Payments for Ecosystems Services

Findings and Perceptions from the USA

Report

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Executive Summary

Most ecosystem services have traditionally been regarded as 'free goods'. This has led to ecosystems becoming degraded or destroyed due to a lack of incentives to protect them. Payments for Ecosystem Services (PES), including public and voluntary payment schemes and cap and trade schemes, attempt to rectify this, often through market mechanisms. The use of these schemes has become more widespread particularly in the USA and some developing countries.

If designed and implemented well PES offer great potential for protecting ecosystems. Wetland and conservation banking has developed in the USA to help compensate for environmental impacts by providing credits for areas of wetland or habitat created or restored elsewhere, and is now widely accepted as the most effective option in meeting offsetting legislation in this arena. Water quality trading has developed in the US, providing an innovative approach to meeting requirements under the Clean Water Act, and is an approach that has been largely overlooked in Europe so far.

Partly in anticipation of federal regulation, the world's largest voluntary carbon market in the world has emerged in the US. Several carbon trading initiatives are also under development at state and regional levels.

Forestry offsets are included in most carbon trading initiatives in the US. Of an estimated 40 carbon offset providers in the US, 10 offer forestry offsets. For forestry, there are interesting questions about the role of government in the voluntary carbon markets. Potential roles in the monitoring, verification and certification of projects are being considered, and the US forest service has already raised some private sector funding for projects providing offset credits. This raises some concerns about the competitiveness of the market, and potential conflicts of interest. Any involvement by the FC in the UK voluntary market will face similar scrutiny.

In the absence of international agreement on tackling deforestation, PES schemes have emerged as one way in which tropical deforestation can be tackled. Schemes focused upon forestry have been adopted in several countries, including Costa Rica and Mexico.

A number of issues remain largely unresolved. These include issues relating to ensuring additional services are provided, assessing the cost and environmental effectiveness of schemes, and designing schemes to take account of multiple ecosystem services, distributional justice and, especially in relation to tackling tropical deforestation, priorities such as poverty alleviation.

Further research and policy analysis is needed in considering potential introduction of PES mechanisms in the UK.

1. Introduction

The flow of benefits ecosystems provide to households, communities and economies are termed 'Ecosystem Services' (ES).[1] As a consequence of having characteristics typical of 'public goods',[2] most ES, such as biodiversity conservation, water filtration, and carbon sequestration, have traditionally had little or no commercial value,[3] with their lack of market value considered a principal driver of ecosystem degradation and destruction. Despite the substantial contribution to the economy and society as a whole, lack of commercial value has led to there being little or no economic incentive for resource owners to ensure ES continue to be provided.

Many of the world's ecosystems have been degraded or are under threat of degradation. According to the Millennium Ecosystem Assessment, for example, 23% of mammals, 12% of bird species, and 25% of conifers are now threatened with extinction, with current extinction rates up to a thousand times higher than the background rate.

Payments for Ecosystem Services (PES) create incentives for economic agents to take the value of ES into account in making decisions.[4] This can help increase conservation and underpin compensation mechanisms for unavoidable impacts.

PES involve a financing mechanism (for resource owners), a payment mechanism (for beneficiaries) and an overarching governance structure.[5] While there is no generally accepted definition,[6] with classifications often based upon type of ES, payment mechanism, or legal status,[7] broadly defined, PES systems are diverse, including public and voluntary payment schemes, and offset and cap-and-trade schemes.[8]

Rough estimates suggest that the total volume of transactions worldwide is currently valued in billions of US dollars. Schemes have developed rapidly in the US and many other countries in recent years, with estimated growth rates typically in double digits (see Appendix I).

A global review of emerging markets for forest environmental services identified over 280 actual and proposed PES schemes in 2000/1.[9] Viewed as having a potentially very important role in conserving and expanding forest cover, and in leveraging private sector funding for these activities, schemes can be relevant in a range of contexts. These include both stemming loss of forests in countries such as the US,[10] where the rate of conversion of private forests reached a million acres a year in the 1990s and an additional 23 million acres of forests may be lost by 2050,[11] and in tackling tropical deforestation to achieve global climate change mitigation and biodiversity conservation goals.[12] Some key issues in considering the potential of PES schemes are outlined in Appendix II.[13]

This report provides a rough sketch of PES schemes in the United States for water, biodiversity, and carbon, and current developments, highlighting issues

relevant to the UK. It also briefly discusses schemes in relation to tackling tropical deforestation.[14]

It draws upon information gathered during a visit to the US in May 2007 (Appendix III) exploring experiences and perceptions of PES. This provided a useful overview of schemes in the US in areas of carbon, water and biodiversity, while allowing views on their performance, and potential integration across markets to be explored, with meetings at the World Bank and with NGOs broadening discussions to developing country schemes.

[1] This fits the Millennium Ecosystem Assessment (2005b, p.v) definition of "benefits people obtain from ecosystems." (The latter is defined as "a dynamic complex of plant, animal, and microorganism communities and the nonliving environment interacting as a functional unit", such as 'natural forests'). However, ES remains a contested concept, with little agreement on its precise definition or coverage. ES have also been defined as "the benefits human populations derive, directly or indirectly, from ecosystem functions", where the latter are "habitat, biological or system properties or processes of ecosystems" (Costanza et al, 1997, p.253), and as "flows of materials, energy and information from natural capital stocks, which combine with manufactured and human capital services to produce human welfare" (Costanza et al, 1997, p.254). Narrower definitions have also been proposed, such as "components of nature, directly enjoyed, consumed, or used to yield human wellbeing" (Boyd and Banzhaf, 2006, p.8).

[2] 'Public goods' are goods or services such as street lighting that cannot be divided and sold to individual consumers (Klemperer, 1996) as a result of having benefits that are 'non-rival' (enjoyment by one person does not detract from their enjoyment by others) and 'non-excludable' (it is not feasible, or too costly, to prevent others enjoying the benefits).

[3] Costanza et al (1997, p.259) note, "If ecosystem services were actually paid for, in terms of their value contribution to the global economy, the global price system would be very different from what it is today."

[4] The basic premise is that "in the end, we will only protect what we value" (Bayon et al, 2006, p.xviii).

[5] See: Mayrand and Paquin (2004, Fig 1, p.7).

[6] E.g. A far narrower definition of PES than that adopted in this paper is "mechanisms whereby indirect service users, fairly identified, pay ecosystem providers." (Stefano Pagiola, World Bank, pers. com).

[7] Mayrand and Paquin (2004).

[8] While for the purposes of this report a broad definition is accepted, questions remain as to whether it is meaningful to encompass such a wide range of mechanisms using a single concept.

[9] including 75 for carbon sequestration, 72 for biodiversity conservation, 61 for watershed protection, and 51 for landscape beauty (Landell-Mills and Porras, 2002).

[10] Loss of forests due to fires and land development are currently severe problems in the US. Almost half (49%) of the US Forest Service's budget currently goes on fire-fighting, and the proportion increasing. There are increasing rates of forest conversion in California (http://www.climateregistry.org/docs/PROTOCOLS/Forestry/04.06.14_Final_Forest_Protocols_Board_Overview.pdf), although trends for the US as a whole indicate a slight increase in total forest cover in the conterminous US from 246m ha in 1987 to 251m ha in 2002 (EPA, 2007, 7-6).

[11] This estimate takes into account changes including conversion of agricultural land to forest, as well as trends in public forests (Alig et al, 2003). Over 11% (over 40m acres) of private forests are considered at risk of housing development by 2030 (Stein et al, 2005).

[12] It is thought that new PES schemes in the US could bring in significant additional private sector funds, potentially halving the number of applications for federal assistance currently turned down due to budgetary limitations.

[13] These informed the indicative questionnaire drawn up prior to the study visit to the US (Appendix V).

[14] Comprehensive analysis of these issues is beyond the scope of this report.

2. Definitions and Key Issues

Summary

Payments for Ecosystem Services (PES) constitute mechanisms compensating resource owners for the provision of services (benefits of nature) for which they have traditionally gone uncompensated. Schemes have developed rapidly in the US and several other countries in recent years, with the total volume of transactions worldwide currently valued in billions of US dollars. Key issues include environmental performance, cost-effectiveness, distributional justice, and handling the multiplicity of services provided by a given ecosystem.

Definitions

The Millennium Ecosystem Assessment (2005b, p.v) defines 'Ecosystem Services' (ES) as the "benefits people obtain from ecosystems".[1] While definitions vary, with little agreement on the precise coverage,[2] ES can be broadly conceptualised as encompassing the flow of benefits that ecosystems provide to households, communities and economies.

Many ES have characteristics typical of 'public goods' and cannot easily be divided and sold to individual consumers. Akin to street lighting, their benefits are often 'non-rival', so that enjoyment by one person does not detract from their enjoyment by others, and 'non-excludable', so it is not feasible, or too costly, to prevent others enjoying the benefits.[3] This generally results in the absence of markets, or in market failure, little demand and under-provision.

As a consequence, ES such as biodiversity conservation, water filtration, and carbon sequestration, have traditionally had little or no commercial value. Despite the substantial contribution to the economy and society as a whole, lack of commercial value has led to there being little or no economic incentive for resource owners to ensure ES continue to be provided. Costanza et al (1997, p.259) note, "If ecosystem services were actually paid for, in terms of their value contribution to the global economy, the global price system would be very different from what it is today".

Many of the world's ecosystems have been degraded or are under threat of degradation. According to the Millennium Ecosystem Assessment, for example, 23% of mammals, 12% of bird species, and 25% of conifers are now threatened with extinction, with current extinction rates up to a thousand times higher than the background rate. The lack of market value for ES is considered a principal driver of ecosystem degradation and destruction.

Based upon the premise that "in the end, we will only protect what we value" (Bayon et al, 2006, p.xviii), PES involve the creation of mechanisms to

compensate resource owners for the provision of ES, thereby providing incentives for them to take their value into account in making decisions. This can help foster conservation and underpin compensation mechanisms for unavoidable impacts.

There is no generally accepted definition, with classifications often based upon type of ES, payment mechanism, or legal status, but PES are viewed as having a common structure involving a financing mechanism (for resource owners), a payment mechanism (for beneficiaries) and an overarching governance structure.[4] Broadly defined, they encompass a wide range of systems, including public and voluntary payment schemes, and offset and cap-and-trade schemes.

Rough estimates of the total value of PES transactions worldwide are in billions of US dollars. Schemes have developed rapidly in the US and several other countries in recent years. A global review of emerging markets for forest environmental services identified over 280 actual and proposed schemes in 2000/1, including 75 for carbon sequestration, 72 for biodiversity conservation, 61 for watershed protection, and 51 for landscape beauty.[5] Rough estimates of growth rates in the value of PES transactions worldwide typically are in double digits (see Appendix I).

Key Issues

PES schemes are of potential relevance in a range of contexts. They are considered important in stemming loss of forests in 'developed' countries such as the US, and in bringing in significant additional private sector funds for nature conservation. Losses of forests due to fires and to land development are currently severe problems in the US.[6] Almost half (49%) of the US Forest Service's budget currently goes on fire-fighting, and the proportion increases each year. The rate of conversion of private forests reached a million acres a year in the US in the 1990s, and net of conversion of agricultural land to forest and trends in public forests, it has been estimated that an additional 23 million acres may be lost by 2050.[7] In the US PES schemes are viewed as potentially being able to raise sufficient finance to halve the number of applications for environmental federal assistance programmes currently turned down due to budgetary limitations. PES schemes are also viewed as important in tackling tropical deforestation and achieving global climate change mitigation and biodiversity conservation goals.

Key issues worth highlighting include:

1) **Environmental Performance**
'Additionality' is one of the most important considerations in judging the environmental performance of PES schemes and in the verification and certification of associated projects. It involves demonstrating that greater environmental benefits exist than would have arisen in the absence of the PES

scheme or project under a 'business-as-usual' ('baseline') scenario. Demonstrating additionality is difficult ex-post given the absence of a counter-factual showing exactly what would have happened had a project not gone ahead. Although conceptually easy to understand, additionality is difficult to prove in practice and, in the context of carbon, has been a source of continuing controversy in establishing which projects should be allowed under the CDM.[8] Other important issues in judging environmental performance include permanence, leakage, double-counting, co-benefits, and measurement method or type of accounting used.

Assessing the environmental performance of PES schemes is very important also in voluntary markets where payments for the associated benefits are sought. Some consider that difficulties of consumers in determining the veracity of quality claims and absence of a common standard could result in poor quality driving out high quality, undermining the market and possibly leading to its eventual collapse.[9]

With measurement and valuation methods still under development, some consider excessive concern with additionality a hindrance in developing regulation-driven PES schemes, preventing necessary agreement being reached.[10]

2) **Cost-effectiveness**

Economic instruments such as PES are often argued to be more efficient regulatory tools than traditional 'command-and-control' policy instruments, reducing the cost of achieving given environmental goals. In some cases cost-effectiveness has been the primary motivation for their introduction. For example, the New York City authorities famously chose to invest $1.5 billion over 10 years in the Catskill Watershed programme to improve forestry and farm practices and reduce water pollution from microbial pathogens and phosphorus rather than spending $6-8 billion on constructing a new water filtration plant.[11]

PES are not always more cost-effective, however. Transactions costs may exceed the additional environmental benefits, especially where the value of ecosystem services is low.[12]

Low transactions costs can be a major advantage of voluntary PES schemes compared to regulatory-driven ones. For example, the cost of getting approval from the Clean Development Mechanism (CDM) Executive Board under the Kyoto Protocol for carbon offset projects ranges from US$50,000 and $250,000, with the UNDP estimating that total up-front costs typically account for 14%-22% of the net present value of carbon credit revenues for small-scale CDM projects.[13] Lower transactions costs can help increase the coverage of PES schemes.[14]

3) **Distribution**
Explicitly, or implicitly, regulation-driven PES involve some of those who previously benefited without charge subsequently having to pay for ES, resulting in redefinition and realignment of property rights. By limiting use rights and introducing 'grandfathering' or other allocation mechanisms, cap and trade systems, for instance, can involve significant wealth transfers, and create barriers to new entrants.[15]

4) **Multiplicity**
Ecosystems such as forests provide a range of ES. 'Bundling' these in a single PES scheme increases complexity. However, the alternative of having a multiplicity of schemes applying to an ecosystem may, in aggregate, lead to unanticipated results.

[1] The Millennium Ecosystem Assessment (2005b, p.v) defines an 'ecosystem' as "a dynamic complex of plant, animal, and microorganism communities and the nonliving environment interacting as a functional unit".
[2] E.g. Costanza et al (1997) variously define ES as "the benefits human populations derive, directly or indirectly, from ecosystem functions", where the latter are "habitat, biological or system properties or processes of ecosystems" (p.253), and as "flows of materials, energy and information from natural capital stocks, which combine with manufactured and human capital services to produce human welfare" (, p.254). Narrower definitions include that proposed by Boyd and Banzhaf (2006, p.8), as "components of nature, directly enjoyed, consumed, or used to yield human wellbeing".
[3] Klemperer (1996).
[4] See: Mayrand and Paquin (2004, Fig 1, p.7).
[5] Landell-Mills and Porras (2002).
[6] There are increasing rates of forest conversion in California (http://www.climateregistry.org/docs/PROTOCOLS/Forestry/04.06.14_Final_Forest_Protocols_Board_Overview.pdf), although trends for the US as a whole indicate a slight increase in total forest cover in the conterminous US from 246m ha in 1987 to 251m ha in 2002 (EPA, 2007, 7-6).
[7] Alig et al (2003).
[8] Trexler et al (2006).
[9] Trexler et al (2006).
[10] Bayon et al (2006).
[11] ESC (2006).
[12] Mayrand and Paquin (2004).
[13] Krolik (2006) cited in Bayon et al (2006).
[14] Bayon et al (2006).
[15] E.g. on distributional consequences of the introduction of rights allocations in EU sea fisheries, see: Valatin (1991).

3. Wetland and Conservation Banking

Summary

In the USA, wetland and conservation mitigation banks have sprung up, offering an interesting model for the way in which conflicting demand on land use can be managed. Ecosystem services associated with biodiversity conservation are complex, with management generally simplified by being based upon land area rather than detailed assessment of services provided.

Introduction

Measuring ecosystem services associated with habitat conservation and biodiversity is complex. While definitions vary, the concept of Biodiversity captures the variability among living organisms, including variability within and between species and ecosystems. Covering such a variety of aspects makes it complex to manage, especially as the associated ecosystem services can be local, national or international in scale and difficult to measure. Typically, arrangements for the protection of associated species and services are not made directly, but relate to the area of land providing suitable habitat.

Discussion

In the USA, the main pieces of legislation covering the aquatic environment and biodiversity, respectively, are the Clean Water Act of 1977 and the Endangered Species Act of 1973. Both pieces of legislation have a requirement for the minimisation and offsetting of unavoidable impacts, including for development and infrastructure activities such as road and dam building.

The Clean Water Act covers both impacts on water quality and wetlands. Section 404 of the Water Quality Act sets out a requirement for ‘no net loss of wetlands’. In order to gain a permit for any activity, an applicant must show that they have taken steps to avoid the damage where possible, and minimised and provided compensation for any unavoidable impacts. The process is governed by Army Corps of Engineers, advised by the Environmental Protection Agency.

The Endangered Species Act provides for the classification and protection of species, listed as either ‘endangered’ or ‘threatened’, and the conservation of associated ‘critical’ habitats essential to the survival and recovery of these species. As with section 404 of the Clean Water Act, Section 10 of the ESA requires a Habitat Conservation Plan to be submitted for any activity that may impact endangered species. Similar to provisions applying to wetlands under the Clean Water Act, in order to gain a permit to proceed, an applicant must show that they have taken steps to avoid the damage where possible, minimising and providing compensation for any unavoidable impacts. Such compensatory mitigation may include creating new wetlands, or restoring, enhancing or protecting wetlands elsewhere. Offsetting has to take place

before any land is developed. The process is governed by the US Fish and Wildlife Service advised by the Environmental Protection Agency.

Wetland and conservation banks emerged to provide a timely and cost-effective means for developers to comply with these offsetting requirements. To meet their requirements under the Clean Water Act, developers initially offset wetland loss exclusively through creation of wetlands nearby, resulting in a patchwork of small mitigation sites across states. These were difficult to maintain by developers and difficult to monitor for the regulator. A report by the Environmental Research Council in 1991 deemed the majority of these sites inappropriate and poorly designed. Furthermore, several studies indicate that up to a third of the compensatory mitigation required was never carried out.[1]

Wetland mitigation banks and subsequently conservation banks emerged in the 1990s when entrepreneurs realised the potential of the economies of scale associated with creating new wetlands and habitats on larger sites. Mitigation banking is a market-based approach, with credits bought from a mitigation banker who is responsible for creating a new area of wetland or habitat, or restoring, enhancing, or preserving an existing wetland or habitat. The mitigation banker is also responsible for obtaining approval from the regulatory agencies for the establishment of the wetland or conservation bank, requiring prior approval to sell the associated credits. The number of credits required by a developer depends upon site characteristics, such as hydrology and vegetation. For developers, purchasing bank credits speeds up obtaining a permit, while allowing them to transfer their liability for mitigation.[2] During the period January 2000 – April 2005, a total of 47 transactions in wetland bank credits valued at US$290m and covering over 9,000 hectares of wetland were recorded.[3]

For the regulator banking facilitates monitoring, as banks tend to be larger than on-site mitigation projects. Proponents of wetland mitigation banking point to a rigorous approval process and cost-efficiencies associated with economies of scale, but it is clear that banks do not always deliver the environmental benefits promised at the outset. A recent evaluation of nearly 400 hectares in twelve of the longest established of the 25 banks in Ohio found that one quarter of the area sampled was shallow un-vegetated pond rather than wetland, one quarter of the remaining area was poor quality wetland, and one third of the banks largely failed to meet ecological assessment criteria.[4]

Box 3.1: Case Study: Wetland Mitigation Bank – Wildlands Inc

Established in 1991, Wildlands Inc is one of the largest private US companies involved in Conservation banking. Based in California, it has established both wetland mitigation banks and conservation banks, some on adjacent areas of the same site. The first of its banks was created to the west of the Mississippi in 1994. Since then the company has established 9 more mitigation banks, with projects in California and Washington State. A given site may contain portions of land developed for different purposes, such as vernal pools as a conservation bank and seasonal marshes as a wetland bank.[5]

Another alternative open to developers to meet requirements to compensate for unavodable impacts is a system of in-lieu fees. This involves a developer making payments to a public, non-profit or other organisation to undertake the compensatory mitigation required

While there is great interest in the US in market-based approaches to financing nature conservation, there also remain some notable examples of government funded schemes.

Box 3.2: Case Study: US Conservation Reserves Programme – Set Aside

This federal based programme sets out long-term contracts with farmers to protect biodiversity through removing lands from production. Under the scheme 36.8m acres, equivalent to around 10% of US cropland, were withdrawn from agricultural production, involving annual payments to farmers totalling $1.8bn in July 2007. Projects covered by the programme, including tree planting and retention of tree cover, are considered to also make a significant contribution to carbon sequestration, and in total are thought to offset at least a quarter of the total carbon dioxide emissions from the agricultural sector.[6]

UK Context

The most important piece of legislation in the Biodiversity Policy arena is the EU Habitats Directive.[7] This aims to contribute to the maintenance of biodiversity through the conservation of sites in member states containing habitats and species of European importance. Member states are required to take measures to maintain or restore natural and semi-natural habitats, and the favourable conservation status of wild species.

Compliance with the Habitats Directive in the UK is primarily the responsibility of the planning authorities. A developer can request consent from the local planning authority, with an assessment undertaken at the site to assess the

likely impact of the land development, and consent only granted if it is shown that there will be no detrimental impact. If this is not evident, changes may be required before the project is approved. An offset in terms of an equivalent site elsewhere may be required if the site is deemed of national interest. In the UK this involves a decision of the Secretary of State, who must secure measures to replace the habitats affected. The Directive does not explicitly state the location of the habitat, or indeed the quality of it, just that the 'overall coherence of Natura 2000 should be protected'. This suggests that offset areas could fall out with UK regions.

Conclusions

Among many stakeholders in the USA there was the perception that mitigation banks offered the best solution to meeting legislation requirements there. However, for forests, protection is only indirect, and forecasts by the Forest Service project that a total of over 40 million acres (11%) of private forests will be lost to housing development by 2030. [8]

For the UK, it provides an interesting insight into a way in which habitat destruction could be offset. Compensatory mitigation may offer a flexible approach to managing the conflicting demands on land.

[1] See: BEST (2001, p.101).
[2] See: Robertson and Mikota (2007).
[3] The average price per credit was US$36,357 (See: http://ecosystemmarketplace.com/pages/marketwatch.overview.transaction.php?market_id=4).
[4] See: Mack and Micacchion (2006) and Kenny (2006)
[5] See: http://www.wildlandsinc.com/about.htm.
[6] Follet (2007), See: http://www.fsa.usda.gov/Internet/FSA_File/jul2007.pdf.
[7] transposed into law in England and Wales through the Conservation Regulations 1994 and the Nature Conservation (Scotland) Act 2004 in Scotland.
[8] Stein et al (2005).

4. Watershed Management

Summary

In the USA the management of watersheds for water quality has increasingly moved towards the use of trading schemes to meet regulatory requirements. In the UK requirements to meet the Water Framework Directive have favoured more traditional measures.

Introduction

Compared to other ecosystems, watershed management is relatively straightforward. Watersheds are generally a localised resource, with few stakeholders in the watershed area and payments often made to those upstream who have a large influence on the quality of the water environment. Users often include large utility companies, with payments for services negotiated on a case-by-case basis, rather than relying upon the interaction of multiple buyers and sellers in markets to set payment levels competitively. Funding for these types of schemes generally falls to water users who are increasingly compliant to paying for these services.

Discussion

In the USA the federal law protecting Water Quality is the Clean Water Act 1977. This establishes the goals of eliminating releases to water of toxic substances, including nutrients and sediments. It also has requirements for ensuring the quality of surface water meets standards for recreational use.

Experimentation with water trading began in the 1980s, most notably in the Fox River (Wisconsin) and the Dillon reservoir (Colorado). The experiments prompted policy makers to re-examine the benefits and feasibility of water quality trading. In 1996 the EPA released a draft framework to facilitate the development of these programs, and in 2003 set out a Water Quality Trading Policy. The popularity of this type of program was encouraged by the success of the acid rain programme, and facilitated by the establishment of 'Total Maximum Daily Loads', a measure of the maximum amount of a pollutant a water body could receive and still meet water quality standards.

The majority of trading programmes focus on reducing phosphorous or nitrogen based pollutants, but there are also programmes to reduce sediment runoff and temperature. Programmes exist in many states across the USA.[1] For example, in Long Island, Connecticut, the state established a reduction goal of 64% for nitrogen by 2014 for 79 Publicly Owned Treatment Works. An Equivalent Nitrogen Credit was developed to account for differing locations and variations in nitrogen delivery efficiency to the Sound. An Act passed through Connecticut State legislature guaranteed the legal rights of those involved, and authorised the establishment of a Nitrogen Credit Trading Program. The first year of trading produced more than the required level of

reduction in nutrient load, with the state Clean Water Fund buying excess credits to clear the market.

Water Pollutant Trading and Offsetting based upon a Total Maximum Daily Load (TMDL) is a cap and trade system in water quality that operates in several parts of the USA. This allows those with high costs of pollution abatement to contract with other entities with lower abatement costs to meet their reduction targets. Market participants tend to be municipal and industrial dischargers, with the market being regulated by public authorities.[2]

Box 4.1: Case Study: Clean Water Service, Portland, Oregon

Clean Water Services (CWS) provides sanitary and surface water management services for Washington Country, one of the five Oregon counties covering the Portland metropolitan area. Within the county it serves 480,000 residents, maintains 769 miles of sewer lines, 439 miles of storm sewers and cleans 58 million gallons of wastewater per day. The Tualatin river is a tributary of the Willamette River, the only natural major water resource in the region, and consequently is vital to maintaining water quality. The EPA has encouraged the use of water trading as an alternative to more traditional approaches, and CWS has been a recipient of a grant to establish this in the Tualatin Watershed area. CWS will be the first to trade temperature credits in Oregon.

Traditionally measures would have included controlling quality at the point of water discharge. Whilst this work has continued, CWS has taken a more creative approach, using projects along the watercourses to improve water quality. A programme of work using trees and plants for shading water and thus reducing water temperatures has been embarked upon alongside biodiversity programmes. Amongst these are several projects to improve the water quality through enhancement projects along tributaries of the Tualatin River, such as those at Englewood Park and Beaverton Creek. These have involved programmes such as restoring the natural shape of the watercourse, and replacing invasive plant species with natural species. All these measures contribute to habitat and channel diversity.

Nevertheless, setting up these projects is not without difficulties. Often the department is required to acquire land through a conservation easement, which may require extensive negotiations with landowners.

One of the examples of water PES most often cited is establishment of a scheme in the Catskills in the late 1990s to protect the drinking water of New York City. Increasing fees to water users by 9% freed up revenues to spend both acquiring land and expanding Protected Areas in which farm and forest owners are compensated for withdrawing land from production and improving management techniques. The Land Acquisition Program commits New York City to acquiring at least 355,050 acres of environmentally sensitive undeveloped land in its upstate watersheds over a ten-year period through

voluntary purchase of land title or conservation easements. The city has so far acquired or obtained easements on around 70,000 acres at a total cost of US$168m. Water quality issues remain, however, as a fine for violations of drinking water turbidity standards imposed by the EPA in 2006 illustrate. [3]

Interestingly there are also programmes that look at the trade between point and non-point trading. The Minnesota River Basin is one such example. Since 1997 two point source polluters have traded with non-point sources for nutrient reduction credits. Credits for non-point source controls such as stream bank stabilisation, cattle exclusion, wetland restoration and cover cropping are traded. A higher ratio of reduction to compliance is used to ensure additionality and help take into account the many uncertainties that exist in converting non point source loads.

UK Context

The most influential piece of legislation in the Water Policy arena is the EU Water Framework Directive 2000, which requires all inland and coastal waters to reach 'good status' by 2015. Establishing a river basin district structure within which demanding environmental objectives will be set, including ecological targets for surface waters, it calls for the most cost effective measures to be selected to achieve good ecological status. Good ecological status remains undefined. The focus of the legislation is on the preservation and restoration of the water bodies, not just minimising negative impacts.

In the UK the response to this legislation thus far has been General Binding Rules on low risk activities, with registration and licenses on high-risk activities. The majority of activities fall under the small low risk activities that are captured under General Binding Rules. Water Quality trading has not been considered a viable option, thought to be due to the administrative burden.

Conclusions

In the right circumstances, water quality trading offers a flexible approach which allows stakeholders in watersheds to work together to meet regulations. It offers several advantages to policymakers. Appropriately utilised, it can offer savings in reduced compliance costs. Arguably it may achieve environmental standards more quickly and encourage innovation in meeting these.

There remain some unresolved issues. Property rights in particular are a tricky issue. In the USA conservation easements often have to be obtained for work along a watercourse. The landowner retains ownership rights but signs off the land for management to the easement holder into perpetuity. Tackling non-point pollution, i.e. pollution from agricultural and urban run off, is more difficult, but there are examples of trading systems where these sources have been included.

[1] For details of state and individual trading programmes, see: http://www.epa.gov/owow/watershed/trading/tradingmap-big.html.

[2] During the period January 1995 – March 2005, by Ecosystem marketplace recorded 11 transactions valued at US$11m covering over 8,000 hectares worldwide (including Wetland Mitigation, the North Carolina Ecological Enhancement Program, schemes in Costa Rica and Mexico, and the Hunter River Salinity Trading scheme in Australia). (See: http://ecosystemmarketplace.com/pages/marketwatch.overview.transaction.php?market_id=8).

[3] See: http://yosemite.epa.gov/opa/admpress.nsf/31f0470aec334c5c852572a000655938/067b00072 25ca3a7852571610064781a!OpenDocument; See: http://www.epa.gov/region02/water/nycshed/protprs.htm.

5. Carbon Trading

Summary

Despite the USA's poor international reputation on climate change, there has been significant activity at both a regional and state level. Partly in anticipation of future federal regulation, the world's largest voluntary carbon market in the world has developed in the US.

Discussion

Current US policy aims to reduce greenhouse gas (GHG) emissions per $ of GDP (GHG 'intensity') by 18% over the 10 year period to 2012. Mandatory restrictions are not currently viewed by the administration as necessary to meet this target.[1]

Almost a dozen climate change bills are currently being considered by the US Congress and Senate - see Box 5.1.

Box 5.1: Federal Initiatives

With only one exception (a carbon tax proposal), all the 11 climate change bills currently under consideration by the US Congress and Senate envisage introducing a cap-and-trade system. Some of the bills are limited to the power generation sector, which accounts for 40% of US emissions, while others cover most of the economy (up to 88% of national emissions). Some focus on restricting emissions intensity in line with current US policy, while others propose a cap on the level of emissions in sectors covered. The proposed treatment of offsets differs, with some being limited to US offsets and others allowing international ones. Sometimes agriculture and forestry are treated separately. In some cases percentages from different sectors are spelt out. Only one Bill includes agriculture and not forestry. Technical issues regarding permanence and additionality are mainly left open. Soil carbon is viewed as more controversial than forestry. Although there is currently less scepticism on the Hill about the science, there is still significant resistance to introducing restrictions, and questioning about why the US should do something if large 'developing' nations do not. Differences between Bills reflect the main interests of the states of their sponsors. Regional impacts, such as on states reliant on coal, are a significant concern.

Once a federal law is signed, state regulation becomes more constrained. Inter-state commerce laws then apply, generally prohibiting states from exceeding federal limitations.[2]

However, it appears most likely that a federal climate mitigation bill will not be signed until early 2009. In the absence of federal limitations, several regional and state-level initiatives are under development. These include a regional greenhouse gas initiative (RGGI) by north-east states, and a climate initiative by western states - see Box 5.2.

Box 5.2: Regional Initiatives

i) North-East Regional Greenhouse Gas Initiative
Seven north-east states (Connecticut, Delaware, Maine, New Hampshire, New Jersey, New York, and Vermont) signed a Memorandum of Understanding (MoU) in December 2005 to establish a regional greenhouse gas initiative (RGGI).[3] The agreement will cap carbon dioxide emissions from electricity generation plants with a capacity over 25MW using over 50% fossil fuel at current levels in 2009, aiming for a 10% reduction by 2019.[4] Massachusetts and Maryland have now also joined the initiative, and Rhode Island is committed to join.[5] Types of offsets that may initially be approved include methane destruction (landfill gas capture and combustion), and sulphur hexafluoride (SF_6) capture and recycling. Offset projects within the US are covered by the scheme.[6] While it up to each state to decide how to allocate allowances, one quarter are to be allocated for consumer benefit or strategic energy purposes (e.g. promoting energy efficiency, mitigating ratepayer impacts, promoting renewable or non-carbon energy technologies), for stimulating innovative abatement technologies, and/or paying for administrating the programme. Options for auctioning initial allowances have been investigated.[7]

ii) Western Climate Initiative
Five western states (Arizona, California, New Mexico, Oregon, and Washington) signed a MoU in February 2007 to establish a Western Climate Initiative. Members agreed to cap regional GHG emissions at 15% below 2005 levels by 2020 (approximately 33% below business-as-usual levels). The states have also agreed to establish a market-based system, such as a cap-and-trade scheme, by August 2008, and each has joined the newly established Climate Registry. Utah and British Columbia (Canada) have also now joined the initiative. In addition, four other states in the US, 3 Canadian provinces, and one Mexican state have become official observers. [8]

While a few states, including Alabama, Kentucky, Oklahoma, West Virginia and Wyoming, have prohibited the adoption of mandatory restrictions on GHG emissions,[9] more than a dozen states have adopted their own reduction targets. California and Florida have adopted the most ambitious targets so far, each aiming to reduce their emissions to 80% below 1990 levels by 2050, as Table 2 below shows.

Table 2: State-level Greenhouse Gas Emission Targets in the US

State	Emission targets
Arizona	2000 levels by 2020 50% below 2000 levels by 2050
California	2000 levels by 2010 1990 levels by 2020 80% below 1990 levels by 2050
Connecticut	1990 levels by 2010 10% below 1990 levels by 2020 75%-85% below 2001 levels in the long-term
Florida	2000 levels by 2017 1990 levels by 2025 80% below 1990 levels by 2050
Hawaii	1990 levels by 2020
Illinois	1990 levels by 2020 60% below 1990 levels by 2050.
Massachusetts	1990 levels by 2010 10% below 1990 levels by 2020 75%-85% below 1990 levels in the long-term
Maine	1990 levels by 2010 10% below 1990 levels by 2020 75%-80% below 2003 levels in the long-term
Minnesota	15% below 2005 levels by 2015 30% below 2005 levels by 2025 80% below 2005 levels by 2050
New Hampshire	1990 levels by 2010 10% below 1990 levels by 2020 75%-85% below 2001 levels in the long-term
New Jersey	1990 levels by 2020 80% below 2006 levels by 2050.
New Mexico	2000 levels by 2012 10% below 1990 levels by 2020 75% below 2000 levels by 2050
New York	5% below 1990 levels by 2010 10% below 2000 levels by 2020
Oregon	Stabilise by 2010 10% below 1990 levels by 2020 75% below 1990 levels by 2050
Rhode Island	1990 levels by 2010 10% below 1990 levels by 2020
Vermont	1990 levels by 2010 10% below 1990 levels by 2020 75%-85% below 2001 levels in the long-term
Washington	1990 levels by 2020 25% below 1990 levels by 2035 50% below 1990 levels by 2050

Source: Pew Center on Global Climate Change
(http://www.pewclimate.org/what_s_being_done/in_the_states/emissionstargets_map.cfm).

Box 5.3: State Initiatives

California

Viewed by some as the world's sixth largest economy and emitter of GHGs,[10] California passed the Global Warming Solutions Act (AB 32) in August 2006, adopting a target of reducing the state's emissions to 1990 levels by 2020.[11] A plan on how reductions by significant greenhouse gas sources are to be achieved has to be adopted by January 2009, with regulations on cost-effective reductions using market and other mechanisms adopted by January 2011,[12] and a cap on emissions phased in from 2012.

Established by California statute in 2001 as a non-profit voluntary registry for greenhouse gas (GHG) emissions,[13] the California Climate Action Registry (CCAR) helps companies and organisations with operations in the state to establish GHG emissions baselines against which any future GHG emission reduction requirements may be applied. It also encourages voluntary actions to increase energy efficiency and decrease GHG emissions. Members, who include businesses, non-profit organisations, municipalities, state agencies, and other entities, agree to register both their direct GHG emissions and their indirect GHG emissions from electricity use for all operations in California, and are encouraged to report emissions nationwide.

Reporting CO_2 emissions is required during the first three years of participation, with reporting of the other GHGs - methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulphur hexafluoride (SF_6) - encouraged. In return for voluntary participation, the State of California agreed to offer its best efforts to ensure that participants receive appropriate consideration for early actions in the event of any future state, federal or international GHG regulatory scheme. The Registry has developed a general protocol and industry-specific protocols providing guidance on how to inventory GHG emissions, including what to measure, how to measure it, back-up data required, and certification requirements.

Oregon

Under the Oregon Carbon Dioxide Standard passed in 1997, electricity generation companies have to offset around one sixth (17%) of their emissions in order to obtain a permit to operate a new plant. (Since 2004 a similar provision has also applied in Washington State). [14]

One way developers can comply with this is by paying a fee to the Climate Trust,[15] a non-profit organisation established for the purpose of acquiring offsets. Having invested a total of $9m in offset projects in the US and in developing countries expected to offset almost 2.6Mt CO_2, the Climate Trust is currently one of the largest institutional purchasers of offsets in the US.

With mandatory federal restrictions yet to be introduced, and limits still to be implemented at regional or state level, there is no evidence yet to judge the cost-effectiveness, or environmental performance of regulatory carbon trading schemes in the US. However, air quality trading programmes for sulphur dioxide (SO_2) and nitrogen oxides (NO_x) as part of the US Acid Rain Program (see Appendix II) are well established and widely considered to be working well.

In the absence of mandatory restrictions on emissions, voluntary markets have played the largest role in the development of PES schemes for carbon to date, even if a larger share of transactions relates to other forms of emission reduction.[16] There are currently an estimated 40 US offset providers (70 globally).

The principal driver of voluntary carbon markets is widely considered to be the expectation of regulations, with corporate social responsibility (CSR) being citied as another reason. By contrast, a recent survey of suppliers of carbon offsets suggests that CSR and ethical stewardship are the most important motivations globally for customers, with CSR ranked in importance at 3.9 on average on a five-point scale, compared to a ranking of 2.8 for the anticipation of regulation, the lowest ranking of any of the seven factors suggested.[17]

The Chicago Climate Exchange has played a leading role in the development of voluntary GHG markets in the US. It is currently the world's largest voluntary carbon market in terms of the volume of transactions - see Box 5.4.

Box 5.4: Chicago Climate Exchange

Established in 2003, the Chicago Climate Exchange (CCX) is currently the only voluntary, legally-binding emission reduction and trading system in North America. Members include companies, such as the American Electric Power Corporation (the largest emitter in the Western hemisphere), states, such as Illinois and New Mexico, municipalities, and universities. Members commit themselves to reducing their emissions by 6% by 2010 at 1% per year relative to a 1998-2001 average, with reductions independently verified by the National Association of Securities Dealers.[18]

CCX has developed standardised rules for issuing carbon credits for six categories of offset project,[19] including methane destruction (from landfill and agriculture), agricultural practices (continuous no-till, strip-till, or ridge-till), renewable energy, CDM eligible projects, and projects in Brazil (e.g fuel switching). Offset providers can register large-scale projects directly on the exchange, and sell them on their own behalf, but projects involving less than 10,000 tCO_2e a year must be sold through an Offset Aggregator serving as the administrative representative of multiple offset-generating projects on behalf of project owners. All offset projects must have CCX-approved verifiers.[20]

There are a range of reasons for companies signing up to voluntary emissions reductions, including providing a 'pre-compliance' opportunity to test out carbon trading before mandatory restrictions are introduced,[21] and corporate social responsibility.[22] In its first three years over 14 million tonnes CO_2e were traded, with prices currently around US $4 a tonne CO_2e.[23]

The Chicago Climate Exchange is by far the largest single voluntary carbon market in the world, accounting for 10 $mtCO_2e$ traded in 2006, representing an estimated 2/5ths of all global voluntary market trades.[24]

The New York Mercantile Exchange, currently the largest physical commodity futures exchange in the world, may also soon start carbon trading.[25] A few multinational companies, including Suncor and BP-Amoco, have established internal cap and trade schemes for GHGs, although these have not invariably been associated with a cut in emissions (e.g. Suncor increased its overall emissions from 2000-2005). [26]

There are widespread concerns about lack of transparency and the level of transaction costs in carbon markets. Furthermore, the quality of carbon offsets is currently very variable.

A voluntary federal register of carbon schemes was established under Section 1605(b) of the Energy Policy Act of 1992.[27] In May 2007 31 states, including California and Oregon, became founding members of the Climate Registry. Aimed at developing a common reporting system to measure, track, verify and publicly report greenhouse gas emissions consistently and transparently between states, the initiative will include third party verification of offsets (in contrast to the federal register).[28] The Canadian provinces of British Columbia and Manitoba have also announced their intention to participate.

Several non profit organisations have also been developing standards for voluntary markets. These include CCX, CCAR, the Climate, Community and Biodiversity Alliance (CCBA), and the Climate Group. In addition, the Center for Resource Solutions is developing a certification scheme for offset providers based upon recognising suppliers' own standards – see Box 5.5.[29]

Despite its concerns, the US government has not been directly involved in certifying or verifying offsets, or setting standards. It will become more involved if 2007 US Farm Bill proposals to invest $50m developing standards, establishing credit registries and providing credit audit and certification services, are approved. The aim of establishing a new standards board is to add credibility to carbon offsets and facilitate national ES trading by helping overcome barriers to the emergence of markets such as uncertainties in quantifying benefits, performance risks and liabilities, and high transaction costs.[30]

Box 5.5: Center for Resource Solutions

Lack of transparency in the voluntary markets led the Center for Resource Solutions, a non-profit organisation based in San Francisco, to start developing a certification scheme for offset providers. Based on similar principles to its successful 'Green E' scheme for renewable energy, the system will allow approved organisations to use its logo to indicate that GHG reductions claimed have been verified and are real, while also providing information on the verification standard used and type of offset. Aimed at ensuring consumers, whether individual or corporate, get what they have paid for, and enhancing confidence in voluntary offset markets, the initial focus is the US, with potential for the scheme to be extended to other countries. [31]

Creation of wealth valued in tens or hundreds of billion dollars is likely under proposed national carbon trading schemes in the US, dwarfing the value of allocations of rights under SO_2 and NO_x trading schemes, and potentially representing the largest transfer of wealth for over a century.[32] Recognising the distributional implications of 'grandfathering' - free allocation of permits -, five

states have announced that all their emissions permits will be auctioned, which may be considered preferable in avoiding transfers of wealth to existing emitters.

UK context

Many of the same issues faced in the US, including questions about the potential role of public authorities in establishing standards, monitoring, auditing, and certifying, as well as in designing regulatory schemes that avoid undesirable distributional consequences, appear equally relevant to the UK. For example, 'grandfathering' emissions allocations under the EU ETS reportedly led power companies in the UK to make £2 billion in windfall profits in passing on notional costs to consumers [33]

Faced with widespread concerns about poor quality offsets and lack of transparency in the UK market,[34] DEFRA recently launched a draft voluntary code of best practice. Aimed at increasing standards and transparency, ensuring reductions are additional and credits not double counted, raising consumer confidence and preventing credibility of the whole market being undermined,[35] the code covers credits from regulated markets only, these being viewed as the most robust and verifiable.[36] Those covered include Certified Emission Reductions (CERs) generated by Kyoto Protocol Clean Development Mechanism (CDM) projects (in non-Annex I countries), which are independently certified, Emission Reduction Units (ERUs) generated by Kyoto Protocol Joint Implementation (JI) projects (in Annex I countries), and EU Allowances (EUAs) generated under the EU Emissions Trading Scheme (ETS). Whether credits from regulated markets are more robust remains controversial, however. The first phase of the EU ETS is widely recognised to have involved an over-allocation of emissions permits, having little impact on emissions to date (although the system is expected to be tightened up in the next phase). Furthermore, some CDM projects have reportedly offered no additional environmental benefits, or created perverse incentives, stimulating production and subsequent destruction of chemicals such as HFC-23.[37] As some of those interviewed in the US noted, the new code effectively excludes the entire voluntary supply chain.

Conclusions

Although several schemes are under development at state and regional level, experience of regulatory-driven carbon trading in the US is currently non-existent. As in the UK, carbon trading is widely considered useful to reduce GHG emissions for climate change mitigation. Perceptions of the potential importance of regulatory-driven carbon trading schemes for climate change mitigation are based in part on the success of cap-and-trade schemes in other areas, such as under the Acid Rain Program.

In the absence of federal restrictions, many states have adopted GHG emission reduction targets, some of which appear more ambitious than the target

proposed by the UK government of a 60% reduction in emissions from 1990 levels by 2050.

[1] See: http://www.whitehouse.gov/news/releases/2002/02/climatechange.html.
[2] Federal restrictions can be subject to legal action, however, as currently with the State of California's challenge to the Environmental Protection Agency's ruling on car emission standards.
[3] See: http://www.rggi.org/agreement.htm.
[4] see: http://www.pewclimate.org/what_s_being_done/in_the_states/rggi/.
[5] See: http://www.governor.ri.gov/other/statemessage07.php, http://mass.gov/?pageID=pressreleases&agId=Agov3&prModName=gov3pressrelease&prFile=reduce_greenhouse_gases011807.xml, and http://www.gov.state.md.us/pressreleases/070420.html.
[6] A two-stage price trigger mechanism provides additional flexibility if average allowances prices rise above $10/tCO2 (in 2005 $, adjusted by the Consumer Price Index and increased at 2% pa), allowing for possible inclusion of offsets from outside the US. See: http://www.rggi.org/docs/program_summary_10_07.pdf.
[7] See: http://www.rggi.org/auction.htm.
[8] See: http://www.westernclimateinitiative.org/ewebeditpro/items/O104F13074.pdf.
[9] Yowell and Ferrell (2005).
[10] See: http://www.environmentaldefense.org/article.cfm?contentid=4889.
[11] See: http://www.leginfo.ca.gov/pub/05-06/bill/asm/ab_0001-0050/ab_32_bill_20060927_chaptered.pdf.
[12] See: http://gov.ca.gov/index.php?/print-version/press-release/4111/.
[13] See: http://www.climateregistry.org/ABOUTUS/Legislation/.
[14] Yowell and Ferrell (2005).
[15] See: http://www.climatetrust.org.
[16] E.g. other forms of renewable energy generation such as solar and wind power, energy efficiency measures, and capture and destruction of methane from landfill, and other industrial gases.
[17] Hamilton et al (2007, Table 9, p.51).
[18] See: www.chicagoclimatex.com, http://www.chicagoclimatex.com/about/members.html and http://www.chicagoclimatex.com/about/pdf/CCX_Corp_Overview_2005.pdf.
[19] This list is taken from: http://www.chicagoclimatex.com/environment/offsets/index.html.
[20] See: http://www.chicagoclimatex.com/about/pdf/CCX_Corp_Overview_2005.pdf.
[21] and helping establish de facto emissions rights that are more likely to be recognised once mandatory restrictions are introduced.
[22] E.g. see: Deutsch, C. H. (2006). U.S. Companies explore ways to profit from trading credits to emit carbon, New York Times, December 28, http://www.nytimes.com/2006/12/28/business/28carbon.html?ei=5088&en=c008286333d12d5d&ex=1324962000&partner=rssnyt&emc=rss&pagewanted=print).
[23] CCX (2006).
[24] Hamilton et al (2007).
[25] See: http://www.nymex.com/index.aspx and http://www.msnbc.msn.com/id/18591849/.
[26] See: http://www.suncor.com/data/1/rec_docs/571_Climate_Change.PDF.
[27] See: http://www.usda.gov/oce/global_change/gg_reporting.htm.
[28] See: http://www.theclimateregistry.org/The_Climate_Registry_Press_Release.pdf.
[29] See: http://www.chicagoclimatex.com/content.jsf?id=582, http://www.climateregistry.org/PROTOCOLS/FP/, http://www.climate-standards.org/standards/index.html, http://www.theclimategroup.org/assets/Voluntary_Carbon_Standard_Version_2_final.pdf and http://theclimategroup.org/index.php/news_and_events/news_and_comment/voluntary_carbon_standard_update/.

[30] See: http://www.usda.gov/documents/07finalfbp.pdf, p.59.
[31] See: http://www.green-e.org/getcert_ghg_faq.shtml.
[32] Dallas Burtraw, presentation at Carbon Trading Conference, University of Essex, January 2007.
[33] Robinson and O'Brien (2007).
[34] E.g. see: http://www.ft.com/cms/s/8f475dda-24d0-11dc-bf47-000b5df10621.html.
[35] See evidence from DEFRA to the House of Commons Environmental Audit Committee: http://www.publications.parliament.uk/pa/cm200607/cmselect/cmenvaud/331/331.pdf, Q402, Q404 and Q409.
[36] See: http://www.defra.gov.uk/environment/climatechange/uk/carbonoffset/codeofpractice.htm.
[37] See: Robinson and O'Brien (2007).

6. Forestry Offsets

Summary

Subject to much controversy in the UK, inclusion of forestry offsets within GHG cap-and-trade schemes is widely viewed in the US as beneficial, allowing more ambitious emission reduction targets to be set, while increasing the supply of offsets and reducing the costs of meeting any given emissions reduction target. Federal and state governments are developing ways to facilitate the forestry sector's involvement as an offset provider to voluntary markets, and the US Forest Service currently obtains some private sector funding for forestry offset demonstration projects.

Discussion

Having declined by an estimated one third to one half since European settlement,[1] there are currently an estimated 749 million acres of forests (over one acre with at least 10% tree cover) in the US. They cover around a third of the total land area.[2]

Land use, land use change and forestry (LULUCF) resulted in an estimated net carbon sequestration of 830mt CO_2e in 2005, which is officially considered to have offset around 14% of total US CO_2 emissions. Forests accounted for 84% of the LULUCF total, sequestering 190mtC in 2005, which is considered to have offset almost 12% of total US CO_2 emissions.[3]

According to a recent study, carbon sequestration by forests could be doubled in the short term using economic incentives. A constant price of \$50/tCO_2e, for example, is estimated to stimulate tree planting, increasing net emissions reductions to 877 mtCO_2e in 2015 and 1,296 mtCO_2e in 2025 (becoming negative by 2055 due to market-driven land use changes).[4]

Government programmes currently provide very limited direct incentives to forest owners for carbon sequestration. This is a benefit category taken into account in the Environmental Benefits Index used by the US Department of Agriculture (USDA) to score applications made by farmers under the Conservation Reserve Program (CRP), a federally-funded programme targeting environmentally-sensitive land, but it is a relatively minor factor.[5] Funding is available under the Healthy Forests Reserve Program for projects promoting recovery of threatened and endangered species that also enhance carbon sequestration.[6] Some of the the 2007 US Farm Bill proposals, such as establishing a Community Forests Working Lands Program to conserve forests near towns and cities, also mention carbon sequestration as an objective.

Many cap-and-trade schemes under development at state and regional level are likely to include forestry offsets. Offsets from afforestation projects, for example,

will be allowed under the North-east regional greenhouse gas initiative. Forestry offsets also look almost certain to be allowed in California, and CCAR has been developing a forestry protocol (stipulating that projects have to be permanently dedicated, promote and maintain California's native forests, and be based upon 'natural' forest management practices of mixed species and age classes).[7]

The inclusion of forestry offsets within regional trading schemes and those in key states such as California increases the likelihood that they will also be included in a future federal system. Their inclusion is widely viewed as beneficial in allowing more ambitious emission reduction targets to be set.

Forestry accounts for a relatively small proportion (~3%) of offsets registered on the Chicago Climate Exchange (the largest voluntary market) since its inception in 2003,[8] but accounts for a far larger proportion of transactions in other voluntary markets. A recent survey suggests that forestry offsets account for around one half of project-based transactions associated with Verified Emissions Reductions and voluntary Emissions Reductions in the other ('over-the-counter') voluntary markets in the US, and 36% of such transactions worldwide.[9] Of the estimated 40 US carbon offset providers, around ten offer forestry offsets.

The US Forest Service is currently obtains limited private sector funding for forestry carbon offset demonstration projects on public land - see Box 6.1. Such funding is viewed by some as a potentially important means of financing projects on public land that would not otherwise go ahead. Accepting private sector funding for forestry offsets on public land can be problematic where the proportion of the purchase price of the offsets received by the public authorities would be relatively small, reflecting a lack of transparency in the voluntary sector about the level of transaction costs.

***Box 6.1: Public Forestry Offsets**:*

The US Forest Service currently obtains limited private sector funding for forestry carbon offset demonstration projects on public land through the National Forest Foundation's Carbon Capital Fund. Funding secured to date is expected to finance replanting 100 acres of land deforested by wildfire in the Custer National Forest, straddling Montana and North Dakota. Two further demonstration projects are planned for 2009 in California.[10]

In addition, the US Fish and Wildlife Service is reported to be a partner with the Carbon Fund in a 1,100 acre forest restoration project in Louisiana.[11]

Were offsets from public forestry to be undertaken on a significant scale, they could be regarded by some as constituting unfair competition with other

providers, potentially distorting the market by being able to provide offsets more cheaply and undercutting provision by the private sector. However, the current emphasis is on undertaking demonstrator projects and developing appropriate growth and yield models, thereby adding credibility to forestry offsets and helping facilitate development of the market by the private sector. Where public forest services also became involved in monitoring, verification, or certification of offset projects, potential conflicts of interest could arise. In some cases state forest services have already become involved in such activities. The Texas Forest Service, for example, has become a CCX verifier for carbon offset projects (although it is not an offset provider at present).[12]

US Forest Service involvement in carbon sequestration projects on private land is also under consideration. This has already occurred in some cases at State level, see: box 6.2.

As with carbon offsets in general, the quality of forestry offsets is highly variable. Guidelines on carbon accounting for forestry offsets have recently been adopted as part of the voluntary federal register of carbon schemes established under Section 1605(b) of the Energy Policy Act,[13] and many of the standards for voluntary markets being developed by non-profit organisations encompass particular types of forestry offset. For example, standards being developed by CCX include afforestation, forest enhancement and forest conservation projects, those of CCAR cover perpetual easements promoting and maintaining California's native forests through mixed species and ages mangement practices, CCBA covers projects that support local communities and conserve biodiversity, and the Voluntary Carbon Standard encompasses afforestation and reforestation projects.

Offsets offered in the voluntary carbon market include so-called 'gourmet carbon' encompassing co-benefits, such as biodiversity conservation or planting trees close to where customers live. Such bundles of ES are of interest to companies with a range of corporate social responsibility and public relations reasons for offsetting, and to individuals with broad ethical reasons, but not to buyers seeking purely to reduce emissions. [14]

Box 6.2 :State Initiatives:

Oregon

The Oregon Forest Resource Trust was established by the state's legislature in 1993 as part of the Oregon Department of Forestry[15] as a source of venture capital to improve management of non-industrial private forests, and provides a mechanism for electricity utilities to comply with state offsetting requirements. PacifiCorp (a Portland-based utility), for example, invested $75,000 in the Trust in 1994 in return for 0.145 Mt of carbon offsets, with a further $1.5m invested in 1999 from the Klamath co-generation project to provide 1.16 Mt of carbon dioxide offsets over a 100-year period from a 2,400 acres site and offset 2.8% of the plant's emissions.[16]

The state provides up to 100% of afforestation costs for Trust projects, with ownership of associated carbon offsets transferred to the Oregon Board of Forestry to fund the Trust (with forest owners retaining a right to buy out the Trust during the first 25 years by repaying funds received at a loan rate of 6.8%). Projects are managed by the landowner under a 200-year contract based upon an agreed plan, with technical assistance and monitoring undertaken by the Oregon Department of Forestry. Carbon sequestration is estimated based upon assuming a 60-year rotation, with 20% of the offsets retained by the trust as an insurance pool to replace offsets lost due to harvesting, land use change, or natural catastrophe.[17]

Over 1,000 acres were enrolled in the scheme by late 2002,[18] with some indications suggesting uptake by landowners has been limited by insufficiently generous terms. A bill (S.1457) sponsored by an Oregon senator in 1999 would have provided start-up funds to allow forestry agencies in other states establish similar revolving loan funds aimed at increasing carbon sequestration by forestry projects.[19]

Illinois

The state of Illinois in partnership with the CCX and Delta Institute launched the Illinois Conservation Climate Initiative (ICCI) in 2006, offering landowners the opportunity to earn and sell GHG emission reduction credits through the CCX, including for afforestation and reforestation projects. 5,000 acres of forests are currently covered by this initiative.[20]

The Forest Service is involved in deepening the knowledge base on the benefits of forestry offsets. For example, the US Forest Service Pacific South West Region, is currently investigating the impact of forest fire prevention on GHG reduction with a view to the inclusion of such projects as offsets. (It has also recently joined CCAR).[21]

The US Forest Service has also been considering a potential role in helping provide insurance for private sector forestry offset projects against catastrophic fires and other hazards, and using the premiums used to fund forestry projects that would not have otherwise been undertaken. Although the idea remains to be developed, it is thought that it would not involve the Forest Service acting as an underwriter or issuing insurance certificates, but would help insure against project risk through tree planting or reforestation, by providing a place for it to occur (e.g. as public land is more secure). As with public forestry carbon offsets, key issues include establishing a baseline for public forestry and demonstrating projects provide additional benefits that would not have been obtained from projects already planned, and preventing "political leakage". The latter could arise if legislators were subsequently to decide to reduce state funding for public forestry on the basis of the increased private funding.

The potential increase in the profits of private forest owners as a consequence of selling forestry offsets is widely viewed as desirable to the extent that it leads to increased carbon sequestration and conservation of forests, but could also be viewed as constituting an inequitable re-distribution of wealth to landowners.

UK context

Forestry offsets remain controversial in the UK. Characterised by some as akin to 'Medieval 'indulgences' allowing 'sinners' to continue with unsustainable lifestyles undisturbed by their consciences, Smith (2007, p.6) argues that instead of helping avoid climate change threats "…the existence of offset schemes presents the public with an opportunity to take a 'business as usual' attitude".[22]

The current position of the UK government is that offsets are only of value when used in conjunction with, rather than instead of, reducing emissions. If forestry offsets remains outside the EU ETS, alternative mechanisms will be required to ensure landowners have incentives to value carbon sequestration by forests.

Similar issues to those faced by public agencies in the US regarding interaction with voluntary markets are also relevant to the UK. These include the appropriate role of public authorities in establishing standards, monitoring, auditing, or certifying offsets, in ensuring additionality of benefits, helping provide insurance for private sector offsets, use of the public estate for offsets. As some of those in the US noted, as it currently stands the new DEFRA draft voluntary code of best practice for offsets effectively excludes virtually all forestry projects as only offsets from the regulated markets are covered, which currently include almost no forestry offsets. (CDM forestry projects are the exception, being included as part of the EU ETS, although up to August 2007 only one forestry project has been approved out of a total of almost a thousand projects).[23]

Conclusions

It appears a widely held view in the US that forestry offsets can play a potentially important role in climate change mitigation. For some a principal advantage is in helping achieve tougher emission reduction targets than would otherwise be the case, while others consider the main advantage to be the associated increase the supply of offsets reducing the cost of compliance in meeting emission reduction goals. Forestry has a higher profile in the USA compared to the UK, with a larger land mass and greater scope for increasing forest cover. The positive view of carbon offsetting has led the US Forest Service to become involved in forestry offset demonstration projects and in facilitating the provision of carbon offsets by private owners, viewed as helping retain forest cover in the face of property development pressures.

[1] Wayburn et al (2000).
[2] Stein et al (2005).
[3] See: EPA (2007, Table 7-1 and 7.2).
[4] Murray et al (2005, Table 4.A.1, p.4-25).
[5] See: http://www.fsa.usda.gov/Internet/FSA_File/crpebi03.pdf.
[6] See: http://www.nrcs.usda.gov/programs/HFRP/ProgInfo/Index.html.
[7] See: http://www.climateregistry.org/PROTOCOLS/FP/.
[8] See: CCX (2007).
[9] Hamilton et al (2007).
[10] See: http://www.becomeafriend.org/carboncapitalfund/.
[11] See: http://www.carbonfund.org/site/pages/our_projects/category/Reforestation/.
[12] See: http://txforestservice.tamu.edu/main/article.aspx?id=3218&terms=offset.
[13] See: http://www.usda.gov/oce/global_change/Forestryappendix.pdf.
[14] Bayon et al (2006).
[15] See: http://159.121.125.11/forasst/SF/FRT/statute.htm.
[16] Cathcart (2000).
[17] See: http://www.ccffa-oswa.org/Cathcart.html.
[18] http://159.121.125.11/forasst/SF/FRT/accomp.htm.
[19] See: Cathcart (2000), http://www.govtrack.us/congress/bill.xpd?bill=s106-1457.
[20] See: http://illinois.gov/PressReleases/ShowPressRelease.cfm?SubjectID=2&RecNum=5715 and http://www.illinoisclimate.org/documents/EnrolledAcreagebyType02262007.pdf .
[21] See: http://www.climateregistry.org/MEMBERS/.
[22] See also recent editorial in Forestry and British Timber.
[23] See: http://cdm.unfccc.int/Statistics/Registration/RegisteredProjByScopePieChart.html.

7. Tropical Deforestation

Summary

Tropical deforestation currently accounts for around a fifth of global carbon dioxide emissions. Avoided deforestation is considered relatively inexpensive per tonne of carbon saved compared to other approaches, but is currently excluded from financing under the Kyoto Protocol Clean Development Mechanism (CDM). Most PES schemes focus upon particular ES rather forests per sae, although some notable examples of forest-based PES schemes exist in Costa Rica and some other countries. While too early for comprehensive evaluation, as yet there is little evidence that national schemes have significantly reduced deforestation.

Discussion

Deforestation in the tropics is currently estimated at around 5%-10% a decade. By the middle of this century little may remain of tropical forests.[1]

Like forests themselves, drivers of deforestation are diverse. Deforestation occurs where returns to those involved are higher than when forest cover is retained. Significant factors can include population pressure, poorly defined or enforced harvesting rights, increased timber or agricultural prices, improved road access and lower transportation costs.[2]

PES can provide incentives for forest conservation where the value of the ecosystem services provided by forests is greater than the value of agriculture or other uses on conversion. Schemes can work with community property rights and do not require private ownership. They require these rights to be well defined and enforced. However, this is often not the case, especially in regions at or beyond agricultural frontiers.[3]

Tropical deforestation currently accounts for around a fifth of global carbon dioxide emissions. Avoiding deforestation is generally relatively inexpensive per tonne of carbon saved compared to alternative ways of reducing emissions. According to the Stern Review, direct yields from converting forests to farming (including timber revenues), are equivalent to less than $\$1/tCO_2$ in many areas and usually well below $\$5/tCO_2$. Opportunity costs in terms of national income foregone (including domestic value added and export tariffs) would be higher, and costs could range up to around $\$30/tCO_2$ in some areas were tropical deforestation to be avoided altogether.[4]

Although increasing over time, it is estimated that the opportunity cost of forest protection (in terms of alternative opportunities foregone) in the 8 countries responsible for 70% of these emissions is currently around $5bn a year. This

includes net income from timber sales, opportunity costs of agricultural production (the difference in returns between agricultural production and retaining forest cover), administration and enforcement costs, and some transitional costs.[5]

Excluded from financing under the CDM (only afforestation and reforestation projects are allowed), international financing opportunities to reduce tropical deforestation are currently limited. A Biocarbon Fund was established in 2004 with the aim of cost-effective emission reductions, promoting biodiversity conservation and poverty alleviation with an initial endowment of US$54m as a public-private initiative to pilot projects sequestering or retaining carbon in forests and agricultural land.[6] Proposals to establish a Forest Carbon Partnership Facility under the auspices of the World Bank to pay for emissions reductions are also currently under consideration.

Incorporating avoided deforestation into international climate agreements could enable far more ambitious global emission reductions to be met.[7] Several proposals have recently been made either for its inclusion, or for introduction of a parallel mechanism. These include a proposal by Papua New Ginea and Costa Rica to include voluntary commitments on avoided deforestation as part of future commitments under the Kyoto Protocol or UN Framework Convention on Climate Change, and a proposal by Brazil for a separate mechanism providing incentives to reduce these emissions.[8]

Some official development assistance for reducing tropical deforestation is available, including £50m allocated in the 2007 UK budget to support 10 Congo Forest countries as part of the new Environmental Transformation Fund, but there has been a marked decline in the global total going to forestry. Official development assistance for forest and biodiversity conservation was halved during the 1990s from around US$2bn - $2.2bn at the beginning of the decade,[9] although the UN Forum on Forests agreed in 2006 to mobilise significant new finance to reverse the decline in assistance for sustainable forest management.[10]

Limited funding for avoided deforestation projects is available through voluntary carbon markets. A recent global survey of carbon offset providers indicated that it accounts for around 3% of 'over-the-counter' transactions worldwide (excluding those on the CCX), with projects located predominantly in South America. [11]

As elsewhere, most PES schemes in developing countries focus upon particular ES rather forests per sae. Nonetheless, a few notable examples of forest-based PES schemes exist, such as in Costa Rica and Mexico.

Box 7.1 Case Study: *The PES scheme in Costa Rica*

Costa Rica is the first developing country to establish a large scale PES scheme. Forest Law No. 7575 of 1996 established the Fondo Nacional de Financiamento Forestal (FONAFIFO),[12] and provided a basis for small and medium-sized landowners to be paid for GHG mitigation, hydrological services, biodiversity conservation, and visual amenity.

The Pagos por Servicios Ambientales (PSA) scheme allows landowners to apply for fixed payments per hectare for sustainable forest management and reforestation activities. In return for payments, a legal easement is established preventing land development, with rights to the ES transferred to the government for the period of the agreement.[13] The scheme is financed primarily by a fossil fuel sales tax (which provides around $10m a year), and partly by other ES users and development assistance, including a World Bank loan and grants from the Global Environment Facility (GEF).[14] Contracts (typically for 5 years) with hydropower companies, public water suppliers, irrigation users, hotels, and companies bottling water were negotiated by FONAFIFO to pay for hydrological services provided by upstream forest owners. Developing a Certifiable Tradable Offset (CTO) relating mainly to avoided deforestation and representing a net 1tC reduction in emissions, FONAFIFO sold 200,000 CTOs to the Norwegian Government and a group of Norwegian power producers for US$2m in 1996.[15] It has also agreed to sell around 0.6mtCO_2e by 2017 to the Biocarbon Fund, and aims to generate $1m a year from sales by 2012. While payments from national users of landscape and of biodiversity ES have proved difficult to negotiate, with assistance from a GEF grant, a Biodiversity Conservation Trust Fund has been established to help provide long-term funding for conservation of high priority areas lacking the potential for carbon or water financing. (These cover an estimated 0.9m ha out of the total of 1.4m ha).[16]

Around 10% of the country's forested area is currently covered by the scheme. Although nationally over-subscribed, finding sufficient applicants to disburse funds collected from water users has been problematic in some watersheds.[17] In administrating the scheme, FONAFIFO's costs are capped at 7% of its budget, estimated at an average of US$3 per ha for the 250,000 ha under contract in 2005.[18] Charges by local intermediaries to assist applicants, including technical assistance and monitoring services, can account for 12%-18% of the total value of payments.[19]

Introduction of a revised water tariff in 2005, including fees earmarked for watershed conservation, marked a shift away from payments under voluntary agreements to mandatory payments. This is expected to increase annual funding ten-fold from US$0.5m under existing voluntary agreements to around US$5m. Payments to FONAFIFO under user agreements can be deducted from the new fees.[20]

Mexico (where 66% of its most important aquifers are categorised as over-exploited, and extraction is reportedly 190% higher on average than the replacement rate) introduced a PES scheme for forest hydrological services in 2003 along similar lines to that in Costa Rica aimed at protecting priority watersheds. Financed by water fees, landowners are paid $27 per hectare to conserve cloud forest (which cover 17,000 ha, around 3% of the total forested area, and are considered to have a particularly strong influence on water quantity), and $18 per ha for other forest types. Three hundred local communities signed 5-year agreements during 2003-2006, resulting in 150,000 ha of forest being covered by the scheme.[21]

Brazil adopted provisional regulation No. 2166-67 in 2001 allowing landowners to meet requirements under the 1965 Forest Code for a minimum percentage of landholdings to be kept forested (20% in southern states, 35% in the northern savannah, and 80% in the Amazonian forest) by a reserve on a different property. A similar arrangement within a given ecosystem had also been allowed in 1998 in the Amazonian region under provisional regulation No. 1736. (It is an additional requirement to preserving riparian woodland, forests beside lakes and ponds, on steep slopes and on hilltops). Potentially this could allow a trading system of transferable reserve obligations (or transferable development rights) to develop, permitting landowners with more than the minimum of forest cover to sell credits to others, but more effective monitoring and compliance institutions would be required. Due to higher returns from alternative activities such as timber extraction and agricultural conversion to growing soybeans, coffee, and vegetables, monitoring and enforcement difficulties, and official corruption, many do not meet the reserve requirements, with forests completely eliminated in some areas.[22] Interest in trading stems partly from its potential to reduce the compliance costs of landowners. In addition to providing incentives to conserve forests, it is thought the system could help protect and expand areas of higher biodiversity value located in remote areas.[23] (The fifth largest country in terms of land area, Brazil is also one of the richest in biodiversity, thought to have at least 10%-20% of the world's species).[24]

Following the 1998 Yangtze floods, China introduced a logging ban and forest conservation measures under the Natural Forest Protection Programme (NFPP), and initiatiated a PES scheme - the Sloping Lands Programme (SLP) - in 2000 aimed at reducing soil erosion, sedimentation and consequent flooding, and desertification. The NFPP included a logging ban until 2010 in 30m hectares of natural forest and the permanent protection of another 31m ha of forests within the Yangtze and Yellow River watersheds, and 33m ha of forests in northern China and inner Mongolia, with a US$12bn budget allocated partly to create new job opportunities for 3/4m forest enterprise employees laid off as a consequence. The SLP offers payments, seedlings and grain to farmers planting trees or grass

on steep, erosion-prone farmland, and is funded by a 350bn Yuan (US$44bn) budget over 10-years.[25]

Principal drivers of PES schemes in 'developing' countries include a mix of national supply-side factors, such as perceived cost-effectiveness in tackling policy problems, and international demand (e.g. CDM, Biocarbon, NGOs and other funding sources). Corporate social responsibility (CSR) is important in some cases, and is thought to generally be more important in the case of some multinational companies than for domestic ones, but is generally considered less important than actual or expected regulation. (E.g. in the case of American Electric Power, planting 15m trees to sequester 1mtC over 40 years in Brazil under the Department of Energy's Climate Challenge Program was reportedly due to building up credits prior to US regulation being introduced).[26] At project level some initiatives raise finance through more than one scheme (e.g. the Mantadia-Zahamena Corridor Restoration and Protection project in Madagascar which aims to establish forest corridors for biodiversity benefits, as well as reducing deforestation, protecting watersheds and improving soil fertility).[27]

Most of the PES schemes are too recent for definitive judgement to be made. However, preliminary evaluations have been undertaken in some cases.

Box 7.2 Case Study: *Impacts of PES in Costa Rica*

The aim of the PSA scheme was reportedly recognition of the ES provided by forests, rather than avoiding deforestation per sae.[28] However, it is also widely credited with helping halt and reverse deforestation. Forest cover is reported to have increased from 25% at the end of the 1980s to 40% by 1997, and 46% in 2002,[29] and deforestation to have fallen since the introduction of the scheme.

It is difficult to separate out the impact of the scheme from other policy changes, such as a prohibition on clearing forests also included in Forest Law No. 7575, and factors such as falling profitability in livestock rearing, favourable to forest preservation. One difficulty is that introduction of the scheme was reportedly a quid pro quo for a ban on clearing forests.[30]

Findings of empirical studies are mixed, with use of different methods, study areas and periods making comparisons difficult.[31] Some studies suggest the scheme has been effective in reducing deforestation. For example, econometric estimates based upon data from the Cordillera Volcanica Central Conservation area suggest that primary forest cover was 10% higher in 2005, and propensity score-matching results based upon 1997-2000 data from Sarapiqui indicate that the scheme protected mature native forest.[32] Other studies have reported little or no impact. A recent study reports that deforestation rates were not significantly lower in 1997-2000 in areas receiving payments than in other areas, suggesting the scheme had no direct role in reducing deforestation during that period.[33] Some studies suggest that many participants would have protected their forests anyway in the absence of payments.[34]

The Costa Rican government argues that the scheme has had widespread benefits. These include income generation for the rural poor, improvement of watersheds, carbon sequestration, biodiversity conservation, and improved health and infrastructure.[35]

In most cases watershed ES are not monitored directly. (The Upper Virilla is an exception, however, with monitoring showing water quality improvements since 2001).[36] The fact that both the 5-year voluntary agreements with the private hydropower companies under the scheme were renewed for a further 10 years (and that they were renewed prior to the new water tariff being introduced), suggests that payments for hydrological services have been working well in these cases.[37]

In Mexico only a tenth of funds in 2004 went to the fifth of areas at highest risk, while half went to areas of low or very low risk that would probably have been conserved anyway, suggesting that the scheme has been fairly ineffective in preventing deforestation.[38] Achieving watershed protection was reportedly hampered by funding being spread regionally, with only 10% of funds in 2004

spent in areas with over-depleted aquifers, and at least 85% in areas where aquifers were not over-exploited.[39]

In China the combination of measures adopted under the Natural Forest Protection Programme and under the Sloping Lands Programme led to rapid expansion of forest cover, with the SLP resulting in 7.2m hectares of sloping farmland and 8m ha of barren hills being planted with trees in the period 1999-2003. However, in some areas poor soils, provision of low quality seedlings and lack of subsequent management resulted in many trees dying soon after planting (e.g. in Qingjian County only about 100 of the 400,000 trees planted survived), while lack of enforcement allowed farming to continue, or subsequent reconversion of the land to agriculture.[40] Evidence suggests that the SLP led to significant reductions in sedimentation in some areas (e.g. silt run off in Tianquan County was estimated to be a fifth lower on converted lands than comparable unconverted farmland).[41] (With an estimated 1.3bn tons of sediment from sloping farmlands being deposited annually in the Yangtze and Yellow rivers up to 1998, this was viewed as a major cause of the floods).[42] Successes in reducing deforestation domestically (associated mainly with measures under the NFF) led to China importing more timber and wood products, which may have displaced some logging to countries such as Indonesia, Gabon and Myanmar where tropical deforestation rates are high and environmental governance weak.[43]

Little information is generally available on the impact of PES schemes on low income groups,[44] which can vary due to wider effects on labour and other markets.[45] To the extent that they supplement, diversify or stabilise their incomes, or improve the quality of ES services they receive, PES schemes can have beneficial effects. However, to the extent that the poor are not resource owners, do not have recognised property rights, cannot afford transactions costs of accessing schemes, lose access rights,[46] or face higher service charges, PES may further marginalise and impoverish the poor. A recent study of two communities involved in a forestry carbon sequestration project in Mexico, for example, argues that exclusion of the poorest farmers and women from design and implementation of the project contributed to reinforcing existing power structures, inequities and vulnerabilities.[47] Schemes that involve privatisation may restrict access to ES to those who cannot afford to pay,[48] and concerns have also been expressed about the potential role of PES in depriving communities of legitimate land-development aspirations, as well as in undermining traditional conservation values.[49]

Schemes can be designed to reduce poverty, but trade-offs generally exist between poverty reduction, environmental goals and cost-effectiveness (e.g. regions with high deforestation rates may be areas of relative prosperity).[50] Technical efficiency of PES schemes may require directing payments to particular areas, such as with the most threatened ecosystems, which may not accord with poverty reduction goals or be politically acceptable.[51] In Mexico the PES programme was targeted at peasant communities in the poorest rural

areas,[52] with payments being made to communities rather than individuals, but this is argued to have reduced the environmental benefits of the scheme. In Costa Rica a GEF-funded project to increase participation of poor farmers, women and indigenous populations led to a twenty-fold increase in women landowners and a tenfold increase in indigenous community-owned land covered by the PES scheme over the period 2000-2006, although smaller landowners reportedly found accessing the programme difficult.[53] Several NGOs work closely with local communities, explicitly incorporating impacts on the poor or on livelihoods in the design of projects involving PES.[54]

Conclusions

It is too early to evaluate the performance and sustainability of such PES schemes. Experience to date is too limited.

The view of US stakeholders in this arena is that PES can make an important contribution to tackling deforestation if property rights are well defined and if income from alternative uses is relatively low. There is evidence at local level of individual projects successfully raising funding for tropical forest conservation through various PES mechanisms, such as payments from international sources for carbon or biodiversity benefits. However, little evidence appears to exist to demonstrate the effectiveness of national level PES schemes, and this holds also in the case of Costa Rica, which has the best known forestry PES scheme.

[1] See: Chomitz et al (2007) and http://siteresources.worldbank.org/INTRES/Resources/469232-1127252519956/Note_9_Deforestation_06.16.05.pdf.
[2] Chomitz et al (2007).
[3] Chomitz et al (2007).

[4] See: Stern (2006, p.540), Grieg-Gran (2006) and Sohngen (2006).
[5] Stern (2006, p.537).
[6] See: http://carbonfinance.org/Router.cfm?Page=BioCF&ItemID=9708&FID=9708.
[7] Chomitz et al (2007).
[8] See: Stern (2006, p548 and p.551).
[9] Khare et al (2005).
[10] UNFF (2007).
[11] See: Hamilton et al (2007).
[12] See: http://fonafifo.com/english.html.
[13] On the different rates that apply see: Pagiola (2006) and Sánchez-Azofeifa et al. (2007).
[14] Pagiola (2006).
[15] See: OCIC (1999) and Pagiola (2006).
[16] Pagiola (2006).
[17] Pagiola (2006).
[18] Grieg-Gran (2006).
[19] Miranda et al. (2003).
[20] Pagiola (2006).
[21] See: Alix-Garcia et al. (2005), Chomitz et al (2005) and http://assets.panda.org/downloads/pesnewsletter19.pdf.
[22] Chomitz (2004).
[23] See: Chomitz et al (2005).
[24] Bernades (undated).
[25] See: Chomitz et al (2005) and Chunquan et al (2004).
[26] Yowell and Ferrell (2005).
[27] Vitale (2006).
[28] Pagiola (2006).
[29] FONAFIFO estimates cited by Miranda et al (2003).
[30] Pagiola (2006).
[31] Pagiola (2006).
[32] Results from Tattenbach et al. (2006) and from Sills et al. (2006) cited by Pagiola (2006).
[33] Sánchez-Azofeifa et al. (2007).
[34] Pagiola (2006) cites survey results from Ortez et al. (2003) and Miranda et al. (2003).
[35] See: http://www.imfn.net/uploads/user-S/11326014971Minister_intro_to_PES.pdf.
[36] Miranda et a. (2003).
[37] Pagiola (2006).
[38] Alix-Garcia et al. (2005, Table 10, p.37).
[39] Alix-Garcia et al. (2005, Table 7, p.35).
[40] Sun and Liqiao (2006).
[41] Sun and Liqiao (2006).
[42] Chomitz et al (2005).
[43] See: Chunquan et al (2004, Fig 3.2, p.31, and Fig 3.3, p.32).
[44] Landell-Mills and Porras (2002).
[45] Zilberman et al. (2006).
[46] E.g. see: Smith (2007).
[47] Corbera et al (2007).
[48] Lovera (2005).
[49] See: Wunder (2007) and Corbera et al (2007).
[50] See: Zilberman et al. (2006), http://assets.panda.org/downloads/pesnewsletter19.pdf.
[51] Chomitz et al (2005).
[52] Eijodos. (See: http://assets.panda.org/downloads/pesnewsletter19.pdf).
[53] See: http://www-wds.worldbank.org/servlet/WDSContentServer/IW3P/IB/2007/03/21/000020953_20070321110303/Rendered/PDF/ICR433.pdf.
[54] E.g. Environmental Defense and Conservation International.

8. Conclusions and Recommendations

Conclusions

Evidence from the US suggests that, well designed and implemented, PES schemes have considerable potential to help protect ecosystems. Mitigation banking provides an innovative method of helping compensate for environmental impacts and is considered more successful than the other options tried in conserving wetlands. Experience of water trading and other cap-and-trade schemes suggests such programmes can offer flexible and efficient mechanisms to reach environmental goals, providing monitoring, enforcement and other transactions costs are not too high.

The findings demonstrate the importance of regulation as a driver of many PES schemes. Mitigation banking, for example, is driven principally by requirements under the Clean Water Act and Endangered Species Act, and much of the activity in the voluntary carbon markets is thought to be driven by the expectation of regulation in this field. Similarly, PES schemes in countries such as Costa Rica and Mexico are driven primarily by national regulation.

In the absence of regulation, there has been a rapid expansion of voluntary carbon markets in the US. Inclusion of forestry offsets in these markets raises questions about the role of the Forest Service and potential conflicts of interest. Similar issues may be expected to arise in the UK context.

Regulation-driven PES schemes can have significant distributional impacts. It is thought that a national carbon trading scheme in the US, for example, could lead to the creation and allocation of rights valued at over $100bn. PES schemes may be most effective when targeted to those who would otherwise destroy ecosystems, rather than rewarding existing good practice, and trade-offs often exist between pursuing environmental objectives and poverty reduction goals.

Although too early to judge their performance in most cases, as yet there is little evidence to demonstrate that, by themselves, national level PES schemes introduced have significantly reduced tropical deforestation. (This may be less true at micro-level of individual projects). In both Costa Rica and China increased forest cover and reduced deforestation were associated with a combination of a PES scheme with more traditional measures (logging bans).

Schemes to avoid tropical deforestation appear to have much potential, but can also face significant hurdles in terms of institutional and governance issues. Well defined and enforced property rights are essential for PES schemes to operate, but need not involve private property.

Problems of international leakage may also be significant. The example of China suggests that reduced deforestation in one country may lead to an increase in others.

Recommendations

Further research and policy analysis is needed in considering the potential introduction of PES mechanisms in the UK. This is recommended to include assessing the feasibility of using PES schemes to meet regulations such as the Water Framework Directive, exploring the potential role of forestry in these schemes, and examining the design (e.g. robustness and distributional implications) of potential mechanisms.

Most existing schemes take a piecemeal approach that does not value all the services provided by an ecosystem. Further research could usefully be undertaken on the potential for 'bundling' multiple services within a single scheme.

Research is also needed to help reduce current scientific uncertainties, develop more robust methods to quantify ecosystem services, and establish baselines. Quantifying the additional benefits provided by PES schemes ('additionality') is of key importance in evaluating their performance.

Collaboration and co-ordination should be sought with other stakeholders (including government departments, environmental regulators and interest groups). Developments in PES elsewhere should be monitored to inform this process. A more joined-up approach among potential stakeholders will help to develop policy mechanisms that gain wide support and maximise effectiveness.

Appendix I: Global Estimates

In their seminal paper on valuing the world's ecosystem services, Costanza et al (1997) provide rough estimates of the total annual value of ES provided by forests based upon reviewing the literature for 17 major categories, with non-renewable ES (fuels and minerals) and the atmosphere excluded. The estimates, summarised in Table 2, suggest that temperate / boreal forests give rise to total annual ES of US $1.2 trillion. (No values are given for some ecosystem services, such as water supply and habitat/refugia, suggesting this is likely to be an under-estimate). The value estimated for all forests is US $6.5 trillion a year at 2006 prices.[1]

Table 3: Estimated Value of Forest Ecosystem Services (at 2006 prices)

Ecosystem Service	Value per ha per yr (US $)		Total annual Value (US $10^9)		% of the estimated total for all biomes	
	Temperate/boreal	All Forests	Temperate/boreal	All Forests	Temperate/boreal	All Forests
Gas regulation						
Climate regulation	121	194	358	944	38.0	100
Disturbance regulation		3		13		0.5
Water regulation		3		13		0.9
Water supply		4		20		0.9
Erosion control		132		642		80.9
Soil formation	14	14	41	67	55.8	91.6
Nutrient cycling		498		2416		10.3
Waste treatment	120	120	354	582	11.3	18.6
Pollination						
Biological control	6	3	16	13	2.8	2.3
Habitat / refugia						
Food production	69	59	204	288	10.7	15.1
Raw materials	34	190	102	923	10.2	92.9
Genetic resources		22		107		98.3
Recreation	50	91	147	442	13.1	39.3
Cultural	3	3	8	13	0.2	0.3
Total	416	1336	1230	6484	2.7	14.1

Source: Costanza et al (1997, Table 2, p.256).[2]

The estimates for total annual ES provided by temperate / boreal forests and by all forests represent 7% and 38%, respectively, of the total for all terrestrial biomes. While forests were estimated to provide over 90% of the global value of renewable raw materials (see Table below), this represented only a fraction of the total value of ES provided by forests (8% for temperate / boreal forests and 14% for all forests). Raw materials and food together accounted for less than a quarter of the total value of ES provided (representing just under 25% of the total for temperate / boreal forests and 19% of the total for all forests).

While exact figures are not available, rough recent estimates of the total volume of transactions and associated annual growth rates for carbon, water and biodiversity PES schemes worldwide are given in Table 2 below. These suggest that the annual global volume of transactions in each case amount to billions of US dollars,[3] with annual growth rates typically in double digits.

Table 4: Annual Value of Transactions in PES systems worldwide

PES Driver	Type / Sector	Current global volume of transactions (US $ million)			Current annual growth rate in global volume of transactions		
		Carbon	Water	Biodiversity	Carbon	Water	Biodiversity
Regulation (cap & trade)	Forestry (E.g. Kyoto, LULUCF).	100			10%		
Regulation (cap & trade)	Carbon trading (Project-based reductions)	1000			70%		
Regulation (cap & trade)	Species Offsets (US alone)			45			10%
Regulation (cap & trade)	Water quality trading (excl. developing countries)		7			5%	
Regulation	Ecosystem Offsets (incl. Wetlands and streams).			1000			20%
Government	Conservation payments & biodiversity offsets[4]			3000			30%
Government	Water-related ecosystem services		1000			10%	
Government -mediated	Water trading (payment for ecosystem good)		2000			20%	
Philanthropy / Tax	Land trusts & conservation easements (US alone)			6000			5%
Private sector (incl. private element of public schemes)	Watershed management		5			10%	
Voluntary	Forestry	15			10%		
Voluntary		150			30%		
Voluntary	Conservation payments & biodiversity offsets			20			25%
Voluntary	Bioprospecting			30			5%

Source: rough estimates provided by Ecosystem Marketplace (Ricardo Bayon).

[1] Where a trillion is defined as a million million (c.f. a UK billion).
[2] values have been reflated by multiplying by the RPI (all items) for 2006 Q3 and dividing by that for 1994 Q3 from http://www.statistics.gov.uk/ [series: CHAW].
[3] Where a billion is defined as a thousand million (i.e. following usage in the US).
[4] flora & fauna alone (excluding water and soil conservation).

Appendix II: Other US cap-and-trade schemes: the acid rain programme

Regulation of sulphur dioxide (SO_2) under the 1990 Clean Air Act commits the US to reducing emissions to 10 million tons below 1980 levels by 2010. Seasonal regulation of nitrogen oxides (NO_x) also exists in many states.

Aimed at reducing ground-level ozone levels (smog), large-scale emitters (power plants) are required to reduce their SO_2 emissions by about 50% from 1980 levels,[1] and have been issued with a 30-year stream of tradable allowances based upon their historical emissions. They are allowed to bank unused allowances for future use, or sell them to others.

SO_2 emissions are reported to have fallen nationally from 17.3mt in 1980 to 10.6mt in 2001. NO_x emissions have dropped in North-east states to 60% below 1990 levels.[2]

[1] See: CCX (2004, Fig 1, p.6).
[2] World Bank (2004), http://www.epa.gov/airmarkets/progsregs/arp/basic.html and http://www.epa.gov/airmarkets/progsregs/arp/docs/clearingtheair.pdf.

Appendix III: Itinerary

May 21-25, 2007 | Washington, D.C.

Monday, May 21

10am-12pm Rob Doudrick (National Ecosystem Services Coordinator)
Beth Egan and Trey Schillie (Ecosystem Services)
Jerilyn Levi and Chris Farley (International Programs)
Linda Langner (Resource Valuations & Use Research)
Ed Gee (Woody Biomass Utilization Team)
Karen Solari and Becca Madsen (State & Private Forestry)
Josh Trapani (Policy Analysis)
US Forest Service, Yates Building, 1400 Independence Ave., SW

1pm-2:30pm Morgan Robertson (Wetlands Division)
US EPA, EPA West Building, 1301 Constitution Ave NW entrance

3.30pm-4pm Michael Jenkins, Kate Hamilton, Ricardo Bayon (Video Conference)
Forest Trends, 1050 Potomac Street, NW

Tuesday, May 22

9am-10am Tom Boggus, Associate Director, Texas Forest Service
'marketing Ecosystem Services in Texas'
(Valuing Ecosystem Services Seminar, **US Forest Service**)

10am-12pm Bob Rose (Policy Analyst, Office of Water)
Ginny Kibler (Water Quality Trading)
Kavya Kasturi (Water Quality Trading)
Andrew Manale (National Center for Environmental Economics)
Gregg Serenbetz (Wetlands Division)
Kim Klunich (Climate Change Division)
Kathy Hurld (Water Quality)
Morgan Robertson (Wetlands Division)
US EPA Office of Water, Policy Office, 1200 Pennsylvania Avenue, N.W.

1pm-2pm George Kelly
Environmental Banc & Exchange, LLC

2pm-3pm Carl Lucero
US Department of Agriculture **Natural Resources Conservation Service**

3pm-4.30pm Jon Soderberg, **U.S. Corps of Engineers**
David Stout, **US Fish & Wildlife Service**

4.30pm-5pm Mira Inbar (Biodiversity offsets)
Forest Trends

Wednesday, May 23

10am-11am Robert Bonnie, Michael Bean
Environmental Defense, 1875 Connecticut Avenue, NW

1pm-2.30pm Sandra Brown (Senior Scientist)
Winrock International, 1621 N. Kent Street, Suite 1200, Arlington, VA

3pm-3.45pm Kate Hamilton (Voluntary carbon markets)
Ecosystem Marketplace

Thursday, May 24

11am-12.30pm Stefano Pagiola (Senior Environmental Economist)
World Bank, 1818 H St. NW 18th St./Pennsylvania Ave.

3pm-4pm Sarah Davidson (Macroeconomics for Sustainable Development)
Sarah Lynch (Director, Agricultural Markets)
Melissa Moye (Director, Center for Conservation Finance)
Owen Cylke (Sustainable financing & PES)
WWF US 1250 24th St. NW

5pm-5:45pm Ken Chomitz (Senior Advisor, Independent Evaluation Group)
World Bank 1818 H St. NW

Friday, May 25

10-11:30am Ben Vitale
Conservation International 2011 Crystal Drive, 5th floor, Arlington, VA

12.30-1.30pm C.T. "Kip" Howlett
National Association of State Foresters

3pm-4.30pm Dallas Burtraw (Senior Fellow)
Juha Siikäki (Fellow)
Allen Blackman (Senior Fellow)
Resources for the Future1616 P St. NW

May 28-30, 2007 | San Francisco, CA

Monday, May 28

Visit to Muir Woods (US public holiday)

Tuesday, May 29

9am-10am Bernie Weingardt (Regional Forester)
Mark Nechodom (Sierra Nevada Research Center)
US Forest Service

10:30-11.30am Craig Denisoff (Vice President)
Westervelt

12:30pm-4pm Steve Morgan (Chairman & CEO, **Wildlands Inc**)
Ken Sanchez (Endangered Species Prog., **US Fish & Wildlife Service**)
Wildlands Inc 3855 Atherton Road, Rocklin & site visit

6-7pm Ricardo Bayon
Ecosystem Marketplace

Wednesday, May 30

10-11am Adam Davis
Ecosystem Investment Partners San Rafael

1pm-2.30pm Jan Hamrin (President)
Cathleen Fogel (Climate Change)
Lars Kvale (Measurement & Verification services)
Center for Resource Solutions Presidio Building 97, San Francisco

3:00-4.45pm Laurie Wayburn (President)
Michelle Passero (Director, Policy Initiatives)
Emily Russell-Roy (Policy Associate)
Pacific Forest Trust The Presidio, 1001-A O'Reilly Ave, San Francisco

May 31, 2007 | Portland, OR

Thursday, May 31

8am-9:30am Bettina von Hagen (Vice President, **Ecotrust**)
Mike Burrnet (Excecutive Director, **The Climate Trust**)
Jean Vollum Natural Capital Center, Suite 200, 721 NW Ninth Avenue

10.30am-2pm Bobby Cochran (**Clean Water Services & Willamette Partnership**)
Sara Vickerman (**Defenders of Wildlife & Willamette Partnership**)
Gina Larocco (Defenders of Wildlife & Willamette Partnership)
Kevin Halsey (**Parametrix**)
Kenna Halsey (Parametrix)
Hillsboro & site visit

2:30-3:30pm Bob Deal
US Forest Service 620 SW Main St, Suite 400

4pm-5pm Marvin Brown (State Forester)
Peter Daugherty (Program Director)
Oregon Department of Forestry

Appendix IV: Indicative questionnaire

Name of PES scheme:

A) Coverage
Ecosystem Service(s) covered (in case of C specify any other GHGs)[1]:
Geographical coverage:
Date of introduction:
Time period covered:
Sector(s) covered:
Size of firm covered:
Is participation voluntary or mandatory?

B) Underlying Rationale
Rationale for setting up the scheme
What does the scheme hope to achieve?

C) Involvement
Organisation(s) involved in establishing the scheme
How have you been involved in the scheme?

D) Implementation:
Methodology for measuring Ecosystem Service(s) covered (e.g. inclusion of soil carbon, roots, foliage, carbon accounting method used):
How is the baseline (change in ecosystem service provided) measured?
How is 'additionality' measured (difference with and without scheme)?
How is 'fungibility' handled (what services are comparable)
How is 'permanence' (time-frame for delivery of service) handled?
How is potential 'leakage' (shifting activities within US or abroad) addressed?
Are there incentives for continued improvements in the long-term?
Are 'co-benefits' taken into consideration and, if so, how ('bundling' / trade-offs)?
Organisation(s) responsible for monitoring:
Cost of monitoring (e.g. average per ha of land or forest)?
Were new property rights defined or existing rights strengthened?
How is system administered?
Organisation(s) responsible for administration (incl registration & certification of transactions):
Cost of administration (e.g. average per ha of land or per transaction)?
How is system enforced?
Organisation(s) responsible for enforcement:
Cost of enforcement (e.g. average per ha of land or forest)?
Cost of initially setting up scheme
Costs borne by landowners (e.g. average per ha of land or per transaction)
Costs borne by public agencies (e.g. average per ha of land)
How are failures to meet promised objectives (e.g due to natural hazards such as fire, or land use change) handled (e.g. insurance schemes)?
Are there significant overlaps with other measures (e.g. certification/licensing)?
Main problems that have arisen/ are anticipated?
Main directions for future development (e.g. potential links to schemes in other countries)?

E) Role of Forestry
Is the forestry sector involved in the scheme?
If so, is it treated any differently from other players?
If not, is it likely to be included in the future? Has it been explored?
Have their been any issues about including it in the scheme?
How important do you perceive the role of forestry in achieving the aims of the PES?
Main directions for potential future development (e.g. inclusion of reduction in deforestation rate)?

F) Performance
What mechanisms are in place to assess the environmental performance of the scheme?
How does environmental performance compare to other schemes (e.g. for existing schemes, has an evaluation been undertaken)?
To what extent are environmental benefits 'additional' and not explicitly offset by disbenefits elsewhere (e.g. carbon sequestration by GHG emissions by other sectors under carbon trading rules)?
How is cost-effectiveness (e.g. environmental performance per $ spent on administration, monitoring and enforcement) assessed?
What evidence is there that scheme is (or will be) cost-effective compared to alternatives?
Are there intangible (non-monetary) benefits/disbenefits?
'Distributional' impacts occurred/anticipated (e.g. benefits only large land owners / small firms disadvantaged due to high transaction costs)?
Unexpected/unintended consequences (e.g. increased land prices, unforeseen shifts in land use)?

G) Perceptions
Do you feel that the monitoring mechanisms used adequately capture the performance of the scheme?
In your experience is this scheme an adequate way to protect the environment?
Is it sustainable?
How do you think it compares to other tools for protecting the environment (e.g. forest certification schemes)?
How is the industry responding to the scheme?
How do the purchasers of ecosystem services view the scheme (what do they get & why do they buy)?
What criticisms (from NGOs or others) have been made of the scheme?

I) Potential
Have you done any work to assess the potential of expanding the PES across a wider range of services?
Do you think it is feasible?
Are you concerned that there are overlaps with this scheme and others for similar services?

[1] methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6)

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