**Introduction to afternoon session** *Petrina Rowcroft (Principal Environmental Economist, URS/Scott Wilson)*
13.50	**Breakout session 2** How do we respond to the key challenges?
14.45	**Breakout session 2** Feedback

15.00	**Coffee Break**
15.15	**Breakout session 3** Establishing a framework for implementation of PES in practice
16.00	**Breakout session 3** Feedback
16.20	**Next steps and closing remarks** *Petrina Rowcroft (Principal Environmental Economist, URS/Scott Wilson)*
16.30	**Close**

National Workshop

Date:

Friday 8th April 2011, 9.30 – 16.30

Location:

Zoological Society of London, London

Attendance List:

Surname	Name	Organisation
Baker	Martin	Ofwat
Brooke	Diane	RWE npower
Carver	Kate	The Wildlife Trust
Clarke	Liz	URS/Scott Wilson
Couldrick	Laurence	Westcountry Rivers Trust
Donovan	Deanna	JNCC
Dunn	Helen	Defra
Durham	Christopher	Defra
Egan	Jim	Farming and Wildlife Advisory Group
Everard	Mark	Environment Agency

Surname	Name	Organisation
Eyre	Simon	Anglian Water
Fessey	Mark	URS/Scott Wilson
Furness	Martin	Ofwat
Haigh	Nick	Defra
Harlow	Julian	Natural England
Hayes	Mike	National Planning Forum
Hughes	Stephen	Montgomeryshire Wildlife Trust
Knight	Paul	Salmon and Trout Association
Leake	Alastair	Game and Wildlife Conservation Trust
Legg	David	Environment Agency
Margerison	Ceri	British Ecological Society / Natural Capital Initiative
Molloy	Dominic	RSPB
Oates	Robert	Thames Rivers Restoration Trust
Owen	Nicola	Mineral Products Association
Payne	Michael	Environmental Consultant representing NFU
Radermacher	Kristina	Defra
Reed	Mark	Aberdeen University
Richardson	Jeremy	URS/Scott Wilson
Rickard	Arlin	Association of Rivers Trusts
Ross	Martin	South West Water
Shannon	Delia	Aggregate Industries
Sheppard	Liz	DECC
Smith	Steve	URS/Scott Wilson
Smith	Bob	Hanson
Snowdon	Pat	Forestry Commission
Thomson	Ken	The James Hutton Institute
Valatin	Gregory	Forest Research
Waters	Dr Ruth	Natural England
Watts	Bill	Environment Agency
Wells	Andrew	Crown Estate
Winder	Frances	Woodland Trust

Surname	Name	Organisation
Wright	David	Fauna and Flora International
Young	Michael	Tarmac Limited
Baker	Martin	Ofwat
Brooke	Diane	RWE npower

Agenda:

09:30	**Registration** Tea and coffee
09:45	**Welcome** Dr Steve Smith (Associate, URS Scott Wilson)
09:50	**PES: A brief introduction** Dr Steve Smith (URS Scott Wilson)
10.05	**Natural Environment White Paper (NEWP) update** Helen Dunn (Study Lead, Defra)
10:15	**Barriers to PES** Dr Steve Smith (URS Scott Wilson)
10:40	**Breakout session 1** Measures to address the top barriers to PES
11:25	**Plenary 1** Feedback from Session 1
11:40	**Potential for PES in the uplands** Dr Mark Reed (University of Aberdeen)
11.55	**Coffee break**
12:10	**Opportunities for PES** Dr Steve Smith (URS Scott Wilson)
12:25	**Breakout session 2** Measures to capitalise on opportunities
13:10	**Plenary 2** Feedback from Session 2

13:25	**Lunch**
14:00	**PES in practice 1: water catchments** Dr Laurence Couldrick (Westcountry Rivers Trust)
14:20	**PES in practice 2: urban** Robert Oates (Thames Rivers Restoration Trust)
14.40	**Study recommendations** Dr Steve Smith (URS Scott Wilson)
15.00	**Coffee break**
15.10	**Breakout session 3** Facilitating future PES
15.55	**Plenary 3** Feedback from Session 3
16.15	**Wrap-up and close** Dr Steve Smith (URS Scott Wilson)
16.30	**Optional free entrance to London Zoo**