Payment for Ecosystem Services

A report for *emda*

Ove Arup & Partners Ltd

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Payment for Ecosystem Services in the East Midlands

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Executive Summary

Introduction

Ecosystems can provide a range of benefits and services to society and the economy. By way of example, ecosystem services can include clean and regular water supply, the production of food and fibre and the protection of communities from hazards. These services are an essential underpinning for the whole East Midlands economy. Importantly, large sections of the East Midlands economy are directly dependent upon a well-functioning environmental infrastructure e.g. water supply, tourism and health.

The role of public and private sector bodies in supporting, encouraging and helping bring about economic benefits from financially self-sustaining ecosystems is poorly understood, particularly within the UK and at the regional governance level.

As part of *emda*'s role in improving the economy and environment of the East Midlands, the Agency commissioned Arup, working with the Centre for Environmental Management at Nottingham University as contributors, to undertake a study into the role of regional bodies in supporting Payment for Ecosystem Services (PES).

The study is intended to deliver well argued and evidenced recommendations for the future role and influencing mechanisms of regional bodies and local authorities in supporting PES models, with particular reference to the potential for public/private sector partnerships in this area.

Ecosystem services

Nature provides the East Midlands with a vast array of often undervalued material, health and cultural benefits. Nature also supports cultural wealth and sustains the health of residents and workers alike. Although society's well being is totally dependent upon the continued flow of these ecosystem services, they are predominantly provided "free of charge". The absence of a value means that no economic incentive exists to maintain those services.

The "Business as Usual" pathway of growth through continued exploitation of these resources only remains sustainable for as long as our natural capital renews itself and remains available. The UN Millennium Ecosystem Assessment has revealed that human use of ecosystem services is, however, overwhelming the ability of natural systems to continue to supply those needs whilst renewing themselves. Evidence from the East Midlands suggests that the problems of over consumption are observable within the region's ecosystem services for (e.g. locally provisioned ecosystems goods and services such as timber and fibre) even without accounting for future growth.

Whilst globalisation has lessened the dependency of regional enterprises on ecosystem services based on the provision of material goods like timber, fibre and food from within the region, there are still a whole range of services whose functionality is no less valuable to the regional economy but often go unrecognised. The contribution of ecosystems to the delivery of services that control flood water, purify water, support culture/ tourism, promote healthy populations or support the provision of material goods (e.g. soil quality) often goes unnoticed. Whilst these services are undervalued, the cost of *not* having these services would be reflected in the financial economy through higher insurance costs, more expensive infrastructure, erosion of the visitor economy and poorer labour productivity. Due to longer term security of supply issues, it may be advantageous for the region to seek to maintain and even raise the productivity of its ecosystems in the future.

Payment for ecosystem services

The opportunity cost associated with the loss of an ecosystem service is potentially immense with lasting implications on the growth potential achievable in the financial economy. Currently, there is mounting concern over the loss of pollination services following

the much publicised colony disorder collapse afflicting bee populations which are estimated to be worth £30 billion worldwide (Benjamin and McCallum, 2008[1]). Substituting for the loss of an ecosystem service (once it has occurred) may be either impracticable or vastly more expensive than taking counter measures to sustain the service.

The commitment of financial investment to sustain ecosystem service outputs does, however, require a clear financial business case to justify it. More controls may simply lead to stagnation rather than any improvement. Valuing ecosystem services is a first step to realising the benefits in sustaining those services and eventually paying for their provision.

Payments for ecosystem services (PES) refers to either funding the owner of an ecosystem to maintain, enhance or stabilise the provision of an ecosystem service or purchasing from the owner of a (unitised ecosystem) service such as a carbon credit. The term "Payment for Ecosystem Services" is still a fluid term spanning market based initiatives like carbon trading, through to the purchase of land that contains an ecosystem supplying a vital service to more conventional government interventions like existing agri-environment payments.

Identifying a financial value

Confidence in the valuation of an ecosystem service is fundamental to the viability of PES approaches. In the absence of a tangible market value, valuations have to be established through the use of acceptable proxy measures. Valuations are typically based on primary research that establishes a value (by using proxies) for a market based on either costs avoided, or replacement value associated with the continued provision of a service or surveys that establish people's willingness to pay for a service. Collectively, these techniques establish a "Total Economic Value" for the service. The expense of primary data collection would make it impractical given current methods and costs to collect context specific data on the East Midlands region for all but a small sample of cases. The concept of "benefits transfer" overcomes this barrier by allowing a valuation established for a similar service located outside the East Midlands to be used as a basis of valuing a service located within the region. The transferability of a value depends upon the way values are expressed in terms of a measurable quantity at the location to which the value is going to be applied. Typically, services are expressed in terms of a financial value per unit area of an ecosystem. Defra has developed an extensive database of valuations case studies that can be used for this purpose.

These techniques do, however, raise a number of important issues concerning the robustness of the valuations and their impact on public policy. The calculated value of an ecosystem service will be sensitive to the physical boundaries placed on an ecosystem. Boundaries will be dependent upon the type of classification systems used to distinguish one ecosystem from another. The compatibility of classification systems will, in turn, have an impact on the appropriateness of using a particular valuation like those available in Defra's database. Moreover, the assumption that each unit area of an ecosystem contributes equally to the delivery of a vital service for people runs counter intuitive to actual evidence on how natural systems behave. A fixed valuation based on a single unit measure (e.g. based on land cover) may also be insensitive to natural variability in the flow of a service which will be affected by extraneous events like climate change. Given gaps in the evidence, it is therefore suggested that a pilot exercise should be undertaken in the East Midlands to explore some of these issues further.

[1] *A World Without Bees, Benjamin & McCallum, 2008 London: Guardian Books.*

The baseline condition of existing ecosystem service production in the East Midlands

An analysis has been undertaken of the ecosystem service characteristics of the region with the findings summarised in the table below. More detail can be found in table 6.1 on page 58.

Stable	Food production (Namely the productive capacity of land); Navigation (Well functioning rivers and canals)
Declining	Pollination (population of pollinators e.g. bees); fisheries (the productive capacity of marine ecosystems); Water provisioning (level of discharge to ground water and surface water); Genetic (the level of genetic biodiversity); Global Climate regulation (the capacity for carbon sequestration in peat uplands); Flood protection (from natural habitats); Soil erosion from surface run off (decreased quality of soils).
Unknown	Specialist fibre (e.g. thatching); Biofuel production; Ornamental Resources (e.g. flowers and animal products; Local climate regulation (e.g. wind breaks); Local air quality; Pest and disease regulation.
Increase	Bio gas from animal waste; Certain classes of renewable energy production (e.g. wind; bio waste assimilation); Landscape (e.g. Recreational uses of the landscape – observing nature and hunting/ fishing.)

These findings support the general assessment contained in the Millennium Assessment that there are grounds for concern in relation to ecosystem service output especially given regional growth aspirations. Practically, our analysis suggests that in particular, future threats to the security of supplies drawn from outside the region may make land productivity an increasingly important factor for the region e.g. the tension for land use between food and bio fuels.

The East Midlands: existing activity

Little evidence exists that the region's resource intensive industries are looking beyond the traditional approach to environmental impacts (based on establishing the effect of an operation on a receptor) to consider their dependency on a flow of ecosystem services. The Food & Drink and tourism sectors show some recognition of their reliance on these services but without an explicit recognition. However, sector plans currently do not translate this basic awareness into a wider analysis or valuation strategy. Whilst the East Midlands Regional Economic Strategy (RES) includes a strong policy theme concerning natural resource consumption, the cross link to enterprise seems less well developed in terms of specific sector strategies and general business support.

Challenges in securing engagement with a buyer community, for the purposes of developing this study does not mean that buyer activity is absent in the region. For example, we have uncovered the potential for PES schemes in the water supply sector. However, there are a number of uncertainties over the valuation of the services (which complicate the issue from both 'buyer' and 'seller' perspectives).

At the other end of the scale from large water companies, tourism represents a sector populated by a myriad of small enterprises (for example in sub sectors like holiday accommodation and attractions on the East Coast). Usually, no single enterprise dominates in relation to their impact on ecosystem service provision (e.g. based around a valued landscape). Under these conditions there is a significant market failure based around how the costs of maintaining these services are divided between the beneficiaries.

Towards a strategy for stabilising and improving ecosystem services in the East Midlands

Verification, valuation and boundary effects mean that the establishment of a robust system supporting the flow of ecosystem services within the region can not be achieved simply. The scope for challenge by both buyers and sellers is significant alongside the range of gaps in knowledge about what the baseline condition of ecosystem services in the East Midlands.

Currently no organisation owns the task of managing the establishment of PES in the East Midlands rather the knowledge and potential levers of control are split across a number of different organisations including Natural England and the Environment Agency. Moreover, no incentive exists for one of the existing players to lead without certainty over how they would be compensated for taking the role.

Relying on the formation of "business to business" PES contracts could introduce its own form of bias in the management of ecosystems by pulling land management towards the production of certain ecosystem services rather than others which may have a wider societal benefit. Sectors dominated by small and medium sized enterprises in sectors like tourism and construction typically lack the capabilities to assess business risk in the same manner as larger companies meaning that they are less likely to become sophisticated buyers.

The management of future growth of the region is also predicated on the continuance and increase in ecosystem services. The Regional Spatial Strategy[2] will require large quantities of material to build and then maintain all the additional houses, infrastructure and business accommodation expected over the next twenty years. This growth will draw in materials purchased from within the region but also outside it. More critically, growth will also require localised ecosystem services that regulate flooding; maintain water quality and manage air quality to remain stable or increase. Measured at the regional scale, many of these services are already considered to be under stress. New development can, however, contribute to the delivery of ecosystem services in their own right through the use of green infrastructure.

A review of existing working practices and the institutional arrangements currently in place would suggest that a "business as usual" approach would not address the twin aims of providing a coherent framework for maintaining the performance of regional ecosystem services delivery or sustained economic growth.

Market failure arguments[3] could be used to support the implementation of a comprehensive approach. Arguably, one of the two main environmental regulatory agencies could take responsibility for creating a comprehensive approach, although there may be compatibility problems with existing activities. Some scope would seem to exist for 'packaging' suppliers of ecosystems and matching them with potential buyers. The evidence base justifying the flow of benefits, therefore, becomes critical.

Identifying priority actions

The study findings suggest that without a clear business case and risk assessment, potential buyers of ecosystem services are unlikely to spontaneously form relationships with suppliers to maintain/ increase supply. Encouragingly, tools do exist that allow businesses to assess risk and opportunities; these may be useful devices for business representative organisations to promote awareness of an ecosystems approach.

A minimum organising capacity is assumed necessary to develop and implement PES in the East Midlands. A review of existing organisations, combined with evidence from consultative workshops, suggests that there are uncertainties over who should provide leadership. There may be a role for *emda* and its partners to take forward this responsibility and devolve it to a

[2] *Regional Spatial Strategies were a feature of Government Planning Policy at the time of writing*
[3] OffPAT Advice Note 1/2009 *The Rationale for Public Sector Intervention in Economic Development and Regeneration Programmes and Projects*

special purpose vehicle set up with a specific remit to promote the establishment of payment systems within the region.

Priority Regional Actions

The following 'Priority Regional Actions' have been identified for the region:

	Action	Timescale
Action 1	Promote good practice standards in the reporting of natural resource consumption among businesses (business support) especially among resource intensive sectors.	Short Term (1-2 Years)
Action 2	Promote good practice companies in respect of reporting on ecosystem impacts to the ethical investment market.	Medium term (3-5 Years)
Action 3	Integrate the concept of Ecosystem Service Districts into SIRS.	Longer Term (5+ Years)
Action 4	Fill evidence base gaps concerning ecosystems unknown.	Medium Term (3-5 Years)
Action 5	Use ecosystem services valuation techniques within scheme appraisals.	Short Term (1-2 Years)
Action 6	Pilot a single ecosystem service district to establish financial values.	Short Term (1-2 Years)
Action 7	Consider adoption of an eco-credits approach to assessing green infrastructure.	Longer Term (5+ Years)
Action 8	Feasibility study into a PES delivery vehicle.	Short Term (1-2 Years)
Action 9	Review the Impact of East Midlands Climate Change Scenarios on the Projected Output of Ecosystem Services Across the Region.	Medium Term (3-5 Years)
Action 10	Support the creation of a market infrastructure by key stakeholders (verification, payments systems).	Longer Term (5+ Years)
Action 11	Map key sector business locations.	Short Term (1-2 Years)

Conclusions

The timescales assigned to the priority actions are indicative. Those actions which are attributed to medium or longer term periods will require action in the short term to establish the groundwork and evidence base from which these actions can be built and delivered.

1 Assessing the Scope for Payments for Ecosystem Services in the East Midlands – key concepts

1.1 Aim of the study

Natural resource systems (or ecosystems) can provide a range of benefits to society and the economy. These include clean and regular water supply, the production of food and fibre and the protection of communities from hazards. Importantly, some of the key industrial sectors within the East Midlands economy are directly dependent upon a well-functioning environmental infrastructure.

However, the role of public and private sector bodies in supporting, encouraging and helping bring about economic benefits from financially self-sustaining ecosystems is poorly understood, particularly within the UK and at the regional governance level.

As part of the Agency's role in improving the economy and environment of the East Midlands, *emda* commissioned Arup, working with the Centre for Environmental Management at Nottingham University as contributors, to undertake a study into the role of regional bodies in supporting Payment for Ecosystem Services.

The East Midlands Regional Economic Strategy (RES) already recognises the role played by "environmental infrastructure" (Priority 6a) in supporting the region's economy. The ecosystem services model conceptualises this role in terms of a flow of services created by natural systems that provide homes and businesses with a range of hitherto free benefits.

The study is intended to deliver well argued and evidenced recommendations for the future role and influencing mechanisms of regional bodies and local authorities in supporting Payment for Ecosystem Services (PES) models, with particular reference to the potential for public/private sector partnerships in this area. In essence, it is concerned with defining the regional role in maintaining these services when growth of the financial economy and population is depleting the ability of natural systems to provide these benefits.

1.2 Managing ecosystems for people

Human well being depends upon the way ecosystems work. Whilst ecosystems provide the obvious basic essentials of life, for example food and water, they also have a role to play in regulating the environment in which we live and our enjoyment of that environment.

Urbanisation has tended to isolate communities from the natural environment, encouraging the perception that societies can thrive independently of nature. Scientific evidence, together with public and political recognition of the issues, increasingly suggests that perceptions are deceptive and that human societies do not exist in isolation.

One way of demonstrating this is the ecological foot-printing tool developed by the Stockholm Environmental Institute (SEI). The tool has reduced societies' material consumption to a basic unit of measure called the global hectare which converts energy and materials consumption into land equivalents[4]. This analytical tool has already been used to demonstrate that a developed economy lifestyle replicated across the entire globe would require the land resource equivalent of three planets (Worldwide Fund for Nature, 2006).

1.3 Defining an ecosystem service

In essence, an ecosystem service can be defined as "the benefits ecosystems provide"[5] . Ecosystem services are broadly understood to be the output of ecosystems that contribute to the well-being of people.

[4] Chambers, N; Simmons, C and Wackernagle, M. (2000) *Sharing nature's interest: ecological footprints as an indicator of sustainability. London, Earthscan Publications*
[5] Millennium Ecosystem Assessment (2005), *Ecosystems and Human Well Being,* Island Press, p1

1.4 Payment for ecosystem services

Payments for the use of previously free services from nature is almost counter intuitive yet such mechanisms could provide a stream of previously untapped funding to maintain the flow of services and simultaneously encourage users to limit consumption. Some stakeholders in the management of the region's environment see these payment systems as supporting environmental objectives in the region. Payment systems do, however, present a challenge because there is no market price for most of the services provided by the natural environment.

Many aspects of paying for these services lie within the gift of national and international legislators as witnessed by the way the Kyoto Protocol brought into being international carbon trading. Payment for ecosystem services (including carbon sequestration) are, and will, continue to be shaped by the frameworks set outside the region.

A key question for the regional agenda concerns the degree to which payments for ecosystem services reflect the varying spatial intensity of these functions. Some of these services play a localised role (e.g. regulating flooding with a flood plain) whilst water purity can have implications for remote upstream communities supplying towns/cities downstream. Some local assets create services of global importance e.g. the sequestration of carbon dioxide attributed to the Amazon rainforest. Alternative payment models could reflect localised variations using different ecosystem service intensities as a basis for more flexible payment systems.

1.5 Ecosystem services as a concept

Although the importance of the links between people and the environment has long been understood, in modern societies the significant benefits that flow from our natural capital are often overlooked. The majority of people take them for granted, because such things as the supply of clean water and fresh air, the assimilation of wastes and the regulation of climate have traditionally 'taken care of themselves'. Also, our economy often makes use of the free goods and services that nature provides, without reflecting the wider costs that such exploitation of natural resources might have. As a result the integrity of ecosystems can be damaged and the contribution they make to human well-being undermined.

The scale of damage to our natural capital has recently been illustrated by the Millennium Ecosystem Assessment (MA)[6]. This was published in 2005, and was the first comprehensive global assessment of the consequences of ecosystem change for human well-being. It found that around 60% of the ecosystem services evaluated were currently being degraded or used unsustainably. The finding has major implications for development, poverty alleviation and the strategies needed by societies to cope with, and adapt to, long-term environmental change (especially those effects predicted as a result of unavoidable climate change). Indeed it was concluded that as a consequence of the impact of current social and economic trends, it is unlikely that the global community will achieve the so-called Millennium Development Goals[7], which include ensuring environmental sustainability and the eradication of extreme poverty and hunger by 2015.

Figure (1.1) overleaf illustrates the link between ecosystem services and human well-being. The impact of human pressures on ecosystem services is not, however, a problem that is exclusive to the developing world. The significant contribution that the MA has made globally was acknowledged by the House of Commons Environmental Audit Committee who went on to review its relevance in the UK context.[8] .

[6] Millennium Ecosystem Assessment op.cit.

[7] http://www.un.org/millenniumgoals/ (accessed 24th January, 2009)

[8] House of Commons Environmental Audit (2007): Government Response to the Committee's First Report of the Session 2006/2007: The UN Millennium Ecosystem

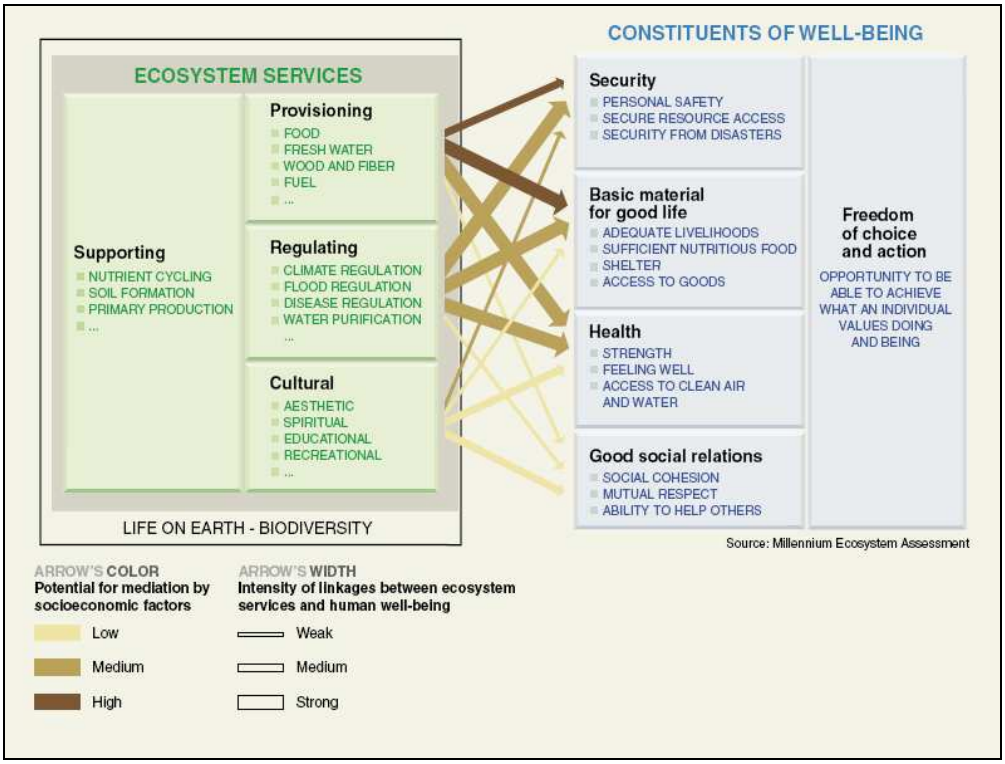


Figure (1.1): The Links between Ecosystem Services and Human Well-being (after MA, 2005)

Source: Haines-Young & Potschin 2009

Defra (2008) have now committed £0.5 million over two years to enable the identification and development of effective policy responses to ecosystem service degradation. As a result of the focus on ecosystem services stimulated initially by the MA, and subsequent debates in the UK and Europe[9], there is now considerable interest in understanding the range of benefits derivable from 'well-functioning' ecosystems at the national, regional and local scales.

In England for example, Defra have commissioned a number of studies that have sought to identify what the current evidence base can tell us about the status and trends of ecosystem services at national scales. Natural England and the Environment Agency have also commissioned other work that is respectively exploring issues surrounding the future of ecosystem services in the uplands, the role of land management in securing water supply, the mitigation of flood risk and carbon sequestration[10].

There is a kind of cascade linking the two ends of a 'production chain'. For example, the presence of a woodland or wetland in a catchment may have the function of slowing the flow of surface water to a stream or river. This function can have the potential of reducing the intensity of flooding downstream.

Assessment. Report HC848, 28PP.and
http//www.publications.parliament.UK/pa/cm200607/cmselect/cmenvaud/354/354.pdf

[9] Eureca2012 http://www.eea.europa.eu/

[10] Haines-Young, R., Potschin, M., Rollett, A. and Tantram, D. (2008): England's' Upland Ecosystem Services. Phase I. Final Report to Natural England (Project Code FST20/79/023) CEK report No 9 – and www.environment-agency.gov.uk/

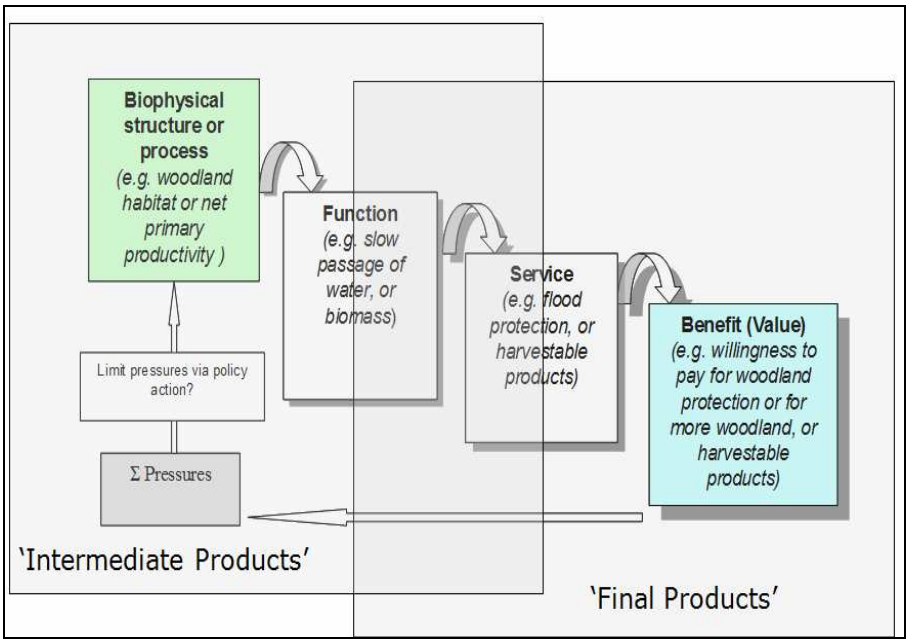


Figure (1.2) The relationship between biodiversity, ecosystem function and human well being (Source: Haines-Young & Potschin 2009)

Figure (1.2) makes the distinction between ecological structures and processes on the one hand, and ecological functions on the other. The idea of a function is used to describe the capacity or property of the system that eventually gives rise to the service. Thus in the example of flood protection shown in Figure (1.2), primary productivity is the process that generates the standing crop (biomass) of a forest, which has the capacity of potentially slowing the passage of water through the local hydrological system.

It is useful to distinguish functions from structures and processes, because those same ecosystem components may have the capacity to support other services. Thus the standing crop of a forest may have give rise to a screening or buffering effect in relation to wind or noise.

Provisioning Services *Products obtained from ecosystems* • Food • Fresh Water • Fiber • Biochemical • Genetic resources	**Regulating Services** *Benefits obtained from regulation of ecosystem processes* • Climate regulation • Disease regulation • Water regulation • Water purification • Pollination	**Cultural Services** *Nonmaterial benefits obtained from ecosystems* • Spiritual and religious • Recreation and ecotourism • Aesthetic • Educational • Cultural heritage
Supporting Services *Service necessary for the production of all other ecosystem services* ● Soil Formation ● Nutrient cycling ● Primary Production		

Table (1.1) Ecosystem Services

Source: Millennium Ecosystem Assessment

Although the notion of an ecosystem service is relatively easy to describe, there is, however, no single agreed way of categorising them. The framework of the Millennium Ecosystem Assessment is widely accepted as a useful starting point (Table 1.1), but it is recognised that it has its limitations (e.g. Wallace, 2008[11]).

Services are broadly classified into those which directly relate to provisioning, regulating and cultural dimensions of well-being, and those of a more intermediate character that support them. Examples of more specific services in each of these categories are given in Table (1.1) although it should be noted that considerable overlap exists between the different themes, and so the placing depends very much on specific contexts.

1.6 Establishing a methodology

The current study seeks to take stock of the ecosystem services in the context of the region's economic development, and to assess whether the output of these services is adequate both now and in the future.

Whilst a substantial body of literature exists on ecosystem services and payments for ecosystem services (PES), the evidence base for assessing ecosystems potential within a single region of a developed economy is limited. Some discussion exists concerning the institutional basis of setting PES but mainly from the developing world. One concept that appears relevant is the idea of "ecosystem service districts".

1.6.1 Ecosystem service districts

The "regulating", "cultural" and "supporting" ecosystem services are more spatially fixed around the location of the bio-physical structure whose functionality produces the service. Irwin et al. (2007) introduce the concept of "ecosystem service districts" that would identify "ecosystem services, their sources and their users"[12].

A key matter for the region and sub regions is the fact that the distribution of ecosystem services will vary according to the geography of the biophysical structure or process originating the service in the first place. The complication is that the "ecosystem service district" may well extend beyond the physical boundaries of the biophysical structure. The functionality of a biophysical structure can create "spill-over" effects beyond boundaries that create benefits for businesses.

Any proposal to pay for hitherto "free" ecosystem services would need to take into account where these 'spill over' effects occur and create a rationale for defining beneficiaries (hence value). It is the instance of boundary effects associated with ecosystem service provision where sub national bodies would need to play a key role.

[11] Wallace, K. (2008). Ecosystem Services: Multiple classifications or confusion? *Biological Conservation*, 141, 353-354.

[12] Irwin,F. and Ranganathan, J (2007) *Restoring Nature's Capital - An Action Agenda to Sustain Ecosystem Services*, World Resources Institute Chapter 4

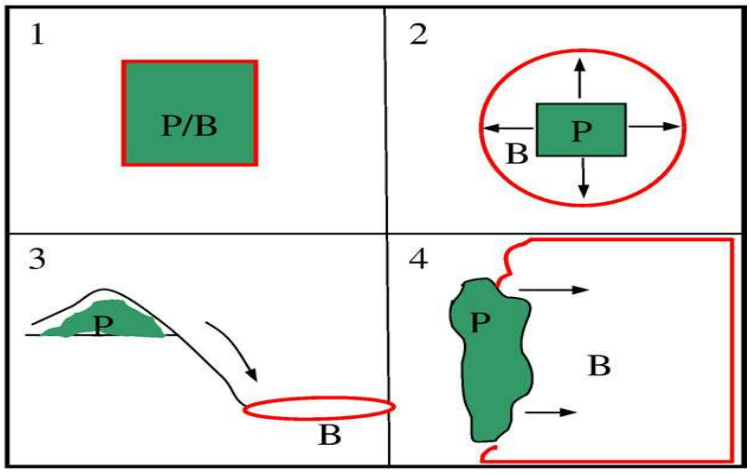


Figure (1.4) Boundary Effects in Practice

Source: Fisher et al. (2009) Defining and classifying ecosystem services for decision making

Figure (1.4) illustrates the possible spatial relationships between ecosystem service production areas (P) and service benefit areas (B). In panel 1, both the service provision and benefit occur at the same location (e.g. soil formation, provision of raw materials). In panel 2 the service is provided omni-directionally and benefits the surrounding landscape (e.g. pollination, carbon sequestration). Panels 3 and 4 demonstrate services that have specific directional benefits. In panel 3, down slope locations benefit from services provided in uphill areas, for example water regulation services provided by forested slopes. In panel 4, the service provision unit could be coastal wetlands providing storm and flood protection to a coastline.

1.7 Study approach

Our approach has been underpinned by a need to explore the incidence of ecosystem services in relation to communities and business sectors within the region in the manner (represented in Figure (1.5)). In order to examine this we have sought to map the inter relationships.

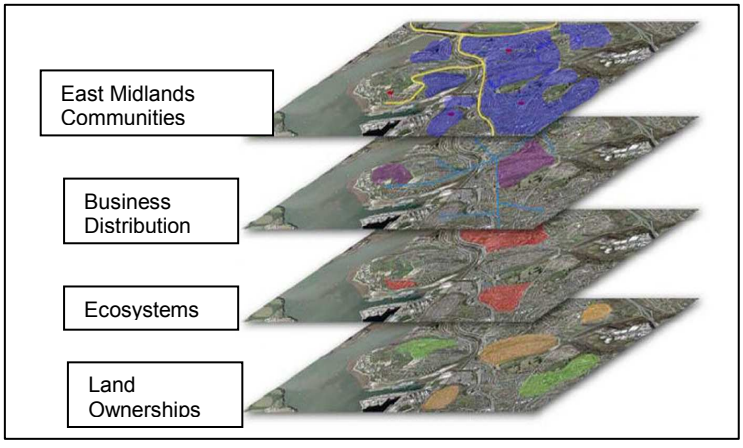


Figure (1.5) Mapping Spatial Relationships

The study investigates the relationship between each layer and articulate key issues related to how the flow of services between each layer can be valued and framed within models of PES. Our starting point is to understand some of the key concepts before moving onto the East Midlands specific analysis.

1.8 Structure of the report

Chapter 2 -	Overviews of Payment for Ecosystem Services
Chapter 3 -	Discusses the means of placing a financial value on ecosystem services;
Chapter 4 -	Overviews the ecosystems of the East Midlands including statutory designations and land ownership
Chapter 5 -	Examines the ecosystem services generated by the region's biophysical assets following the typology established in Chapter 1
Chapter 6 -	Considers the existing evidence on the condition of ecosystem services in the region;
Chapter 7 -	Discusses the spatial distribution of business beneficiaries using ecosystem services;
Chapter 8 -	Extends the analysis out to include ecosystem services generated by Green Infrastructure associated with accommodating planned growth;
Chapter 9 -	Assesses the Region's organisational capacity to deliver PES; and
Chapter 10 -	Considers priority actions for key stakeholders in taking forward PES

2 An Overview of Payment for Ecosystem Services

2.1 Introduction

A number of commentators have discussed the role of schemes involving Payments for Ecosystem Services (PES) amongst many different types of interventions that have been used to achieve the conservation of biodiversity and more recently, environmental or ecosystem services. Much of the debate has focused on developing world issues, where increasingly regulatory and protected area approaches, while critical, have been found to be inadequate in terms of conserving biodiversity and alleviating poverty (Jenkens et al. 2004[13]; Wunder, 2005[9]).

Interest in such schemes has, however grown in developed economies, where other issues arise. For example, not only is there the limitation of public finance and hence the scale of intervention, but also it is often the case that the ecological processes that generate ecosystem services extend beyond areas designated for their biodiversity or landscape importance. Most importantly, there is also the problem of market failure in relation to ecosystem services, in that as public goods, they are often undervalued.

Unfortunately while PES schemes have been widely discussed, there is little consensus about what they entail. Some (e.g. Ferraro and Kiss, 2002[42]) have located them conceptually towards one end of a spectrum of different types of intervention that vary in terms of how direct the link is between incentive mechanisms and the element of biodiversity or ecosystem service being targeted. Their classification has been adapted to make it more applicable to conditions in the East Midlands (Table 2.1).

The implication of their classification is that PES schemes are more 'performance related' than say, agri-environmental payments. The latter often targets features or processes several steps removed for the ecosystem service that Society wishes to influence, and generally the payments reflect the 'income foregone' compared to other economic activities undertaken by the land manager, rather than the value of the service itself.

However, others have suggested that further refinement of the concept is needed. Wunder (2005[9]), for example, suggest that the 'payment' element in PES needs to be defined more precisely, since it can also involve 'markets', 'rewards' and 'compensations'. He argues that the choice of term is important because it indicates what type of intervention is being considered. Figure (2.1) illustrates some of the current ambiguities associated with the terminology of PES.

[13] Jenkins, M.; Scherr, S.J. and M. Inbar (2004): Markets for Biodiversity Services. Potential roles and challenges. *Environment* 46(6): 32–42. accessible via p://www.heldref.org/env.php.

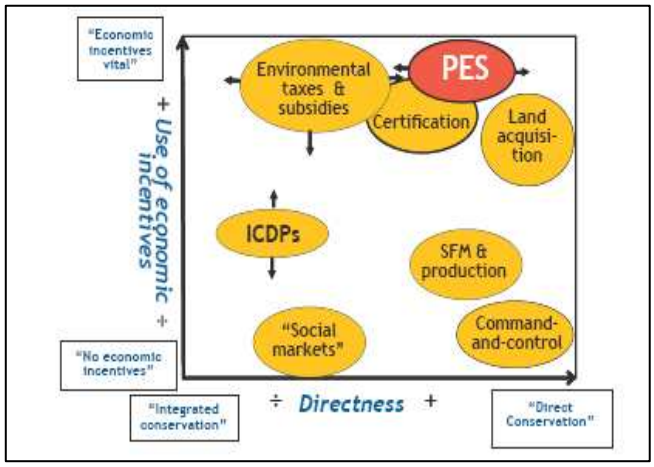


Figure (2.1) Mapping of Intervention Policies and PES

The scope of a PES may involve the competitive interaction between multiple agents (markets), the fair and equitable remuneration for services rendered (reward), or recompense for costs suffered by the service supplier in delivering a particular benefit to society (compensation). Although some of these elements are included in the classification proposed in Table (2.1), it would seem helpful to be more specific about what the 'payment' mechanism is intended to achieve, although it is acknowledged that the term 'payment' is probably the most suitable generic term.

Table (2.1) also indicates some of the strengths and weaknesses of different types of intervention. In relation to the more direct, performance-based mechanisms, the key issue is how to verify that the service is actually delivered.

2.2 Using PES under varying baseline conditions

The use of PES is dependent upon the baseline position of the ecosystem. If the service is already at a low and static level (figure 2.2), and historic monitoring data are available, then it might be possible to assess and verify the impact of the PES scheme. However, as in the case of the East Midlands, where services such as water provisioning and flood protection, pollination and genetic services are declining, the additionality of PES interventions may be difficult to assess.

In the case of situation B Figure 2.2, the service may continue to decline even though payment systems are set up, and it is simply the rate of decline that is modified. The performance of service suppliers might be difficult to assess in such situations, and they may not be fully remunerated for their input. Conversely, if for other reasons the underlying base line is increasing (C in figure 2.2), then the additionality achieved by PES schemes is exaggerated and the performance of the supplier may be over rewarded.

Thus many practical issues must be considered when deciding how to set a baseline and assess the contribution of particular schemes and no single PES approach may be applicable in all situations. What is certain however, is that for PES schemes to work, the buyer must have some understanding of the level of service output that is required and confidence that interventions by suppliers at an appropriate scale can satisfy that demand.

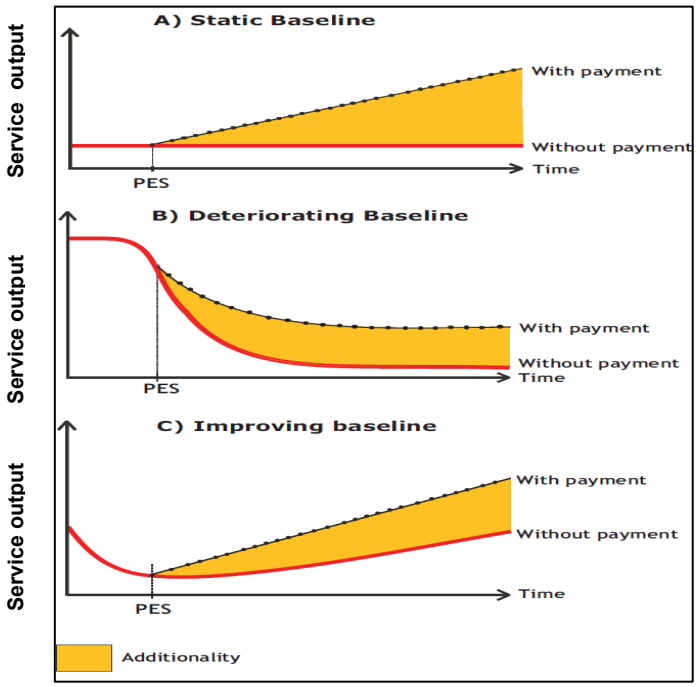

A) Static Baseline
Service output
With payment
Without payment
Time
PES
B) Deteriorating Baseline
Service output
With payment
Without payment
Time
PES
C) Improving baseline
Service output
With payment
Without payment
Time
PES
Additionality

Table (2.1): Spectrum of potential interventions for supporting biodiversity and ecosystem services (after Ferraro and Kiss, 2002[14], and effect, 2006[15])

	Incentive strategy	Example	Strengths/weaknesses
Least direct	Support for the use and marketing of biological materials and ecosystem services	Local foods, products or marketing of 'heritage'	Can be related to market values of products but outcomes for biodiversity and services uncertain
	Support for the use or marketing of biodiversity and ecosystem services within relatively 'intact' ecosystems	Nature-based recreation and tourism, environmental volunteering, shooting	Can be related to market value of products and specific land management practices/objectives but outcomes for biodiversity and services sometimes uncertain because of scale issues
	Incentives for reduced impact land and/or service use	Single farm payment, or support for organic conversion, nitrate vulnerable zones	Easy to administer, targeting sometimes difficult, outcomes for biodiversity and services uncertain because of scale issues
	Direct payment for environmental management (generating biodiversity conservation or enhanced service output as a side product)	Environmental Stewardship and Woodland Grant Schemes, and equivalent private sector interventions, e.g. SCaMP	
	Performance-based payments for conservation or service output	Incentives for habitat restoration or service provision associated with development projects; permit trading	Clear specification of outcomes but requires monitoring and verification
Most Direct	Acquiring land (retirement) and biodiversity or service use rights	Land acquisition for coastal set-back. Purchase of land for conservation based management by NGOs; e.g. Alkborough; land trusts supported by CIL	Success dependent on institutional Environment and local issues. May only be possible in specific locations.

[14] Ferraro, P.J. and A. Kiss (2002): Direct Payments to Conserve Biodiversity. SCIENCE 298: 1718-1719.

[15] Eftec (2006): Valuing our Natural Environment. Final Report. In association with Environmental Futures Limited, 58 pp plus annex. Defra Project Code NR0103.

2.3 PES models

Government agencies and NGO's have traditionally used land acquisition as a way of achieving conservation objectives and a similar approach may be possible in relation to some ecosystem services. We have identified this as the most direct form of intervention, and it is illustrated in our review by the case study of Alkborough Flats. The site covered by the scheme was jointly purchased by Natural England and the Environment Agency, and is now controlled by a management group. The purchase was eased by the fact that 60% of the land was initially in one ownership and that all was bought at market rates with no threat of compulsory purchase. Moreover, the dynamics of the hydrological system were sufficiently well established to be sure from the outset that the scheme would make a significant contribution to flood regulation.

Land acquisition at market values is, therefore, the kind of PES mechanism involving a "one-off "reward to a specific owner. It is clearly also the kind of PES approach that could be applied where specific sites have a critical or strategic importance in relation to service supply, and where acquisition by a non-profit organisation effectively takes ownership of a 'public good'. Land acquisition to enhance the output of ecosystem services may not, however, generally be possible or applicable to all types of ecosystem service. Nevertheless there could be a number of opportunities to extend the approach, say through the establishment of land trusts associated with particular types of development. These could be set up to manage green infrastructure created as part of the conditions of granting a planning application for a major development. Alternatively, funds accumulated through mechanisms such as the Community Infrastructure Levy, could be used to enable interventions elsewhere.

Where land acquisition is not an appropriate or cost-effective way of intervening in the supply of an ecosystem service, PES models involving remuneration to land owners only for some specific service can be considered. Initiatives such as Environmental Stewardship and the Woodland Grant Schemes clearly fall into this category, and while they have traditionally been financed by the public purse, there is also the opportunity for private sector organisations to develop or lead such initiatives. The SCaMP Project, described in the context of improving and sustaining water supply is an example of such an intervention. Elsewhere, similar notable examples include the arrangements that the Vitell Company has made with farmers in north-eastern France to maintain the quality of its water supplies by encouraging management practices that reduce the risk of nitrate contamination to the aquifer[16].

The SCaMP and Vitell case studies illustrate that establishing PES is a complex undertaking, generally requiring consideration of scientific, social, economic, political, and institutional issues the design of new types of governance relationships. No simple model exists, and in the real world it might be necessary to mix different approaches to achieve successful outcomes. In the example of the PES scheme in the Catskill-Delaware Watershed in north eastern USA, where water companies have secured the quality of their water supplies by encouraging appropriate land management rather than investment in treatment works, both strategic land purchase and incentives to communities are involved (Daily and Ellison, 2002[17]). Arrangements also included both compensatory payments as well as reward for participation.

These examples of initiatives to regulate the supply of an ecosystem service by private sector organisations illustrate that payment schemes can begin to reflect the real value of the resource, and thus correct some aspects of market failure often associated with the

[16] Perrot-Maître, D (2006) The Vittel payments for ecosystem services: a "perfect" PES case? IIED & DFID

[17] Daily, G.C. and K. Ellison (2002): The new Economy of Nature. The Quest to make conservation profitable. Island Press, Washington

management and use of natural resources. However, many have argued that society can go further, and that other approaches involving the creation of real markets for ecosystem services can be tried.

In fact, multi-actor markets for environmental services have successfully been established or used for sulphur dioxide emissions, farm nutrient pollutants and carbon emissions (Jenkins et al., 2004[41]). Under such arrangements rights or obligations are created within a broad regulatory framework which allows those with obligations to buy compliance from other landowners or users. However, the development of similar kinds of market arrangement for the full range of ecosystem services may be more difficult because the characteristics of sites matter so much. Some of the issues that arise are illustrated by the example of the wetland mitigation programme in the US which has operated since the 1980s. Here developers are required to offset any damage they do to wetlands by creating, restoring or enhancing a wetland elsewhere to compensate for the loss of natural capital. Conservation banking schemes are a more general version of this approach. The key question that arises in its application is whether compensation is in fact possible, and over what time periods.

In relation to the perceived need to develop the green infrastructure of the East Midlands (see Chapter 8) some kind of conservation banking system could be envisaged, although it is difficult to see how this would operate outside a national framework. Nevertheless, as recent initiatives in the Netherlands have shown, there may be scope for more private types of arrangements to be established that have similar outcomes[18]. Several 'landscape auctions' have been held involving land managers identifying tangible pieces of the countryside, such as a hedge, a pond or a group of trees and calculating the price for maintaining the ecological functioning of these elements over a 10 year period. The option to pay for the management of these landscape elements were then auctioned to the highest bidder, and the money raised is held by a regional trust fund which monitors compliance. Contracts for maintaining the elements sold in the auction are between farmers and the trust fund, as well as between winning bidders and the trust. Management interventions have to be consistent EU policies but arrangements can be more flexible than is often possible with agri-environment schemes. The motivation for companies and individual groups to purchase management options were varied, but in relation to the business sector public image and CSR issues appeared to be significant.

2.4 Case studies

For the purposes of illustrating the diversity of PES, 9 case studies have been profiled including East Midlands and international examples. These case studies include:

- Case Study 1: The Vittel (Nestle Waters) watershed protection programme in Eastern France
- Case Study 2: The Northeim Model Project for agro-biodiversity in Lower Saxony, Germany
- Case Study 3: Nitrates in Groundwater in the UK
- Case Study 4: Managing groundwater resources in south Nottinghamshire
- Case Study 5: Sustainable water management in the Catskill and Delaware watersheds
- Case Study 6: Performance Payments for wildlife in Sweden
- Case Study 7: Alkborough Flats
- Case Study 8: Carbon Trading
- Case Study 9: Wetland Banking in the USA

[18] http://www.cbd.int/doc/newsletters/news-biz-2008-02/?articleid=35

Case Study 1: The Vittel (Nestlé Waters) Watershed Protection Programme in Eastern France

Vittel is one of the largest bottlers of natural mineral water in the world. Its most important water sources in France are in heavily-farmed watersheds. Runoff of nutrients and pesticides risked contaminating the aquifers on which the company's business depends. The company determined that purchasing farmland, reforesting sensitive infiltration zones, and financing farmers to build modern facilities and switch to organic farming was in fact more cost effective than building filtration plants. The cost advantages have been so significant that those in the scheme could be offered extremely profitable terms.

Thus since 1993, the company has supported the PES scheme which covers of 5100 ha of a catchment at the foot of the Vosges Mountains. The program pays all 27 farmers in the area to adopt best practices in dairy farming. The program is implemented through a buyer-created agricultural extension agency (Agrivair), which has persuaded farmers to adopt extensive low-impact dairy farming. Thus they have ceased from using agrochemicals, composting animal waste, and animal stocking numbers have been reduced.

The ecosystem service provided is high spring water quality. While the buyers and sellers are essentially private, the scheme depended partly upon the state acting as an intermediary, in that the government initially provided a small amount of financial aid and a strengthened legal framework that could ensure the enforceability of contracts.

The PES scheme combines conditional cash payments with technical assistance, reimbursement of incremental agricultural labour costs, and even arrangements to take over lands and provide rights to the farmers. Contracts are long-term (18–30 yr), payments are differentiated according to opportunity costs on a farm-by-farm basis, and both land use and water quality are closely monitored over time. Total costs (excluding the intermediary's transaction costs) have been estimated to be the equivalent of US$25 million over 1993–2000. Through carefully researched baselines, an improvement of the service vis-à-vis the declining ES baseline is well-documented, and the high service value clearly makes the investments profitable.

Sources:

Smith, M., de Groot, D., Perrot-Maître, D. and Bergkamp, G. (2006). *Pay – Establishing payments for watershed services*. Gland, Switzerland: IUCN. Reprint, Gland, Switzerland: IUCN, 2008.

Wunder, S., Engel, S., Pagiola , S. (2008). "Taking stock: A comparative analysis of payments for environmental services programs in developed and developing countries." Ecological Economics 65(4): 834-852.

Case Study 2: The Northeim Model Project for Agro-biodiversity in Lower Saxony, Germany

The Northeim project is a pilot that has used tendering mechanisms to determine payments to farmers for changed land uses that would result in improved output of ecosystem services related to biodiversity (species richness and conservation of marginal grassland communities) and their recreational (landscape) value. The aim of the pilot has been to look at the kinds of issue that might arise before implementing such a scheme at national level.

The buyer in this PES scheme is a private foundation which represents key interests in the area; it includes the local administration, the environment agency, the agricultural administration and public groups. The role of the private foundation is to allocation the available budget to a specific set of ecological goods in such a way that it reflects the preferences of the local population. The 'goods' are grasslands with a given set of ecological characteristics; three categories are have been defined, based on different combinations and levels of species richness and additionally the presence of either regionally characteristic or regionally endangered species in the plots within the scheme. The sellers in the scheme are the farmers and land managers who tender to supply these goods once an invitation to bid has been made. The University of Göttingen acts the intermediary, issuing and sorting the bids, and monitoring outcomes.

The farmers entering the scheme agree to reduce the level of agricultural intensification and to adopt practices that favour species richness, so as to enhance biodiversity and recreational benefits associated with the contribution that low intensity grassland makes to landscape. Payments have been made since 2004 to 28 farmers and cover 288 ha of land. In the tendering process 38 farmers submitted 199 offers, of which 159 were accepted. The funding distributed by the scheme amount to around €30,000 per year; payments are variable and contracts run for 10 years.

Sources:

Bertke, E., Marggraf, R., (2005) An Incentive Based Tool for Ecologically and Economically Efficient Provision of Agrobiodiversity. Bogor, CIFOR. See also:

http://www.cifor.cgiar.org/pes/publications/pdf_files/ElkeBertke_pes_oN.pdf

Wunder, S., Engel, S., Pagiola , S. (2008). "Taking stock: A comparative analysis of payments for environmental services programs in developed and developing countries." Ecological Economics 65(4): 834-852.

Case Study 3: Nitrates in Groundwater in the UK

In the post war period the intensification of agriculture led to increased application of nitrogen-based fertilisers. This resulted in increased amounts of nitrate leaching from the soil and increasing concentrations in groundwater. Such contamination led to eutrophication of water bodies and was a potential threat to human health. Thus, in 1980 the European Community set a maximum limit for nitrate in water of 50 milligrams per litre (mg/l) through its Drinking Water Directive, and in 1991, went on to issue a Nitrate Directive. The latter required states to identify waters that were or could be affected by nitrogen pollution from agricultural sources and to designate as 'Nitrate Vulnerable Zones' (NVZs) which included the land from which pollutants are derived. The area designated as an NVZ has steadily been increased and now covers about 70% of England.

The basis of the UK measures was a series of large-scale experiments that began in 1990 and ran though to 2003. Ten groundwater catchments, subsequently increased to 32, were selected as 'Nitrate Sensitive Areas'. Within these areas, a voluntary compensated scheme provided 5-year direct payments from government to farmers who adopted management practices that reduced leaching of nitrates from agricultural land into vulnerable groundwater. The scheme covered about 25,000 hectares in total, and the incentives resulted in reduced application of fertiliser and manure, the maintenance of a green ground cover in winter and, in some areas, conversion of arable land to grassland.

The NSA scheme is an example of a public payment scheme, without an intermediary; the government was the buyer, and the farmer or land manager the seller. The government provided financial aid directly to farmers who entered the scheme. Payment rates were based on the farmer's loss of income and costs resulting from changes in agricultural practices. However, as an added incentive, the payments were higher than income foregone and costs incurred by an estimated 31%. The majority of participants stated that without financial aid they would not continue to farm using the management practices supported by the scheme because of the increased costs and reduced profitability. The NSA scheme has been wound up and the kinds of good agricultural practices that lead to reduction in nitrogen loads in surface and ground waters are promoted through a mixture of cross-compliance measures and agri-environmental schemes.

Source:

Smith, M., de Groot, D., Perrot-Maître, D. and Bergkamp, G. (2006). *Pay – Establishing payments for watershed services*. Gland, Switzerland: IUCN. Reprint, Gland, Switzerland: IUCN, 2008.

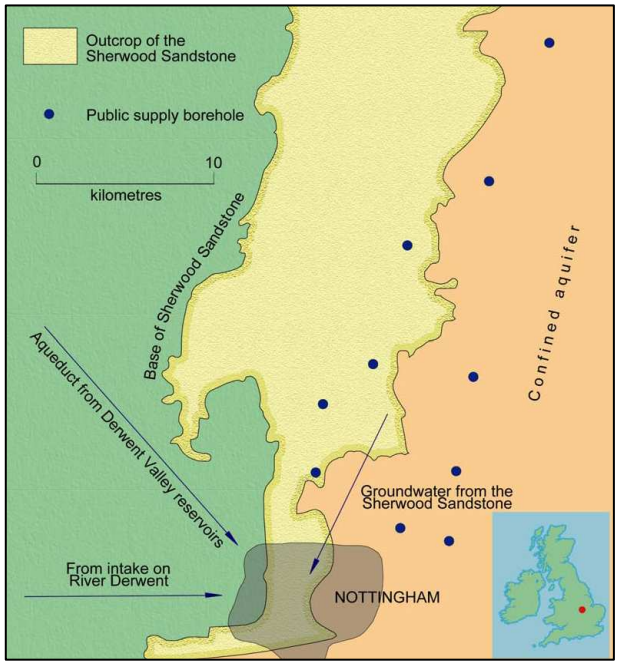
Case Study 4: Managing Groundwater Resources in south Nottinghamshire

The city of Nottingham is at the southern end of an extensive outcrop of the Triassic Sherwood Sandstone, which is one of the largest groundwater reservoirs in the UK.

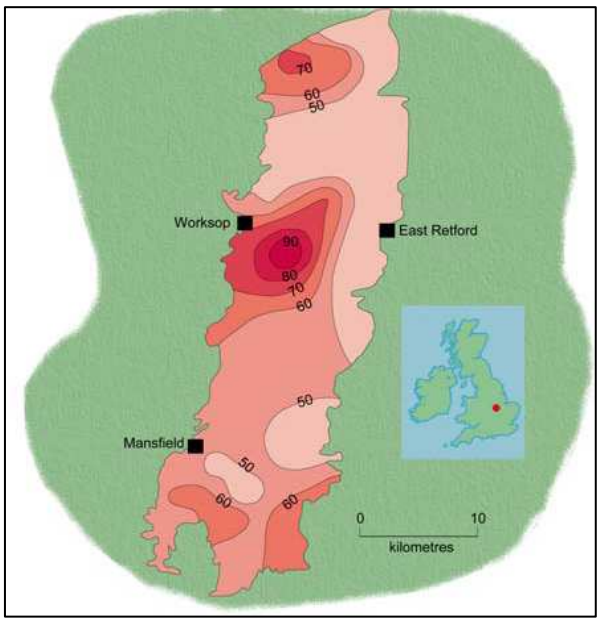
The city has, since the nineteenth century obtained its water supplies from deep wells and boreholes in the aquifer (see inset left). However, it is now fully developed and the objective is to reduce abstraction to a sustainable level which will allow continuous use of the aquifer without damaging surface water features. Thus the quantities of water that can be abstracted under license have been reduced, and the balance of requirements taken directly, by aqueduct, from surface reservoirs in the Derwent Valley, and from the River Derwent which is regulated using water from the Carsington Reservoir.

At present the sandstone aquifer provides about 50% of the supply for the city and surrounding region. However, the concentration of nitrate these ground waters has been steadily increasing since the late 1960s, and despite measures to reduce the nitrogen inputs from farming, careful water management is now required. Water with higher nitrate concentrations is blended with sources from the confined eastern parts of the aquifer, which contains water with a low nitrate concentration. New boreholes have been drilled in the confined zone and also in afforested areas on the outcrop of the sandstone, to secure the supply of waters with low concentrations of nitrate. Some areas on the outcrop of the sandstone, within catchments of public supply boreholes, were designated 'Nitrate Sensitive Areas' (see case study 3), and within them farmers received payments for changing farming practices. Today, the appropriate management of land around some boreholes on the Sandstone aquifer is encouraged through Environmental Stewardship.

Although not formally recognised as a PES scheme, like it could be considered as a public payment scheme.



The Triassic Sherwood Sandstone of Nottinghamshire and patterns of water supply to the city of Nottingham



Distribution of nitrate in groundwater in th eoutcrop of the Triassic Sherwood Sandstone of Nottinghamshire in 1993. The map shows where values exceeded 50 mg/l.

Sources:

UK Groundwater Forum (accesses may 2009) Nitrate and pesticide pollution. See

http://www.groundwateruk.org/archive/nitrate_and_pesticide_pollution.pdf and

http://www.groundwateruk.org/html/depth.htm

Smith, M., de Groot, D., Perrot-Maître, D. and Bergkamp, G. (2006). Pay – Establishing payments for watershed services. Gland, Switzerland: IUCN. Reprint, Gland, Switzerland: IUCN, 2008.

Case Study 5: Sustainable Water Management in the Catskill and Delaware Watersheds, USA

The Catskills and Delaware watersheds provide New York City with 90% of its drinking water supply. The watersheds have a population of 77,000 and cover an area of 4,000 km^2, and historically have supplied high quality waters to the city. Concerns about pollution increased, and in 1989, the United States Environmental Protection Agency (EPA) required that all surface drinking water supplies had to be filtered. However, the EPA regulations allowed that this filtration requirement could be relaxed if there were existing treatment processes or natural watershed services that provided safe water.

In 1992, the City of New York decided to invest in protecting watersheds rather than new water filtration facilities. The latter would have cost about US$ 6 to 8 billion to build and US$ 300 million annually to operate. It was estimated that a new filtration plant would have required a two-fold increase in water bills. In comparison, the costs of investing in watersheds to maintain and restore natural filtration are much lower. Diverse mechanisms for investment in the watersheds have been used, amounting to an investment of between US$1 to 1.5 billion over 10 years. This was financed by a more modest 9% tax increase on New York City water bills.

Funds have been used to finance a US$ 60 million trust fund for environmentally sustainable projects in the Catskill watershed. The City has provided US$ 40 million in compensation to cover the additional costs of dairy farmers and foresters who adopted best management practices. Foresters who adopted improved forest management, such as low impact logging, received additional logging permits for new areas. Forest landowners with 20 ha of land or more that agree to commit to a 10-year forest management plan are entitled to an 80% reduction in local property tax. The City is also purchasing development rights for sensitive land near reservoirs, wetlands and rivers at market price. Farmers and forest landowners are able to enter into 10 to 15-year contracts with US Department of Agriculture to remove environmentally sensitive land from production.

Sources:

Smith, M., de Groot, D., Perrot-Maître, D. and Bergkamp, G. (2006). Pay – Establishing payments for watershed services. Gland, Switzerland: IUCN. Reprint, Gland, Switzerland: IUCN, 2008.

Perrot-Maître, D. and Davis, P. (2001) Case Studies of Markets and Innovative Financial Mechanisms for Water Services. Forest Trends and Thea Katoomba Group.

http://www.forest-trends.org/documents/publications/casesWSofF.pdf

Case Study 6: Performance Payments for Wildlife in Sweden

In 1996 the Swedish government implemented a performance payment strategy to attain and maintain stable populations of wolverines (Gulo gulo), Lynx (Lynx lynx) and wolves (Canis lupus) that are a threat to the reindeer (Rangifer tarandus tarandus) herded by the indigenous Sami people. The focus of these performance payments is strictly on outcome; the actions that led to the conservation outcome are not relevant (Zabel and Holm-Muller, 2008). Conservation performance payments are made to the Sami people based on carnivore offspring and the amount is calculated to offset all the future damage that the animals are expected to cause.

As it is difficult to attribute conservation outcomes to an individual the payment is made to the Sami villages (not to individuals), which decide on the use and internal distribution of the money. Zabel and Holm-Müller (2008) suggest that in densely populated areas with small plots or unclear property rights paying groups of people for performance outcome may be more practical than schemes based on individual payments. The challenge is to allocate the payments in a manner that ensures each herder has an incentive not to kill the carnivores.

In this example, payment is purely on outcome, in contrast to most AEP where payment is based on changes in management practices. Payment purely on the basis of outcome is unlikely to be feasible for the majority of environmental services due to the difficulty in fully documenting the service 'supply chain'. However, for those services where this link can be made explicit this example documents some of the challenges that are likely to be faced. It also highlights the issue of collective reward for service provision, which should be further addressed in AEP design.

Source:

Zabel, A. and Holm-Muller, K. (2008) Conservation Performance Payments for Carnivore Conservation in Sweden. Conservation Biology 22(2): 247-251.

Case Study 7: Alkborough Flats

The Alkborough Flats site is the location of a coastal set-back scheme in the Humber Estuary. It is one of the largest managed retreat sites and one of the largest flood storage schemes in Europe. Although it could be argued that Alkborough is not a PES scheme as such, because it involved a single land purchase, it does has some characteristics of such as scheme in that it involves intervention by a buyer (the state) to secure ecosystem outputs (mainly flood protection plus a range of ancilliary benefits).

The site provides a massive flood storage and energy dissipation area adequate, according to Environment Agency predictions, to reduce high tide levels over a large part of the upper estuary by 150mm. It has been estimated that that sea level will have risen by up to half a metre by the year 2050 on the Humber due to both climate change and geological tilting. At a projected annual sea level rise of 4mm, the Alkborough Flats scheme therefore modifies the regime to account for 25 years of this climate change impact.

The full 400 hectares of the Alkborough Flats site were jointly purchased by Natural England and the Environment Agency, each owning 50% of the land which is controlled through a management group. Purchase was eased by 60% of this land area being formerly in the ownership of one family, and all was bought at market rates with no threat of compulsory purchase.

A 20 metre breach in flood defences was made in 2006 and 1,500 metres of embankment was lowered to permit overtopping in extreme events. 170 hectares of the site is permanently exposed to flooding, reverting to mudflat, saltmarsh and, at least in part, reedbed. As well as providing these flood risk, habitat and amenity benefits, the higher parts of the site will be used for grazing which will add to the range of plants and animals which the site can support. In addition to the biodiversity gains from the project, it will also provide long-term recreational opportunities and economic, environmental and social benefits for local communities. About 5.5 kilometres of footpaths were opened in May 2008, following completion of capital works, which brought the total footpath network at Alkborough Flats up to 8 kilometres, many of them designed for access by people with disabilities. The development of a caravan park and visitor centre has also been associated with the project

Source:

Environment Agency (2009) Ecosystem services case studies.

http://publications.environment-agency.gov.uk/epages/eapublications.storefront/4a11126d014ce434273fc0a80296064f/Product/View/SCHO0409BPVM&2DE&2DE#

Case Study 8: Carbon Trading Market

Carbon trading evolved out of the Kyoto Protocol in 1990 based around a tradable-permit system in which a carbon emitter can buy and sell permission to emit a certain amount of carbon from and to other emitters who are below or above their limit. The rationale behind emission trading is to ensure that the emission reductions take place where the cost of the reduction is lowest therefore lowering the overall costs of combating climate change.

Carbon trading is taking place on a range of scales; from the global level to an individual person basis. This is largely due to the formation of successful institutional structures that have governed and provided support services to the exchange process. The trading markets are formed on the basis of strong exchangeability; as carbon in terms of identity, measurability and impact is much the same anywhere (fungibility). This has allowed intermediaries to regulate the amount of emissions produced in aggregate by setting the overall cap for the scheme but gives companies the flexibility of determining how and where the emissions reductions will be achieved and thereby allowing for cost effectiveness. Carbon trading has developed further in through the wide establishment of common goals and agreements. The Kyoto Protocol set a framework from which carbon trading mechanisms could be formed. The protocol established an agreed consensus that member states would reduce their greenhouse gas emissions by 8% in comparison to 1990 levels. This harnessed the pressure on institutions to configure carbon reduction schemes and emitters to join.

The EU Emissions Trading Scheme (EU ETS) is one of the key mechanisms introduced by the European Union, in response to the Kyoto Protocol. The scheme is divided into phases for which Member States must develop a National Allocation Plan (NAP) approved by the European Commission. These plans must set an overall 'cap' on the total amount of emissions allowed from all the installations covered by the scheme. This is converted to allowances - 1 allowance equals 1 tonne CO^2. The allowances are then distributed by Member States to installations in the scheme. Installations covered by the Scheme are required to monitor and report their emissions. At the end of each year they are required to surrender allowances to account for their installation's actual emissions. They may use all or part of their allocation and have the flexibility to buy additional allowances or to sell any surplus allowances generated from reducing their emissions below their allocation.

Other high profile schemes include; the Chicago Climate Exchange (CCX). The CCX operates a cap and trade system in North America. Reductions achieved through CCX verified by the Financial Industry Regulatory Authority. CCX is a cap and trade system whose members make a legally binding emission reduction commitment. Members are allocated annual emission allowances in accordance with their emissions baseline and the CCX Emission Reduction Schedule. Members who reduce beyond their targets have surplus allowances to sell or bank; those who do not meet the targets comply by purchasing CCX Carbon Financial Instrument Contracts.

Carbon emissions' trading provides a useful insight into how legislation enables the formation of strong institutional frameworks that in turn facilitate a successful trading system. The systems demonstrate the pulling together of environmental goals with an economic context that allows for flexibility and a feasible system.

Case Study 9: Wetland Banking in the United States

This policy permits developers, after allowing for opportunities to avoid and minimize wetland loss, to compensate for wetlands that will be destroyed through development by ensuring the restoration of wetlands in another location.

The regulations mandate trades that ensure equivalent value and function between destroyed and restored wetlands. In practice, however, most trades are valued in units of acreage. Within very loose guidelines, trades between productive (though soon to be destroyed) wetlands and restored wetlands are approved on an acre-for-acre basis. More sophisticated banks require ratios, trading development on one acre of productive wetlands for, say, restoring four or five acres of wetlands somewhere else. Counting acres may make for easy accounting, but it is poor policy. The social value of the habitat is absent from the transaction.

The ecosystem services provided by the wetlands – positive externalities such as water purification, groundwater recharge, and flood control – are largely ignored. Trading acres for acres provides an inadequate measure to capture the significance of what is really being traded. To be sure, such a simple metric allows trades, but other important, unaccounted trade-offs are occurring.

In the USA, private equity fund Parthenon has recently invested in a wetland mitigation banking company (Wildlands Inc.) and is assuming investment returns between 20-30%, and Ecosystem Investment Partners proposes to invest US$ 27.5 million across a variety of landscapes that will generate multiple revenue flows (including timber, water supply and biodiversity) which buy down individual risks associated with particular income streams.

Aurochs Investment (launched in the UK in June 2007) represents another fund that aims to acquire and manage land to protect biodiversity value in particular – with an assumption that returns of 20% are realistic for revenue generated by high-end cattle grazing, fair trade products and eco-tourism. The Ecosystem Marketplace (www.ecosystemmarketplace.com), operated by Forest Trends, estimates the total market value of wetland credits at nearly $290 million as of April 30, 2005.

2.5 Key Issues

A lack of consensus exists as to exactly what constitutes a PES although this is more a reflection on interpretation of different interventions that have emerged in different contexts.

Public schemes are schemes in which local or national government acts as the sole or primary purchaser of a specified ecosystem service or, more commonly, a related land use or management practice. Public schemes may operate at the local or national level.

In private (self-organized) schemes, both buyers and sellers are private entities (companies, NGOs, farmers' associations or cooperatives, private individuals). Private self-organized schemes are typically local schemes.

Trading schemes refer to the establishment of markets in which established rights (or permits) and/or quotas can be exchanged, sold or leased. The existence of a strong, well-defined and functioning legal and regulatory framework is a prerequisite for trading schemes to operate.

3 The Valuation of Ecosystem Services

3.1 Introduction

The issue of valuation is inseparable from the choices and decisions that are made about ecosystem services. Some argue that valuation of some ecosystem services is either difficult or unwise, that placing values on such 'intangibles' as human life, environmental aesthetics, or long-term ecological benefits is impractical. Valuations are, nevertheless, made implicitly when the environment is considered in relation to a whole host of development objectives bound up in human welfare. Another frequent argument is that society should protect ecosystems for purely moral or aesthetic reasons. Yet, there are equally compelling moral arguments that may be in direct conflict with the moral argument to protect ecosystems; for example, the moral argument that no one should go hungry (e.g. Millennium Goals). Moral arguments translate the valuation and decision problem into a different set of dimensions and a different language of discourse that makes the problem of valuation and choice more difficult and less explicit. But moral and economic arguments are certainly not mutually exclusive. Both discussions can and should go on in parallel.

So, although the valuation of an ecosystem service is certainly difficult and fraught with uncertainties, the decisions made as a society about ecosystems imply valuations (although not necessarily expressed in monetary terms). These valuations can be made explicit or remain disguised.

By emphasising the flow of services over a year, this approach taken avoids the hazards of estimating the current and future value of services needed under a "natural capital" approach[19].

The exercise of valuing the services of natural capital 'at the margin' consists of determining the differences that relatively small changes in these services make to human welfare. Changes in quality or quantity of ecosystem services have value insofar as they either change the benefits associated with human activities or change the costs of those activities. These changes in benefits and costs either have an impact on human welfare through established markets or through externalities that by-pass established markets.

Converting a benefit from an ecosystem service into a payment requires some means of converting a physical flow into a financial value. By monetising benefits, valuations can be used to support appropriate payments to compensate public and private ecosystem service providers, thus ensuring those services that are of benefit to individuals continue to be provided. A number of techniques have been developed for attaching financial values to ecosystem services.

3.2 Calculating payments for ecosystem services

3.2.1 Valuation principles

A valuation of ecosystem services measures the Total Economic Value (TEV) of the flow of benefits to individuals arising from the stock of natural capital. This value accrues in four areas:

- **Direct use value** arises where individuals make actual or planned use of an ecosystem service either through consumption (e.g. food) or other uses (e.g. recreation);
- **Indirect use value** is realised when individuals benefit from ecosystem services which support other resources; for example the pollination of food crops by bees;
- **Option value** relates to the benefit individuals perceive from the option to use a resource in the future, either directly or indirectly. For example, a wide species mix

[19] IBRD (2005) "How Much is an Ecosystem Worth? – Assessing the Economic Value of Conservation" IUCN, The Nature Conservancy and the World Bank

in a particular habitat can be thought of as an insurance against the impacts of potential future changes as different species may fulfil different ecological roles; and

- **Non use value** can be derived from the knowledge that the natural environment is maintained, that it will be passed onto future generations (bequest value, e.g. the desire to leave national parks to future generations) that other individuals may use the ecosystem resource (altruistic value, e.g. the provision of parks for those on lower incomes) and value can be derived from the existence of an ecosystem resource without the individual having any actual or planned use of it (existence value e.g. some individuals value the existence of Wales despite having no plans to ever see them).

3.2.2 Valuation techniques

In addition to the calculation of avoided costs (those that would have been incurred in the absence of provision) or the replacement costs (the costs of an alternative method of provision) valuation techniques seek to estimate the Total Economic Value of ecosystem services by calculating how much individuals would be Willing to Pay (WTP) for access to new services or to maintain existing – in effect creating a hypothetical market place. Methodologies for this follow two broad routes:

- **Revealed preference** methods use actual market data to map individuals' preferences. This includes:
    - Factor income – impact of provision of services on incomes
    - Travel costs – spending on travel to access services may indicate their value
    - Hedonic pricing – service demand may be reflected in prices paid for associated goods (e.g. coastal houses)

There is a fear that placing a monetary value on ecosystem services may be inappropriate as it treats environmental assets as commodities and therefore degrades their intrinsic worth. This relies on the view of ecosystems and their services as non-anthropocentric and therefore not something that humans have the right to degrade.

However, while no techniques can capture this intrinsic value, the Total Economic Value approach is particularly broad measure as it captures use, and non-use (existence) benefits. The concept of payments for ecosystem services can be used to compare and prioritise the protection of environmental assets in situations where it is not possible to protect all.

Use of these techniques to support the preservation of the environment and the calculation of fines for damage to it – for example the Exxon Valez $5bn fine (constructed using these valuation principles) put the environment in terms that businesses can understand.

In addition payments for ecosystem services fit well within a wider government agenda:

Attributing a value to ecosystem services can be used to justify the delivery of services particularly in a target driven context;

Responds to calls for market-linked decision making in planning and transport policy as highlighted in the Barker and Eddington reports;

Wider agenda supporting use of market based techniques for environmental questions – carbon trading and quotas.

Box (3.1) Concerns Associated with Attaching Monetary Value to Environmental Assets

Stated preference methods use structured questionnaires to capture individuals' preferences for a change in ecosystem services. This includes contingent valuation where responses to hypothetical scenarios are used to construct values and choice modelling which involves respondents comparing options.

The figure details the use of different valuation methods for ecosystem services:

Valuation method	Element of TEV captured	Ecosystem service(s) valued	Benefits of approach	Limitations of approach
Market prices	Direct and indirect use	Those that contribute to marketed products e.g. timber, fish, genetic information	Market data readily available and robust	Limited to those ecosystem services for which a market exists.
Cost-based approaches	Direct and indirect use	Depends on the existence of relevant markets for the ecosystem service in question. Examples include man-made defences being used as proxy for wetlands storm protection; expenditure on water filtration as proxy for value of water pollution damages.	Market data readily available and robust	Can potentially overestimate actual value
Production function approach	Indirect use	Environmental services that serve as input to market products e.g. effects of air or water quality on agricultural production and forestry output	Market data readily available and robust	Data-intensive and data on changes in services and the impact on production often missing
Hedonic pricing	Direct and indirect use	Ecosystem services that contribute to air quality, visual amenity, landscape, quiet i.e. attributes that can be appreciated by potential buyers	Based on market data, so relatively robust figures	Very data-intensive and limited mainly to services related to property
Travel cost	Direct and indirect use	All ecosystems services that contribute to recreational activities	Based on observed behaviour	Generally limited to recreational benefits. Difficulties arise when trips are made to multiple destinations.
Random utility	Direct and indirect use	All ecosystems services that contribute to recreational activities	Based on observed behaviour	Limited to use values
Contingent valuation	Use and non-use	All ecosystem services	Able to capture use and non-use values	Bias in responses, resource-intensive method, hypothetical nature of the market
Choice modelling	Use and non-use	All ecosystem services	Able to capture use and non-use values	Similar to contingent valuation above

Table (3.1) Valuation methods for ecosystem services
Source: Defra (2007)

Unfortunately, the calculation of Willingness to Pay (WTP) estimates from survey evidence is beset with technical problems including:

Framing - the precise wording or order of questions can significantly change responses;

Protest responses are common. Respondents may register inflated values where their response can be likened to the act of contributing to a cause and "protest zeros" may be returned to show disapproval with an organisation rather than its outputs; and

Respondents' ability to accurately value benefits can be questioned e.g. making judgements on how to value services may often be beyond understanding for individuals, especially where there are no standard benchmarks or bases to relate to. Other individuals may struggle to classify effects as exclusively use or non-use benefits as required for constructing components of a total valuation. For example respondents may struggle to separate physical recreation use values from existence values associated with a woodland.

Box (3.2): Technical Issues Calculating Willingness to Pay

3.2.3 Non economic valuation methods and deliberative and participatory valuation

Ecosystems are usually public goods but when stated preference techniques, such as contingent valuation, are used only individual preferences are elicited. The expression of individual preferences raises equity issues better dealt with through more deliberative and participatory techniques. Beyond the technical issues involved in calculating WTP estimates the use of the valuation methods detailed above have been criticised for failing to capture "how the natural environment makes people think and feel."[20] The methodologies omit the impact of the natural environment on mental wellbeing. The box below details how empirical evidence from wellbeing research may be incorporated to improve these techniques.

[20] Newton, J (2007) Wellbeing and the Natural Environment: A brief overview of the evidence DEFRA

Use of empirical evidence from well-being research may improve these techniques:

Deliberative monetary valuation: The use of formal deliberation concerning an environmental impact to express value in monetary terms for policy purposes, and more specifically as an input to cost-benefit analysis.

Social multi-criteria evaluation: The combined use of participatory techniques and multi-criteria analysis to aid decision making about a number of policy, programme or project options while taking conflicting interests and multiple criteria into account. It highlights transparency and social learning in the appraisal process.

Three-stage multi-criteria analysis: The combined use of participatory techniques and multi-criteria analysis to aid decision making about policy, programme or project options. The sequencing and choice of participants is based on 'co-operative discourse'.

Multi-criteria mapping: An interview-based multi-criteria analysis that focuses on eliciting and documenting detailed technical and evaluative judgements concerning the performance of alternative options.

Deliberative mapping: The combined use of participatory techniques and multi-criteria analysis to aid decision making about policy options. The method highlights the need to explore the arguments participants use to justify their judgements.

Stakeholder decision/dialogue analysis: The combined used of group deliberation techniques and (a qualitative form of) multi criteria analysis to aid decision making about policy options

Source: Newton (2007)

Box (3.3) Alternative and Additional Valuation Methodologies

3.3 Benefits Transfer

Benefits transfer relates to the process of transferring economic values generated for sites that have previously been the focus of primary research to new 'policy sites'. This area of research has the potential for powerful results as it can be used to apply the findings from a single research exercise to a number of similar ecological assets. For example, a study which estimates the value of an urban green space in one city may also provide a reasonable estimate for the same service in another.

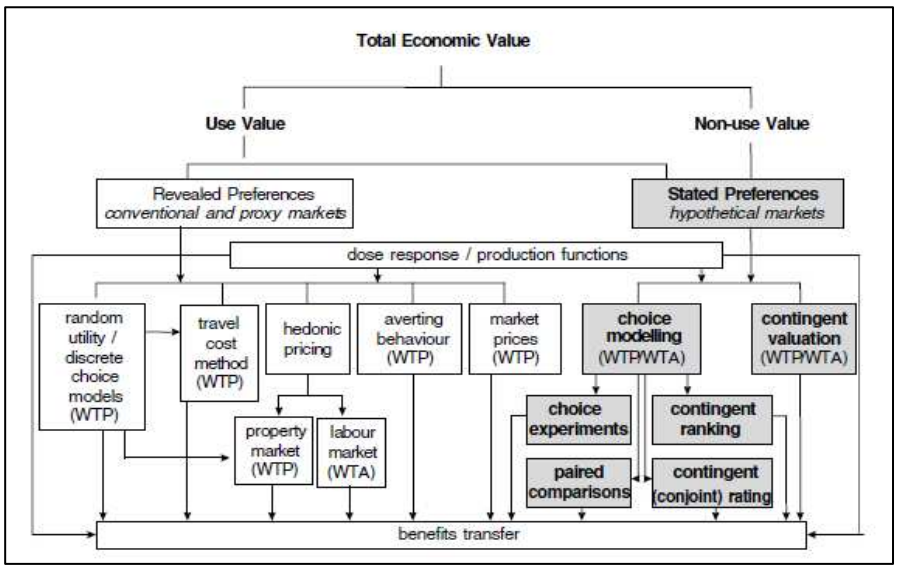


Figure (3.2) Economic Valuation Techniques

Source: DTLR (2002)

At its best, benefits transfer relies on meta-analysis, or the 'study of studies' to transfer results. There is typically a wide variance in results of different WTP studies, however by controlling for different variables between studies (such as details regarding the ecosystem service, the methodology and data quality) meta-analysis has the power to explain much of the difference away creating a much more accurate tool.[21]

Meta-analysis has been applied to a number of topics including outdoor recreation, groundwater, air quality and associated health benefits, endangered species, and the existence of wetlands[22]. However, as benefits transfer analysis relies on the existence of comparable research, it is a more powerful tool only in better researched areas. The implication of this is that it is harder to apply to ecosystem services which are not a-priori considered important.

3.3.1 Remaining issues valuing ecosystem services

Several important issues remain with the use of payments for ecosystem services, and require further research to improve its reliability including:

- **Complexity of multiple provisions** – one ecosystem may provide many different services. For example a forest may provide biodiversity, flood alleviation, and carbon sequestration services. The valuation of each of these services alone will not provide an accurate picture of the importance of the asset;
- **Functional interaction between habitats** – integration between different ecosystems through physical and biological processes make it hard to isolate and value even a single ecosystem when studying dynamics[23]; and
- **Uncertainty and associated risks** – the confidence intervals associated with this research are very large, costs associated with the loss of some ecosystem services may take some time to become apparent or may only be apparent at a different location. Additionally if these changes involve thresholds or alter the stability of a system they may be hard to assess.
- **Non linearity in the flow of services** – neat linear relationships are not common place in nature. Assuming all parts of a given ecosystem supply services of equal value in relation to their area[24] may grossly simply the behaviour of complex systems leading to poor public policy choices.

3.4 Key issues

Techniques exist to convert ecosystem services into financial values based on a variety of techniques used to establish "Total Economic Value", valuations can be transferred to a new policy site through a "benefits transfer" mechanism. Benefits transfer assumes an equivalence of value from one location to the next. The valuation is stronger if it is based on a wider sample of valuation case studies. The evidence base supporting the value of eco services is, however, stronger for certain types of ecosystem service than others.

[21] MPRA (2008)
[22] MPRA (2008)
[23] Eftec (2005) The Economic, Social and Ecological Value of Ecosystem Services. http://www.jncc.gov.uk/pdf/BRAS_SE_Newcomeetal-TheEconomic,SocialandEcologicalValueof EcosystemServices(EftecReport).pdf
[24] UNEP (2008) "The Economics of ecosystems and biodiversity – An Interim report", European Communities

4 Overview of the East Midlands

4.1 Introduction

This section provides a brief overview of the biophysical structures of the East Midlands as a precursor to understanding the flow of ecosystem services that they deliver. In doing so, the report does not intend to repeat the extensive information held elsewhere on the natural environment (e.g. State of the Region). The purpose of the review is to establish the link between the bio physical structures of the region and the broader economy especially land based activities.

A summary of the key characteristics is shown below:

ASSET BASE ASSESSMENT[25]	
Land area	15,627 square kilometres
Coastal/rivers/ major water bodies	3,530 km of rivers and canals. The major rivers are the Trent, Derwent, Soar, Welland, Nene and Rother. 7 EC-defined Bathing Waters
Population statistics	4.19 million population in total 1.11 million (39.9per cent) of whom live in rural areas (English average 28.5per cent people living in rural areas).
Countryside character	34 of the Countryside Agency's 159 Countryside Character Areas in the East Midlands
Land cover	52.6 per cent arable and horticultural, 22.9 per cent improved grassland, 7.9 per cent broadleaved and coniferous woodland, 7.5% semi-natural grassland, heathland, water and rock habitats, 9.1% urban. 5 per cent (799 km²) of the Region is Green Belt (6% of national average)
Flora and fauna	Species of note include: Spotted Flycatcher, Pipistrelle Bat, Argent and Sable Moth, Door-mouse, golden plover, brown hare.
Areas of Outstanding Natural Beauty (AONB)	The Lincolnshire Wolds Area of Outstanding Natural Beauty covers 519 km2 (3%) of the Region. It is one of the largest AONBs in England.
National Parks	The Peak District National Park covers 917 km2 (6% of the Region).
National Nature Reserve (NNR)	10 NNRs covering 1,901 ha (0.12%) of the land area
Local Nature Reserve (LNR)	53 LNRs covering 842 ha
Less Favoured Areas (LFA)	124,000 ha of which 95,000 ha SDA
Environmentally Sensitive Areas (ESA)	The North Peak and South West Peak ESAs cover 35,161 ha within the East Midlands (they cover 63,600 ha in total)
Sites of Special Scientific Interest (SSSI)	382 SSSIs covering 67,423 ha (4.3%) of the Region

[25] A Long Term Policy Perspective for Sustainable Agriculture: Environmental Impacts – Final Report Reference: GRP-P-158

ASSET BASE ASSESSMENT[25]	
Special areas of Conservation (SAC)/ Special Protection Areas (SPAs)	24 SACs (Derbyshire – 20, Lincolnshire – 2, Nottinghamshire – 2)

Table (4.1) East Midlands Asset Base Assessment

4.2 General Description

The East Midlands region covers 12% of England's total land area and its population of 4.2 million represents 7% of the UK total. One in three people live within rural areas, which is higher than the national average. The East Midlands has a hugely diverse and contrasting geography which continues to be a major influence on the social, environmental and economic climate in the region's rural areas. The contrasts range from the moorland upland areas of Derbyshire to the gently undulating farming areas of Nottinghamshire/ Northamptonshire and the low-lying fens of Lincolnshire. Each area has its own pattern of land use and economic activity. At one end of the economic spectrum lie the "Severely Disadvantaged Areas" of upland Derbyshire, at the other is the high output arable farming on the fens of southern Lincolnshire. Lincolnshire is of particular note as it has a highly developed and vertically integrated horticultural industry.

Within this range of regional landscapes, the Peak District National Park in the west, and the coastal areas of Lincolnshire and the Wash in the east, are of special importance for the richness of their biodiversity, including a variety of wildlife habitats and species of high quality and rarity. Agriculture and forestry are the dominant land uses in the region. As industry sectors both agriculture and forestry are still major employers (3.2% of the region's workforce). There are also significant numbers of historic buildings, parkland and other sites that contribute to a rich and varied cultural heritage.

More than half (52.6%) of the Region's land is arable or horticultural land – the highest proportion of all English regions. Improved grassland covers 22.9% of land, broadleaved and coniferous woodland 7.9%, semi-natural habitats 7.5% and urban areas 9.1%.

4.3 Natural environment

4.3.1 Soil

The Region contains a wide variety of soils associated with its range of landscapes. In Peak Park area of Derbyshire, deep acid soils blanket the high moors with limestone in the White Peak while in the Dark Peak shallow soils with limited buffering capacity are sensitive to the effects of acid deposition and over grazing. On the Wolds of Lincolnshire, shallow free draining rendzinas barely cover the chalk. The sandy drought prone soils of Nottinghamshire support historic forests and heath land communities. The clay vales of Northamptonshire and Leicestershire once renowned as grazing pastures now support autumn sown cereals and arable crops. In the Fens, the rich silt alluvial soils border the remaining areas of once extensive lowland peat soils.

The most versatile and productive soils are found in the east of the Region. They are an important part of the Region's resources although drainage of the Fens followed by cultivation and cropping has led to significant loss through oxidisation of the fen peat soils. In the upland the soil and vegetation is sensitive to pressure from recreational activities as well as overgrazing where subsequent erosion can lead to siltation of water courses and riparian habitats.

On the lighter sands of Nottinghamshire, wind erosion and outdoor pig farming are contributory factors to soil erosion. Some 22.1% of the agricultural land is classified as Grade 1 and 2 compared with 16.1% across the whole of England. The better quality Grade 1 and 2 land is predominantly located to the east of the Region, particularly in south east

Lincolnshire surrounding the Wash, with smaller areas in Nottinghamshire and to a lesser extent in Leicestershire; Grade 3 land is predominant in the counties of Leicestershire, Rutland and Northamptonshire and also covers large parts of Lincolnshire and Nottinghamshire. The Grade 4 land, although scattered throughout the Region is predominantly in Derbyshire and the Peak District National Park. Likewise Grade 5 land which is poor from an agricultural point of view is found in the northern area of Derbyshire, covering a large proportion of the Peak District National Park.

4.3.2 Water

Rainfall in the eastern part of the Region is low when demand for water abstraction during the summer is high. The main water resources in the east of the Region are the limestone, chalk and sandstone aquifers in Lincolnshire along with the rivers Nene, Welland, Witham and Ancholme. In the centre of the Region, the Sherwood Sandstone, Carboniferous Limestone and Lower Magnesian Limestone aquifers and the River Trent are the main water resources which are important for agriculture, public water supply and industry. A significant proportion of the water supply is drawn through boreholes and wells from underground reserves in aquifers. Abstraction from some aquifers has depleted available supplies leading to falling groundwater levels, loss of base-flow to water courses and adverse effects on the aquatic and associated habitats. Many aquifers in the East Midlands are now considered fully committed to existing water extraction and most of the surface water catchments throughout the Region are fully licensed for abstraction during the summer months. River quality in the Region has improved by 20-30% since the 1990 River Quality Survey was carried out.

4.3.3 Countryside character

The East Midlands landscape comprises a unique mix of distinct landscape types and individual landscape features. From the upland moors of the Peak District to the flat cultivated Fens, the landscape is both varied and distinctive. Field boundaries are walls in North Derbyshire, ditches in the Fens and hedges in Leicestershire. The Region has the first National Park, the Peak District, as a valued designated natural resource and an area of the finest landscape, the Lincolnshire Wolds Area of Outstanding National Beauty. In addition to these national landscapes designations there are many areas covered by local landscape designations which contribute to the landscape assets of the Region. However, despite recognition of the value and importance of the distinctive landscapes of the East Midlands the overall trend is towards an erosion of individual character across the Region, and so a loss of distinctiveness. There are 34 Countryside Character Areas in the East Midlands.

4.3.4 Cultural and historic environment

Within the East Midlands there is a wealth of historic and cultural resources that contribute towards the distinctive character of the area. This includes over 1,000 Scheduled Ancient Monuments (SAMs) - 6% of national total. Many archaeological features have been lost in recent years and a significant proportion of the remainder are under threat. Many hundreds more historic and archaeological sites are recorded at local level on the county Sites and Monument Register. These sites range from Stone Age burial sites, to field lynchets, medieval ridge and furrow and deserted villages, lime kilns, lead mines and rakes etc. Intensification of agriculture and development is also putting many of these sites at risk.

4.4 Areas of Special Protection and Designation

Although the East Midlands contains a number of notable protected areas – in particular the Lincolnshire Wolds Area of Outstanding Natural Beauty (AONB) and the Peak District National Park – the total area of nationally designated landscapes in the East Midlands is the lowest of all English regions, at 144,000 hectares in 2004.

The East Midlands has the second lowest proportion of its land area designated as Sites of Special Scientific Interest (SSSIs) in England (around 4.5% compared to an average of 7%). In July 2006, around 68% of the total area of SSSIs in the region was classified as being in good or recovering condition. This represents a major improvement since 2002, when just

under half of SSSIs in the region fell into these categories. Overall, the region has made significant progress during the last four years and is approaching the national average condition. However, there remain a number of significant challenges to SSSI maintenance, including the moorlands of the Peak District, the Wash and a range of smaller, isolated SSSIs. It is also important to note that sites in recovering condition are likely to require continued input of resources if they are not to move backwards.

A good example is the Peak District moorlands, where implementation of moorland management plans requires a long-term commitment initially through the existing Environmental Stewardship Agreement schemes. Eight of the 23 designated Countryside Character areas in the East Midlands have seen marked changes that are inconsistent with underlying landscape character. Another 10 have seen some changes inconsistent with character. Only 5 of the 23 areas within the region were considered to have had the character of their landscape enhanced during the period 1990-1998.

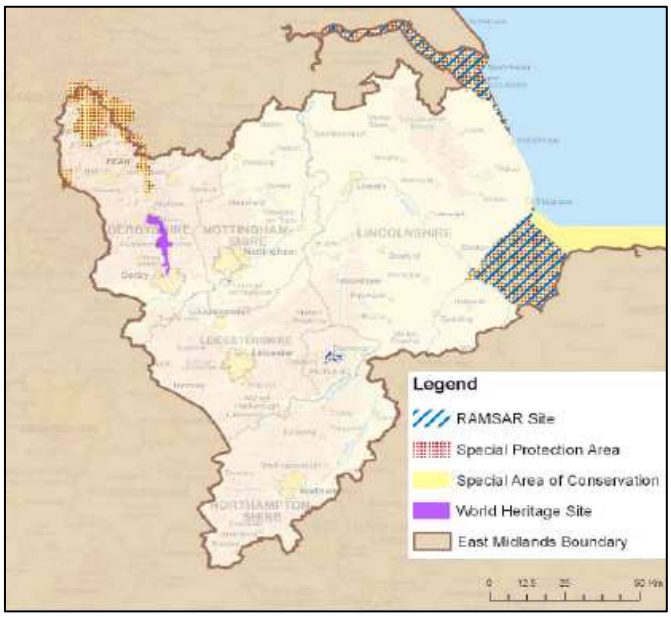


Figure (4.1) Internationally Significant Special Designations in the East Midlands

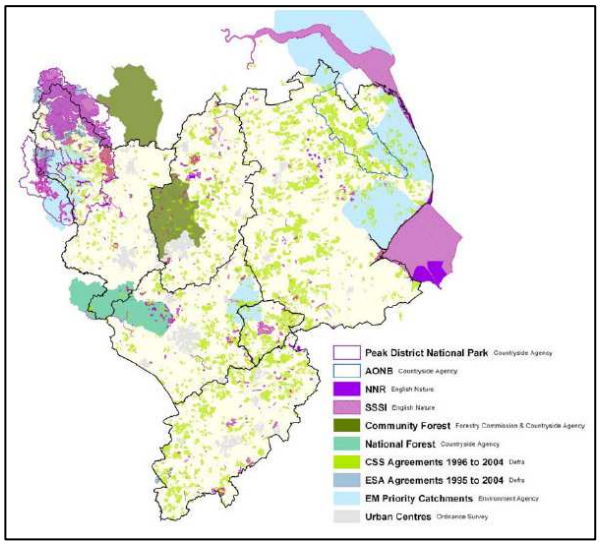


Figure (4.2) Nationally Significant Designations

4.5 Land ownership patterns and concentrations in the East Midlands

The economic interest of the owners of biophysical assets determines how they are used within broad parameters set by society at large. Land ownership details in the East Midlands region are difficult to obtain, however County level data for 2001 shows nearly 40% of land is controlled by a relatively small number of large land owning interests (Table 4.2). Table (4.3) shows the continued importance of traditional private landed estates as well as the importance of institutional land ownership in the region.

Land Ownership Indicators	2001
Total Acreage	3,862,163
Agricultural Acreage	3,014,015
Non Agricultural Acreage	848,118
Population	4,102,300
Owners of Nothing at all	1,871,200
Total Dwellings	1,717,000
Small holdings owners of 0-2 ha	1,080
Landowners over 2 hectares	14,665
Landowners over 500 acres	1,490
Acreage of region owned by owners of over 500 acres	1,457,418
Percentage of land owned by owners of over 500 acres	37.7%

Table (4.2) Structure of Land Ownership in the East Midlands 2001

Source: Cahill (2003) Who Owns Britain and Ireland

Land Owner	Acreage
Forestry Commission	30,400
Local Authorities	33,083
Dioceses	35,426
Church Commissioners	19,556
National Trust	41,495
Ministry of Defence	21,632
The Crown Estates	67,913
Named Privately Owned Estates over 10,000 acres (9)	148,000
Named Privately Owned Estates over 5,000 acres (5)	13,600
Total Land (attributable to identifiable owners)	411,105

Table (4.3) Key Land Owners in the East Midlands 2001

Source: Cahill (2003) Who Owns Britain and Ireland

(Note: Based on Leicestershire, Derbyshire, Nottinghamshire, Lincolnshire and Rutland)

These land owners maintain a freehold interest in key biophysical assets of the region that produce ecosystem services. Some of these interests are passed through tenancy agreements to tenant farmers who act as stewards of the land but with specific economic motivations. In the East Midlands, around 1,229,750 hectares of land are spread across 22,260 farms equivalent to 18,519, holdings[26].

Typically, the economic value of the assets held by land owners and their tenants (outside development areas) is reflected in the income generated from food crops, timber, livestock management, material extraction and so forth. In recent history, the economic returns from agriculture have been low relative to these alternative investments.

4.6 Key issues

This brief overview of the biophysical resources of the region demonstrates two characteristics that provide a rationale for looking beyond traditional policy instruments used to manage the environment.

The first section (especially Table 4.1) shows that whilst areas of the region are covered by designations denoting environmental quality (both national and international), the scale of coverage is still relatively low compared to the overall scale of biophysical resources of the region.

The second part of the section demonstrates that biophysical resources are already owned and managed with a view to securing the output of commodities with a financial value like food crops, wood or other materials.

These economic interests constitute a baseline against which future PES will have to be determined. The statistics emphasising the level of land ownership concentration demonstrate the powerful position occupied by certain land owning interests when considering ways of encouraging changes in land management practice aimed at raising or stabilising the production of ecosystem services.

[26] June 2007 Agricultural and Horticultural Survey – England, Defra

5 Mapping the Flow of Ecosystem Services across the East Midlands

5.1 Introduction

In the previous sections, biophysical assets were identified responsible for the production of ecosystem services in the East Midlands. This section provides an overview of the flow characteristics associated with the major groupings of ecosystem services:

- provisioning;
- regulating; and
- cultural.

Supporting services are treated as part of the functions that underpin these other groups.

5.2 Provisioning

5.2.1 Food

Agricultural and horticultural land occupies around 1.2 million hectares, or 78% of the region's total land area, a figure that has been more or less stable since 1990. Dairying, livestock and mixed farming is dominant in the western and central parts of the region, while arable and horticultural production are more important in the north east and south east. Pig and poultry farming is also important in the eastern areas. Since established markets exist in relation to food production, the value of these 'ecosystem services' are relatively easy to calculate[27]. In 2007/8, the region produced 15% (£1714m) of the total gross agricultural output for England, and contributed about 13% (£582m) of the national GVA for agriculture. Overall agriculture's share of total GVA for the East Midlands was 0.7%, whereas for England the average was 0.4%. In terms of employment and businesses, LANTRA (the Sector Skills Council for the Environment and Land Based Sector) estimate that in 2005 of the 11,486 businesses within the land-based sector, those with links to food production predominate. Agricultural crops and livestock production and production horticulture businesses make up more than 65% of the total.

Although agricultural output is clearly constrained by the biological and physical characteristics of the region, there is little evidence that the productive capacity of agriculture suffers major environmental limitations – except in the 'Less Favoured Areas' of the Peak District. In relation to questions about what we might expect a 'well-functioning' ecosystem to deliver, the major issue is perhaps not output itself, but the ancillary benefits it produces through its influence on other ecosystem services (e.g. landscape quality), or the 'externalities' it imposes on other ecosystems (in terms of say, diffuse pollution loads). Thus PES schemes might play a role in the interventions required to support or mitigate these secondary effects; issues arising in the context of water management, genetic resources and cultural services are discussed below.

In order to emphasise the particular qualities of the East Midlands, the production of specialist and local foods have been identified separately as items 2 and 3 of Table 2, e.g. Stilton, Red Leicester, Lincolnshire sausages, Melton Mowbray pork pies, Lincolnshire stuffed chine, plum bread, Lincoln Red beef, potatoes, vegetables and daffodils are all recognised regional specialities[28]. The maintenance of good environmental quality is essential if the reputation of such products is to be sustained and exploited in the market place, and so targeted PES schemes may be significant in helping to promote existing and new brands.

27 http://www.farmbusinesssurvey.co.uk/regional/index.asp

28 http://www.nfuonline.com/x324.xml

Along with other regions in the UK, the importance of the fishing industry has declined in the East Midlands, but it remains locally significant in some areas especially for the production of shellfish, with a focus in the Wash (Table 2, item 5). In acknowledgement of its national and international importance for nature conservation, the Wash is designated as a Site of Special Scientific Interest, a Special Area of Conservation, a Special Protection Area and a Ramsar Site. It is also nationally important for the production of shellfish. In the early 1990s it had become apparent, however, that over exploitation had damaged the productive capacity of the area. Shellfish stocks had declined with significant consequences for both wildlife and the fishing industry. By 1997, the cockle fishery was forced to close through lack of stock, and harvesting of mussels from natural beds was limited. As a result of management efforts coordinated through the Eastern Sea Fisheries Joint Committee, however, the situation has improved. Natural England has recently reported that the conservation status of the SSSI area is now 'unfavourable recovering' rather than declining, and cockle and mussel stocks have increased. Such experience suggests that sustainable harvesting regimes can be established that are compatible with conservation goals, and that PES type schemes may have an important role in developing the potential of the resource further within the context of an overarching ecosystem approach. The recent report by the English Shell Fish Association, for example, has argued that both public and private investment measures are required to ensure that the fisheries and cultivation sectors remain sustainable and competitive[29]; potential for further development of this provisioning service in the east midlands probably exists.

5.2.2 Fibre and renewable energy

Compared to other regions in the UK, the proportion of land in the East Midlands covered by woodlands and trees is low (around 5%), and traditionally the area has not been seen as major timber-producing or processing region.

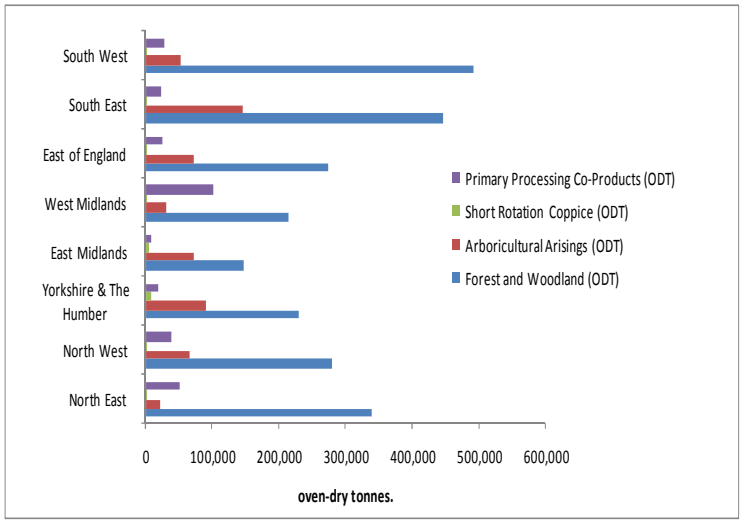


Figure (5.1): Wood fuel by source for English Regions (Source Forestry Commission)

Nevertheless, there are a number of locally important concentrations of commercially managed woodlands and associated business and these may provide a foundation for future development. The current England Forest Strategy has emphasised that the forestry sector is important to rural development, economic regeneration, recreation, and tourism and environment across the region and there is a target to increase woodland cover by about 65,000 hectares by 2021; currently the woodland area is approximately 75,000 ha.

The National Forest, Sherwood Forest and Greenwood Community Forest are identified as priority areas for expansion. In this context, PES type schemes in the form of grant aid, to support training and advice is required in order to stimulate the additional planting and

29 http://www.shellfish.org.uk/assets/Images/strategy.pdf

management needed. The England Forest Strategy also recognises that the development of local marketing and processing of timber based products is needed to achieve the full economic and conservation benefit that can arise from this resource.

The woodlands of the East Midlands, along with other suitable crops such as short rotation coppice, are likely to become sources of renewable energy in the future, although in terms of the volumes of material available, it presently has the smallest potential of all the regions of England (5.1). Nevertheless, it is likely to be important locally, especially when used alongside other sources such as post-consumer wood collected by local authorities[30].

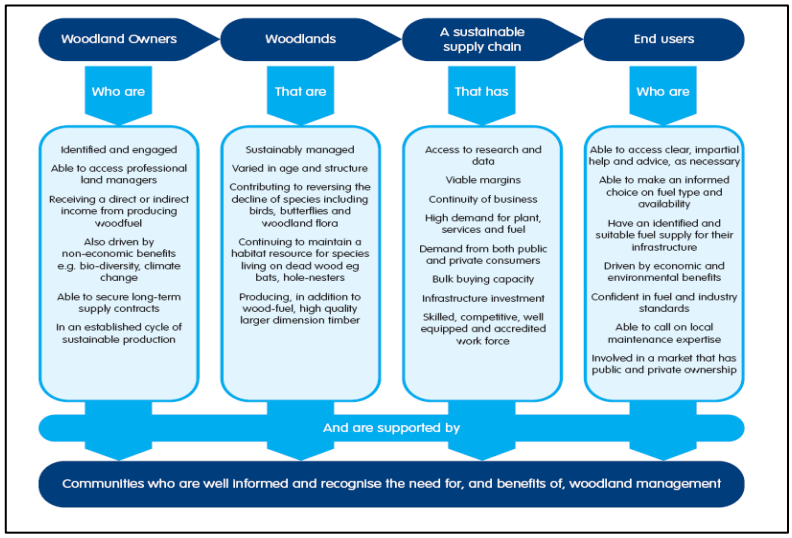


Figure (5.2) Wood Fuel Supply Chain

Source: after Forestry Commission, 2007

The Forestry Commission's (2007[31]) Woodfuel Strategy for England sets out how the Government's target for utilising an additional 2 million tonnes of wood for energy production can be achieved, and argues that the focus should be on the under-utilised woodland and on 'forestry arisings' that are not currently harvested in commercial forestry operations. As the strategy notes, however, there are a number of barriers to the use of the renewable energy potential that woodlands might provide, and it is possible that some might be overcome by suitably targeted PES systems. The barriers include limited awareness of the value of wood fuel systems and difficulty of accessing appropriate technical help and assistance. In woodlands that have not been managed for a number of years, disinterest, and lack of knowledge to access grants and licenses have also been identified as further barriers to progress. Perhaps the most significant factor preventing the exploitation of this resource is the complexity of what the Strategy called the 'supply chain' (Figure 5.2) that is the series of steps that connects the producer of the 'feedstock' to the end user. The Strategy argues that in putting all the elements of the supply chain in place, "The challenge is to advance all of them together." It recommends "a concentrated sub-regional approach rather than a general support mechanism is the key to joining these up", a strategy that might be appropriate in the East Midlands alongside the general plan for expanding woodland cover within the area.

Other sources of renewable energy within the region include biogas (from organic wastes and crops), wind and small-scale hydro. Animal manures for anaerobic digesters come from housed livestock that produce liquid or highly concentrated slurries. Thus the production of biogas is partly controlled by the distribution of dairy cows, pigs and poultry, and given the agricultural geography of the region may be significant in the west and central parts of the region and possibly in the east. The review on *Renewable Energy and Combined Heat and*

[30] www.bioenergygroup.org

[31] Forestry Commission (2007): Woodfuel Strategy for England. www.forestry.gov.uk/england-woodfuel

Power Resources in the UK[32] suggests, however, that wind is likely to be dominant in the region, the majority of which is likely to come from off-shore sources, because of the limited availability of good wind sites on and outside national parks and other environmentally sensitive sites in the region.

5.2.3 Water

The third major provisioning service is water. Both surface and ground water supplies are significant in the region, and as the recent review infers both are under pressure from demand. Some aquifers are fully- or over-licensed in relation to existing water extraction, and most of the surface water catchments are fully or over licensed for abstraction during the summer months[33]. As a result not only are there potential shortfalls for domestic and industrial supply in dry periods, but also there is a threat to aquatic ecosystems in terms of maintaining ecological flows. In the long term, the availability of water may constrain development and limit the extent of ecological restoration within the region. The wetland vision promoted by RSPB and its partners[34], for example, has identified a significant potential for wetland creation within the region which could only be realised if sufficient water is available.

In addition to the issues surrounding water volumes, water quality is also a concern in relation to this important ecosystem service. The Catchment Sensitive Farming programme has identified a number of localities in the region as sites where diffuse pollution resulting from agricultural activities is affecting surface water quality[35]. More generally, about 90% of the region has been designated as a Nitrate Vulnerable Zone following the extension of the scheme in 2002; for England as a whole the proportion is around 55%. Within these areas land managers received payments for modifying farming practices to reduce the amount of nitrate leaching from the soil.

The vulnerability and importance of careful management of the water provisioning service is illustrated by the case of Nottingham, which lies at the southern end of an extensive outcrop of the Triassic Sherwood Sandstone. This is one of the largest groundwater reservoirs in the UK, and supplies roughly 50% of the water used by the city and the surrounding region. However, the concentrating of nitrates in the aquifer has been rising since the 1960s and now exceeds the EU limit for drinking water. To manage the quality of the waters, those with higher nitrate levels have been blended with water from less contaminated boreholes in the east, and that from boreholes sunk in the forested areas on the sandstone outcrop where concentrations of nitrate are lower because of the absence of farming activities. Such initiatives demonstrate the importance of appropriate land management and the potential role that interventions, possibly through some kind of PES scheme, might make in securing the integrity of the resource in the long term.

5.2.4 Genetic services

The genetic provisioning service of the East Midlands has been impacted by human activity. The Regional Economic Strategy for the East Midlands 2006-2020, and the associated evidence documents[36], note that biodiversity has declined faster here than elsewhere in the UK, and suggests that this is partly due to the extensive area of high quality, intensively farmed land that exists within the region and habitat fragmentation. It has been estimated that over the last hundred years or so one plant species has became extinct each year in each county within the region, and 70% of scarce plant species have become extinct since 1970 in Leicestershire, Northamptonshire and Nottinghamshire. Although there are some

[32] Watson, W.J., Hertin, J., Randall, T., Gough, C. (2002). *Renewable Energy and Combined Heat and Power Resources in the UK,* Tyndall Centre Working Paper 22

[33] Environment Agency, 2008, Water resources in England and Wales - current state and future pressures

[34] http://www.rspb.org.uk/Images/wetlandvision_tcm9-132957.pdf

[35] http://www.defra.gov.uk/farm/environment/water/csf/index.htm

[36] http://www.emda.org.uk/res/

nationally and internationally important sites for conservation within the region, it has a smaller proportion of its area designated as an SSSI than the national average. In relation to the status of these sites, the 2008 State of the Region Report[37] notes that about 70% of sites of special scientific interest (SSSIs) in the East Midlands are in favourable or unfavourable recovering condition in 2007. Although this is an increase of about 18% since 2005, it is below the rate for England as a whole (76%) and far short of the 2010 target of 95%, which is therefore unlikely to be achieved.

Improving the environmental quality in the East Midlands and sustaining its biodiversity have been identified as key strategic objectives for the Region[22]. A key step is to reverse fragmentation and decline by encouraging actions to restore degraded wildlife habitats and create new areas for wildlife at the landscape scale.

The 2005 Regional Spatial Strategy proposed the introduction of mechanisms to ensure that development results in no net loss of BAP habitats and species, and that where ever possible that a net gain is achieved. In support of such an objective, the Regional Biodiversity Forum has identified areas for 'Biodiversity Conservation' and 'Biodiversity Enhancement'.

The former have greater ecological value due to a higher proportion of habitats and relatively closer proximity of habitat units compared with other areas of the East Midlands, whereas the latter are areas where the biodiversity is poor or where there are regionally significant opportunities to reverse losses through habitat creation initiatives on a landscape scale. Woodland is a major focus of regional policy, and the regional spatial strategy proposes that Local Authorities, environmental agencies, developers and businesses should help to create new areas of woodland to meet a regional target of an additional 65,000 hectares of tree cover by 2021; especially in relation to the National Forest, Sherwood Forest, and the Greenwood Community Forest. Thus, there is probably considerable scope for intervention through PES-type schemes to enhance the biodiversity resource of the east Midlands and hence enhance the output of 'genetic services' and the associated benefits that biodiversity provides. The Regional Economic Strategy estimates that environmentally sensitive farming and forestry practices sustain about 4,300 land-based jobs in the region, and there is therefore probably scope for further expansion.

5.3 Regulating services

5.3.1 Climate regulation

The potential impacts of climate change on the environmental resources of region have been widely discussed[38]. It has been suggested, for example, that the most significant threats include those in relation to the region's high quality agricultural areas, especially those in Lincolnshire, where water shortages could arise and the likelihood of flooding could increase. At present irrigation plays an important role in sustaining the productivity of these areas. Moreover, over half of the best and most versatile agricultural land in the region is less than 5 metres above sea level; the Lincolnshire coast is already one where the danger of inundation is high. In relation to biodiversity, it is recognised that measures will be required to ensure that it can adapt to the effects of climate change, which threaten a number of key habitats. These include blanket bog, lowland wood pasture and parkland, salt marsh and lowland hay meadows[39].

A wide range of mitigation and adaptation measures will be required to cope with the impacts of climate change. In relation to the 'climate regulation services' provided by ecosystems in the region a number of mitigation measures are possible, including reversing

[37] http://www.emra.gov.uk/files/sor_2008-_full_report.pdf

[38] East Midlands Sustainable Development Round Table, *The Potential Impacts of Climate Change in the East Midlands* Technical Report, August 2000. Entec UK Limited

[39] English Nature (2005) The Effects of Climate Change and Biodiversity.

the general decline of soil carbon in arable soils and enhancing the sequestration of carbon in woodlands and peat.

The planned expansion of woodland in the region will have short term benefits in relation to carbon uptake (while the standing crop matures) as well as the wider benefits for biodiversity and landscape that greater forest cover will bring. Sequestration will only be significant in the long term, however, if wood is harvested and remains locked up in wood products. The mitigation effects of woodland expansion will have to be balanced against the potential impacts on other services such as surface water supply, since increased forest cover may reduce water yields.

A recent review of the scientific literature undertaken by the Woodland Trust, suggested that water yield and base flows were likely to be maintained on newly afforested areas in central and southern England overlying chalk or clay soils, compared to grassland areas, but in the drier parts of eastern England, with less than 750mm annual rainfall on sandy soils, reductions of around 20%-50% compared to grasslands are possible.

A significant contribution that ecosystems in the East Midlands might make to climate regulation is probably through the expansion of wetlands and the associated service of carbon sequestration. As noted above, there is considerable potential for the expansion of wetlands within the region, providing water supplies are adequate.

The large areas of peat in the Peak District are also important in terms of climate regulation. At present the conservation status of many of the areas of upland bog is unfavourable, and they are net carbon sources. This is significant because at national scales peat soils contain nearly half of the UK's soil carbon, even though they occur on only 8% of the land area. These ecosystems can be damaged by wildfires, air pollution or inappropriate land management resulting in erosion and drainage. In the Peak District, it has been estimated that large areas of bare peat (caused by fires and erosion) may release up to 18 $TonCO_2/km^2$. It has been further suggested that if all the moorlands across the Peak District were in favourable condition they could take up around 18 $TonCO_2/km^2$ each year and make a significant contribution in terms of their carbon off-set value.

Major initiatives are now under way to restore the functioning of peatland ecosystems, or at least to arrest their decline, both for the contribution they can make to climate regulation and because of the impact that loss of peat through oxidation and erosion can have on other ecosystem services such as water supply. They also illustrate how interventions through PES-type initiatives may be able to enhance the output of a range of ecosystem services, by considering the multi-functional character of ecosystems. The SCaMP Project[40], for example, being led by United Utilities and RSPB in two upland areas of England, the Forest of Bowland and the Peak District, aims to restore large areas of moorland to secure the quality of its water supplies, the conservation and landscape value of the ecosystems themselves and the benefits these areas make in relation to carbon uptake and storage. The project, which involves significant collaboration with local stakeholders, is significant in the context of reviewing PES-type models, because has been build on a mix of funds from private and public sources.

5.3.2 Flood regulation

The potential of flooding from both river and coastal inundation is significant throughout the region (see Figure 5.4). In line with the Governments strategic approach to the problem, the EA is leading the development of Catchment Flood Management Plans (CFMPs) which aim to encourage an integrated, sustainable and strategic approach to land management in catchments. In relation to the coasts, Shoreline Management Plans (SMPs) are being developed by coastal groups to provide large-scale assessments of the risks associated with coastal processes and long term policy frameworks to reduce risk in a sustainable

[40] http://www.unitedutilities.com/AboutSCaMP.htm

manner. In both contexts a range of land management interventions, together with modified approaches to planning future developments, are being considered[41].

Woodland planting, for example, may modify hydrological regimes, although the effects may be more significant locally than regionally. The recent review of woodlands and water undertaken by the Woodland Trust[42], for example, noted that evidence from regional flood studies in Britain determined woodland area was not significant in flood prediction, although woodland cover in the areas studied was generally small. The literature suggested that, more locally, woodland may reduce small 'muddy' floods at hill slope or headwater catchment scales. Floodplain woodland can also mitigate large flood events by reducing and delaying release of runoff.

The Woodland Trust Review study also suggested that, at least in the context of woodland management, interventions to mitigate flood risk would need to be targeted. Thus restoring non-native conifer plantations on ancient woodland sites may tend to increase the frequency of small floods because broadleaves use less water than conifers, and run-off is higher from such stands. There would be less effect on extreme floods. A similar set of effects would arise following the conversion of coniferous plantation to other semi-natural vegetation, such as heathlands. By contrast, planting woodland on arable land or improved pasture would reduce the frequency of small flood events, although this may need to be offset against the danger that flood plain woodlands may lead to the accumulation of large woody debris which, if washed out by more extreme events, could block bridges and other structures, thereby increasing the risk of flooding elsewhere.

Since woodland planting along with modifications to cultivation practices is proposed as the main land management interventions capable of ameliorating run-off, there is a clear opportunity of linking such actions to PES mechanisms. The current approach proposed by Government is to make maximum use of the status of flood management as a secondary objective in the environmental stewardship scheme, and to the potential benefits for the control of water run-off from soils under the single payment arrangements of CAP. The extent to which such interventions at the holding, rather than the catchment level, will be effective and the need to embed such initiatives in more integrated approaches such as the catchment sensitive farming scheme is yet to be determined. A number of river corridors in the region, including those of the Nene, Trent, Soar, Welland, Witham, Derwent and Dove, have been identified by the Regional Spatial Strategy as strategic targets for action to enhance their multi-functional character.

More radical approaches to the management of hydrological regimes are those envisaged under schemes for managed realignment of river corridors and areas of inter-tidal habitats. The present Government policy is that existing defences will only be maintained where costs are justified by the range of benefits they provide, and that any assessment must take account of the full range of environmental, social and economic issues. An example of the kind of scheme that can be anticipated is the managed realignment at Alkborough at the junction of the Trent and Humber, where a breach in existing sea defences was made in 2006 and sea defences have been lowered to permit more frequent overtopping in extreme events. The site therefore provides both flood storage and a mechanism for energy dissipation during flood events. It will reduce high tide levels over a large part of the upper estuary by 150mm.

[41] Making space for Water (2005) Taking forward a new Government strategy for flood and coastal erosion risk management in England First Government response to the autumn 2004 Making space for water consultation exercise

[42] http://archive.cabinetoffice.gov.uk/pittreview/_/media/assets/www.cabinetoffice.gov.uk/flooding_review/evidence/woodland_trust_attached_report%20pdf.pdf

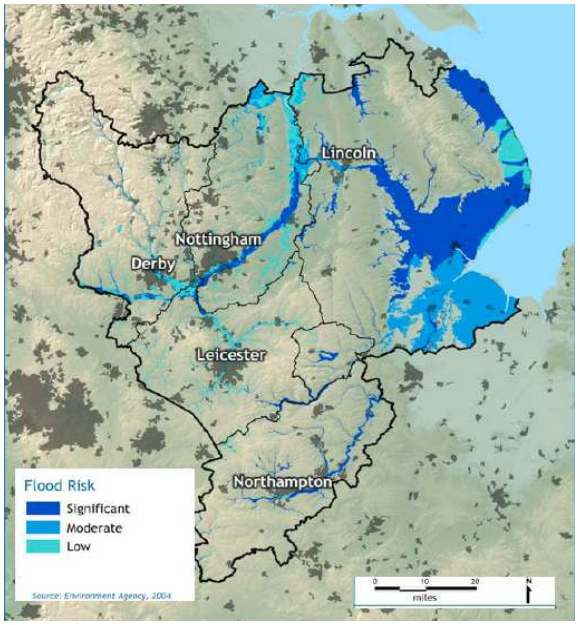


Figure (5.4) Flood Risk in the East Midlands

Source: Environment Agency, 2004

It has been estimated that given the projected annual sea level rise of 4mm in the area, the scheme modifies the hydrological regime is such as way as to account for about 25 years of climate change impact[43]. In addition to improved flood regulation the project will result in the expansion of salt marsh, mudflats and reed beds habitats, contribute to increased carbon sequestration[44] and help develop additional recreational opportunities in the area.

As the Alkborough case study illustrates, flood regulation schemes offer the opportunity for a mix of funding sources to be brought together to secure an enhanced output of ecosystem services, and potentially provide a framework in which PES schemes might well operate. Within the East Midlands, a major coastal realignment has been proposed by the Environment Agency at Donna Nook, on the North Lincolnshire Coast south Cleethorpes, although the scheme here has attracted some criticism[45]. It is clear that particular cases for realignment will require careful consideration of the costs and benefits and the role that PES type interventions might play.

5.3.3 Waste assimilation

The 'waste processing' capacity of ecosystems and their ability to 'purify' air or water is often emphasised as an important regulating service. Soils under grassland, crops or other kinds of vegetation can, for example, play a role in the remediation of wastes because of the naturally occurring microbial populations that are found within them, which can metabolise, transform, and assimilate waste constituents. Ultimately, elements can be reincorporated into natural biogeochemical cycles. Coastal and riverine sediments may also perform an important assimilative or sink service. During the formation of mud-flats, both heavy metals and radionuclides can be removed from the water column and trapped within the sediment.

In making use of such an ecosystem service, a key issue is to understand the capacity of the system to deal with the potential inputs and, in particular, how this capacity varies over space and time. The nature of the problem can be illustrated by reference to potential strategies for land-based disposal of organic materials and the extent of available

[43] http://www.english-nature.org.uk/about/teams/team_photo/alkborough.pdf

[44] Note: climate change impacts may be confounded by uncertainties about relative rates of carbon sequestration, methanogenesis, and the generation of nitrous oxide; Mark Everard, Environment Agency, pers. com.

[45] Mark Everard, Environment Agency, pers. com.

capacities, which are being considered as part of the current Defra funded ALOWANCE Project (ADAS, 2007[46]).

Currently, 3-4 million tonnes of biosolids (treated sewage sludge) (Water UK, 2006[47]), around 90 million tonnes of farm manures (Williams et al., 2000[48]) and 4 million tonnes of industrial 'wastes' (Gendebien et al., 2001[49]) are applied (on a fresh weight basis) annually to agricultural land in the UK. The volume of biosolids, which are a by-product of the wastewater treatment process, has grown since 1991 with the progressive implementation of the EU Urban Wastewater Treatment Directive, the increased levels of treatment needed to meet EU and UK regulatory and policy requirements.

Recent work suggests that biosolids may represent an important resource and that the capacity of soils to assimilate them may be an important service. Although the evidence on the relative environmental footprints of biosolids vs. chemical fertilisers is incomplete, the information available suggests that the environmental footprint of biosolids is lower than chemical sources. Moreover, disposal of biosolids and similar organic materials through assimilation by soils is potentially the most cost-effective economic and environmental option, compared to the disposal by landfill or incineration. Preliminary results from the Defra-funded ALOWANCE Project suggest that about 8-9 million ha of agricultural land in England and Wales is potentially available for the spreading of organic manures, of which 2–3 million ha is already used for farm-generated manures and excreta deposited during livestock grazing. In the case of biosolids, the available land bank is more limited due to restrictions linked to cropping regimes, soil metal levels and pH. However, if we deduct the area already used for farm wastes, then preliminary estimates suggest that there is capacity of around 6 million ha available for spreading other organic materials such as biosolids, composts and paper crumble. The extent of this capacity within the East Midlands is unknown.

5.4 Cultural services

The cultural services provided by ecosystems are wide ranging and are linked in complex ways both to each other and the other types of ecosystem service. They support both formal and informal recreational and tourism activities, the aesthetic and cultural aspects of landscape, and their cultural and social identities of communities. Thus it is hardly surprising that both the Regional Spatial and Economic Strategies[50] place considerable emphasis on sustaining and enhancing the qualities that influence these services of the East Midlands.

The major threats to the historic and cultural resource in the region are development, mineral extraction, cultivation, pipeline construction and road building. In some areas of high visitor pressure, such as the Peak District, visitor erosion is an additional problem. In Lincolnshire, coastal erosion is a further risk.

[46] ADAS (2007b): *Agricultural Land and Organic Waste - A National Capacity Estimator: ALOWANCE*. Defra Project ES0128.

[47] Water UK (2006): *Biosolids Update* - News and Comment from Water UK, April 2006.

[48] Williams, J.R., Chambers, B.J., Smith, K.A. and S. Ellis (2000): Farm manure land application strategies to conserve nitrogen within farming systems. In: A*griculture and Waste Management for a Sustainable Future* (Eds. T. Petchey, B. D'Arcy & A. Frost), The Scottish Agricultural College, pp. 167-179.

[49] Gendebien, A., Ferguson, R., Horth, H., Sullivan, M., Davis, R., Brunet, H., Dalimier, F., Landrea, B., Krack, D., Perot, J. and C. Orsi (2001): *Survey of Wastes Spread on Land.* Final Report of DG Environment Study Contract B4-3040/99/110194/MAR/03. Website http://europa.eu.int /comm/environment /waste/landspreading.pdf

[50] Regional and Spatial Strategies were a function of government policy at the time of writing

Agriculture, in particular, presents many challenges for the region. In 2004, just over half of all sites listed on the National Monuments Record in the East Midlands were on arable land. In Lincolnshire, this figure was even higher, with 63% of sites under cultivation. The East Midlands *Scheduled Monuments at Risk Survey*, [51]undertaken by English Heritage, demonstrated that 527 (35%) of the region's 1,493 Scheduled Monuments are at risk from damage, decay or loss. Of these, 26% are at risk from agriculture (mainly ploughing and erosion caused by livestock). Parklands in the region are declining significantly in the face of increased urbanisation and agriculture. Some areas of the East Midlands have incurred a loss of parkland well above the national average; since 1918 the Trent and Belvoir Vales have suffered a parkland loss of 64% and the Trent Valley Washlands almost 76%.

Cultural ecosystem services & the East Midlands tourism sector

In terms of employment, recreation and tourism are major contributors to the regional economy. The East Midlands Tourism Strategy 2003-2010, published in 2003, estimates that tourism is responsible for about 3.5% of the GDP of the region[52] and suggests that further development is possible. About 40,000 jobs are related to 'environmental tourism' in the region[53].

Already tourism is a significant industry for the region, contributing £5 billion annually to the economy, representing about 3.5% of GDP. Ambitious targets for the industry see it raising visitor expenditure to 4.5% of the region's GDP in 2010.

In 2002 domestic tourists made 11 million trips to the East Midlands and stayed for about 30 million nights. There were about 825,000 visits from overseas to the East Midlands in 2003 (3% of UK total), representing 7,206,000 nights (4% of UK total)

The target is to increase visitor value rather than volume, by placing emphasis on increasing overnight stays. Currently 90% of visitors come for the day, 9% of those who stay come from other parts of the region, and 1% come and stay from overseas. Tourism generates employment for 200,000 people, working in 30,000 businesses of which over 75% are small and privately owned.

The East Midlands already boasts a number of iconic "green" brands such as the Peak District and Sherwood Forest and is characterised by "routes of green" – rich agricultural land, which feeds the farms and the market towns, the parks, forests, wetlands, waterway and lakes. Cultural ecosystem services would also include:

- The Fens, a highly distinctive environment that is building a significant tourism infrastructure;
- Buxton, with its festival and the forthcoming redevelopment of the Crescent and Spa;
- Iconic battlefield sites such as Bosworth Field and Naseby;
- Althorp, last resting place of Diana Princess of Wales;
- Chatsworth, one of the country's greatest country estates;
- Rutland Water, with its outstanding array of water-based activities, proximity to beautiful countryside and importance for wildlife;

The strategy recognises there is often tension between concerns to protect the environment and the desire of tourism operators to develop their businesses.

A number of initiatives that aim to enhance what broadly might be termed cultural ecosystem services can be identified. In 2007, for example, *emda* launched a grant-aid programme as part of the Rural Development Programme for England, to support activities

[51] English Heritage (unknown) "Scheduled Monuments at Risk Survey" English Heritage

[52] http://www.emda.org.uk/uploaddocuments/emTourismStrategyFull.pdf

[53] Regional Economic Strategy for the East Midlands 2006-2020

aiming to help rural communities to diversity into non-agricultural economic activities, support for creation of micro-enterprises; encourage tourism activities and assist in the conservation and upgrading of the regions rural heritage. Elsewhere, Forestry Commission, England, have undertaken to increase the percentage of the population with access to woodland, in some priority areas as an indicator to 'Quality of Place', and to increase the number of visits people make to woodlands and the quality of their experience they have while there in order to establish woodlands contribution to 'Quality of Life'. Although this is a national initiative, given the importance of woodland in the East Midlands, and its planned expansion, it is clearly relevant in the present context.

While interventions to encourage the development of the economic benefits related to recreation and tourism are important, the non-monetary or community benefits arising out of people's active involvement with the environment should not be underestimated. Indeed, it may be that in this area PES-type mechanisms can be an appropriate way of promoting and broadening the delivery of this ecosystem service. A recent national study undertaken by Forest Research, for example, examined the contribution that environmental volunteering made to well-being[54]. It is clear that volunteering should not only be seen in terms of its narrow 'recreational value', but may also be significant in building other aspects of well-being such as community cohesion and mental health. The Forest Research study found that not only did volunteering offer significant training opportunities to young people, but more generally that volunteers experienced a significant 'positive emotional shift' as a result of their volunteering activities. The study concluded that there is considerable scope to build local volunteering partnerships, in line with Government priorities for building community. The recent studies of volunteering in the land-based sector undertaken by LANTRA have also emphasised the need for partnership both with local authorities and civil society organisations.

Direct support (in the form of agri-environmental payments and woodland grant scheme agreements) will clearly be significant in the future in terms of securing additional environmental improvements in the East Midlands that impact on the output of cultural ecosystem services. The voluntary sector also has the potential to make a significant contribution. In addition, the role of other land-based activities should be noted. For example, the economic and environmental benefits associated with sporting shooting has recently been examined[55], and it is apparent that while the numbers of people in a region such as the East Midlands directly employed through these activities is small, the revenues can be substantial. The area of land managed for shooting is also significant.

In the East Midlands, the same study estimated that shooting influences the land management of about 0.8 million hectares of land within the region, and that of this about 0.1 million hectares was managed specifically for shooting. Such land management does, however, have wider conservation and landscape benefits, since it includes tree planting, pond creation, the maintenance of buffer strips and conservation headlands, the planting of cover cops hedgerow management, and wetland creation.

[54] Forest research (2008) Environmental volunteering: motivations, barriers and benefits: Summary Report, http://www.forestresearch.gov.uk/pdf/Env_Volunteering_Summary_Report.pdf/$FILE/Env_Volunteering_Summary_Report.pdf

[55] The Economic and Environmental Impact of Sporting Shooting. A report prepared by PACEC on behalf of BASC, CA, and CLA and in association with GCT.

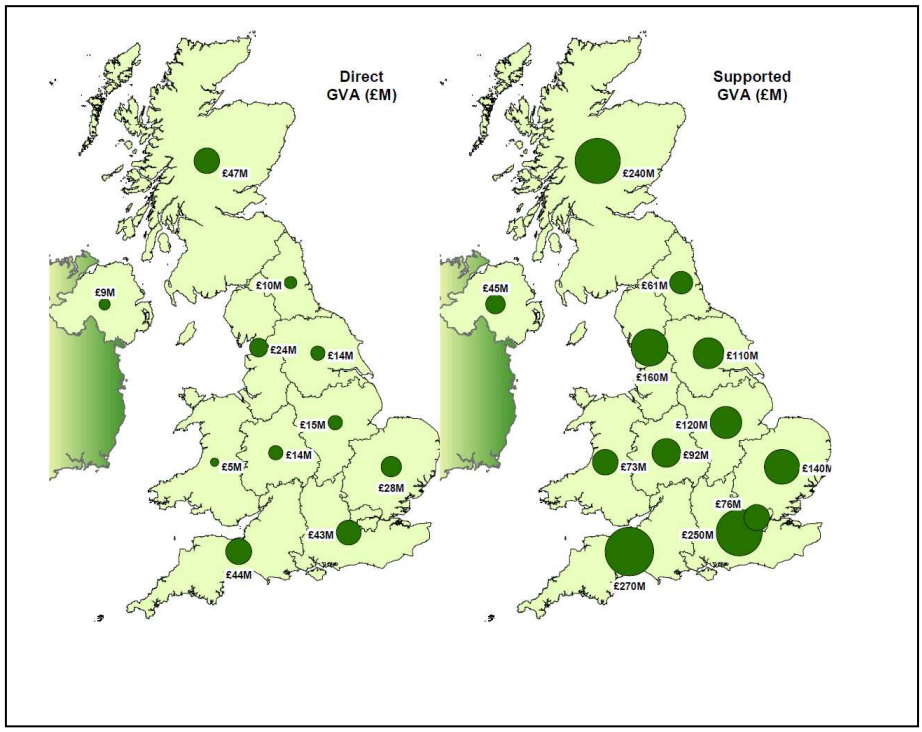


Figure (5.8) The Economic Effects of Shooting (Source: PACEC)

Significantly, when asked the question about how land management practices might change if shooting was stopped, only 21% of land managers said that they would continue to manage their land in the same way, and 20% said they would stop all habitat and wildlife management completely. About half of the funding for habitat and wildlife management cones from external sources (including public funds), and about one quarter from revenues generated by shooting.

5.5 Ecosystem benefits for human health

The association between green space and human health has been the subject of a number of studies. Epidemiological studies, controlled for age, sex, marital and socio-economic status, have provided evidence of a positive relationship between senior citizens' longevity and green space (Takano et al., 2002[56]; Tanaka et al., 1996[57]). Positive relationships have been revealed between green space and self-reported health (de Vries et al., 2003[58]). Payne et al. (1998)[59] found that park users reported better general perceived health, higher levels of activity and the ability to relax faster. Green areas in one's living environment may ameliorate air pollution, and the urban heat island effect (Whitford et al., 2001[60]), and may also lead to people spending a greater amount of time outdoors and being more physically

[56] Takano, T., Nakamura, K.,Watanabe, M., 2002. Urban residential environments and senior citizens' longevity in mega-city areas: the importance of walkable green space. J. Epidemiol. Commun. Health 56 (12), 913–916.
[57] Tanaka, A., Takano, T., Nakamura, K., Takeuchi, S., 1996. Health levels influenced by urban residential conditions in a megacity – Tokyo. Urban Studies 33, 879–894.
[58] de Vries, S.,Verheij, R.A., Groenewegen, P.P., Spreeuwenberg, P., 2003. Natural environments—healthy environments? Environ. Plann. 35, 1717–1731.
[59] Payne, L., Orsega-Smith, B., Godbey, G., Roy, M., 1998. Local parks and the health of older adults: results from an exploratory study. Parks Recreat. 33 (10), 64–71.
[60] Whitford, V., Ennos, A.R., Handley, J.F., 2001. City form and natural processes: indicators for the ecological performance of urban areas and their application to Merseyside, UK. Landscape Urban Plann. 20 (2), 91–103.

active. Indeed, there is a rapidly accumulating body of theoretical (Humpel et al., 2002[61]) and empirical evidence of the importance of physical environmental influences on neighbourhood walking and physical activity. Evidence of the association between levels of physical activity and proximity of green areas in the neighbourhood have been provided in studies which have controlled for age, sex and education level (Booth et al., 2000[62]; Humpel et al., 2004[63]; Pikora et al., 2003[64]).

Bird (2004)[65] developed a model for calculating health care savings attributable to increased outdoor physical activity. Based on a study of five major UK cities, he calculated that if 20% of the population within 2 km of an 8–20 ha green space used that space to reach a target of 30 min activity on 5 days a week, the saving to the UK's National Health Service would be more than £1.8 million a year. This finding makes a strong economic case, as well as a strong social case, for enhancing the urban Green Infrastructure for the purpose of reducing health care expenditure.

5.6 Key issues

The review of ecosystem services starts to show some possible ways of interpreting the spatial impact of different ecosystem services across the East Midlands region.

The geography of ecosystem services provides a foundation for valuing their output to beneficiaries. Building on this foundation, the spatial impact of different ecosystem services could provide a rationale for the definition of Ecosystem Service Districts (ESDs), a concept explained more fully in Chapter 7.

It is also important to note that methods to define ecosystem services are less well defined for cultural services based on perception of value to human welfare.

[61] Humpel, N., Owen, N., Leslie, E., 2002. Environmental factors associated with adults' participation in physical activity. Am. J. Prev. Med. 22, 188–199.
[62] Booth, M.L., Owen, N., Bauman, A., Clavisi, O., Leslie, E., 2000. Socialcognitive and perceived environment influences associated with physical activity in older Australians. Prev. Med. 3, 15–22.
[63] Humpel, N., Owen, N., Leslie, E., Marshall, A.L., Bauman, A.E., Sallis, J.F., 2004. Associations of location and perceived environmental attributes with walking in neighbourhoods. Am. J. Health Promot. 18, 239–242.
[64] Pikora, T., Giles-Corti, B., Bull, F., Jamrozik, K., Donovan, R., 2003. Developing a framework for assessment of the environmental determinants of walking and cycling. Soc. Sci. Med. 56, 1693–1703.
[65] Bird, W., 2004. Natural Fit. Can green space and biodiversity increase levels of physical activity? R. Soc. Protect. Birds; s.l.

6 Assessing the State of Ecosystem Services in the East Midlands

6.1 Introduction

Since ecosystem services cut across the remit of so many organisations, detailed information about them is fragmented. Given the limited time available for this study, an overview of the existing evidence has been relied upon rather than any new assessment, but the exercise is nevertheless a valuable one, in that it allows the identification of both existing sources of information and potential gaps in the evidence base. In view of the difficulties of classifying ecosystem services, and particularly the overlapping nature of some of the categories, a flexible approach has therefore been adopted. The resulting overview of ecosystem services in the East Midlands is shown in Table 6.1.

The scheme presented in Table 6.1 has been designed to reflect the situation in the East Midlands rather than conform to any particular theoretical model. Existing service typologies, such as those of the MA (2005[1]), de Groot et al. (2002[66]), Costanza et al. (1997[67]), Daily (1997[68]) and Wallace (2008[7]) have been used as a checklist, and the material arranged into a set of service-benefit themes, that reflect the production, regulation and cultural service categories used in the Millennium Ecosystem Assessment. However, 'supporting services' have not been treated as a separate theme, but included in the descriptions of the other services to indicate the important relationships between service outputs and the ecological processes and functions that underpin them. Since particular ecological processes, such as decomposition or nutrient cycling, may be involved in the generation of a number of different services they may have multiple entries in the table.

In constructing Table 6.1, care has also been taken to try to indicate how the output of each service might be measured and the nature of the benefit to society that it provides. In order to provide a link into the later stages of the analysis, the table indicates how changes in the value of the output of the service could be assessed. It should also be noted that the concept of an ecosystem service has been interpreted broadly, to include benefits directly related to the biotic characteristics of an ecosystem (i.e. its properties that are dependent on biodiversity) ***and*** those which are more closely linked to abiotic elements, such as geology or landform. Some commentators (e.g. CCW, 2008[69]) refer to the latter as 'environmental' rather than 'ecosystem' services, and prefer the term 'environmental service' to indicate this wider understanding of the benefits that natural capital provides. At this preliminary stage we make no distinction between them and refer to benefits arising from both the biotic and abiotic components of an ecosystem as an 'ecosystem service'.

We have also used a very broad definition of what an 'ecosystem' includes because it is clear that in the context of the East Midlands many services are dependent on both 'natural' and 'cultural' factors. Indeed there are few if any wholly natural ecosystems in the region,

[66] De Groot, R.S., Wilson, M.A. and R.M.J. Boumans (2002): A typology for the classification, description and valuation of ecosystem functions, goods and services. *Ecological Economics* 41: 393–408

[67] Costanza, R., D'Arge, R., DeGroot R., Farber, S., Grasso, M., Hannon B., Limburg, K., Naeem, S., O'Neill, R., Paruelo, J., Raskin, R., Sutton, P. and M. van den Belt (1997): The Value of the World's Ecosystem Services and Natural Capital. *Nature* 387:253–260.

[68] Daily, G. C. (1997): Introduction: What are Ecosystem Services? In: Daily, G.C. (Ed.) *Nature's Services: Societal Dependence on Natural Ecosystems*. Island Press, Washington, D.C.: 1-10.

[69] Rollett, A., Haines-Young, R., Potschin, M. and Kumar, P. (2008): Delivering environmental services through Agri-environment schemes: a scoping study. Report to Countryside Council for Wales (CCW) on behalf of Land Use Policy Group (LUPG).

and so if we focused exclusively on them the study would be very narrow indeed. In general terms, we take an ecosystem to be a coupled socio-ecological system, and focus on how marginal changes in the operation of the ecological component might affect the benefits that flow through to people and how policy makers and managers might intervene to sustain or enhance flow.

The text that follows focuses on the most significant services in relation to the East Midlands.

Table (6.1) Overview of major ecosystem service themes relevant to the East Midlands

	Service theme	Ecosystem structure or process	Ecosystem function (s)	Ecosystem service	Benefit(s)	Measure of output	Direct Value	Indirect value	State & trend
1	Food production	Primary and secondary productivity of agro-ecosystems, nutrient cycling	Productive capacity of land	Food products	Nutrition	Production volumes	Market value of products	Ancillary Environmental services (e.g. habitat management)	Probably stable
2	Food production (specialist, and local)	Primary and secondary productivity, and nutrient cycling associated with organic and other specialist enterprises	Productive capacity and quality of agricultural land	Local and specialist foods	Nutrition, support of local markets, reduced food miles, lower production intensities	Production volumes	Market value of products	Ancillary Environmental services (e.g. habitat management)	Probably stable
3	Food production (specialist, and local)	Bee populations, food plants	Nectar production	Honey products	Nutrition, support of local markets	tons/yr	Market value plus	Pollination services	Declining
4	Food production (informal)	Primary and secondary productivity	Productive capacity of semi-natural habitats	Berries, fungi, game	Nutrition, recreation, local knowledge and customs	Volumes produced, time spent on activity	Equivalent market or labour value	Ancillary Environmental services (e.g. habitat management)	Unknown, but probably stable
5	Food production – fish	Primary and secondary productivity of coastal and marine ecosystems		Fish and shellfish	Nutrition	Weight landed	Market value	Ancillary Environmental services (e.g. birds)	Damaged but recovering slowly

	Service theme	Ecosystem structure or process	Ecosystem function (s)	Ecosystem service	Benefit(s)	Measure of output	Direct Value	Indirect value	State & trend
6	**Fibre**	Primary productivity, nutrient cycling	Standing crop of woodlands	Timber	Renewable materials for construction and manufacture	[m^3/yr]	Market price	Ancillary Environmental services (e.g. habitat management)	Probably stable, but potential for substantial expansion
7	**Fibre (specialist)**	Primary productivity, nutrient cycling	Standing crop of reed, willow beds, etc	Thatching, construction materials	Renewable materials for construction and manufacture	[m^3/yr]	Market price		Unknown
8	**Renewable energy**	Primary productivity, nutrient cycling	Standing crop of woodland or other suitable energy crop	Bio-fuel	Reduced use of fossil fuels	Tons of biomass consumed	Carbon offset value, market value		Unknown
9	**Renewable energy**	Slurry production from livestock farming	Gas generated by decomposition processes	Bio-gas	Reduced use of fossil fuels	Litres of biogas produced	Carbon offset value, market value		Likely to increase
10	**Renewable energy**	River discharge	Hydrological head (site suitability)	Hydro power	Reduced use of fossil fuels	[MW]	Carbon offset value, market value		Likely to increase, but potential of region unknown
11	**Renewable energy**	Wind	Site suitability	Wind power	Reduced use of fossil fuels	[MW]	Carbon offset value, market value		Likely to increase

	Service theme	Ecosystem structure or process	Ecosystem function (s)	Ecosystem service	Benefit(s)	Measure of output	Direct Value	Indirect value	State & trend
12	**Water provisioning**	Nutrient and hydrological cycles	Discharge to ground water	Ground water availability from aquifers	Potable water, water to support ecological functions, reduced water treatment costs	Volume of water supplied for human use and ecological flows	Market value plus reduced treatment costs	Ancillary Environmental services (e.g. habitat management)	Quality and quantity of water impacted by pollution and abstraction
13	**Water provisioning**	Nutrient and hydrological cycles	Discharge to surface water bodies	Surface water resources from rivers, lakes and reservoirs	Potable water and water for industrial purposes (cooling), water to support ecological functions, reduced water treatment costs	Volume of water supplied for human use and ecological flows	Market value plus reduced treatment costs	Ancillary Environmental services (e.g. habitat management)	Quality and quantity of water impacted by pollution and abstraction
14	**Genetic resources**	Populations of rare or endogenous organisms	Generic diversity	Gene pool	Scientific knowledge and ethical benefits	Population sizes	Existence and option value	Ancillary Environmental services (e.g. landscape quality)	Historically has declined; 2010 biodiversity targets unlikely to be met
15	**Ornamental**	Populations of ornamental resources	Ornamental artefacts	Marketable ornamental products	Employment	Amounts harvested sustainably	Market value		Unknown
16	**Climate regulation (global)**	Primary productivity, decomposition	Peat and soil formation	Carbon sequestration	Reduced CO_2 emissions	Net uptake or loss of C	Carbon offset value		Declining, vulnerable

	Service theme	Ecosystem structure or process	Ecosystem function (s)	Ecosystem service	Benefit(s)	Measure of output	Direct Value	Indirect value	State & trend
17	**Climate regulation (local)**	Primary productivity	Standing crops	Buffering capacity against wind	Protection from wind damage	Area of crops protected, number of properties protected	Damage costs avoided		Unknown
18	**Climate regulation (local)**	Primary productivity	Standing crop of trees in urban areas	Shade	Temperature regulation	Number of urban trees	Damage or health costs avoided		Unknown
19	**Air quality regulation**	Standing crop of trees	Trapping particulates and nutrients	Air quality	Health	Volumes of pollutants removed	Damage or health costs avoided		Unknown
20	**Flood protection - rivers**	Appropriate habitat type or structure	Reduced rates of surface flows	Reduced peak flows	Reduced costs of flood protection	Marginal change in flood frequency	Avoided flood protection costs	Ancillary Environmental services (e.g. habitat management)	Probably inadequate given climate change forecasts
21	**Flood protection - rivers**	Suitable habitat or land cover	Water storage	Flood protection	Reduce damage costs due to flooding	Volumes of water stored	Damage cost avoided less losses due to limitations on use	Ancillary Environmental services (e.g. habitat management)	Probably inadequate given climate change forecasts
22	**Flood protection – coastal**	Coastal vegetation	Water storage	Flood protection	Reduced cost of flood protection	Marginal change in flood frequency	Damage cost avoided	Ancillary Environmental services (e.g. habitat management)	Probably inadequate given climate change forecasts

	Service theme	Ecosystem structure or process	Ecosystem function (s)	Ecosystem service	Benefit(s)	Measure of output	Direct Value	Indirect value	State & trend
23	**Waste assimilation**	Nutrient cycling	Decomposition	Waste organic disposal	Reduced volumes of waste going to landfill or other processing	[Tons/yr]	Marginal savings compared to other forms of disposal		Likely to increase
24	**Erosion protection**	Appropriate habitat structure	Reduced erosion surface runoff	Soil protection	Good quality soils	Area at low risk from erosion	Damage cost avoided		Probably inadequate given climate change forecasts
25	**Pest and disease regulation**	Population of pests and disease organisms and their natural predators	Biological control mechanisms	Reduced incidence of pest and disease outbreaks	Improved health and productive capacity	Population levels of pest or disease organisms; incidents/yr	Damage or health costs avoided		Unknown, probably stable but can change suddenly (e.g. bird flu, Bovine TB)
26	**Pollination**	Pollinator populations	Pollination	Pollination of commercial crops and wild plants	Food production	Area of crop relying on natural pollination processes	Costs avoided		Probably declining
27	**Recreation-general**	Semi-natural habitats and farmed landscape	Sense of enclosure or isolation, tranquillity, wilderness	Recreational experience	Physical and mental well-being	[% visits/yr]	Travel costs, WTP		Probably stable, but potential for development
28	**Recreation – observing nature**	Nesting or feeding habitat	Bird population	Bird watching	Physical and mental well-being	[Visits/yr]	Travel costs, WTP		Probably stable, but potential for development
29	**Recreation – hunting and fishing**	Game and fish populations	Game and fish availability	Recreational experience	Physical and mental well-being	Numbers of people involved	Market value, number of jobs	Ancillary environmental services	Probably stable, but potential for development

	Service theme	Ecosystem structure or process	Ecosystem function (s)	Ecosystem service	Benefit(s)	Measure of output	Direct Value	Indirect value	State & trend
30	**Scientific and educational**	Natural and semi-natural habitats	All?	Research	Knowledge	Employment			Probably stable, but potential for development
31	**Aesthetic**	Natural and semi-natural habitats, landscape and seascapes	Scenic diversity,	Scenic quality	Recreational experience, perceived environmental quality	[Visits/yr], enhanced land values	Travel costs, WTP, marginal changes in property and land values		Probably stable, but potential for development
32	**Cultural and social**	Natural and semi-natural habitats, landscape and seascapes	Any?	Voluntary activity	Social cohesion and individual well-being	Participation rates, person-hours/yr	Value of labour if assessed on commercial basis.	Ancillary environmental services	Probably stable, possibly increasing
33	**Navigation**	Rivers and canals	Appropriate river discharge and sedimentation levels	Transport	Movement of people and goods	Passenger miles, volumes moved	Market values		Probably stable

6.2 Summary Analysis of Performance Status

The summary analysis contained in table 6.1 can be re-presented in terms of the presumed performance status of the ecosystem service:

Stable	Food production (Namely the productive capacity of land); Navigation (Well functioning rivers and canals)
Declining	Pollination (population of pollinators e.g. bees); fisheries (the productive capacity of marine ecosystems); Water provisioning (level of discharge to ground water and surface water); Genetic (the level of genetic biodiversity); Global Climate regulation (the capacity for carbon sequestration in peat uplands); Flood protection (from natural habitats); Soil erosion from surface run off (decreased quality of soils).
Unknown	Specialist fibre (e.g. thatching); Biofuel production; Ornamental Resources (e.g. flowers and animal products; Local climate regulation (e.g. wind breaks); Local air quality; Pest and disease regulation.
Increase	Bio gas from animal waste; Certain classes of renewable energy production (e.g. wind; bio waste assimilation); Landscape (e.g. Recreational uses of the landscape – observing nature and hunting/ fishing.)

Table (6.2) Ecosystem Service by Performance Type

6.3 Key Issues

Many categories of ecosystem services are either considered to be stable or likely to increase in terms of their output. An information gap exists with regard to some important categories of ecosystem service. A number of categories (most those associated with water) are already exhibiting signs of stress at current levels of usage without taking into account any future demands from regional growth.

7 Assessing Ecosystem Buyer Potential in the East Midlands

7.1 Introduction

The focus of this study is the assessment of opportunities for payment for ecosystems in the East Midlands which requires some understanding of how and where potential buyers are located in relation to the flow of ecosystem services. Initially, businesses are treated as a spatial layer that overlays the distribution of bio-physical features, flows of ecosystem services and the location of communities. The assessment of risk by business is then considered as a key motivation to become a "buyer".

7.2 A supply chain relationship

There is a conversion process whereby certain economic activities use ecosystem services to produce goods and services that are consumed by a community. Figure 7.1 illustrates the process whereby ecosystem services are used by the consuming businesses to produce goods and services for communities in the East Midlands with a financial end value. The logic of a supply chain relationship is that a "pull" from communities should lead to the formation of a self sustaining and coherent set of supplier/ buyer relationships. However, the absence of a financial value across many ecosystem services means that these relationships are either partial or unrecognised. The supply chain is, however, a useful device to understand why discontinuities and scaling issues have prevented a self sustaining relationship from forming. Communities may, however, be unaware of the initial pull that they exert at the start of the process.

Working within the assumption that the consumption of ecosystem services varies across the geography of the region, the ability to map consumption patterns both spatially and organisationally becomes an essential pre condition to establishing future payment systems.

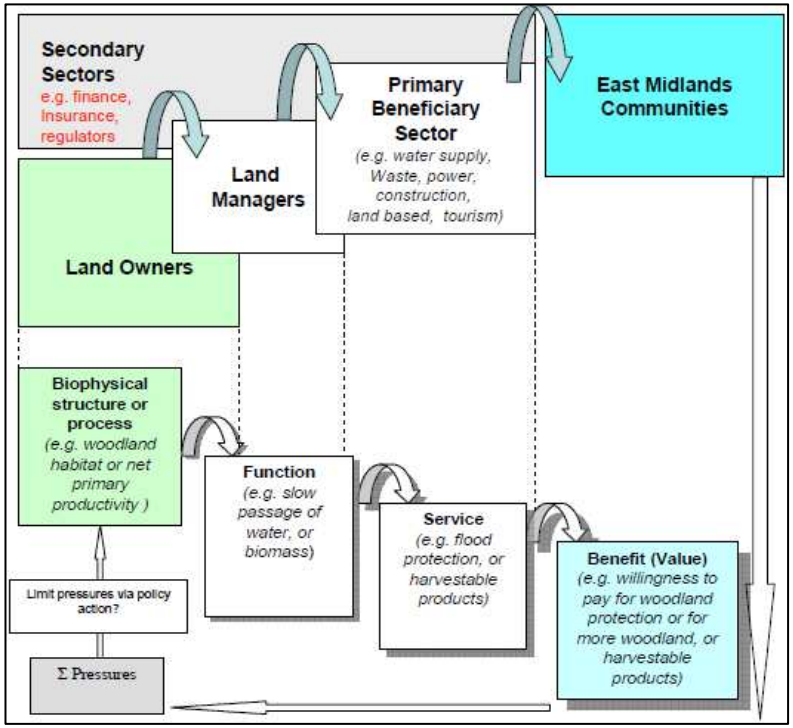


Figure (7.1) Supply Chain Model (based on Haines and Potschin – adapted by Arup, 2009)

Some industry sectors are particularly exposed to variations in the output of ecosystem services, primarily those that rely directly on the availability of provisioning services (e.g. fisheries and forestry), or services derived from them (e.g. water utilities, hydropower, tourism). These risks directly translate into effects on the financial performance of businesses.

In the past, businesses and financial institutions have offset risks by spreading activities to new areas or locations; however, the pace of globalisation and scale of economic activity now means that new and unexploited resources and goods are becoming scarcer and less easy to secure – requiring greater awareness of ecosystem service depletion risks in business and financial planning and assumptions. These risks are, of course, also driving innovation and efficiency in many businesses (e.g. aquaculture to offset losses of fish and shellfish, and energy and water efficiency in industry and agriculture).

7.3 Identifying spatial relationships between business and ecosystems

The ecosystem service district concept raised in Chapter 1 is premised on the idea of being able to identify an area combining users and producers of ecosystem services. This concept is explicitly spatial and requires mapping users and producers. The sectoral descriptions given above relate to a series of

identifiable industrial groupings. The types of sectors identified above have operating premises. Businesses above the VAT registration threshold are required to register their operating address which can be mapped at ward level.

The ability to map businesses at a relatively fine scale provides a means of identifying possible spatial relationships between businesses and supposed ecosystem service flows. Spurious correlations are, however, a danger if random associations are interpreted as something more substantive; for example, a registered tourism business in the Peak District may be solely based on arranging overseas adventure holidays rather than having any association with the cultural services provided by the biophysical asset that is the Peak District.

The example in Figure 7.2 shows two business sectors (colour grading ranges from “brown” representing low concentrations through to “blue/ green representing high concentrations.

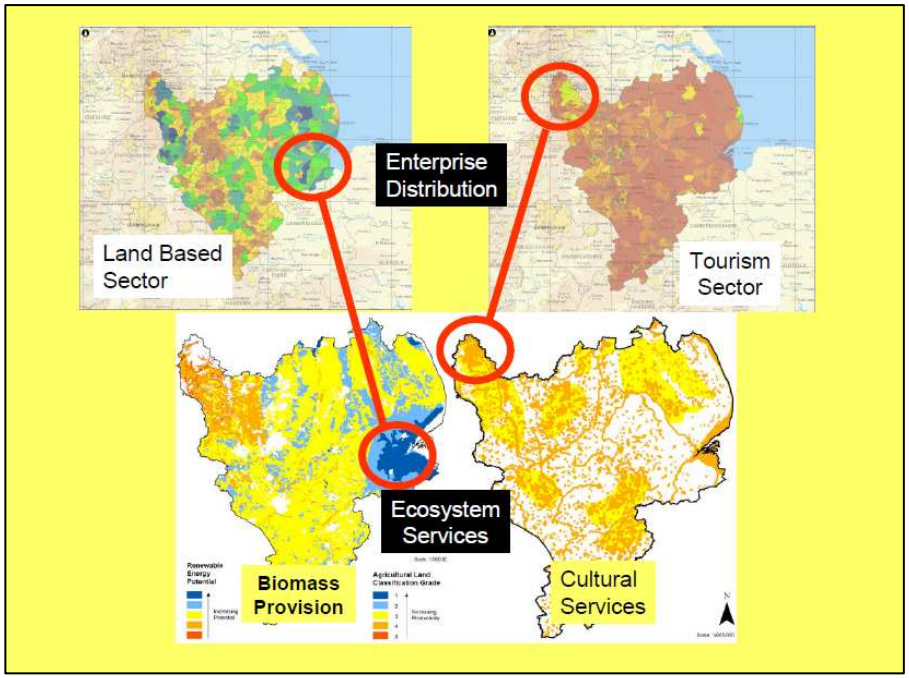


Figure (7.2) Spatial Mapping of Enterprise Concentration and Ecosystem Service.

Source: Enterprise Data from Neighbourhood Statistics, 2008, Ward Based

Figure 7.2 illustrates how the different layers can be “joined up” to infer potential spatial relationships that might inform the creation of an Ecosystem Service District based on a recognised flow of consumption and production. Land based sector enterprises are shown in relation to biomass potential within the East Midlands. Tourism sector enterprises are shown in relation to a flow of cultural services (taken from EMRA’s Public Benefits Mapping Report). The implication would be that enterprises benefiting from the ecosystem services should contribute to their maintenance.

The layering of potential enterprises with associated ecosystems services could be structured in other ways. One option might be to look at payments in relation to their support for finding alternative streams of income for depressed areas. In Figure (7.3), a rural regeneration priority area is shown in relation to potential biomass provisioning ecosystem services and the distribution of land based VAT enterprises. The inference is that land based enterprises diversifying into the management of biomass could become beneficiaries of ecosystem services.

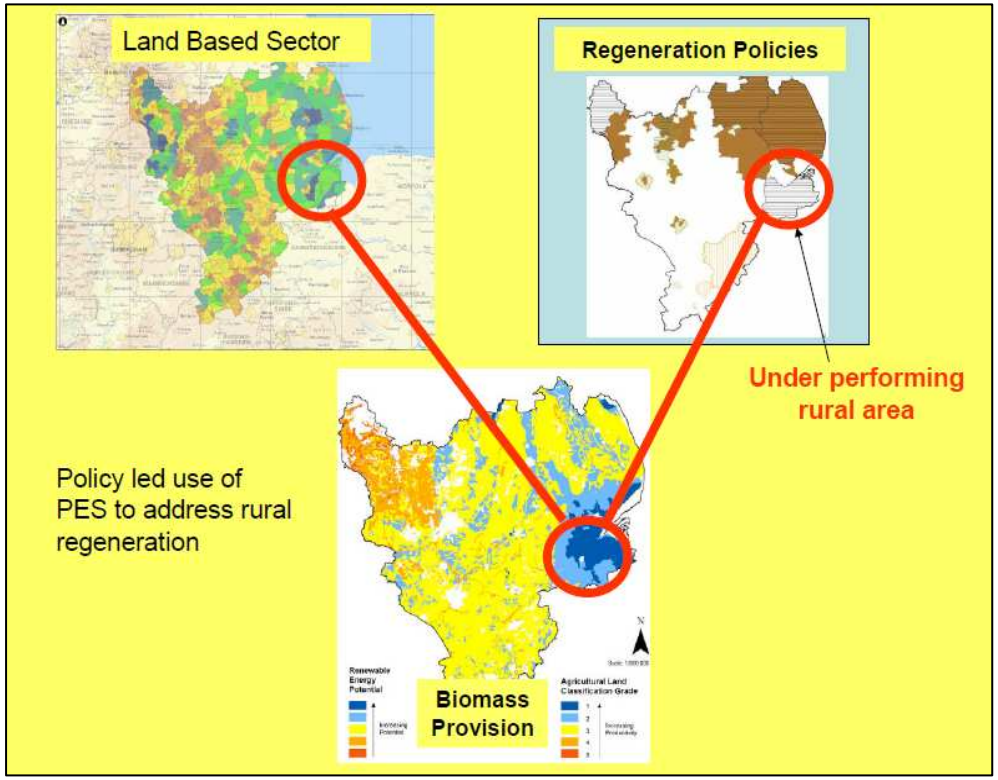


Figure (7.3) Economic Development Led Interpretation of Layers.

Sources: Ward Based Enterprise Mapping VAT Registrations from Neighbourhood Statistics, ONS; Green Infrastructure – Public Benefits Mapping, EMRA

7.4 Emergent Business Strategies for Ecosystems Services

Both these examples suggest that the flow of ecosystems services does coincide with business benefits. A key matter for the design and implementation of a future PES scheme is the degree to which businesses recognize these benefits.

A combination of environmental quality standards, corporate good citizenship and compliance with various product standards means that businesses are already required to gather and process a large array of environmental data when making decisions over future activities.

Some companies are now taking a greater interest in understanding their consumption of natural resources, sometimes with a specific reference to ecosystem services. The initial spur for action tends to be part of a general approach to risk management especially when explaining actions to investors, insurers, activists, employees or neighboring communities. Such an expanded focus would translate into a company needing to understand its dependencies and impacts (both positive and negative) on the flow of ecosystem services.

Figure 7.4 proposes a matrix representing different levels of corporate engagement with environmental matters from minimal compliance with whatever regulatory standards are proposed through to full scale ecosystems efficiency and innovation. The arrows within the figure show potential directions of travel for companies to take. The majority of regional enterprises are likely to fall under the 'minimal compliance' quadrant. Those engaged with Corporate Social Responsibility (CSR) are probably philanthropic in their focus whilst others (possibly those involved with resource intensive sectors) are likely to be focused on risk minimisation.

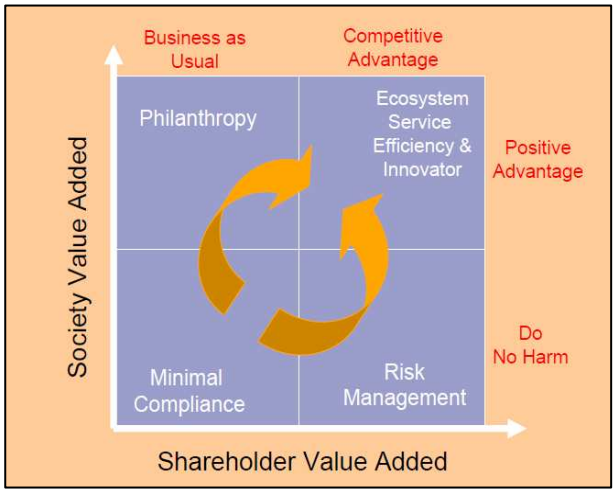


Figure (7.4) Corporate Social Responsibility Strategies[70]

[70] Source: EU Presidency Conference on European Business & Biodiversity Lisbon, 12-13 November 2007

7.5 Assessment of Business Risk

A key determinant in the selection of strategy by business will be their interpretation of business risk. Ecosystem services that are sources of business risk or opportunity typically are those that the company highly depends upon and/or highly impacts. For instance, if a company depends upon an ecosystem service and that service becomes scarce or degrades, then the company may face operational risk in the form of higher input costs or disruption. If a company negatively impacts an ecosystem service by depleting or degrading it, then the company's actions may pose regulatory or reputational business risks. Conversely, a company's actions could positively impact an ecosystem service by enhancing it, giving rise to possible new business opportunities or reputational benefits. The World Resources Institute has published a guide for business to assess its exposure to ecosystem services Risks include:

Operational – Risks might include lower output for hydroelectric facilities due to siltation, or disruptions to coastal businesses due to flooding represent significant risks. Opportunities would include increasing water-use efficiency or building an on-site wetland to circumvent the need for new water treatment infrastructure;

Regulatory and legal - Risks would include new fines, new user fees, government regulations, or legal actions by local communities that lose ecosystem services due to corporate activities. Opportunities would include engaging governments to develop policies and incentives to protect or restore ecosystems that provide services a company needs;

Reputational - Risks would include retail companies being targeted by nongovernmental organization campaigns for purchasing wood or paper from sensitive forests or banks facing similar protests due to investments that degrade pristine ecosystems. Opportunities would include implementing and communicating sustainable purchasing, operating, or investment practices in order to differentiate corporate brands;

Market and product - Risks would include customers switching to other suppliers that offer products with lower ecosystem impacts or governments implementing new sustainable procurement policies. Opportunities would include launching new products and services that reduce customer impacts on ecosystems, participating in emerging markets for carbon sequestration and watershed protection, capturing new revenue streams from company-owned natural assets, and offering eco-labelled wood, seafood, produce, and other products; and;

Financing – Risks would include banks implementing more rigorous lending requirements for corporate loans. Opportunities would include banks offering more favourable loan terms, or investors taking positions in companies supplying products and services that improve resource use efficiency or restore degraded ecosystems.

7.6 Corporate Knowledge Management for Ecosystems

Information tools on ecosystems services (see Table 7.1) are, therefore, being used in ways that help companies move from minimal compliance towards innovating new products and services for the market.

ARIES	A computer model and decision-support infrastructure to assist decision makers and researchers by estimating and forecasting ecosystem services provision and their correspondent range of economic values in a specific area
ESR	A sequence of questions that helps managers develop strategies to manage risks and opportunities arising from a company's dependence on ecosystems
InVEST	A decision-making aid to assess how distinct scenarios may lead to different ecosystem services and human-well-being related outcomes in particular geographic areas
MIMES	A multi-scale, integrated suite of models that assess the true value of ecosystem services, their linkages to human welfare, and how their function and value may change under various management scenarios
NVI	An evaluation benchmark methodology for assessing biodiversity and ecosystem services-related risks and opportunities in the food, beverage and tobacco sectors
BBOP	A toolkit that assesses whether biodiversity offsets are appropriate and provides guidance on offset design
IBAT	A screening tool to help companies incorporate biodiversity into their risk analysis, decision-making and planning processes

Table (7.1) Information Toolset

Source: Measuring Corporate Impact on Ecosystems: A Comprehensive Review of New Tools Synthesis Report By Sissel Waage, Emma Stewart and Kit Armstrong With support from BSR's Environmental Services, Tools and Markets Corporate Working Group December 2008

The use of these tools are often linked to the adoption of reporting initiatives by companies in managing risk.

7.7 Regional Verification

A further issue concerns the visibility of ecosystem services consumption at enterprise level. Many multi site companies procure all manner of goods and services via tenders managed through a headquarters site often located outside the region. Yet, site level consumption data may be a valuable precursor to getting business acceptance of ecosystem service consumption at a regional level. The multi site problem is exacerbated in the case of multi sectoral enterprises.

Verification is also a significant issue in underwriting the existence of a flow of benefits and risks and any variability arising from within the ecosystem. A significant verification process has been established for carbon through the Clean Development Mechanism. The absence of an equivalent verification process is likely to impede the introduction of PES.

7.8 Ethical Investment Linkages

The payments for ecosystem services agenda primarily concerns the internalisation of costs long displaced into the environment without regard for their consequences. As a consequence, its internalisation represents added financial cost – an unwelcome feature during a severe recession.

The "key activity driver" to ethically/environmentally robust investors could be associated with the opportunity to link ecosystem service usage with robust reporting through to the attraction of capital in search of environmentally robust investments. A growing range of reporting frameworks have been pioneered by the financial services community who are increasingly aware of the risks posed by project exposure to environmental risk. These frameworks are now starting to influence the individual project portfolio structures managed by major funders in the developed world. These owners include Pension Funds (see Box 7.1), Sectoral Funds, "High Net Worth" individuals (i.e. philanthropic buyers) like Bill Gates and Warren Buffet.

The Dutch Pension Fund Stichting Pensioenfonds APG is currently the third largest in the world with $300 billion in assets servicing the needs of 2.5 million former Dutch government employees and workers. APG has a standalone global equities sustainability fund with a $200 million portfolio. It has also established a $600 million investment in innovative carbon trading funds including a $360 commitment to a fund created by specialist boutique Climate Change Capital. Other funds include a renewable energy investment fund; sustainable forestry in Africa and a share in a green bank. PGGM is Europe's third largest pension fund with $100 billion assets supporting two million former and current workers in the healthcare and social sectors of the Netherlands has a similar portfolio of investment in green infrastructure, forestry projects and dedicated funds.

Source: "Investing in a Sustainable World – Why Green is the New Color of Money on Wall Street, Matthew Kiernan PhD (2009)

Box (7.1) Dutch Pension Funds – Trends in Green Investment

Under Climate Change and Resource depletion scenarios, companies able to demonstrate the effective management of environmental resources are likely to be more successful in securing investor monies that those working to a "business as usual" standard. Investors are likely to consider companies who account for their use of ecosystem services to be more robust in terms of their ability to service debt or achieve levels of return for equity investors. Analysis reported in Kiernan (2009) already demonstrates the environmental "best in class" out performing the "worst in class" by a considerable margin.

7.9 Key issues

Buyers are essential to establishing a viable basis for PES in the East Midlands. Business is the primary focus and engagement with enterprises must rely on communicating the risks associated with poorly performing ecosystem services and how enhancements can help underpin additional growth in financial outputs.

Risks will vary across enterprise areas with certain sectors likely to experience greater levels of exposure. Supply chain relationships are relevant in understanding exposure to risk. Evidence exists that business advisory bodies have developed guidance for business to follow in assessing risk and these have been supported by assessment tools that support these frameworks. The issue of valuation has been identified in these guides but usually with caveats relating to data quality. Evidently, valuation remains a critical factor to assessing scope for PES in relation to business activity. Given the competitive nature of the financial economy and the current recession it is unlikely that business will, of its own volition, participate in voluntary payment schemes. Strategies for managing ecosystem services could be a future link to attracting ethical investment from financial institutions sensitised to future risk.

8 Green Infrastructure and Ecosystem Services

8.1 Introduction

The previous sections of the report have dealt with ecosystem services emanating from existing biophysical structures. However, the biophysical environment is ever changing. Historically, the East Midlands has been subject to successive modifications by humans from the birth of cultivation and fixed communities. The future will see the modification of the biophysical environment associated with new urban growth planned in the Regional Spatial Strategy[71]. These changes will make a substantive change to the pattern of ecosystem services.

8.2 Existing communities and forecast regional growth

Ecosystem services currently sustain 4.3 million people (2006) across the region in both urban and rural locations. However, this figure presents only a transitory phase in the development of the region. The East Midlands has the fastest growing population of any region in England. Recent projections from the Office of National Statistics indicate that the population of the Region will increase from 4.3 million in 2006 to 4.8 million in 2016 and then to 5.5 million by 2031.

Significant housing growth is planned in the East Midlands to meet the needs of the projected increase in population. The Secretary of State's Proposed Changes to the RSS[72] set out a requirement for at least 509,060 new homes to be built in the region from 2006 to 2026. The emerging RSS sets regional housing provision for each Housing Market Area (HMA) in the Region. To achieve these levels of growth a major step-change in the rate of housing completions will be required, and substantial investment in infrastructure will be needed. The south of the region forms part of the Milton Keynes and South Midlands (MKSM) Area, one of the main growth areas set out in the Government's Sustainable Communities Plan. There are also a number of designated First Round and Second Round New Growth Points across the Region, which are eligible for growth area funding. These include:

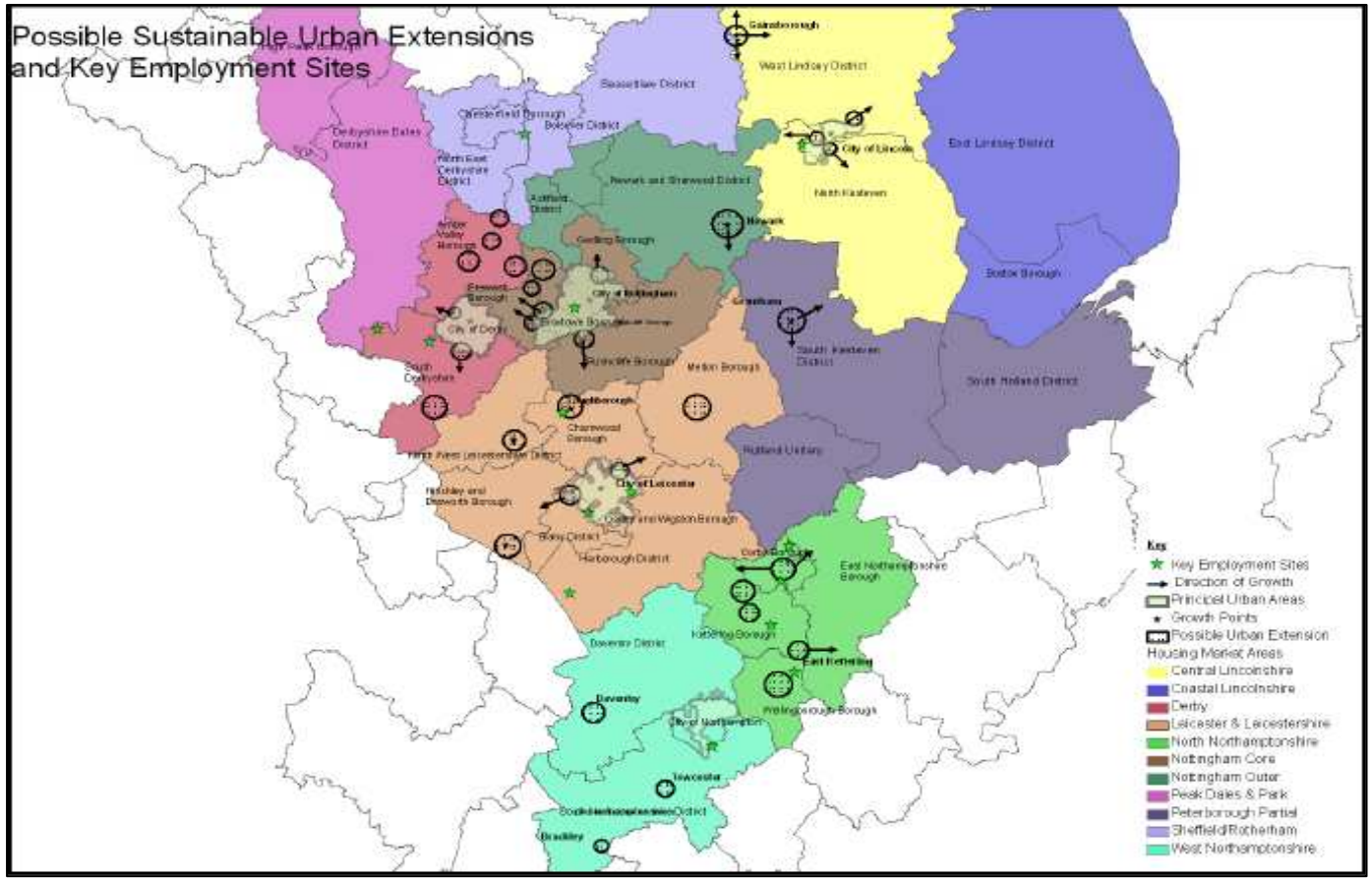
- 3 Cities & 3 Counties - Derby, Leicester & Nottingham (Derby City Council, Derbyshire CC, Leicester City Council, Leicestershire CC, Nottingham City Council, Nottinghamshire CC);
- Grantham (South Kesteven DC and Lincolnshire CC);
- Lincoln (Lincolnshire CC, City of Lincoln Council, North Kesteven DC and West Lindsey DC);
- Newark on Trent (Newark and Sherwood DC):
- Gainsborough (West Lindsey DC, Lincolnshire County Council).
- Designated Growth Points; and
- Eco-town proposals.

The current spatial priorities are represented in the map in Figure (8.1) overleaf.

[71] Regional Spatial Strategies were a government planning policy function at the time of writing.
[72] Regional Housing targets were a feature of the previous administrations planning policy.

New housing and commercial development associated with the building of Sustainable Urban Extensions and the intensification of the existing Principal Urban Areas will lead to greater levels of ecosystem service consumption.

The pattern of growth shown in Figure (8.1) can be compared with the pattern of environmental stress mapped in the public benefits mapping report. Many of the areas subject to environmental damage and stress are in areas likely to receive more development.



8.3 Defining an Integrated Model for Natural/ Artificial Infrastructure Services

Figure (8.2) illustrates an integrated model of development where new development is shown as a consumer of a mix of services from natural and artificial capital. The model could be optimised around a range of indicators representing quantities or financial values once an evidence base had been developed.

Trade-offs can be made between the two types of inputs in relation to delivering new services. E.g. use of wetland purification of water supply as opposed to the use of artificial purification plant or water minimisation (recycling). Substitution between the services provided from the natural environment as opposed to artificial systems can, however, have decreasing returns to scale.

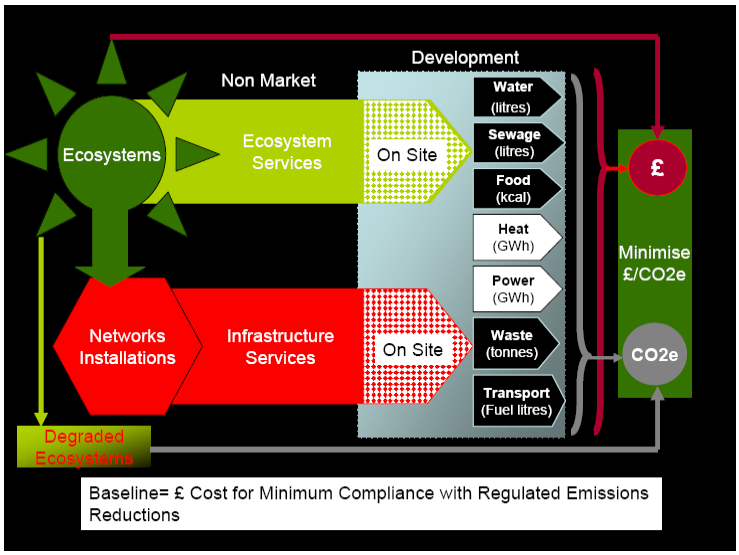


Figure (8.2) Development Model

The trade off is likely to be influenced by how infrastructure service providers are regulated.

In order to help stimulate ecosystem service approaches, economic regulators may allow infrastructure providers to count expenditures on natural capital into their regulated asset base (RAB) accounts for example.

The proposition would be that new development would be required to generate a level of "eco-credits"[73] equivalent to that development's consumption of ecosystem services (water, carbon sequestration, etc).

Developers would be given the choice of how they met their "eco-credit" obligation either through site specific measures e.g. rainwater harvesting or by purchasing eco-credits from third parties.

Theoretically, a developer could exceed their obligation and sell on their surplus eco-credits to a third party e.g. a less dense development.

The eco-credit process would be mediated through some form of supplementary planning document that would relate an eco-credit to specific physical development characteristics e.g. green roofs per square metre of development, natural reed beds per square metre of development, green walls per square metre of development, allotments per square metre. Effectively, this would be a charging schedule or tariff (dependent upon language) and would be linked to the formation of an independently tested and verified evidence base, although it is likely that developers would challenge this proposal.

[73] Birkeland, J (2008) Chapter 11 in "Positive Development – From Vicious Circle to Virtuous Cycles Through Built Environment Design" Earthscan

In theory, eco-credits could be undifferentiated although the risk is that this creates an over supply in one type of ecosystem service and an under supply somewhere else. This may be a particular problem if certain types of ecosystem service credits are cheaper to produce than others.

The Supplementary Planning Document could also include the definition of catchments within which trading of credits is acceptable (there is a dubious basis for offsetting an eco-credit deficit in one area against positive development outside of this area).

A precedent could be said to exist in the existing Code for Sustainable Homes and the earlier eco-homes rating system where credits are awarded for certain types of sustainable characteristics.

Developers could purchase eco-credits from registered suppliers of eco-credits who would need to enter into an agreement to maintain the eco-credit supply. Some of this supply would come from other developments within the purview of the planning system however some of the eco-credits could also come from changes within land management regimes applied by land owners or subsidised by the state.

An intermediary/third party would need to own the maintenance of the stock and enforce restitution if an ecosystem generating a credit relied upon this resource. It is also possible that an agreement to supply eco-credits could be passed onto an agent to manage that relationship after the developer has completed the site. The agent would address the failure of a service. In many cases, private laws of contract would apply if a developer contracted with a third party/intermediary.

Even accepting the difficulties of the current economic environment, this proposal would be quite radical. To gain recognition it would need to be framed in the light of current environmental advice concerning the precarious state of many ecosystems.

Potentially, an eco-credit “charging schedule” could be used as a ’ratchet’ where more eco-credits are demanded from development aligned to evidence concerning unavoidable climate change. This might be linked to an index of weather change for example, and would incur changes to eco-credit requirements from developers as more information became available.

This solution would only be workable if government were to revise national policy guidance in favour of an eco-systems approach. Otherwise, the existing system would encourage developers to challenge decisions made using an eco systems services approach. The credit crunch makes this problem even more acute since the local planning authorities are now willing to defer even traditional planning obligations to stimulate development in their communities. Deferral is likely to lead to build up of a stock of unmet obligations where deficits to the natural environment will become one of many competing concerns for localities to deal with.

The evidence would appear to contradict this approach however, as the significant economic value of green infrastructure is increasingly recognised. It has a role to play in economic prosperity and stability, and work in the Northwest suggests a direct gross value added (GVA) from the environment of around £2.6bn, supporting 109,000 jobs in environmental and related fields. Other benefits cited “include long-term employment, better health, more engaging education and social cohesion. These savings include a reduced need for healthcare, better employee productivity and better adaptation for climate change.”[74]

8.4 Key issues

Human activity is constantly modifying the biophysical structures that deliver ecosystem services. Planned growth strategies anticipate large scale urban development (mainly

[74] http://www.naturaleconomynorthwest.com/

associated with existing urban growth) leading to intensified pressure on existing ecosystem services including those subject to decline.

Green infrastructure requirements placed on new developments offer an opportunity to adjust for spatial deficits in certain types of ecosystem service, especially those related to regulating and cultural services.

The use of eco-credits could represent a means of extracting value from the development process. However it would be a qualitative judgement as to whether the eco-credits traded should be of equal value and such an approach would be open to developer challenge.

9 Assessing Regional Capacities to Manage PES

9.1 Introduction

Evidence from the Millennium Ecosystem Assessment and regionally specific evidence suggest that certain ecosystem services are under severe pressure. Growth aspirations contained within regional strategies would also suggest that a greater level of performance from the natural environment will be needed to meet increased levels of consumption over the next twenty years. The evidence would therefore suggest that there would be benefits in moving towards a "local stewardship" socio-economic model which factors into decision making these broader considerations.

9.2 Preparing the East Midlands for managing a PES agenda

Assuming there is a willingness to adopt the full internalisation of costs, there must also be a competitive advantage for those regions/ countries that can prepare for this shift.

This assumption opens the question as to what an ecologically competitive region would look like or the competencies and capacities that will be needed to create a long term transition in performance.

The types of capacities needed are listed below:

- Clear leadership around the development of this agenda in the East Midlands including the capacity to steer future priorities and agree targeting of scarce funding; responding to performance feedback of ecological performance;
- Assess future trends in ecological performance accounting for climate change, incidence of local pollutants/ anticipate changes in external policies and shock events;
- Control functions to operate new payment mechanisms; skills in the operation of valuation mechanisms;
- Communications – to inform key decision makers in other sectors of the regional economy and promote a new way of working including strategies for managing the change to an ecosystems approach; and
- Feedback mechanisms to evaluate the effectiveness of measures on the natural environment.

9.3 An assessment of current regional capacities

A review of existing working practices and the institutional arrangements currently in place would suggest that there are significant gaps in the approach especially when considering practical implementation.

Regional thinking around the issue of an ecologically competitive region are still taking form and this study is an example of how these thoughts are coming together with the help of the Regional Development Agency. The Agency's moves are also underpinned by progressive statements in their Regional Economic Strategy that explicitly recognise the natural environment as key factor in the productivity of the East Midlands. Other bodies such as the Regional Assembly are also developing their expertise and understanding of the issues.

Moreover, the economic slump has shifted the attention of many bodies onto maintaining the existing financial economy. Concern with the slump has, however, encouraged ideas around how the public sector could facilitate a "green recovery" which could include useful "hooks" into an ecosystem services approach.

The recession has, however, given credence to the notion that the financial economy must be "fixed" first to create financial surplus that can be channelled into the environment at some future date. The core assumption that the financial economy is bigger than the environment remains unquestioned.

Whilst there is evidence that regional partners are thinking about the region in useful ways to support this agenda, this is currently not able to influence 'control' functions that manage / operate national agri-environment schemes in the region. A battery of schemes channel public funding into the East Midlands through the Entry Level Stewardship Scheme; Higher Level Stewardship Scheme; Countryside Stewardship Scheme and so forth. Participation is dependent upon land owners agree to adopt certain management practices in return for subsidy.

The criteria for these programs has to be agreed with the European Commission as a sensitive sector subject to state aid considerations so the scope for localising the operation of these schemes is limited beyond spatial targeting.

In terms of looking forward however, there are a range of bodies that monitor and report on the state of ecosystems in the region – Environment Agency, Regional Assembly, Natural England etc. Co-operation and data sharing occurs through bodies like the East Midlands Regional Observatory who produce the "State of the Environment" report. The degree to which these influence and inform decisions that might help moves towards a new competitive model is uncertain.

Below the regional level, there are a range of NGOs (e.g. Wildlife Trusts) and individual local authorities undertaking a mix of intelligence gathering, promotion and in some cases funding of ecosystem services or the provision of volunteer services. Some of this activity may not be recognised by the parties concerned as being formally part of this agenda but it is nevertheless, a contributor to an ecosystem services approach (e.g. planning officers negotiating contributions to green infrastructure).

This analysis suggests that regional leadership around a common vision is still developing; that there are discontinuities in the way regional intelligence is used to inform/ influence the way levers are used to promote payments systems and that some of the control functions that administer payments to improve ecosystems are often determined independently of regional objectives.

Creating a focus for developing these capacities in the future would, therefore, seem to be a useful way of creating a platform for an ecologically competitive region.

9.4 Creating additional capacities in the East Midlands

Our assessment of current regional capacities combined with the problems concerning business engagement on this issue may justify the development of new delivery vehicles structured to meet the task.

The purpose of these new delivery vehicles would be to provide a shared vision amd practical 'space' to allow key parties to focus their work and contributions accordingly. Practically, the new delivery vehicles would be steered by participants drawn from the existing range of partnerships involved with ecosystems or biodiversity.

Given the need to sell ecosystem services to the business community, a majority participant in any vehicle would need to be drawn from the business community. Achieving participation would be difficult until such time that government clearly signalled its intentions to move towards a local stewardship approach with appropriate legislative drivers in place. In the interim, participation may be generated from companies who already have strong environmental credential displayed in their Corporate Social Responsibility policy frameworks.

The example shown in Figure 9.1 demonstrates what a delivery vehicle would be tasked to do.

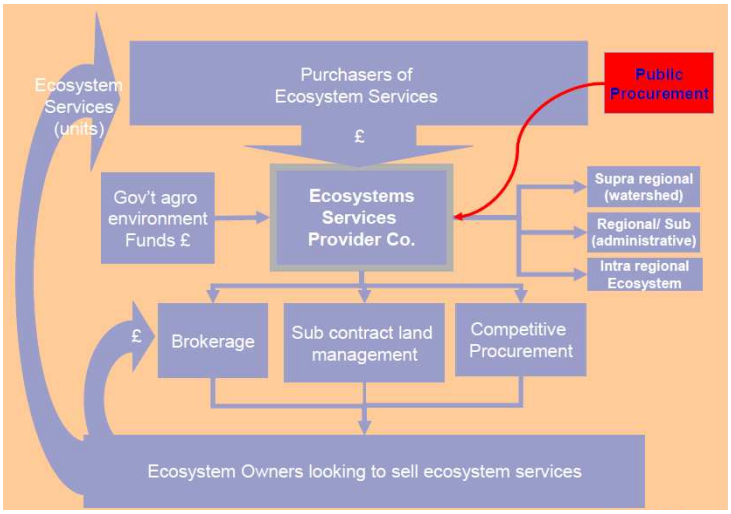


Figure (9.1) Delivery Vehicle for Ecosystem Services (ES)

Many of the structural issues surrounding such a vehicle would share similar characteristics with development vehicles used in regeneration and energy. The model in figure 9.1 essentially assumes that a delivery vehicle would take responsibility for sourcing services for a customer from a variety of sellers. Some of the sellers would be effectively "single source" due to the nature of the ecosystem service being non transferrable whilst others would be capable of transferability. The delivery vehicle would reduce the transaction costs involved for the customer which could be well outside traditional core business for that sector. The delivery vehicle would receive income through a "finders" fee and make additional income from cases where land owners subcontract management of the ecosystem to the delivery vehicle which may then subcontract that service to smaller and specialist companies from a 'suppliers' list.

One of the key design decisions for a vehicle is its focus. An ecosystems service focus might mean developing a delivery vehicle for a specific watershed or peat land. The advantages of this approach would be that there would be a direct mirroring of the ecosystem onto the organisational structure creating a transparent relationship. The disadvantages are that it would create a supply led body with geographic limits associated with its spill-over effects.

A focus on buyers either at a sub-regional, regional or supra regional level would create a very different set of motivations for the delivery vehicle managers. The primary function would be to match the needs of consuming sectors of the East Midlands economy with providers of ecosystem services. The delivery vehicle would be able to drive an element of competition between providers in cases where the services were transferable (accepting that this might not always be possible).

Assuming a shift in government policy, it might be possible to see this type of delivery vehicle becoming attractive to a private sector company looking to diversify its service portfolio. Indeed, some of the alternative delivery vehicles now contemplated to support other aspects of sustainable policy may view ecosystems service provision as a viable diversification opportunity. Energy Service Companies (and the next logical step of Water and Energy Service Companies and so forth)fit this future institutional landscape.

Over the longer term, some of the existing agri-environmental schemes could be channelled through such vehicles. However, there are many barriers around state aids and European policy that would need to be overcome first.

9.5 Key issues

A minimum organising capacity is assumed necessary to implement PES in the East Midlands. A review of existing organisations, combined with evidence from consultative

workshops, suggests that there are uncertainties over who could provide leadership. A delivery vehicle is proposed to fill the deficit based on transferable experience from another policy arena.

10 Priorities and Development Scenarios for the East Midlands

10.1 Introduction

The previous section considered some of the characteristics of individual ecosystem services to assess their suitability for PES interventions. This process is essentially a technical assessment using precedent and transferable experience as a guide.

However, the determination of PES priorities has to sit within a wider policy framework where the technical capacities to apply PES are reconciled against wider socio economic and environmental criteria.

This chapter considers the results from the two stage sieve process in the light of broader objectives for the East Midlands and the assumed likelihood of implementation given wider socio-political choices.

The factors likely to influence selection of PES are:

- Wider objectives related to environmental objectives;
- East Midlands management of growth agenda issues;
- Scoping business capabilities; and
- Socio-economic/ political capabilities (see Appendix A3).

10.2 Determining priority actions

A number of Priority Actions have been identified (see 10.3 below). Each of these actions has been assessed against four key 'impacts' or criteria, namely:

Will the action improve regional ecosystems?

The primary objective of developing payment systems is to improve the performance of ecosystems in delivering services. As a criterion, this would suggest that those ecosystem services considered to be under performing should be prioritised. A judgement must also be made as to the level of confidence policy makers might wish to attach to the resources generated by different interventions making a difference for ecosystems supplying services. Some interventions are more certain of directing funds towards the desired purpose.

Will the action improve the flow of non public funds?

Whilst the primary objective of the study is to improve ecosystem performance, a secondary consideration is to establish the scope for introducing non governmental resources into the development of ecosystem services. This issue may become significant if restraints are placed on public expenditure over the next decade.

The scope for East Midlands leadership?

Many aspects of PES rely upon the national framework established for its operation. The design and development of PES can not act independently of the broader socio economic environment within which it is functioning. Currently, the development of PES would fall within Public Service Agreements covering the period of April 2008 until March 2011 where the natural environment is expressed as a general priority with the aim of:

> *"to secure a diverse, healthy and resilient natural environment, which provides the basis for everyone's well-being, health and prosperity now and in the future; and where the value of the services provided by the natural environment are reflected in decision-making"*

Within this PSA statement, Defra has agreed a two year action plan for the development of the ecosystems services concept based on the development of four priorities:

- Priority area 1: Promoting joined-up working within Defra and the Defra network to deliver environmental outcomes more effectively;
- Priority area 2: Identifying opportunities for mainstreaming an ecosystems approach;
- Priority area 3: Using case studies that demonstrate the benefits of taking an ecosystems approach; and
- Priority area 4: Developing ways of valuing ecosystem services.

Policy has been directed towards developing an evidence base to support ecosystem services as a viable policy tool including a preferred route for valuation. Part of this support has been the publication of Defra's "An Introductory Guide to Valuing Eco systems Services". This guidance is meant to clarify methodologies for assessing environmental impacts rather than supplement them (December 2007). Official policy has not however indicated a formal position on how PES may or may not be used in the context of a wider uptake in the use of eco systems.

Regional actions need to fit around national actions and it is recognised that many aspects of PES will depend on future national policy initiatives necessary to create a basis for viable actions.

Will the action adversely affect regional competitive advantage?

The implementation of PES must be considered in context. Action taken to apply a PES in the East Midlands part of the Peak District would raise questions of fairness in relation to businesses located outside the East Midlands but still benefiting from the ecosystem services produced.

10.3 Priority regional actions

The following 'Priority Regional Actions' have been identified based on the available evidence, and assessed in terms of the impacts described in section 10.2 above.

Action (1): Promote good practice standards in the reporting of natural resource consumption among businesses (business support) especially among resource intensive sectors.

A range of government and business initiatives have been established to report business impacts on ecosystems service consumption. These need to be disseminated on as wide a basis as possible especially among companies exercising supply chain influence over small and medium sized enterprises.

This priority action also includes implementing existing mechanisms more effectively. For example, the ISO 14001 standard tends to be applied more rigorously in traditional "brown" environmental management areas of waste water, energy use and hazardous materials management due to the preferences of the auditors of these quality standards.

Impact Criteria	Assessment of impact
Improve Regional Ecosystems	Indirectly by encouraging greater resource productivity within the business community
Improve flow of non public funds	Preparatory action in advance of national framework development
Scope for East Midlands leadership	Yes
Impacts on regional competitive advantage	Neutral

Table (10.1) Assessment of Action (1) Impacts

Action (2): Promote good practice in respect of reporting on ecosystem impacts to the ethical investment market

This action needs to be allied with more rigorous corporate reporting on ecosystem service consumption. East Midlands enterprises who gain a reputation for good practice in the management of ecosystem services should be able to gain preferential access to ethical investment funds seeking high sustainable development standards.

Creating a link between the handling of ecosystem services and gaining access to providers of capital can help create a virtuous circle beneficial to the maintenance of ecosystems.

Impact Criteria	Assessment of impact
Improve Regional Ecosystems	Indirectly by encouraging greater resource productivity within the business community
Improve flow of non public funds	Preparatory action in advance of national framework development
Scope for East Midlands leadership	Yes
Impacts on regional competitive advantage	Neutral

Table (10.2) Assessment of Action (2) Impacts

Action (3): Integrate the concept of Ecosystem Service Districts into SIRS[75]

The creation of a Single Integrated Regional Strategy offers an opportunity to further develop the concept of an Ecosystem Service District (based on an evidence base justifying the supply of ecosystem services and beneficiaries).

Impact Criteria	Assessment of impact
Improve Regional Ecosystems	Yes, embedding a concept to prioritise PES interventions.
Improve flow of non public funds	Yes, preparatory action in advance of national framework development
Scope for East Midlands leadership	Yes through regional planning powers.
Impacts on regional competitive advantage	Potentially negative if compensatory actions not taken within functional areas.

Table (10.3) Assessment of Action (3) Impacts

Action (4): Address evidence 'gaps'

Section 4 of the report highlighted a number of ecosystems where little information is known on the condition of the regional ecosystem and the flow of services.

The areas for further investigation include - Specialist fibre (e.g. thatching); Bio fuel production; Ornamental; Local climate regulation (e.g. wind breaks); Local air quality; Pest and disease regulation.

Impact Criteria	Assessment of impact
Improve Regional Ecosystems	Indirectly by filling in evidence gaps on the state of the region's ecosystem services.
Improve flow of non public funds	Neutral
Scope for East Midlands leadership	Yes
Impacts on regional competitive advantage	Neutral

Table (10.4) Assessment of Action (4) Impacts

[75] Regional Spatial Strategies were a government planning policy function at the time of writing therefore this proposal will need to be understood in the context of any new government guidelines.

Action (5): Use ecosystem services valuation techniques within scheme appraisals

Chapter 3 introduced the techniques used to value ecosystem services. Valuable opportunities exist to test the comparative cost of maintaining ecosystem services rather than reproduce the same services through artificial means.

Experience from the Catskills Project clearly showed the cost differential between supply of New York's water requirements through a purification plant versus the maintenance of a watershed ($6 billion versus $2.7 billion). These comparative cost assessments need to be encouraged especially when considering artificial infrastructure needs.

Impact Criteria	Assessment of impact
Improve Regional Ecosystems	Yes, in relation to improving choices that affects ecosystem services.
Improve flow of non public funds	Only indirectly through associated private leverage.
Scope for East Midlands leadership	Must accord with any relevant national appraisal requirements.
Impacts on regional competitive advantage	Opportunity to rationalise investment strategies and ensure good value for money.

Table (10.5) Assessment of Action (5) Impacts

Action (6): Pilot a single ecosystem service district to establish financial values.

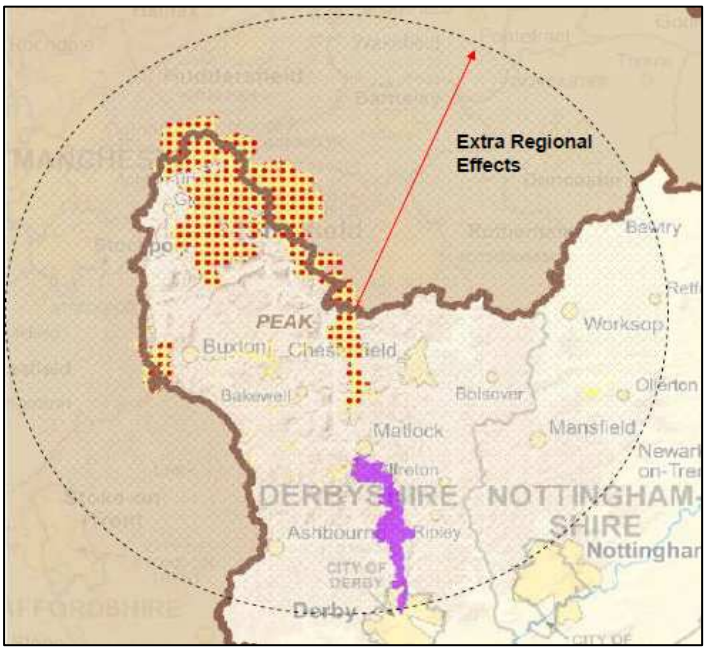
This study started from the premise that spatial variations in the flow of ecosystem services justified a regional approach. The evidence and re- interpretation of existing material tends to support the existence of significant spatial variations that would effectively be hidden if a uniform utility pricing model were adopted.

A key problem is the transaction costs associated with managing the regional approach around assessing the ecosystem service districts. In this case, it might be prudent to use a piloting process to go through the learning stages and establish what needs to be done in terms of systems, verification, information systems and so forth. The Peak District might offer a good example to test out an approach to information management and partnership formation. As indicated in Figure (10.1), the ESD would require partnerships outside the region to deal with the functional impact of a PES.

Impact Criteria	Assessment of impact
Improve Regional Ecosystems	Indirectly by encouraging greater resource productivity within the business community
Improve flow of non public funds	Preparatory action in advance of national framework development
Scope for East Midlands leadership	Yes, through future reviews of the RSS (SIRS).
Impacts on regional competitive advantage	Dependent upon achieving cross boundary agreement

Table (10.6) Assessment of Action (6) Impacts

Figure 10.1: Peak District Based ESD



Action (7): Consider adoption of an eco-credits approach to assessing green infrastructure

Delivering the scale of urban growth expected in the RSS[76] will place new pressures on parts of the East Midlands already under environmental stress. An opportunity exists to embed an eco-credits approach to maximise the ecosystems return from new development subject to adequate national support.

Impact Criteria	Assessment of impact
Improve Regional Ecosystems	Indirectly by encouraging greater resource productivity within the business community
Improve flow of non public funds	Preparatory action in advance of national framework development
Scope for East Midlands leadership	Yes
Impacts on regional competitive advantage	Potentially negative if done in isolation and without national backing

Table (10.7) Assessment of Action (7) Impacts

[76] Regional Spatial Strategies were a government planning policy function at the time of writing therefore this proposal will need to be understood in the context of any new government guidelines

Action (8): Feasibility study into a PES delivery vehicle

The PES delivery vehicle is a response to the views expressed in the second workshop which failed to identify a natural regional lead for this activity.

Impact Criteria	Assessment of impact
Improve Regional Ecosystems	Yes, by reducing the transaction costs of delivering improvements to key ecosystems
Improve flow of non public funds	Yes, by acting as an intermediary for the private sector to engage with.
Scope for East Midlands leadership	Dependent upon national policy to fully enable such an innovative approach
Impacts on regional competitive advantage	Could offer a form of competitive advantage if it can deliver improvements on a lower cost basis.

Table (10.8) Assessment of Action (8) Impacts

Action (9): Review the Impact of East Midlands Climate Change Scenarios on the Projected Output of Ecosystem Services Across the Region.

It was not the purpose of the study to investigate climate change effects on the East Midlands per se and it was for these reasons that climate change was assumed to be a constant through the study process. However, the climate change scenarios for the East Midlands mean that the ecosystem service outputs from across the region are likely to change substantively. Some ecosystems are likely to be overwhelmed by the rapidity of change now expected. New species could be expected to become successors to older, more established varieties. This outcome is likely to create uncertainties for any contractual relationships struck between a buyer and seller which may require some form of risk sharing device to hedge against future uncertainties.

Impact Criteria	Assessment of impact
Improve Regional Ecosystems	Improve regional intelligence on how climate change may change the flow of key ecosystems. A precedent exists for this type of work in relation to the sub regional study considering managed retreat strategies in Lincolnshire.
Improve flow of non public funds	Neutral over the short run.
Scope for East Midlands leadership	Yes due to the need for understanding fine grained effects.
Impacts on regional competitive advantage	Neutral

Table (10.9) Assessment of Action (9) Impacts

Action (10): Support the creation of a market infrastructure by key stakeholders (verification, payments systems)

All markets require an infrastructure to work effectively (from brokering opportunities through to effective administration like payments systems).

Impact Criteria	Assessment of impact
Improve Regional Ecosystems	Creates an essential infrastructure to conduct transactions effectively.
Improve flow of non public funds	Indirectly by building up an evidence base supporting PES
Scope for East Midlands leadership	Yes but conditional on the co-operation of key agencies such as Natural England and the Environment Agency.
Impacts on regional competitive advantage	An effective infrastructure is essential to providing an effective means of conducting future transactions. The region needs the most effective means of doing this relative to other regions.

Table (10.10) Assessment of Action (10) Impacts

Action (11): Map key sector business locations

Implementing an Ecosystem Service District approach needs an understanding of where businesses are located in relation to the flow of services. Existing databases do not offer a sufficiently fine grained analysis of business sectors.

Impact Criteria	Assessment of impact
Improve Regional Ecosystems	Indirectly by improving regional intelligence on how business relates to ecosystem services
Improve flow of non public funds	Indirectly by building up an evidence base supporting PES
Scope for East Midlands leadership	Yes
Impacts on regional competitive advantage	Neutral

Table (10.11) Assessment of Action (11) Impacts

10.4 Delivery Timescale for Priority Actions

The timescale for each of the Priority Actions identified in section 10.3 has been assigned a 'delivery' timescale:

Short term - deliverable within 1 - 2 years;

Medium term – deliverable within 3 – 5 years; and

Longer term – delivery would take 5 years plus.

These timescales are indicative. Those actions which are attributed to medium or longer term periods will require action in the short term to establish the groundwork and evidence base from which these actions can be built and delivered.

Priority Actions	Time period
1: Promote good practice standards in the reporting of natural resource consumption among businesses (business support) especially among resource intensive sectors.	Short term (1-2 years)
2: Promote good practice companies in respect of reporting on ecosystem impacts to the ethical investment market	Medium term (3 – 5 years)
3: Integrate the concept of Ecosystem Service Districts into SIRS	Longer term (5+ years)
4: Fill evidence base gaps concerning ecosystems whose characteristics are unknown	Medium term (3 – 5 years)
5: Use ecosystem services valuation techniques within scheme appraisals	Short term (1-2 years)
6: Pilot a single ecosystem service district to establish financial values.	Short term (1-2 years)
7: Consider adoption of an eco-credits approach to assessing green infrastructure	Longer term (5+ years)
8: Feasibility study into a PES delivery vehicle	Short term (1-2 years)
9: Review the Impact of East Midlands Climate Change Scenarios on the Projected Output of Ecosystem Services Across the Region.	Medium term (3 – 5 years)
10: Support the creation of a market infrastructure by key stakeholders (verification, payments systems)	Longer term (5+ years)
11: Map key sector business locations	Short term

Priority Actions	Time period
	(1-2 years)

Table 10.12 Delivery Timescales for Priority Actions

11 Conclusions

Payments for ecosystem services require buyers and sellers. Sellers can be identified through the ownership of key biophysical assets in the region, buyers are however much more elusive. A critical precondition for the identification of buyers is to understand the flow geography of ecosystem services and for buyers to have understood the risks associated with failing ecosystem services. Our assessment suggests that whilst it is possible to map spatial associations, the risk assessment by business is largely absent. Yet it is the risk assessment that drives a business decision to become a buyer.

Globalisation has lessened the dependency of regional enterprises on provisioning services from within the region. Fibre and food produce are traded between the East Midlands, other parts of the UK and internationally, and so, these services have become less significant to resource consuming sectors. Low transport costs have made it possible for regional specialisation, based on comparative advantage, even in basic commodities like food. These trading links have, however, been formed around transportation systems that rely on cheap fossil energy fuels. As these fuels become more expensive, it will cease to be viable to move large quantities of low value raw materials great distances, and comparative advantage for regions may increasingly come to rely upon the raising and sustaining of local provisioning services. Whilst there are considerable uncertainties concerning the future direction of energy policy and the pace at which markets and technology will adapt to rising prices, the precautionary principle would be to prudently manage ecosystem services now.

Practically, our analysis suggests that most of the provisioning services are currently stable; however future scenarios may demand an increase in these services. Regional land productivity may become an increasingly important factor for the region if national energy policy demands a greater share of biomass within the primary fuels mix of the region. Over time the twin threats of an expanded world population and a contraction in productive land resulting from climate change may also make it more important to increase self sufficiency in food supplies.

Despite this analysis, it is not surprising to see resource intensive industries in the East Midlands pay relatively little regard to the condition of regional sources of material resource. As highlighted in the main body of the report, some regional priority sector plans recognise how their competitiveness is intertwined with locally derived ecosystem services especially food & drink (e.g. local food specialities) and tourism. The next step is for this awareness to be converted into a wider analysis or valuation strategy. The region is well supported in terms of generic forms of business support delivered through Business Links but this offer could be further developed to look at dependency upon a set range of regional ecosystem services. The East Midlands Regional Economic Strategy includes a strong policy theme concerning natural resource consumption and protection; this could also be further developed to describe the role of ecosystem services in enterprise including the risks and benefits that exist.

Bilateral PES schemes are most likely to happen, without intervention where companies are actively translating risks into strategies that justify the formation of a PES. A good example are large companies like water utilities who have the capacity to identify and manage risk much better than small and medium sized enterprises. Water utilities also possess the advantage that they operate at a scale where there is a fairly good symmetry with some of the ecosystem service districts identifiable in the region.

It would seem likely that these bilateral PES deals will continue to evolve if national regulatory standards are modified to allow them to happen. Currently, utilities companies are allowed to invest in infrastructure proposals to manage the supply of potable water or the management of drainage and the management of waste water. Water companies are, however, unlikely to invest if they can not establish the level of service involved and the continuity of that service. The industry regulator must also clarify the inclusion of land purchase or payments to third party land owners within the regulated asset base of the

water companies, this development would be likely to encourage an otherwise conservative industry to develop PES schemes.

These bilateral arrangements will inevitably raise issues over whose values are used to derive a PES. Risk led assessments are likely to encourage companies to base PES on private cost calculation (e.g. based on alternative technical solutions) rather than a wider societal based valuation. The calculation of private costs may still discount certain services derived from a given ecosystem. Further work is being done on an international scale, to establish a common set of valuation principles, but as yet this evidence gap still exists.

There are different barriers to creating PES schemes in those sectors which are made up of lots of small enterprises for instance Tourism or Food & Drink. Usually, no single enterprise dominates at the scale of an ecosystem service district (e.g. based around a valued landscape) supporting their activities and the enterprise. Under these conditions there is a significant market failure based around the asymmetry between buyers and sellers. These asymmetries can be identified in other sectors where the scale of enterprise is predominantly small in relation to the scale of the ecosystem service district.

OFFPAT guidance to RDAs accepts asymmetrical market relationships as evidence of a market failure (see Annex A) sufficient to justify market intervention. In the case of tourism, the conditions are unlikely to emerge where spontaneous associations emerge among tourism enterprises and land owners/ managers to create PES schemes. Agreement on attributing a specific liability for maintaining an ecosystem among a myriad of competing interests would seem problematic. Intervention in the form of group based purchase offers a means of overcoming the market failure so long as it is possible to recover the costs from the individual small enterprise beneficiaries. In cases like this, the evidence base justifying the flow of benefits becomes critical. OFFPAT guidance also identifies that information imperfections are a rationale for public intervention. This term is commonly applied to circumstances where the evidence base is still uncertain and incomplete, a description that is readily applicable to the development of payment for ecosystem services.

Biodiversity is seen as a key marker for the resilience of an ecosystem against catastrophic, non linear changes in ecosystem services output. Although the precise nature of the relationship between biodiversity and ecosystem service output is still unclear, a low level of biodiversity may risk a sudden change in an ecosystem service output. It is important to acknowledge at this point that climate change might be one of the future trigger points affecting variability in ecosystems output.

Non linear relationships pose a challenge to the idea that values can be transferred from one study area to another. The implication of attempting to overcome this barrier is that the costs of valuing a PES scheme would increase if it was deemed necessary to accumulate more primary evidence on service output. In addition, non linear relationships are also evident in the interdependency observable between ecosystem services; this may also need to be taken into account when considering more complex PES schemes that involve values transfer between areas.

Recognising the value of this report as a regional resource, *emda* in partnership with Natural England propose to disseminate this report to wider body of stakeholders though two distinct channels. The first will disseminate the findings of the study to key Local Authority representatives to give them a clear indication of the importance of ecosystem services in their area. The work will provide Local Authorities with an understanding of how development can impact on ecosystem services and also how suitably designed development can be, not just benefit neutral, but be designed to increase the level of ecosystem services.

The second is designed to more specifically engage the business community. The report will be used to develop a case study example of how Payment for Ecosystem Services could be mobilised within a particular sector. Using the food and drink sector as an example, we will bring together a number of key stakeholders to debate how some of the examples suggested in the report might be operationalised in the East Midlands.

Annex A - Market Failure

A precursor to understanding PES opportunities is a better understanding of the concept of "market failure". This concept is a critical rationale for establishing a basis for possible Agency intervention given HM Treasury guidance. The most desirable outcome for ecosystem would be for consumers of ecosystems services to pay the full cost of provision to the suppliers of those services. Economic theory clearly establishes a functional market relationship would produce the most socially desirable outcomes for all.

The problem is that these services exhibit the classical characteristics of "public goods" or "club goods"[1] where it is impracticable to exclude consumers from consuming the benefits (ecosystem services) of those goods (ecosystems). One of the reasons that services emanating from an eco system are non excludable is that their positive external effects "spill over" the physical boundary of the ecosystem producing the service. Thus, landscapes buffering flood waters from penetrating the built environment are providing services beyond their boundaries to towns and cities in their hinterland.

As a public good, ecosystem services are usually perceived as being available without cost to the consumer. Indeed, the service can become invisible to consumers because it has historically being regarded as "free".

An ecosystem's ability to supply a flow of services is determined by the general "health" of the ecosystem rather than notional demand for services from the human population. Ecosystem services could, therefore flow into the "market" producing either a glut or a scarcity.

Pressure on ecosystem supplying services could threaten the continued delivery of ecosystem services e.g. through development encroachment or negative "spill-over" effects from human activity. Resolving this threat implies corrective signals to mitigate the over consumption of scarce ecosystems services thereby preserving the future capacity of previously free goods to sustain themselves.

The incidence of market failure is accelerated by the desire to continue to grow (e.g. stated objectives that involve closing the regional productivity gap and building more houses) increasing the level of over consumption. The performance of eco systems are themselves threatened by accelerated rates of climate change. Historically, ecosystems have always responded to climate change but over extended periods of time. Scientific evidence suggests that climate change is likely to create shock impacts that will make adaptation extremely difficult. The resultant destruction will degrade ecosystems performance beyond that triggered by localised human impacts.

Potential methods to mitigate the impact of market failure include:

- Expanding the extent of protected designations requiring compliance with minimum standards thereby expropriating the means of maintaining the ecosystem from landowners through compliance enforcement;
- Developing behavioral signals that encourage the internalisation of ecosystems costs in the market costs of goods and services e.g. eco labeling;
- Direct consumers or third party on behalf of consumers acquires property rights over the ecosystems generating ecosystems service including the on going maintenance costs of ecosystems;
- Ecosystem restoration costs absorbed by value capture from new development by requiring developers required to make good damage to ecosystems through payments related to ecosystem services or other proxy for damage (e.g. stock indicator);

- Ecosystem Service costs covered through the creation of a transferable property right to consume a quantity of ecosystems service up to a specified limit- suppliers of ecosystems service generate “credits” with a monetary value;
- Ecosystems restoration costs managed through a government or third party establishing a transfer payment to a hypothecated fund to maintain ecosystems between consumer/ beneficiaries of an ecosystems service and the supplier;
- Ecosystems restoration cost substituted by artificial alternative e.g. purpose built infrastructure such as flood defences; water purification plant; sewage treatment; desalination plant to make good deficiencies in the flow of ecosystem services;
- Charge levied in proportion to the degradation caused against a baseline ecosystems or ecosystem services degradation;
- Ecosystems restoration costs met from general taxation funds or utility charge settlement e.g. funding to support a particular action without specific reference to an ecosystem services output.

The range of solutions include PES and non PES approaches to market failure which illustrate the relationship of PES to both traditional (regulation approaches) and non traditional solutions (e.g. greater use of eco labelling). These potential solutions to market failure are however subject to a broader range of institutional, behavioral and physical constraints.