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Payments for Ecosystem Services
Literature Review

A review of lessons learned,
and a framework for assessing PES feasibility

By: BioClimate Research and Development

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1. Introduction

This document presents a review of selected literature to date on payments for ecosystem services (PES) schemes. Payments for ecosystem services (PES) are, as the name implies, payments made to compensate and incentivise individuals or groups engaged in activities that support the provision of ecosystem services. PES is a mechanism that has gained increasing interest and recognition over the past decade or so, and is emerging as a central tenet of "contractual conservation" (Wunder, 2008).

PES is not a new concept however; PES schemes have existed in some form or another since the 1880s (Haapoja, 2004), but have gained increasing attention over the past decade as its strengths as a conservation tool have become better understood and recognised, and necessary pre-conditions for and characteristics of effective PES schemes have been drawn out of targeted reviews and case studies.

This study firstly distils these key pre-conditions and considerations for developing a PES scheme from available literature, and secondly uses these conditions and considerations to develop a framework for assessing opportunities and feasibility of implementing a PES scheme in a given context.

The objectives of the review can be summarised as follows:

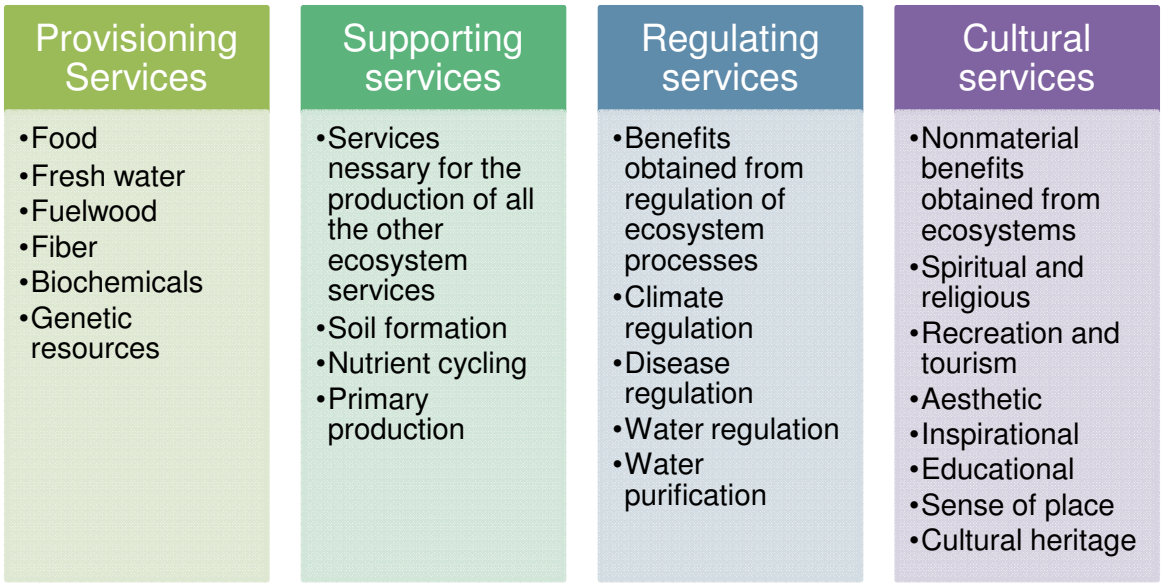
1. To define and describe the payments for ecosystem services concept and rationale;
2. To identify key elements and characteristics of a PES scheme and how these can and have varied in PES schemes to date;
3. To identify, with reference to case studies and other review literature, the key attributes and requirements in terms of baseline conditions and design features necessary to implement and operate a sustainable PES scheme, and;
4. To develop and present a framework for assessing opportunities for PES and PES scheme feasibility in a given context.

1.1 What are Ecosystem Services and why do we need to pay for them?

Ecosystem services are, in broad terms, the benefits that people derive from ecosystems. Some definitions of ecosystem services are more restrictive than others, limiting the definition to those services provided by natural and semi-natural habitats or 'wild nature' (e.g. Cowling et al, 2007). This definition excludes services derived from more managed or 'man-made' land-use systems and exclude provisioning services derived from agriculture and aquaculture. Other definitions are wider and encapsulate all services provided by all ecosystems, including food and timber (EC, 2008). This wider definition is adopted by the Millennium Ecosystem Assessment (MEA, 2005), which represents a leading authority on the definition of ecosystem services. The MEA purported to analyse ecosystems "*through the lens of the services they provide to society, how these services in turn benefit humanity, and how human actions alter ecosystems and the services they provide*" (Carpener et al, 2009).

The MEA categorised ecosystem services into four types: provisioning, supporting, regulating, and cultural (see figure 1 below), depending on the nature of the service and benefit derived by society.

Figure 1: Ecosystem services as defined by Millennium Ecosystems Assessment (2005)



Many of these important ecosystem services are systematically under-valued. They are not captured by existing price signals and are therefore likely to be under-valued and not considered fully, or even at all, in decision-making processes regarding land-use and management. Existing price signals may capture the full or partial value of some ecosystem services, particularly provisioning services such as food or fuel (TEEB, 2009), where there are 'direct use values' associated with the services. Services where the value is less direct and perceptible, however, are unlikely to be captured by price signals, leading to their loss or under-supply. Land-users that have a direct influence over the provision of the ecosystem service, e.g. rural farmers, often have no reason to value the service themselves, and in addition may not appreciate the impact of their land-use choices on the provision of the service.

This can lead to what is called an 'externality': an impact (normally negative in this sense) of an activity on an unrelated third party, such as a downstream user of water, or global society at large in the case of large-scale deforestation. Consider a land owner in Brazil, for example, who chooses to clear forest for cattle-grazing. He is unlikely, in the absence of incentives or requirements, to take into account the potential climate change impacts on a farmer in Africa or community in Bangladesh. PES schemes attempt to address this problem by compensating landowners and land managers for the ecosystem services they provide, or incentivising them to provide extra ecosystem services, thus 'internalising' the externality. The need for schemes that compensate providers of ecosystem services also stems from the fact that the beneficiaries of ecosystem services are often located some distance away from the locus of the generation of the service. They do not have control over or responsibility for the delivery of the service, yet freely 'consume' or benefit from the service.

Not all of the ecosystem services listed in the Millennium Ecosystem Assessment will be appropriate for a PES scheme (Jindal et al, 2007). Ecosystem services that are appropriate for PES are, firstly, those that are under-valued or not valued which threatens their supply. In addition, PES schemes must be able to attract a stable funding source. In order to be 'marketable' or attract funding to make payments possible, services must be perceived as valuable and the flow of the services needs to be apparent ('tangibility'). Classification of types of ecosystem service forming the basis of PES schemes have thus tended to converge not around the classifications of the MEA, which focus on the specific nature of the service

(provisioning, supporting etc), but around the unit or commodity that is measured and has successfully formed the basis of a payment scheme, such as biodiversity conservation or carbon service provision. PES schemes tend to target those services provided by terrestrial forest ecosystems, although other terrestrial ecosystem types (e.g. wetlands), and non-terrestrial ecosystem types can also provide important ecosystem services and may form the basis of PES schemes. **The ecosystem services that are most commonly delivered through PES schemes are carbon sequestration and storage, biodiversity conservation, watersheds and landscape beauty.** These services are further described in the sections below.

PES schemes are becoming increasingly popular as traditional 'command and control' (i.e. regulatory) or donor funded conservation approaches are often found to be imperfect and expensive (Richards and Jenkins, 2007), difficult to enforce or have only temporary effects (Pagiola 2002), potentially socially disruptive (Sanchirico and Siikamaki, 2007) and as overseas development assistance for forestry has decreased (Richards and Jenkins, 2007).

Payments for 'Ecosystem Services' or 'Environmental Services'?

It is worth noting that the terms payments for ecosystem services, and payments for environmental services, tend to be used inter-changeably and refer generally to the same concept. Wunder (2008) argues that PES should refer to environmental services, as some services such as the carbon sequestration services of an exotic, monoculture tree plantation, are specific rather than systemic i.e. they do not rely on a functioning ecosystem. This argument is potentially controversial, as biodiversity is arguably a necessary underpinning requirement for the delivery of all ecosystem services, including climate regulation. This discussion falls out with the scope of this assessment, however, and we shall proceed using the term "ecosystem services" and assume that in literature the terms are used to refer to the same concept.

1.1.1 Carbon sequestration and storage

Activities that mitigate (reduce) carbon emissions or increase carbon sinks (through carbon sequestration) and are considered to have a positive impact on climate regulation. PES for carbon services normally relate to land use, land-use change, and forestry initiatives. Preventing deforestation, decreasing the impact of logging or preventing the drainage of wetlands or peat lands are practices that mitigate emissions. Planting trees, changing agricultural tillage or cropping practices, or re-establishing grasslands increase carbon sinks by sequestering carbon (Pearson, 2005). Table 1 below lists land management systems and associated activities (Voluntary Carbon Standard, 2007) that can form the basis of PES schemes.

Table 1: Examples of land management for carbon sequestration and/or emissions reduction. Source VCS, 2007.

Land management	Activity
Improved forest management	Conversion from conventional logging to reduced impact logging Conversion of logged forests to protected areas Extending the rotation age of evenly aged managed forests Conversion of low-productive forests to productive forests
Enrichment planting	Planting commercially important timber species (preferably native species) in areas of degraded forest
Avoided deforestation	Activities which prevent deforestation and forest degradation directly or that provide income and/or resources through practices that do not threaten forest cover
Agroforestry	Planting trees that provide useful products with existing agricultural or forest areas

1.1.2 Biodiversity conservation

Biodiversity is defined by the United Nations Convention on Biological Diversity as "*the variability among living organisms from all sources, including, 'inter alia', terrestrial, marine, and other aquatic ecosystems, and the ecological complexes of which they are part: this includes diversity within species, between species and of ecosystems*".

The protection of, or provision of, biodiversity is often characterised as one of a variety of ecosystem services. Maintenance of biodiversity is, however, arguably better understood as the overarching requirement for all ecosystem services because it affects all other ecosystem services (TEEB 2009, Blignaut and Aronson 2008). Biodiversity is often a general prerequisite for healthy ecosystems which provide services.

Despite this important distinction, many PES schemes purport to target and deliver 'biodiversity services', and the funding mechanism used to support activities is aligned to objectives of biodiversity conservation. For these reasons, PES schemes designed to conserve biodiversity are considered in this report as a category of PES scheme, although it is likely that biodiversity conservation will be a necessary activity throughout different types of PES schemes including carbon, watershed and landscape beauty. Some examples of activities that can be implemented to conserve biodiversity are given in Table 2 below.

Table 2: Examples of activities for biodiversity services.

Biodiversity service	Activity
Conservation of natural ecosystems	National parks, nature reserves, species/habitat conservation areas, landscape conservation areas
Conservation and sustainable development of species	Protect endangered species and rare species, sustainable development of species, control and remove invasive alien species
Habitat restoration	Restore and maintain high diversity of native plants which support a diverse array of wildlife
Minimise impact on biodiversity	Low-impact farming practices

1.1.3 Watershed Services

A watershed is an area that drains to a common point. Watershed services are those that contribute to the natural supply of fresh water, and can be influenced by land use, particularly upstream land use on downstream land or water users. Vegetation cover and soil management can influence the interception, infiltration, storage, runoff, and evapo-transpiration of water (Wunsher, 2008). The quantity and quality of water services provided by terrestrial ecosystems can be affected by activities such as logging, fires, the application of agro-chemicals, and other unsustainable agricultural land uses (Alpizar at al, 2007). Table 3 below shows some examples of watershed services and associated activities, derived from a sample of planned and ongoing projects.

Forest cover is widely believed to provide valuable watershed services, although specific data and evidence can be scarce (Pagiola, 2002). The relationships between forest cover and watershed services have been described as follows:

- The total annual yield of fresh water increases with the percentage of biomass removed
- Infiltration is reduced by deforestation and subsequent soil degradation (this may reduce dry-season flows)
- Forest cover may prevent surface erosion and shallow landslides (Wunsher, 2008).

Table 3: Examples of watershed services. (Source: Adapted from Porras, 2008)

Watershed service	Activities
Improved water quality	Rehabilitation of degraded areas through tree planting
Improved water quality	Improved land practices e.g. switch to organic agriculture
Improved water quality and quantity	Soil conservation and zoning
Reduction of sediments in lake	Soil conservation techniques, use restriction through reduced grazing intensity and tradable water rights
Improved water quantity	Protection of existing forests
Regulation of water flows and quality, reduction of environmental vulnerability to landslides	Protection and restoration of existing forests
Regulation of water flows, reduction of landslide risk	Combining trees with agricultural production (agroforestry, silvopastoral practices, shade-grown coffee, live fences)
Protection, conservation and management of strategic water sources	Soil and water conservation techniques in small watersheds; no slash-and-burn, management of crop residues, natural regeneration of forest through selective logging, management of coffee farms
Improved water quantity and quality	Conservation of existing forests and reforestation
Improved water quantity and regulation	Conservation of natural forests, improved agriculture
Reduction of sediments and improved water regulation	Mostly conservation of existing forests and prevention to conversion

1.1.4 Landscape/Scenic Beauty Services

Ecosystems can provide non-material services to humans for tourism, recreation and for spiritual or religious value, classified by the MEA (2005) as 'cultural services'. PES schemes in this area tend to focus on payments to conserve landscape beauty, often linked to the provision and marketing of services for tourism and recreation[1]. Activities found in schemes targeted at preserving landscape beauty can include regulating access to areas, reduced hunting, education and alternative employment, protection from encroachment and degradation (see also table 4 below).

Table 4: Examples of landscape beauty services

Landscape beauty service	Activity
Avoided deforestation	Activities which prevent deforestation and forest degradation directly or that provide income and/or resources through practices that do not threaten forest cover
Habitat preservation	Forest conservation, agroforestry

1.2 Defining PES: key characteristics

A PES arrangement is a contractual one between an entity that pays for the ecosystem services and the 'service provider'. Wunder (2005) provides an often cited working definition for a payment for ecosystem services as:

a. A voluntary transaction where
b. A well-defined environmental service or a land use likely to secure that service
c. Is being 'bought' by a (minimum of one) service buyer
d. From a (minimum of one) service provider
e. If and only if the service provider secures service provision (providing conditionality)

Within these defining characteristics, PES schemes may vary considerably, due to different ecological, socio-economic or institutional contexts, or different principles and objectives guiding scheme design. Schemes may be designed to ensure the supply of ecosystem services directly to a 'user' (e.g. watershed services supplied by up-stream users to downstream users) or be funded by a third-party that does not directly use or benefit from the ecosystem services (e.g. a government funded PES scheme). The key distinguishing factor in a PES scheme is 'conditionality'; payments are made in return for delivery of a service, which must be quantified in some form.

Jack et al (2008) lay out a number of characteristics that may differ between different PES projects or schemes, and provide a useful tool for comparing schemes:

1. Which services are being provided?
2. Who are the providers, implementers and intermediaries?
3. Are incentives given to individuals or communities?
4. What are the eligibility rules for participation?
5. How are the payments funded?

Pagiola (2002) has further condensed the key issues or questions to be addressed in developing a PES scheme (specifically in the context of watershed services) into four categories:

1. Identifying and quantifying services;
2. Identifying key beneficiaries and charging them;

[1] Arguably there is cross-over here; tourists may wish to access landscape beauty for spiritual reasons

3. Developing payment systems that work;
4. Addressing institutional and political economy issues.

The authors have drawn on these frameworks to develop the following framework for the literature review (see table 5 below). The body of the report follows this framework with the **aim of identifying the key attributes or PES scheme design, implementation and operation, and contextual pre-conditions necessary for a sustainable PES scheme:**

Table 5: PES scheme framework

1. Identifying actors and a funding mechanism Who are the beneficiaries and providers of the service (actors)? What types of funding mechanism are there and on what scale do they operate?
2. Identifying sites and quantifying the ecosystem service How are sites selected for PES schemes? How are ecosystem services quantified? What is the unit of transaction?
3. Developing an institutional framework What are the institutional requirements to design and manage a PES scheme? What level and kinds of capacity are required?
4. Identifying social, legal and political issues What legal barriers could there be to PES implementation? What political barriers could there be to PES implementation? What social barriers could there be to PES implementation?
5. Designing the payment mechanism How are payment levels set? Who receives payments? How are benefits shared? Are incentives in cash or in kind? How are payments targeted to ensure efficiency? What transaction costs are involved? Are payments conditional upon inputs or outputs (e.g. transaction costs)? How are outputs monitored?

2 Identifying actors and a funding mechanism

There has now been considerable experimentation with different PES schemes and approaches. Transactions for ecosystem services tend, however, to fall within one of the following types of overall scheme (adapted from Richards and Jenkins, 2007):

- **Self-organised private deals**, where private entities contract and pay for private services directly with service providers
- **Public payment schemes** to private land and forest owners where the government is the main or only buyer (or provides a subsidy), acting on behalf of service users
- **Open trading of environmental credits** either under a regulatory cap or floor or in voluntary markets
- **Eco-labelling or certification** of forest or farm products, where consumers buy certified sustainable supplies and pay a premium for promised ecosystem benefits

PES schemes can operate at a variety of geographic scales from local to global, and may or may not operate in the context of a market. They vary from a private contract between local actors (e.g. an agreement between an upstream land manager and downstream water user), a national PES scheme administered by a government agency, and a global market-based scheme where ecosystem services are commoditised and traded, for example in the global carbon market.

The scale of the scheme is likely to be dictated by the nature of the service. For example, as watershed services tend to be more directly of benefit to local actors, agreements to provide watershed services are often with local beneficiaries. Ecosystem services such as climate regulation are more likely to be global in nature as climate regulating activities have a positive global impact. Self-organised schemes tend to be set-up at the initiative of the service buyer or an NGO acting as an intermediary, and tend to operate at a smaller–scale than national schemes run by government bodies (Wunder, 2008). This is summarised diagrammatically in Figure 2 below. Public payment schemes and global PES markets are discussed in further detail below.

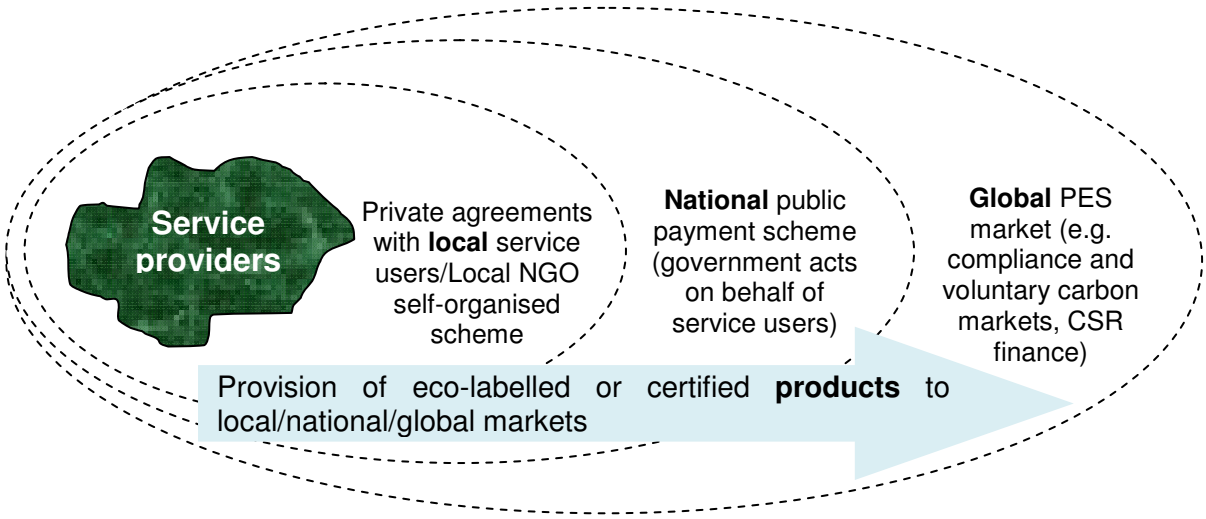


Figure 2: Types of PES scheme: local, national and global

Willingness to pay is a key enabling factor (Jindal et al, 2007) for PES. Payments for ecosystem services can be financed through the marketing and sale of ecosystem services in a marketplace, but do not require a market in order to operate. All sources of monetary capital can be brought together for PES: public, private, and philanthropic. Many PES schemes are set up and administered by governments using public funds. Schemes where ecosystem services are sold in markets as commodities may be partially financed through development or philanthropic funding.

Funders of PES schemes can range from local beneficiaries of the ecosystem service e.g. downstream users of watershed services, to global beneficiaries of services such as climate regulation. Actors 'purchasing' ecosystem services may be private individuals, companies or governments, and may fund PES as a direct beneficiary of ecosystem services, or on behalf of a group of beneficiaries or society at large (e.g. a government may wish to fund a national PES scheme on behalf of its constituents, or an NGO may wish to fund a scheme on behalf of society at large). Table 6 below lists some of the main categories of actors that fund PES schemes, according to the different types of ecosystem service being provided:

Table 6: Types of PES scheme funder

Type of PES scheme	Types of potential funder/'purchaser'
Carbon sequestration and emissions reductions services	• Governments and industries required to reduce emissions to comply with regulations (and emissions reductions can be achieved through the purchase of carbon credits) • Agencies or municipalities seeking to improve air quality • Businesses and individuals purchasing carbon offsets voluntarily e.g. driven by corporate social responsibility
Biodiversity services	• Conservation agencies and organisations working on private lands • Tourism industries, especially for protection of key species that draw in tourists • Land developers (purchasing offsets for damage or developments, or for amenity values) • Farmers and agricultural industry (to protect pollinators, sources of wild products)
Watershed services	• Governments acting on behalf of beneficiaries e.g. populations in flood prone areas • Industrial, agricultural water users • Municipal water utilities, consumers • Hydroelectric power generators
Landscape beauty services	• Tourism industries • Governments acting on behalf of beneficiaries

Many PES contractual arrangements are conceptually about an exchange between different 'communities'. The provider of the ecosystem services ('service provider') is often a local, rural community, which undertakes, either as a group or individually, activities that help to protect, restore, and improve the ecosystems they depend upon for food, fuel, income, materials, and medicines. The source of funds or 'purchaser' of ecosystem services, the 'funder', is often an entity that in some way represents the 'international community' or public sector, and provides money for ecosystem services.

Pagiola (2002) notes that the beneficiaries likely to pay for ecosystem services and thus participate in a PES scheme are those that are both easily identifiable and organised, therefore able to negotiate. Populations not organised into groups are therefore unlikely to participate in PES schemes. In the case where beneficiaries of ecosystem services are a population or society at large, it is more likely that an NGO or government agency will step in to fund PES on behalf of the beneficiaries. The use of PES is not restricted to an instance

where the 'beneficiary' pays. This may also be the case where an NGO wishes to commit funds to and administer a PES scheme, for example to conserve biodiversity and build capacity in an area to support long-term ecosystem restoration. The NGO acts on behalf of global society and its interest in preserving biodiversity as a global public good.

Funding often goes through an 'intermediary' in a PES scheme before reaching communities, particularly where ecosystem services of large numbers of service providers are aggregated, or where beneficiaries are located at a distance from providers. NGOs can also play significant roles in developing PES schemes and may occupy a number of roles, for example as funders of PES (i.e. providing funding on behalf of the beneficiary), as intermediaries acting as 'project coordinators', or initial developers of schemes that are then coordinated by a local organisation. Other roles could include:

- Contributing technical expertise and working with companies and governments to develop transparent guidelines and methodologies
- Helping to build the capacity of companies, governments, and communities to engage in discussions and develop a PES scheme
- Helping to monitor and evaluate ecosystem service delivery
  Source: adapted from ten Kate et al (2004)

Private companies may also become involved as actors in developing and implementing PES schemes (ten Kate et al, 2004), for example by acting as intermediaries. They may be involved as project partners or on a consultancy basis, for example providing financial and technical services.

2.1 Public payment schemes

Although PES studies and literature have increased massively in recent years, PES or 'PES-like' schemes are not a new phenomenon. In the 1880s, PES is thought to have been first introduced in the form of conservation easements in the US. PES schemes commonly form part of the mix of economic instruments used to ensure or incentivise ecosystem service generation, particularly in developed countries where there is supporting legislation and the necessary level of governance and administrative culture to support large-scale PES.

There are many cases where financing from a government body or other representative agency is the only feasible approach, because the social benefits of ecosystem services are "public goods" (Wunder et al, 2008). Public goods are shared, and no one can be excluded from using them ('non-excludability'). Beneficiaries can therefore be "free riders", benefiting from an ecosystem service not contributing to the activities required to generate the service. In the case, a government body or representative of society may step in to address this externality by making payments for the ecosystem service on behalf of beneficiaries.

Governments may pass on all or part of the costs of the PES scheme to service users through compulsory fees. Mexico's program of Payments for Hydrological Environmental Services (PSAH), for example, is financed from a portion of the revenue generated from water use fees (Muñoz Piña et al., 2008) Alternatively, the government may simply absorb the cost, acting as the service buyer on behalf of national service users, or seek outside funding from global sources such as the Global Environmental Facility or World Bank. The recognition in the latter case is that schemes generate services that represent 'global public goods'.

National PES schemes are likely to encompass more than one ecosystem service (e.g. carbon and watersheds). The European Union, for example, spends approximately 2 billion Euros each year supporting PES schemes (TEEB 2009) for activities with the aim of delivering various ecosystem services. A large proportion of this finance is applied to what are known as 'agri-environment' schemes. Activities include conservation of high-value habitats and biodiversity, less intensive agriculture, management of low-intensity pasture systems and preservation of landscape and historical features. Similarly in the United States,

a number of publicly funded conservation programs use a PES mechanism under the Farm Bill. Programs include a Grassland Reserve Program, Wetland Reserve Program, and Wildlife Habitat Incentives Program (Greenhalgh, 2006). One of the largest PES schemes is currently the Chinese 'Grains-to-Greens Programme', which aims to reduce flood risk by reforesting cropland to reduce soil erosion on steep slopes, and simultaneously aims to provide habitats for the endangered Giant Panda (TEEB 2009).

National PES schemes are also likely to have one or more 'side objectives' such as local development and poverty reduction (Wunder, 2008) which may boost political support and widen the available avenues of finance. EU agri-environmental schemes for example use funding allocated by member states for rural development (EC Agriculture and Rural Development, 2009B). This tendency has, however, been criticised by some who perceive it as an 'overloading' of PES schemes, which may ultimately be counter-productive and undermine the environmental benefit (Wunder et al. 2008).

2.2 PES markets

Ecosystem service markets have the potential to provide additional income to ecosystem service providers. Currently there are both regulated and voluntary markets for water, carbon, biodiversity, although the extent and stage of development of these markets vary significantly.

Carbon (or carbon dioxide) is often the metric for PES schemes, and the only service for which there is a relatively developed global market. Carbon markets may be divided into two broad categories, the compliance market, created by the Kyoto Protocol to the UN Framework Convention on Climate Change (UNFCCC), and the voluntary market, where projects and standards have emerged out-with the compliance framework.

Large volumes of carbon credits have been generated and traded in international carbon markets. However, carbon services from land-use projects have been marginalised due to a variety of concerns and perceptions. For example, there are concerns that as forest carbon services tend to be reversible and are not as easily quantified and commoditised as other types of carbon unit (e.g. from renewable energy projects) so have less value on carbon markets. Leakage is also a concern that affects the value of forest carbon services, meaning the concern that activities in one location leading to carbon benefits may simply displace activities to other areas resulting on no net benefit. The result of these concerns is that the main compliance frameworks for trading carbon services, either do not recognise carbon services from forestry (e.g. the European Union Emissions Trading Scheme, or 'EU ETS') or have failed to have an impact in this area e.g. the Clean Development Mechanism of the Kyoto Protocol, which accepts afforestation and reforestation projects, but has not had a significant impact with only three small projects registered.

Despite these limitations, carbon markets have provided the major market-based source of PES finance, due largely to the funds made available for voluntary carbon offsetting. A buyer from the private sector's willingness to pay may be less related to the perceived value of the service, but driven by the public relations value of engaging in the scheme and drivers of corporate social responsibility. For these reasons, buyers of carbon services are often also willing to pay premiums for what are perceived as project 'co-benefits' such as poverty reduction and protection of biodiversity, and may be attracted to the more tangible, people-focused benefits of land-use projects. Degradation in the quantity or quality of natural ecosystems is linked to the reduction of human well-being (Aronson, 2007), and the provision of ecosystem services often goes hand in hand with social benefits such as:

- Advancement of community and smallholder land use rights and tenure
- Poverty alleviation
- Better standards of living and livelihood diversification
- Increased resilience and ability to adapt to climate change
- Knowledge sharing

- Transfer of skills
- Participatory planning, the strengthening of community structures and financial networks
- Reduced dependency on aid and government support
- Greater ability to pay for education and access to healthcare

A promising prospect for increased and more stable flows of finance from carbon markets is the development of a global mechanism for reducing emissions from deforestation and degradation (REDD or 'REDD-Plus', which would also encompass afforestation and reforestation) under the UN Framework Convention on Climate Change (UNFCCC). Although it may be some years before a mechanism comes to fruition and it is still unclear how the funding mechanism will work in practice (e.g. a fund-based mechanism, or cap and trade mechanism), and how payments will be distributed (e.g. on the basis of historical emissions levels or another system), there is widespread agreement that a mechanism is required and momentum behind its development.

This momentum has had the effect of mobilising funds for 'REDD readiness' programs. These programs have focused mainly on developing methodologies, building capacity in developing countries and setting up pilot projects. Large-scale funds made available have included the World Bank Forest Carbon Partnership Facility ($250 million available for country-level grants) and the Congo Basin Forest Fund (CBFF), a £100 million joint fund of the UK and Norwegian governments for initiatives related to forest conservation in the Congo Basin. The World Bank is also supporting carbon sequestration projects through the BioCarbon Fund, which purchases carbon from both carbon sequestration and avoided deforestation projects.

The frequent use of carbon as a metric for PES is due in part to the relative ease of objectively quantifying carbon services in comparison with other types of benefit such as biodiversity, but largely also due to the growing urgency of the climate change mitigation agenda (Richards and Jenkins, 2007). Development of PES schemes is facilitated when the commodity being generated can be readily measured with a metric related to operation decisions (Krupnick and Siikamäki, 2007).

Watershed services have also become the focus of a growing number of PES schemes for which PES markets have emerged, albeit at a smaller and more local scale. Although most schemes are dependent on income from the public sector, the majority (70%) of schemes are estimated to be receiving some funding from private users (IIED 2008). Most watershed PES schemes are characterised by a single or few large buyers (Jindal et al, 2007). Despite the development of the PES concept for watershed services over the past decade or so, including a pioneering national Costa Rican scheme (Pagiola et al, 2004), the private sector has been relatively slow to enter the market and make significant levels of transactions. Few payment schemes for water services derive funding from increasing domestic water-user fees. The IIED study (2008) found that where domestic users did pay, payments were set at a very low level, and were often voluntary, so no incidents of protest were found.

Central and South American countries have been the leaders in developing PES schemes for watershed services, with little activity thus far in Africa. The Working for Water project in South Africa is the main example case in Africa. Pagiola (2002) argues that the context where beneficiaries are most likely to enter in to PES agreements is where the water service is currently satisfactory, and forest cover is still intact, so a strong argument can be made to the potential buyer that compensation is required as a precaution. It seems likely that watershed PES schemes will continue to operate largely through public or NGO funded schemes in the near future, with some supplementary contributions from large-scale local water users and industries.

Ecotourism has been used as a means of generating funding for PES and commercialising biodiversity protection (Mills and Porras 2002), as areas with high levels of biodiversity can often have significant potential for tourism income. Ecotourism is the fastest-growing area of

the tourism industry, and the World Tourism Organisation has estimated that spending will increase by 20% a year (TEEB 2009). It is arguable that the ecosystem service actually being paid for here is landscape beauty, as the payment is normally actually for the right to access and view areas considered beautiful, rather than a payment for biodiversity.

Out-with the market for carbon services, PES schemes for biodiversity may have the most global potential for market-based financing due to the global appeal of biodiversity and potential for marketing biodiversity offsets. Various compliance or voluntary business models have emerged to protect biodiversity and to pay for ecosystem services. Examples of commodities are provided in table 6 below:

Table 7: Examples of commoditisation of biodiversity services. Source: Mills and Porras, 2002

Biodiversity service	Commodity	Number of cases
Ecosystem, insurance, option and existence values	Protected areas	16
Option value	Bio-prospecting access rights	12
Pest and disease control functions, insurance and choice values	Biodiversity-friendly products	11
Global ecosystem, insurance, option and existence values	Company shares	9
Ecosystem, insurance, option, and existence values	Debt-for-nature swaps	7
National ecosystem, option and insurance values	Biodiversity credits/offsets	4
Ecosystem, insurance, option and existence values	Management contracts	3
Ecosystem, insurance, option and existence values	Land lease/conservation concession	2
Ecosystem, insurance and option values	Conservation easements	1
Ecosystem, insurance, option and existence values	Logging right/development rights	1

Wetland banking in the United States is an example of buying and selling ecosystem service credits on the market. Wetland banking is the process of tracking wetland buffer credits that are designated for replacement of future wetland losses. A central body, the Board of Water and Soil Resources (BWSR) oversees the banking operations for the state of Minnesota, and maintains a record of deposits and withdrawals. Land owners and LGUs participate by submitting plans, maps, description of methods to be used, best management practices to be incorporated, and a 5-year monitoring plan. Any wetlands added to the wetland bank must also be part of a perpetual conservation easement (Anakoa Natural Resources, 2009).

Regulated biodiversity markets are found mainly in the United States and Australia and use the concept of compensatory credits. Habitat impacts are “offset” by an equal amount of restoration and protection in an area that has similar ecological value. Biodiversity offsets are conservation activities intended to compensate for the residual, unavoidable harm to biodiversity caused by development projects. Biodiversity offsets are seen as a tool to

manage the adverse impacts of development activities on biodiversity. They are seen to lead to a better balance between the costs and benefits of biodiversity conservation and economic development (ten Kate et al. 2004).

There are potential benefits from biodiversity offsets for companies, developers, and investors, as well as environmental regulators and policy makers, organisations promoting the conservation of biodiversity, and for communities affected by development projects.

With biodiversity offsets, companies may be able to:

- undertake projects that may not otherwise be possible,
- have better relationships with communities,
- improve their reputation,
- gain easier access to capital,
- use biodiversity offsets as a tool to manage social and environmental risks,
- reduce costs of compliance with environmental regulations,
- make use of strategic opportunities as new markets and businesses emerge (Source: ten Kate et al., 2004):

Environmental regulators and policy makers may use biodiversity offsets (ten Kate et al., 2004):

- As a mechanism to encourage companies to make contributions to biodiversity conservation without new rules
- As a means to ensure development projects are planned in the context of sustainable development
- As a method to better balance the costs and benefits of biodiversity conservation and economic development

Organisations promoting biodiversity conservation may find biodiversity offsets of use due to (ten Kate et al., 2004):

- More in situ conservation activity may occur with biodiversity offsets than otherwise
- Trade small, highly compromised sites for larger areas of habitat where conservation outcomes are more secure – offset degradation of natural habitat of relatively low biodiversity value for conservation or restoration of high biodiversity value
- Integrate conservation into development planning, internalise externalities, and to integrate biodiversity conservation into investment plans of companies
- Offsets may give greater economic value to biodiversity, natural habitat, and the restoration of degraded ecosystems.
- New source of finance for biodiversity conservation

Affected communities may benefit from biodiversity offsets (ten Kate et al., 2004):

- As a means to ensure developers rehabilitate project sites and benefit conservation in the surrounding area, increasing livelihoods and amenity values
- An opportunity to negotiate environmental, economic, and social outcomes at the landscape scale
- A means to identify pre-project biodiversity and ecosystem benefits to ensure that ecosystems function during and after the development process

In the United States, “habitat banking” markets were established under the Clean water Act and the Endangered Species Act, to cap habitat loss at the federal level. The endangered species habitat and wetland restoration banking markets are starting to develop further. In Australia, New South Wales launched a BioBanking scheme in 2008 (Markit, 2009). There is a limited market for voluntary biodiversity offsets, and the use of biodiversity offsets as part of development projects is accepted as best practice by governments, companies, and NGOs. A number of companies are building institutional support for voluntary offsets, and several groups of companies (International Council of Mining and Metals, ICMM) and multi-

stakeholder partnerships (Energy and biodiversity Initiative, EBI), have been working on the subject (ten Kate et al., 2004). The largest challenge to the development of biodiversity offsets is the lack of guidelines and tools to help those involved clarify objectives, design effective projects, and to demonstrate their success or failure (ten Kate et al., 2004)

Despite the emergence of several schemes and models, the market for non-carbon ecosystem service credits is still small in practice, but growing. Within the Markit registry, a recently launched on-line interactive registry to track trading of ecosystem services, only one seller of biodiversity credits is listed, the Malua BioBank (Markit, 2009). In a 2009 overview of the biodiversity credit market in New South Wales, Australia describes the demand for biodiversity credits within Australia in terms of potential demand (Department of Environment, Climate Change, and Water NSW, 2009).

The Malua Biobank sells biodiversity conservation certificates for rainforest conservation in Sabah, Malaysia (Malua Biobank, 2009). It aims to restore and protect 34,000 hectares of orang-utan habitat in the Malua Forest Reserve. Each certificate generated represents the restoration or protection of 100 square meters of rainforest within the Malua Forest Reserve. By purchasing Biodiversity Conservation Certificates, buyers make a contribution to forest conservation rather than an offset for rainforest impacts that a company may have elsewhere.

The Markit Environmental Registry provides an online facility for issuance, housing, ownership transfer and retirement of Biodiversity Conservation Certificates (Hawn, 2008), and also 'houses' the credits generated by voluntary carbon projects under several leading standards including CarbonFix, Climate Community and Biodiversity Alliance and Plan Vivo. It will be interesting to learn whether the advent of on-line central registries has an impact on the volume of credits traded in the voluntary markets

Mills and Porras (2002) identified seven commodities being used to market landscape beauty, shown in table 7 below alongside the number of cases found:

Table 8: Commodities used to market landscape beauty. Source: Mills and Porras, 2002.

Commodity	Number of cases
Access rights/permits	22
Package tour/tourism services	15
Management agreement/projects	14
Ecotourism concession	4
Photographic permits	1
Land acquisition	1
Land lease	1

Payments for landscape beauty schemes are likely to involve site-specific transactions related to access to land and forest management contracts (Mills and Porras, 2002), although some national schemes have also been developed where governments have developed payment systems.Government payments normally involve compensation of communities living in or adjacent to scenic attractions that generate government revenue or protected areas. Market creation has been slow, despite access fees being in use for a long time, as governments are often slow to capture consumers' willingness to pay, and often set at low levels to encourage high numbers of visitors. Willingness to pay for access to landscape beauty will rise where the site is more unique (Mills and Porras, 2002).

2.3 Key observations

- The majority of PES schemes to date have been publicly funded, with governments acting on behalf of large numbers of beneficiaries of ecosystem services, to incentivise land-management practices that provide multiple services, with an emphasis on climate regulation, biodiversity, watersheds and landscape beauty. Public funded schemes often focus on generating rural development benefits which is important for continued funding.
- Beneficiaries likely to fund PES schemes, where the beneficiaries are local users of the ecosystem services, are those that are easily identifiable and organised into groups or organisations.
- Funding from market-sources has largely come from the voluntary carbon market, although markets for other ecosystem services have slowly began to emerge.
- PES scheme developers should target 'unique' areas in terms of scenic beauty, where willingness to pay for access or services is high, in order to access higher potential levels of payments for stakeholders involved in delivering the services.
- Stable funding for PES is likely to come from several sources i.e. 'blended funding' including market-based, public, philanthropic and investment sources.

3 Identifying sites and quantifying ecosystem services

3.1 Site selection and targeting

Providers of ecosystem services are those actors in a position to safeguard the delivery of the ecosystem service, generally private land holders and communities with land tenure or resource-use rights. PES programs are thus generally aimed at private landholders, although they can also be aimed at public lands, such as protected areas, which are controlled and managed by government institutions (Engel, 2008).

Site selection will depend on a number of factors. A PES concept may start with a large area or group of landowners in mind e.g. rural farmers in Mexico, forest dependent communities in Cameroon, and need to go through a process of 'homing in' on sites most appropriate for PES. PES finance may be most effectively and efficiently applied by identifying and targeting the sites with the most favourable conditions.

As a starting point, sites should normally only be eligible where an 'externality' exists, i.e. the service providers are not already being paid or compensated for the services they are providing (Wunder, 2008), and there is a risk of losing the environmental service.

Wunsher (2008) emphasises that payments for ecosystem services and the services provided must be 'additional', i.e. the services generated would not have been generated in the absence of PES finance. Thus, if PES finance were to be used to pay a farmer to plant trees he already planned to plant, or paid him not to fell an area of forest he had no intention of felling, the ecosystem services would not be additional, and the use of PES finance for this site would be inefficient. By considering both ecosystem service levels and threats (i.e., the probability that ecosystem service would not have been provided in the absence of PES) in selecting among potential PES sites, the real benefits of the program can be enhanced (Engel, 2008).

As well as targeting sites to ensure maximum efficiency, PES finance should be targeted where it can practically make a difference. In other words, additionality may need to be balanced with practicality. PES scheme developers should consider the level of finance available and consider where this will realistically incentivise land-use change (i.e. use of PES finance to 'compete against' potential income from highly lucrative timber concessions may not be realistic or the best use of finance). Garcia-Fernandez et al (2008) describe this as adopting PES in the most appropriate "stage of forest transition". Using PES finance to reduce deforestation, for example, they argue is likely to be most *desirable* in areas with high deforestation pressure and high remaining forest cover (i.e. high threat, high benefit), yet most *feasible* where deforestation has not yet reached a serious level. Ecosystems can be extremely resilient to pressures and continue to provide services up to a point, but then go into rapid decline once past a certain threshold (TEEB 2009), which may render the implementation of a PES scheme less feasible.

To ensure that PES finance achieves a significant impact, critical source areas where benefits of payments have the potential to be high and attributable need to be located and targeted (Jindal et al, 2007). The importance of attributability of benefits to land management decisions is highlighted by the example of a local watershed project in Sukhomajri, India, where actions of villagers were clearly linked to the watershed services. Efforts to scale-up the scheme through replication failed, however, as in other locations the ecosystem services were not as easily traceable to actions (Jindal et al, 2007).

A Honduran pilot project applied the following two-step approach to identify high-benefit, high-risk sites (Alpizar et al 2007):

1. Rank water sources based on number of households they service, current levels of water extraction and number pf potential future households using the sources;

2. Rank sites in the drainage areas of the above water sources based on their potential for providing watershed services and their vulnerability to reduction of services, taking into account rock type, presence of soil failures or fractures, soil texture, slope, land use, organic cover and pollution sources.

Site selectors may also consider that to date, successful cases of watershed PES schemes have often taken place in areas of low population density (Jindal et al, 2007). Table 9 below lists other selection criteria that may be used to identify high value, high risk sites.

Sites delivering the highest level and value of ecosystem service tend to be those with high levels of biodiversity. Various tools exist to identify sites of high value for biodiversity conservation, one of which is the High Conservation Value Forest (HCVF) Toolkit. A High Conservation Value Forest is the area of forest required to maintain or enhance a High Conservation Value (Jennings, 2003). Classifications of HCV forest are described below in table 10.

Table 9: Ecosystem services and potential selection criteria

Ecosystem service	Estimation	Selection criterion
Biodiversity services	Habitat types as surrogate for biodiversity	Connectivity – distance to other protected areas and conservation corridors
Carbon services	Carbon before and after land-use change	Connectivity/accessibility – distance to other protected areas and conservation corridors
Water shed services	Slope as a proxy for erosion and sedimentation potential.	High water use intensity
Landscape/ scenic beauty	Assume loss in forest cover reduces landscape beauty	• Visibility calculated from lookout points spaced equal distances along national roads • Identify areas where there is existing willingness to pay (e.g. tour operators charging tourists for eco-tours)

Table 10: High conservation value forest. Source: Adapted from Jennings, 2003

HCV	High conservation value	Elements and Examples
1	Forest areas containing globally, regionally or nationally significant concentrations of biodiversity values (e.g. endemism, endangered species, refugia).	• Protected areas • Threatened and endangered species • Critical temporal use E.g. Presence of globally threatened bird species in a Kenyan montane forest.
2	Forest areas containing globally, regionally or nationally significant large landscape level forests, contained within, or containing the management unit, where viable populations of most if not all naturally occurring species exist in natural patterns of distribution and abundance.	E.g. A large tract of Mesoamerican lowland rainforest with healthy populations of jaguars, tapirs, harpy eagles and caiman as well as most smaller species.
3	Forest areas that are in or contain rare, threatened or endangered ecosystems.	Example: Patches of a regionally rare type of freshwater swamp forest in an Australian coastal district.
4	Forest areas that provide basic services of nature in critical situations (e.g. watershed protection, erosion control).	• Forests critical to water catchments • Forests critical to erosion control • Forests providing barriers to destructive fire Example: Forest on steep slopes with

HCV	High conservation value	Elements and Examples
		avalanche risk above a town in the European Alps.
5	Forest areas fundamental to meeting basic needs of local communities (e.g. subsistence, health).	Example: Key hunting or foraging areas for communities living at subsistence level in a Cambodian lowland forest mosaic.
6	Forest areas critical to local communities' traditional cultural identity (areas of cultural, ecological, economic or religious significance identified in cooperation with such local communities).	Example: Sacred burial grounds within a forest management area in Canada.

3.2 Defining and quantifying the ecosystem services

One of the first steps in the design of a pay-for-services program is assuring that buyers and sellers agree on the definition of services that are going to be sold and how the provision of services will be documented (Krupnick and Siikamaki 2007).

While carbon is certainly at the forefront of PES development and policy, it is often argued that there is a need to bundle diverse environmental services, and to develop and institute mechanisms to reward the providers of those diverse services. Carbon stocks are closely related to forest cover, so maintaining and enhancing carbon stocks is likely to support the maintenance of biodiversity and other ecosystem services. Due to these linkages, carbon is often used as the predominant or exclusive metric in a project that has diverse environmental (and social) goals over and above delivering carbon services.

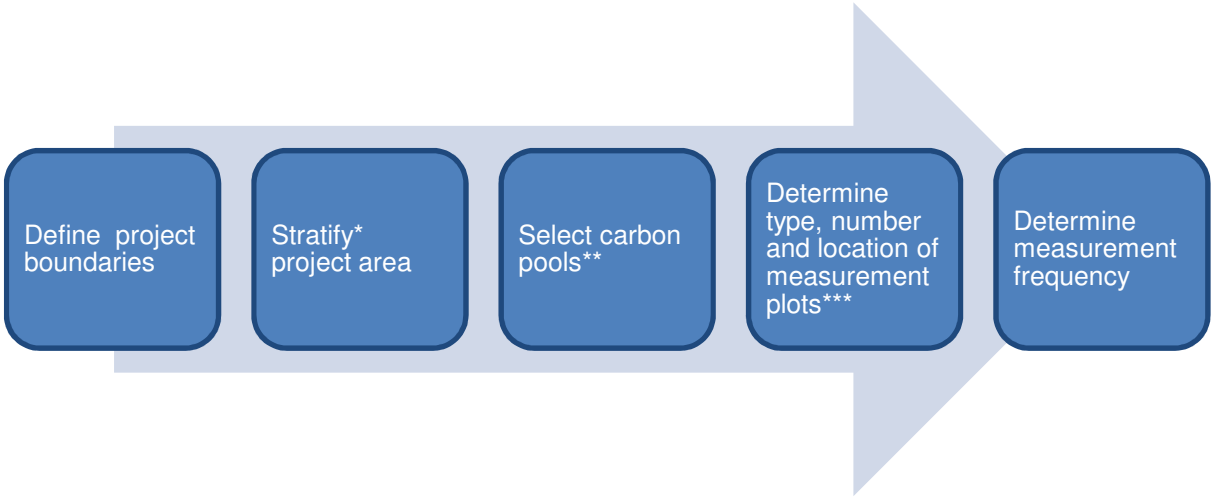
Tallies et al (2008) note that there may be intrinsic trade-offs in projects between the different ecosystem services that can be provided. For example, in a project involving the development of more productive agriculture, where the overriding objective is reducing rural poverty, the choices which might lead to the most poverty reduction may not have the maximum biodiversity, or indeed any biodiversity benefit.

Clear definition of which ecosystem services are being targeted and paid for in project documentation will then help to guide negotiation between buyers and sellers and facilitate price discovery. PES scheme developers should consider the stability and sustainability of the funding mechanism and seek long-term agreements where possible. The continued provision of ecosystem services will very likely depend on the continued financing of the PES program (Wunder et al. 2008). Where a defined user-group is financing a program and directly benefiting from it, payments depend on the users being satisfied that they are receiving the ecosystem services. In government financed programs, sustainable financing will depend on continued budget allocations. Where there are necessary time-lags between the provision of financing and delivery of ecosystem services, as is often the case with land-use projects, service buyers need to understand and be realistic about time-frames (Jindal et al, 2007).

There is now widespread agreement in the conservation arena that we need to 'measure what we manage' in order to implement effective, long-term solutions and policies. Quantifying ecosystem services can vary significantly in complexity depending on the service in question, site and activities generating the service. There is likely to be a trade-off between the accuracy of quantification of services and the cost of measurement (Krupnick and Siikamäki, 2007). As measurements of actual levels of ecosystem services often involve complicated, and poorly understood ecological relationships, most PES programs use "proxies", which may be fairly coarse estimates (Alpízar et al, 2007). In order to create and access PES markets there is a need for a common unit that is marketable (Mills and Porras, 2002).

For carbon sequestration projects, the link between land use and ecosystem service is generally well established, and can be monitored in the field relatively easily (Wunder et al. 2008). Estimation of carbon services requires information about the amount of stored carbon before the implementation of PES activities (the baseline) and after PES activities (the 'carbon benefit' or 'carbon impact').Carbon measuring plans can be designed following the steps below in figure 3:

Figure 3: Carbon measurement plan. Source: Pearson, 2005



* 'Strata' within a project are areas of different land use / land cover. They are defined to reflect consistent differences in biomass stocks (Avoided Deforestation Partners, 2009).

** 'Carbon pools' are different classes of materials containing carbon. The selection of carbon pools to measure depends on the expected rate of change, magnitude and direction of change, and the cost of measuring. Where a carbon pool is expected to decrease as a result of project activities, it should be measured and monitored. Where pools are expected to increase by a small amount relative to the overall rate of change, they need not be measured or monitored (Pearson, 2005).

*** 'Measurement plots are areas were biomass is measured.

Table 10 below lists carbon pools and methods of quantification or estimation for land use, land-use change, and forestry projects. Box 1 gives further resources for carbon service quantification and monitoring.

Table 11: Carbon pools for the survey of forest carbon stocks. Source: Pearson, 2005

Carbon pools	Quantification
Above-ground woody biomass	Trees are simple to measure and contain substantial amounts of carbon. The measurement of trees is carried out with sample plots through non-destructive testing and the use of allometric equations.
Below-ground woody biomass	Below-ground woody biomass includes tree roots. Below-ground woody biomass is estimated from above-ground biomass measurements made in sample plots through non-destructive sampling and the use of allometric equations.
Dead wood	Dead wood tends to be a significant component in mature forests. It includes standing dead trees and downed dead wood. Dead wood is estimated from measurements of standing dead trees and coarse woody debris in sample plots.
Leaf litter	Variation in leaf litter fall throughout the year can make quantification of this carbon pool time consuming and expensive.
Soil organic carbon	Soil organic carbon is likely to change at a slow rate. It tends to be more important in grazing land or cropland. There tend to be high costs of quantification and monitoring for this carbon pool.

Box 1: Resources for quantifying and monitoring carbon services.

The Intergovernmental Panel on Climate Change (IPCC) has published a guide about good practice for land use, land-use change, and forestry (LULUCF). This guide, which provides guidance on methodologies and equations for the quantification of carbon in LUCLUF is available online (IPCC, 2003).

There are a variety of resources for quantifying and monitoring the carbon benefit from projects.

The Sourcebook for land-use, land-use change, and forestry projects by Pearson is a useful reference for developing and implementing land use, land-use change and forestry (LULUCF) projects (Pearson, 2005).

For forestry and agroforestry, Winrock has published a document entitled, A Guide to Monitoring Carbon storage in Forestry and Agroforestry Projects.

For reduced forest degradation, the team “Kyoto: Think Global, Act local” has produced a Field guide for assessing and monitoring reduced forest degradation and carbon sequestration by local communities (K:TGAL, 2009).

Table 13 below shows information about a sample carbon sequestration PES project (Wunder, 2007), including factors affecting site selection.

Table 12: Example PES carbon sequestration project. Source: Wunder, 2007.

Example PES project:	PROFAFOR, Ecuador
Which ecosystem services does the area generate?	Carbon sequestration The Forests Absorbing Carbon dioxide Emissions Forestation Programme (PROFAFOR) was established in 1994 with carbon-fixing plantations, mainly in the highland region of Ecuador
What is the unit of transaction?	Carbon benefit is quantified in units land area (tC/ha/yr).
How are sites selected for PES schemes?	Biophysical conditions and economic criteria were used in selecting sites for plantations. Biophysical characteristics were slope, soil quality, and altitude. Economic criteria included the local marketability of timber and concentration in geographical blocks. Most plantations were established in high altitude zones because land opportunity costs were considered lower for highlands than lowlands.
What activities bring about the ecosystem benefit?	Land owners plant trees to form plantations.
How can the ecosystem service be quantified?	PROFOFOR measures permanent sample plots annually and extrapolates the results to the entire contracted area.
What is the level of risk or threat to the ecosystem service?	Plots adjacent to PROFAFOR project plantations serve as the baseline. No major changes were expected in the absence of the project, and the planted hectares of the project have provided additional tree cover.

The development of markets for biodiversity conservation has been hindered by the difficulty in defining a universally acceptable 'common unit', and a need to make fairly complex biophysical comparisons (Boyd and Wainger, 2003, Barton et al, 2009). PES schemes, in order to be cost-effective and scalable, require as rapid as possible biophysical assessment methods, to reduce costs of setting baselines (Wunder, 2008). Biodiversity services can be estimated by considering species distribution, representation, and minimum sustainable population and area requirements (Wunsher, 2008).

Sites supporting a large number of species, particularly rare or endangered species, and defined by natural boundaries are generally considered the most biologically valuable (Boyd and Wainger 2003). Rapid assessment methods should be used to gain an understanding of biodiversity in a PES area. A measurement unit for biodiversity is likely to include a mix of emphasis on diversity, abundance, uniqueness and rarity (Shields, 2000), but no single set of measures has yet emerged as a universally accepted tool for analysis. A constraining factor is that many sites which are potentially important for conservation lack biodiversity information such as species lists, distributions, and habitat relationships. Some rapid assessment techniques developed to quantify biodiversity are presented in Box 2.

Box 2: Biodiversity rapid assessment techniques

One example of a rapid assessment method is the Mackinnon lists technique, which was developed for birds in tropical forests by Mackinnon and Philips in 1993. This technique is based on assembling a list of the first ten species detected, the next ten detected, and so on. The relative abundance of each species is measured by the proportion of the species in the sample (recorded in the lists). Each of the ten species lists is a time and space independent sample of the animal community present.

The Mackinnon lists technique is useful to capture the species complement of an area. In contrast, the point counting method of rapid assessment is useful to reflect the structure of species communities by an index of community evenness. The hybrid rapid assessment methodology combines the strengths of both the Mackinnon lists technique and the point counting technique (O'Dea et al, 2004).

Measurement of landscape beauty also presents problems of devising an objective quantification tool. Service values would depend on the number of people who view the landscape and their individual level of appreciation (Wunsher, 2008). A simple approach to estimate landscape beauty is to assume that a) any loss of forest cover reduces landscape beauty services, and b) an area's degree of scenic contribution depends on visibility (Wunsher, 2008).

Difficulties in precisely quantifying the level of services provided in biodiversity, landscape beauty and watershed schemes means that PES agreements for non-carbon ecosystem services are likely to be based on a proxy such as a payment per hectare of forest cover. Benefits are assumed based on the 'conventional wisdom' that there is a positive correlation between forest cover and the service, such as water quality (Kaimowitz 2000). Jindal et al (2007), however, emphasise the importance of the science on which watershed schemes are based, as the assumption that trees increase water yields is not necessarily correct, and service agreements might fail if based on a faulty understanding of the linkages.

A comprehensive study of existing water PES schemes by the IIED (2008) found that all existing schemes follow a 'land-based approach' where landholders are paid for implementing land-use activities or systems thought to have a strong linkage with generating watershed services. The study found the following land-use activities were used as a proxy for delivering watershed services, with the first two being the most common:

1. Improved land use practices, including improved agriculture and ranching practices
2. Conservation and protection of existing ecosystems
3. Reforestation
4. Rehabilitation of degraded ecosystems

Added complexity in quantifying ecosystem services, particularly where a proxy is being used as a unit of transaction, such as forest cover, is created due to the implications of 'threshold effects'. In order to generate a significant biodiversity benefit, an area may have to reach a certain level of forest cover (the threshold), before marginal increases in forest cover begin to positively correlate with biodiversity increases (Mills and Porras, 2002). Threshold considerations can also apply in watershed service schemes, in that in order to generate ecosystem services, a sufficient proportion of land managers in an area need to participate (Jindal et al, 2007). This may have implications for the scheme design; for example, in the watershed PES scheme in New York, at least 85% of landowners in the service provision area had to join for the service agreements to be valid.

3.3 Key observations

- Sites where PES schemes may have a significant impact may be identified using a two-step approach, first to identify areas where ecosystem services (or the potential for delivering ecosystem services) are high, and secondly identifying in which of these sites the ecosystem services are under threat (i.e. high-benefit, high-risk sites).
- With the exception of carbon services, techniques for quantifying ecosystems services are often lacking in universal acceptance or are expensive and complex, leading to the common use of proxies such as area of forest cover as a unit of transaction for PES.

4 Developing an institutional framework

PES schemes require an institutional framework where the following functions can be carried out:

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

Institutional functions are normally carried out by an 'intermediary' or 'project coordinator'; either an existing organisation, or organisation set up specifically to manage the scheme. Institutional requirements, and likely barriers to project implementation, are likely to differ for projects of different scales. PES schemes may vary from small, local projects, where funding comes from local users or government, to national schemes, where multiple ecosystem services are delivered, from a range of different actors, with a funding mechanism involving payments from global actors. The institutional set-up, and requirements for factors such as government buy-in, political stability and level of administrative capacity required will therefore depend on scale and context. Management of PES schemes must always be adaptive (Cowling et al, 2007) to deal with local contexts, particularly where the scheme intends to apply in various sites on a regional scale.

An area where PES has been described as 'truly under-performing' other conservation tools is the high cost of negotiating PES contracts (Wunder, 2008). PES scheme coordinators need to have a strong capacity to understand and negotiate contractual terms, and to develop cost-effective mechanisms (e.g. standardised template contracts) for replication and scaling-up. A barrier to the development and scaling-up of some schemes is the institutional limitation of the organisation. Users of water services, such as municipal suppliers, tend to be engineer dominated and not have a team to negotiate PES agreements (Pagiola 2002).

In increasing instances, motivated communities, with the support of NGOs, have set up businesses to directly benefit from PES, known as 'community-based ecotourism'. Land stewards, rather than negotiating with intermediaries, directly supply services. This is found increasingly in the case of landscape services, where communities provide direct services such as guides, accommodation and food. Mills and Porras (2002) describe this as 'vertical integration'. However, the presence of an intermediary will normally be required in most PES schemes where there are multiple service providers and multiple funders.

The extent of government and legislative support required for a PES scheme will depend on the intended scale of the scheme. Local schemes may be possible with very little government involvement or support, yet the ability of a scheme to scale-up, and the potential to set up a national PES scheme, is linked to a government's willingness to intervene and provide enabling legislation (IIED 2008). Local schemes have found to be supportive in informing the development of national schemes as pilot initiatives.

Pagiola (2002) shows the national PES scheme for water services in Costa Rica as an example where a PES scheme set up utilised an existing institutional framework as a base to build on, which enabled the rapid implementation of the scheme once agreements were made with beneficiaries. Costa Rica already had a system to make payments for reforestation when the new Forestry Law came into force which recognised the provision of hydrological services by forest ecosystems, and was able to incorporate the PES scheme into the roles and responsibilities of existing institutions. Wunder (2008) argues that many global environmental problems may be best addressed through scaled-up, government run schemes incorporating PES. Existing participatory approaches used by governments have

been described as a “window of opportunity” for mainstreaming ecosystem services, and bringing PES initiatives into the activities of organisations that are already empowered to make routine decisions about the use of land and water resources (Cowling et al, 2007).

It is generally thought that the implementation of a future ‘REDD’ mechanism will involve national level implementation and governance. Implementation of national REDD schemes is therefore likely to involve a need for considerable up-front funding in order to develop a national ‘carbon’ infrastructure, capable of providing the necessary administrative and technical support and supporting policy and legislative backdrop (Richards and Jenkins, 2007).

4.1 Key observations

- PES schemes, particularly where they involve multiple buyers/funders and multiple land-users, require an intermediary institution with a clear governance and organisational structure and ability for sound and transparent record keeping
- PES schemes may be easier to set-up and deploy more quickly and cost-effectively where an existing institution can take on the coordination role that has relevant experience (e.g. administering payments, facilitating or monitoring an existing scheme related to land use), ideally involving the same groups to be targeted by the new PES scheme.
- Where an appropriate institution does not already exist, setting-up an intermediary institution should involve a consultation with relevant stakeholders and the PES scheme developers should consider how different stakeholders can be represented in the intermediary institution (e.g. through membership, share-holding, board of directors)
- Intermediary institutions (and intended ‘buyers’ of services) must have the capacity to enter into and negotiate long-term contractual agreements. Where PES schemes are to be administered by
- Implementation of a national REDD programme in a developing country will require significant start-up funding to develop the necessary institutional infrastructure. Pilot projects can play a significant role in providing lessons and building capacity in advance of national implementation.

5 Social, legal and political issues

5.1 Establishing legal and political conditions

Establishing legal and political background conditions relevant to PES scheme development is a crucial early step. One of the key legal conditions to establish is the forms of land-tenure rights in place in the target sites. Local ecosystem managers need to have the right and authority to manage ecosystems and benefit from payments. Lack of clear land-tenure may be a barrier to PES scheme development and implementation. Where ecosystems belong to no one, they tend to be neglected, even for the on-site impacts of management decisions (Engel, 2008), and unclear land-tenure may lead to land-use disputes leading to cessation or disruption of activities.

Security of tenure becomes increasingly important when PES participation requires long-term investments, which is often the case in land-use schemes where activities tend to be long-term, for example reforestation (Pagiola and Platais, 2007). A barrier in the Costa Rican scheme for watershed services, for example, was the requirement for participants to have title deeds, imposed by national law, for public funds to be used for contracts with participants in the scheme. Because many participants lacked title deeds, the scheme allocated private funds (e.g. from HEP suppliers) to those without title deeds, and public finds to those with. This highlights the importance of having an adaptive project coordinator able to design flexible and creative solutions, and the potential benefits of blended funding sources where restrictions are placed on one source.

The type of land-tenure may also affect whether PES is an appropriate and feasible economic instrument. Barton et al (2009) suggest that PES are particularly appropriate where target sites are privately owned farmland, but for other land-use types, other instruments such as conservation easements or private reserves may be more effective. Elinor Ostrom, the Nobel prize winning economist, demonstrated that sustainable resource use regimes can be very effectively developed in the context of collective community ownership (TEEB 2009). PES schemes may therefore be most effective where targeted at these types of land holding. Where there is lack of clarity on land-tenure in an area, a PES scheme developer may be able, if feasible and appropriate, to take a role in supporting communities to assert and define their land-tenure rights.

The PES scheme developer should also consider how the implementation of a scheme might affect customary use rights and therefore impact on local livelihoods and community relations. In developing countries, use rights to collect forest products or to grazing grounds may be informally distributed (TEEB 2009). Before a scheme is implemented, scheme developers should conduct some level of socio-economic analysis, involving communities, to deduct how sites are used to support livelihoods, and consider how the scheme could impact these customary uses. As far as possible, PES documentation including service agreements with communities, should define and describe user-rights to ensure those rights are not undermined by the PES scheme.

Establishing existing levels of legal protection in the target sites is also important in establishing whether payments for ecosystem services are required and appropriate. An area that is already legally protected may be ineligible for PES finance under the type of scheme planned. For example, a carbon project may not be considered additional under a carbon standard where the area is already legally protected by law. It is important to note, however, that existing legal requirements to deliver ecosystem services do not necessarily render a site or service provider ineligible for PES, because legal additionality may not be an objective or requirement of the particular PES scheme. Most standards in the voluntary carbon market, for example, accept that legally protected areas may be eligible for PES

where it can be shown that there is only legal protection 'on paper' and in reality there are clear and evidenced threats to the ecosystem services, for example due to lack of government capacity to enforce protected areas. This shows how PES can be used to supplement 'command and control' measures where they are not being effectively applied. The key therefore is establishing what legal requirements exist and whether or not they are considered effective.

In the Costa Rican PES scheme, the Forestry Law of 1996 prevents land owners from clearing areas of natural forest, however, PES can be accessed for conservation of the same forest. PES here are being used as compensation for and to incentivise compliance, or to manage a transition towards compliance. PES may be an effective way of affecting changes in lifestyle and habits through buffering some of the distributive impacts and by providing short to medium-term support, which may eventually be withdrawn as better practices become embedded in an area.

The Costa Rican example also demonstrates how PES scheme developers should investigate how existing laws or regulations affect the ability of land owners to enter into PES contracts and receive payments e.g do they have to have title deeds in order to receive public funds? Service providers may also be able to register PES contracts as part of their title deeds, which may be a beneficial mechanism for ensuring permanence of PES activities. Part of the PES scheme in Costa Rica is an option for service providers with reforestation PES agreements to, in return for further payments, extend their commitment period for a further 10-15 years. The mechanism for doing so was to register the agreement as part of the deed to the property. This means that if the land is subsequently sold, the PES contractual obligations transfer as an easement to the new owner.

Establishing the type of land-tenure and any levels of legal protection is also important for areas surrounding the target PES site. Targeting sites in close proximity to protected areas can be an effective way of generating maximum biodiversity benefits by reducing pressure on protected areas (Pagiola et al, 2004).

PES schemes may also have the option available to use legal instruments such as conservation easements to ensure conformance with PES agreements. Within the United States, conservation easements are used to conserve natural and agricultural lands. One of the attractive features of conservation easements is their flexibility; the legal agreement reflects both the owner's needs and conservation objectives of the partner organisation. A conservation easement could include continued agricultural activity, hunting, or recreational activities, and it might only be for a proportion of the owner's land (UF, 2009).

Many land owners like conservation easements because they are voluntary, local, and respect the owners' private property rights. For the land owner, the donation of an easement is a tax-deductable charitable gift. The tax-deductable easement value is the difference between the value of the land at fair-market prices with and without the easement restriction. An additional benefit to the land owner is that once the land is converted to an easement, the property taxes normally decrease because the development potential has decreased (Haapoja, 2004). Conservation easement areas are dedicated to perpetual conservation purposes, and monitoring can be expensive. Conservation agencies which are easement holders are recommended to hold a stewardship fund to pay for monitoring separate from the operating budget (Haapoja, 2004).

The ability for PES contracts to be enforced legally through contracts or mechanisms such as conservation easements depends on the legal and institutional context in the project area and governance capacity of local and national authorities. PES contracts enforced through legal conservation easements, the enforcement of which is tied into the existing legal system, for example, are more likely to be applied in developed countries where there is sufficient administrative capacity. The choice of commodity in a PES scheme is likely to be heavily influenced by the availability of funding and administrative capacity of the organisation acting as the intermediary (IIED 2008).

Barton et al (2009) note the importance of considering the impacts or success of a PES scheme in the context of the different policies and economic instruments affecting conservation practices across a "landscape mosaic". Disentangling the effects of the PES scheme from the effects of other policies and changing conditions may be difficult or nearly impossible. Developers of PES schemes should ensure that they are aware of the legal and political context and factors which may affect the success of the scheme and how PES could be used to compliment other policies and instruments. For example, a PES scheme for carbon services from forest conservation should establish what existing applicable policies are in place regarding timber extraction and forest clearing on the land type in question (e.g. public, private, communally owned). PES may be considered a particularly useful tool to incentivise better land-use practices in buffer zones around protected areas.

To encourage PES schemes, governments can:

- Provide an enabling policy framework. PES are more likely to succeed with effective law and policy on conservation; environmental impact assessment and mitigation, land use planning and zoning; conditions for extractive and other industrial developments with ecosystem service impacts, clear national sustainable development goals and priorities with associated ecosystem service strategies and action plans.
- Communicate national and local conservation policies
- Collaborate with stakeholders to develop guidelines about best practice for PES
- Engage at the national or local level in site-specific negotiations on the design for ecosystem service offsets (Adapted from ten Kate, 2004)

The level of political stability in the area is also a key consideration to whether a PES scheme can feasibly be implemented and is likely to be sustainable. A study of PES watershed projects looking at whether projects identified in 2002 in an earlier study were still functioning in 2008, found that where projects had ceased to function, political instability was often a factor (IIED, 2008). In another 2008 study of the success of World Bank funded projects with objectives of both poverty reduction and biodiversity protection, major factors in project failure were considered to be those that tended to be out with an individual project's control, such as political or economic factors (Tallis et al, 2008). It is therefore important to consider what national factors, such as the political situation, may prevent PES implementation. The interaction between national level factors and local levels schemes is summarised in figure 4 below.

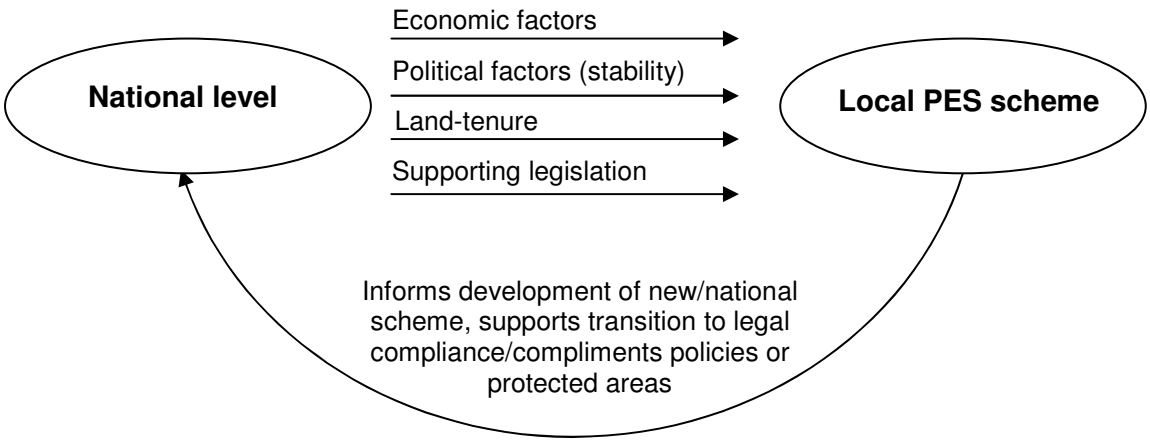


Figure 4: Interaction between national factors and local PES scheme

5.2 Social context

Some level of social capacity or 'active civil society' is likely to be a necessary pre-condition to implementing a PES scheme with rural smallholders or communities (TEEB 2009). Communities need to be able to engage in training and planning workshops, so need to have a minimum capacity to mobilise, and where communities participate in activities in groups, capacity to develop and implement a mechanism to receive and share funds. Barton et al (2009) observe that setting up an effective PES scheme to reduce deforestation is not only more feasible where deforestation has not yet reached a serious level, but also where forest communities are well-organised internally and able to receive and disburse PES to address local threats and pressures on the forest resource. Working through groups such as environmental cooperatives is also crucial to enable the PES scheme coordinator to tailor the scheme to the local context, and working with an initial pilot group in a new scheme site can be useful to test activities before widespread implementation.

PES activities are more likely to be sustainable and permanent when they meet the needs and priorities of communities. Participatory mechanisms are therefore a necessary part of successful PES project design. Understanding the livelihood context and how ecosystem services support local well-being is crucial to understanding which PES activities are likely to be viable in the long-term, wanted by communities and thus generate the highest possible environmental benefit. Regional or national level research may have already been carried out in the area to ascertain how ecosystem services support economic growth and employment (TEEB 2009), that may be useful in informing PES scheme design. Japan and India are currently working on such assessments for example. PES schemes may then be more efficiently delivered where the PES generating activity (e.g. reforestation) can be integrated into livelihood activities and the continued productive-use of land (Pagiola, 2002). For example, coffee producers could implement shade coffee systems in order to deliver carbon and potentially biodiversity and water services.

Communities acting as service providers may need to go through a trust-building exercise with the service buyer or intermediary institution (Barton et al, 2009) in order to understand the rationale for the scheme, nature of the transactions they are making and what will be expected of them. The publication "Participatory Methods Training Workshop Manual" from the University of LEEDS (University of LEEDS, 2008), is a useful reference for tools and skills that can facilitate effective stakeholder participation. Where PES programs go through a participatory process of PES negotiation with groups of service providers, they are not only more likely to be sustainable, but also can potentially provide platforms for democratisation and improved governance at the community-level (Wunder, 2008). Such 'co-benefits' can, as previously discussed, be attractive to service buyers and donors and lead to a more sustainable or diverse funding mechanism. Therefore, investing start-up funds in comprehensive community sensitisation, training, negotiation and follow-up meetings are not necessarily 'wasted' transaction costs (Wunder, 2008).

The most common side objectives of PES projects providing ecosystem services are poverty alleviation, regional development, and employment creation. PES schemes may be aligned to achieving Millennium Development Goals. Targeting the rural poor in a PES scheme is not necessarily the pursuit of a side objective or 'co-benefit' however. It is now widely recognised that there is a strong link between ecosystem degradation and the persistence of rural poverty (TEEB 2009) and therefore PES may be more needed and more effectively targeted in this social context. Arguably, impacts or design features that are described as 'co-benefits' such as community development, may in fact be a necessary aspect to ensuring the achievement of the ecosystem service, as long-term provision of ecosystem services requires a level of governance and community capacity.

5.3 Key observations

Stakeholder involvement

- The involvement of participating communities in PES scheme design is crucial to ensuring the scheme has local 'buy-in' and is complimentary to livelihood activities.

Land-tenure and customary rights

- Participants need to have clear rights to benefit from PES payments or rewards, either through land-tenure or clear, undisputed user rights to the land delivering the ecosystem service, and to enter into contracts transferring rights to ecosystem services. This is normally related to land-tenure; groups, individuals or institutions providing ecosystem services generally need to have clear, long-term and undisputed rights to the land from which the ecosystem service is generated. PES schemes should identify the land-tenure context, including types of land-tenure, means of verifying land-tenure, and likelihood of disputes or land tenure reform at an early stage.
- Projects may need to be adaptive to the local land-tenure context to enable maximum participation (e.g. develop a mechanism for local verification of land-tenure where deeds are unavailable).
- The opportunity for a nation as a whole to institute and effectively operate PES schemes is related to the clarity of land tenure types and stability of the land tenure situation. Where there is conflict, disputes or uncertainty over who has the right to benefit ecosystem service payments, PES schemes are unlikely to take root.
- PES scheme developers should be aware of how ecosystems support livelihoods in target sites and how the scheme may impact on livelihoods and customary or traditional user rights. PES scheme documentation should define and describe these rights to ensure they are respected and not undermined by the scheme.

Political instability, conflict

- A level of political stability, particularly for regional or national schemes involving government actors, is required for the successful long-term implementation of a PES scheme. PES schemes cannot be applied in situations of strong and ongoing conflict, particularly where this affects security of land-tenure and results in significant displacement of service providers.

Rural poverty

- There is a strong link between ecosystem degradation and rural poverty. PES schemes will often be targeted at the rural poor, and the reduction of rural poverty is likely to be a necessary core aim of a PES scheme, rather than a 'co-benefit'.

6 Designing the payment and 'delivery assurance' mechanism

6.1 Setting payment level

Although various tools exist for ecosystem service valuation, the potential for use of these tools is still largely unrealised (TEEB 2009) and the payment levels in PES schemes are likely to be derived from a combination of practical factors rather than a technical evaluation of the economic value that can be attributed to the ecosystem service. These factors are likely to include the market price of the ecosystem service (i.e. buyer's willingness to pay), or other factors affecting availability of finance (e.g. amount the government is able to allocate to a national PES scheme given financial or political constraints), and crucially the level of payment needed to incentivise the participant, and cover opportunity costs.

For a PES scheme to be economically viable, the willingness of the entity paying should equal or exceed the provider's opportunity cost plus the transaction costs of administering the PES contract (Wunder, 2008). For example, the opportunity cost for a farmer to establish trees for carbon payments could be to forego income from profitable cropland. Rough farm-level opportunity cost calculations will often suffice to evaluate PES feasibility (Barton et al, 2009).

Payments made to individual participants in a scheme can be indexed to output i.e. the quantity of the ecosystem service provided and its determined value (e.g. payments for carbon sequestration or wildlife offspring). In Plan Vivo projects (community-based land-use projects registered under the Plan Vivo Standard[2]) for example, the total level of payment made is directly linked to the quantity of carbon credits delivered and the price that the ecosystem services (Plan Vivo Certificates) can fetch. Payments therefore vary for each participant depending on the buyer's willingness to pay, and quantity of ecosystem service provided in terms of carbon.

Contrastingly, PES programs may base payments on inputs e.g. number of trees planted, or number of working hours clearing exotic species (Engel, 2008). An example is the International Small Group and Tree Planting Program (TIST) in India and Uganda[3]. Participants in TIST are farmers who plant trees in return for staged payments for carbon sequestration services. The level of overall payment received by the farmers is directly related to number of trees planted rather than quantity of carbon sequestered. When trees are cut down, the participant loses part of their payment. This may be particularly appropriate where the output is not perceptible to the landowner so it is more difficult for them to relate to the delivery of that output as a condition of their payment.

The IIED study (2008) found that in general for watershed services, payments are linked to inputs, specifically a payment per area of land brought under the scheme, rather than directly related to a unit of actual water service. One exception was found in Indonesia where payments are linked to the amount of sediment reduction.

Incentives in PES projects are also not always limited to, and do not necessarily include cash payments, although cash payments often form a significant part of incentives. Cash payments often form a significant part of incentives, but incentives are not always limited to cash payments, and incentives may not necessarily include cash payments either. This has led to arguments that the term 'payments for ecosystem services' itself should be changed to a broader term such as 'rewards for ecosystem services' (Jindal et al 2007).

Although in most contexts cash payments are likely to be accepted, introducing cash payments for services that are traditionally non-economically valued might be considered

[2] www.planvivo.org
[3] http://www.tist.org/

socially inappropriate, and non-monetary payments might be preferable (Wunder 2008). Non-cash incentives such as facilities for the community (e.g. a health centre of new school), access to land and tenure rights, loans, project support or access to equipment might form the basis of the compensation or reward. An example of land-tenure rewards for ecosystem services is in Suberjaya, Indonesia, where farmers are given access and rights to land as long as they manage land in a way conducive to watershed conservation. A potential drawback of non-cash incentives such as tenure rights is that, in the case of non-delivery of services, they may be difficult to withhold (Jindal et al 2007).

PES incentives may be given to groups or individuals. For carbon sequestration on private land, payments are often made to individuals. For carbon mitigation on community land (i.e. forest conservation), payments are often made to a community. Where payments are made to a community the PES scheme coordinator must ensure, through acting as a facilitator, that there is agreement in the community on how benefits are to be divided and disbursed.

It is essential for PES scheme viability and equity that payments reach the grassroots level where activities are carried out. A fundamental problem with the market for landscape beauty identified by Mills and Porras (2002) was that tour operators often do not pass on benefits to the grassroots level, to the local land stewards that supply the service. This inequitable set-up was viewed as a crucial hindrance to market development, made possible by an imbalance of power between the provider of the ecosystem service and actors generating revenue from the service, leading to a perpetuation of market externalities.

Mills and Porras (2002) note a move throughout the late 1990s towards recognising that benefits of ecotourism need to be shared, and equitable distribution of benefits including transfers to local communities are often found in definitions of ecotourism. The Mount Cameroon Inter-communal Ecotourism Board[4] describe sustainable ecotourism as needing to be based on three principles:

1. Environmental and socio-cultural compatibility
2. Creation of financial/economic benefits for local communities and ensuring re-investment in infrastructure and wildlife management
3. Creation of environmental and cultural awareness.

The initial development of the scheme involved bringing together all relevant stakeholders including village representatives, local hunters, councils, travel agencies and other businesses and government representatives to agree on the development of a payment mechanism. A simple benefit sharing structure was determined whereby tourists paid guides and porters directly, and an additional 'tourist fee' which goes into a stakeholder fund to be shared by the different groups at the end of each season[5]. The scheme also benefits communities (and probably also biodiversity[6]) through providing local hunters with alternative sources of employment. Some landscape beauty schemes have also established independent trust funds with legally binding mandates to distribute funds.

Many PES projects have contracts for where project period exceeds the payment period. For example, in an effort to assure the permanence of plantations, PROFAFOR increased the contract duration from 15 to 20 years to 99 years. The communities interviewed did not seem to take this extension seriously. Wunder (2007) suggests that the permanence on

[4] See the Mount Cameroon Inter-communal Ecotourism Board website. http://www.mount-cameroon.org/objectives.htm

[5] See http://www.mount-cameroon.org/objectives.htm

[6] Benefits to biodiversity through provision of alternative employment could reasonably be assumed where the hunting level was unsustainable and where the hunting levels reduce through providing alternative employment i.e. the hunter's previous activities are not simply taken over by someone else.

participating lands depends more on long-run socio-economic changes (e.g. population pressure or prices of timber and agricultural products) than on the longer contract duration.

Table 14 below shows the payment mechanism for the PROFAFOR PES project.

Table 13: Example PES carbon sequestration project. Source: Wunder, 2007.

Example PES project:	PROFAFOR, Ecuador
Which ecosystem services does the area generate?	Carbon sequestration The Forests Absorbing Carbon dioxide Emissions Forestation Programme (PROFAFOR) was established in 1994 with carbon-fixing plantations, mainly in the highland region of Ecuador
Are incentives given to individuals or communities?	Incentives go to individual land owners, or incentives go to communities.
How are benefits shared?	Where payments are made to communities, benefits are shared amongst households.
How are levels of payments calculated to ensure they provide a sufficient incentive?	Landowners receive initial payments of US$100-$150/ha for seedling production and plantation, which represents approximately 80% of estimated plantation and management costs which include labour, tools, and transportation. The remaining 20% of payment is paid after three years, on the condition that a minimum seedling survival rate of 75% can be demonstrated. At the end of the 15 to 20 year cycle, a minimum of 70% of the revenue from the sale of harvested trees is received by landowners. If the landowners replant at the end of the cycle, they receive the full payment. If they do not replant, they must pay 30% of harvested sales revenues to PROFAFOR.
Are payments conditional upon inputs or outputs?	20% of payments are conditional upon outputs. The rest of the payment is paid upfront to establish the plantations. 20% of payments are withheld until the 3rd year, and payment is contingent on plantation condition. For individuals, contract compliance is encouraged by establishing a lien on their lands. PROFAFOR has had some success pursuing infractions of individual contracts. For communities, liens are prohibited by law, so community contracts specify that payments be reimbursed if the terms are not fulfilled. PROFAFOR has found it impossible to get defaulting communities reimburse payments.
How frequently are payments made and for how long?	80% of payments are made upfront, and 20% is paid after 3 years, conditional upon the establishment of the plantation.
Are incentives in cash or in kind?	Participants receive both cash payments and payments in-kind. Payments in-kind include seedlings, training, and all by-products (including thinning and pruning).
How are outputs monitored and verified?	Outputs are monitored annually using permanent sample plots from which results are extrapolated to the rest of the contracted

Example PES project:	PROFAFOR, Ecuador
	area. The process has been certified by companies including Swiss company SGS.

6.2 Conditionality of payments

A key factor that distinguishes PES schemes from other conservation approaches is that financing is linked to, and conditional upon, continued delivery of a service (Jindal et al, 2007). It is similar to a trade relationship rather than an aid relationship or 'command and control' measure; Wunder (2005) describes conditionality as the 'business-like principle'. Bond et al (2009), in a review of selected PES schemes commissioned by the IIED, emphasise the importance of the possibility of non-payment and/or exclusion where service providers do not meet the terms of their contract (commonly PES schemes are deficient in this need).

An important caveat to Wunder's working definition of PES is that often there may actually be weak evidence of delivery or quantity of the service provided (Richards and Jenkins, 2007), due to technical difficulties in quantifying services and establishing links between activities and the resulting increase in ecosystem service (e.g. the exact impact of afforestation on water quality). Conditionality might be limited to monitoring the activity undertaken (i.e. the input) rather than measuring outputs.

For payments to be conditional, the environmental service must be monitored. Indicators or "proxies" are developed as performance measures for easy recognition. PES monitoring can be divided into two parts: a) monitoring if the ecosystem providers are following their contracts by carrying out specified land use and b) monitoring if land uses are generating the desired ecosystem services (Engel, 2008). Monitoring by itself is not sufficient to ensure compliance unless non-compliance is sanctioned. In most case studies, the primary sanction for non-compliance is the loss of future payments, either temporarily or permanently (Wunder 2008).

In order to create meaningful incentives where inputs are mainly up-front or in the early years of a PES contract (e.g. for tree-planting), schemes may benefit from weighting payments in the early years (Wunder, 2008). In Plan Vivo projects for example, payments are generally linked to the achievement measureable project 'milestones', such as the number of trees planted, or the percentage of surviving trees. Where these milestones occur early in the project activities, projects have the flexibility to 'frontload' payments. This helps to incentivise participants in the crucial stages when there are high establishment costs, high labour costs, and when project activities have not yet yielded fruit (e.g. benefits such as honey, fruit, or timber).

6.3 Targeting PES finance and minimising transaction costs

PES schemes may vary in the extent to which the PES finance is 'targeted' so that sites generating more or higher value ecosystem services receive higher payments therefore are the most incentivised. Sites at risk of losing ecosystem services may be targeted, and higher payments may be targeted to areas of higher value.

Targeted PES is not a new concept. The Environmentally Sensitive Areas (ESA) Scheme, set up by the UK's Ministry of Agriculture, Fisheries and Forestry (now the Department for Environment, Food and Rural Affairs) in1987, offered incentives to farmers to adopt agricultural practices to safeguard and enhance areas of high landscape, wildlife or historic value. Payments varied widely between areas or 'stages', from £70 per hectare for unimproved pasture land, up to £400 per hectare for buffer strips important for local wildlife[7].

[7] Source: University of Reading website: http://www.ecifm.reading.ac.uk/compensatory_schemes.htm

Targeting has been recommended for the set of publicly-funded Farm Bill conservation programmes in the US. The top three recommendations from the World Resources Institute (Greenhalgh, 2006) to produce the greatest environmental outcome from projects are:

- Allocate finds based on the largest environmental benefit by applying cost-effectiveness criteria
- Standardise the ranking criteria for conservation programs, while leaving the identification of environmental concerns to country technicians and stakeholders
- Link conservation payments to quantitative measures or estimates of environmental performance, where possible.

Despite the obvious benefits of targeting high value sites with higher payments, payments structures are often more simple e.g. flat rates paid per hectare of land managed, particularly in schemes in less developed countries, and where linkages between land-use activities and levels of ecosystem service are less apparent. In the Costa Rican PES scheme for watershed services, payment levels were determined in a relatively ad hoc way, largely due to a lack of precise information on the linkages between forest cover and water services. All participants received the same payment regardless of the area, therefore the payment scheme was thought to not be efficient in its use of PES finance (IIED, 2008, Alpizar et al, 2007). A teak plantation, for example, which harbours less biodiversity and can increase soil erosion rather than preventing it, would lead to the same payment as a native woodlot. Better information on the linkages between different types of forest cover and watershed services in the long term was at the time thought vital to retaining buyers of services and to scheme expansion (Pagiola, 2002).The scheme has now evolved towards greater targeting and therefore more efficient distribution of resources, with a higher proportion of PES contracts for services from important buffer zones in and around biological corridors (Barton et al, 2009).

Another example of targeted payments in a less developed country can be found in Mexico, where higher rates are paid for protection of cloud forest than for other ecosystems (IIED, 2008) in the national PES scheme. Likewise in Honduras (the Copàn program), PES scheme developers developed an index of 15 land-use combinations commonly found in the project area, and ranked them for the level of ecosystem services they were likely to provide (e.g. certified organic coffee farms ranked higher than coffee farms with no shade or soil cover). The 'services ranking' index was developed by international experts and used to determine the level of payment each participant received (Alpizar et al, 2007). Participants are incentivised to move from lower rankings to a higher ranking, but also have the flexibility to improve land–use practices incrementally and choose what suits their circumstances.

The drawback of developing such targeting mechanisms may be the costs involved, and it may be more complex to draw up such targeting indices where PES schemes are developed over larger scales with a wide range of different ecosystem types. Benefits gained from targeting should be balanced with the cost of developing the targeting mechanism (Alpizar et al, 2007). Developments in remote sensing technology and the resulting increased precision of remote quantification of carbon stocks and ecosystem type classification provide opportunities for PES schemes to use more precise proxies (Alpizar et al, 2007), but this depends on the availability of this technology in the project area and technical capacity of the scheme developer to utilise it.

Requirements for service agreements, monitoring and continued participation and record keeping amongst other things mean that PES schemes tend to be relatively "information-intensive", resulting in high transaction costs, particularly in the initial phases of a scheme's design. Initial transaction costs include identifying and bringing together stakeholders, negotiating contract structures and payment mechanisms, identifying sites and setting the

ecosystem service 'baseline' (i.e. what level of service is provided in the absence of PES), and other aspects of system design. Factors likely to lead to higher transaction costs are:

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

Transaction costs once a scheme is up and running are likely to significantly decrease, including continued monitoring, administration of payments, and a continued level of stakeholder engagement. Wunder (2008) cites the example of the Ecuador carbon sequestration project PROFAFOR, where start-up costs were estimated as US $184 per hectare, and running costs once operational were US $3 per hectare.

An example of a project adapting to reduce transaction costs and enable scaling-up is again found in the Costa Rican national PES scheme, where initially the mechanism for accessing payments in the nation was for each participant to submit an individual management plan. This was found to be a barrier to entry, particularly for smaller land holders, and resulting in high transaction costs. In response, a mechanism was introduced, enabling groups of small landholders to aggregate their efforts and submit a joint plan.

6.4 Ensuring additionality

PES schemes, to distribute funds efficiently and ensure that entities' funds actually result in an increase in ecosystem services, clearly need to target areas where ecosystem services can be increased or are under threat. Some of the strengths and weaknesses of the varying levels of precision of payment proxies are summarised in Table 15.

Table 14: Implications of varying levels of precision of proxies used for payments

Proxy used for payment	Level of precision	Strengths	Weaknesses
Area of forest protected (ha) not distinguished by species or ecosystem type, or level of threat to ecosystem service	Low	Simple therefore low development cost, easier to administer, may be perceived as more fair by communities	Less cost-effective, payments may not create additional ecosystem services, no scope for rewarding activities with higher biodiversity benefits
Number of trees per hectare, not distinguished by species or ecosystem type, targeted at areas where services are under threat	Medium	Fairly simple therefore still low development costs, more likely to be additional	May still support activities with negative biodiversity or soil quality impacts
Area of forest protected, distinguished by ecosystem type, with higher payments for more threatened and more valuable ecosystems	High	More likely to be additional and change behaviour, more likely to be cost-effective and protect biodiversity	Higher development cost, more administratively complex, communities may perceive the system as less fair

The Costa Rican example has been criticised for failing to ensure additionality of ecosystem services. As payments for conserving forests were available to all land managers, regardless of whether the land manager intended to, or was likely to clear the forest or not, it is thought that the program was focusing on the wrong land by making payments for ecosystem

services that would likely have been delivered anyway, therefore leading to an inefficient use of resources (Alpizar et al, 2007), as the payments were less likely to result in an actual change in behaviour.

6.5 Avoiding perverse incentives

PES schemes make efforts to avoid perverse incentives (e.g. cutting down natural forest in order to access a reforestation PES scheme).

Earlier incentive schemes for reforestation in Costa Rica was found to be creating perverse incentives for companies to buy up land, deforest and then access incentives for tree-planting. The watershed PES scheme responded to this by including a requirement that timber had not been harvested for 2 years previous to joining the scheme.

6.6 Key observations

- Payments in PES schemes must always be **conditional** i.e. linked to performance or input to ensure conformance to planned activities. The ability of communities to engage in more 'trade-like' relationships is key to motivation and long-term success.
- Payments should be **linked to monitoring** and normally staged over a long period in order to create ongoing incentives, although finance may be weighted towards the beginning of the agreement particularly where there are significant inputs required in earlier stages of implementation.
- Projects require a cost-effective mechanism for engaging participants, such as simple planning tools, template agreements, or the ability to aggregate efforts of multiple participants. Projects often access and work with communities through already formed groups such as cooperatives or local resource management groups
- Payment mechanisms must be equitable and must ensure that payments reach the grassroots level i.e. reaches those implementing the activities generating the ecosystem service, not just the intermediary. A PES scheme developer must therefore consider existing power relations and imbalances between the different stakeholders and actors early on in a scheme's development.
- PES schemes designed to target areas generating the most valuable ecosystem services, particularly in terms of biodiversity benefit, can achieve higher efficiency. This can be achieved by developing more precise proxies. The ability of a scheme to do this may be dependent on the administrative capacity of the intermediary and resources available. There are likely to be trade-offs between cost and precision of targeting possible. Schemes aimed for adoption by developing countries may benefit from erring on the side of simplicity, particularly at first, where possible to stimulate greater uptake.
- Payments should be targeted at area where the ecosystem service is under threat and payments can change behaviour, to ensure services paid for are additional to what would have been delivered anyway in the absence of the PES scheme.
- The **level of finance available** and sustainability of that source of funding should be considered when designing the payment mechanism and levels of payment. Whilst ideally payment levels should be set at a slightly higher rate than opportunity costs, PES scheme developers need to be pragmatic about the availability of finance and what that means in terms of what land use practices can realistically be influenced through PES payments.
- PES scheme developers should consider the **possibility of creating perverse incentives** (e.g. cutting down natural forest in order to access a reforestation PES scheme) and design systems in order to avoid perverse incentives (e.g. exclude participants where natural forest has been felled recently)
- Key **stakeholders** including local communities and local government representatives should meet as early as possible in a scheme's development to discuss levels of involvement, needs and benefit sharing structures.

- Permanence on participating lands may depend more on long-term socio-economic changes (e.g. population pressure or prices of timber and agricultural products) than on contract duration after payments cease. PES schemes should be designed to ensure payments, or other benefits, continue for the duration of the PES contract.
- In designing the payment mechanism the scheme developer should consider whether cash payments are culturally and socially appropriate for the service provider community, and be prepared adapt to local values.

7 Methodology for Assessing Opportunities for PES

There is a substantial body of literature available about PES and PES-like schemes, from which lessons have been learned, and from which it is possible to draw out favourable conditions for a PES scheme, and necessary design steps and key considerations when attempting to set-up a cost-effective and efficient PES scheme.

Key steps were found to include the identifying appropriate high benefit sites, engaging with communities to ascertain local needs and priorities, defining property rights and other relevant social, legal and political background factors, and targeting finance to ensure additionality, equity and long-term incentives.

Key conditions favourable to developing a PES scheme were found to include clear land tenure, organisational capacity in communities and institutions, a stable and long-term source of funding, and a supporting legal and policy environment (the latter being particularly important for scaling-up local schemes to regional or national level).

PES schemes can vary widely in their scale, context and objectives, and their design must be adapted and appropriate to the local context in order to succeed. Flexibility, equity and good governance are key features that should underpin PES scheme design and implementation.

Drawing on the key points presented in this literature review, we propose a methodology to assess the opportunity for a PES program. There are two sections: selecting a site, and designing a PES mechanism. Both are presented with a flowchart outlining the main steps and a table which elaborates on the main points.

Selecting a site

After the initial steps of drawing up a project idea, finding funding, and identifying the project coordinator, a process can be followed to assess the potential of a site as part of a PES programme.

The main points to consider when assessing a site for a PES programme are:

- Political context (is there government approval for the PES programme?)
- Potential ecosystem services (are they at risk?)
- Community (does the community have organisational capacity?)
- Legal context (are there land-tenure or resource-use agreements?)
- Practicality of the economics (is there enough funding to incentivise participants?)

Once all of these points have been considered, a decision can be made as to whether or not a site is acceptable to be included in a PES programme.

Designing the PES mechanism

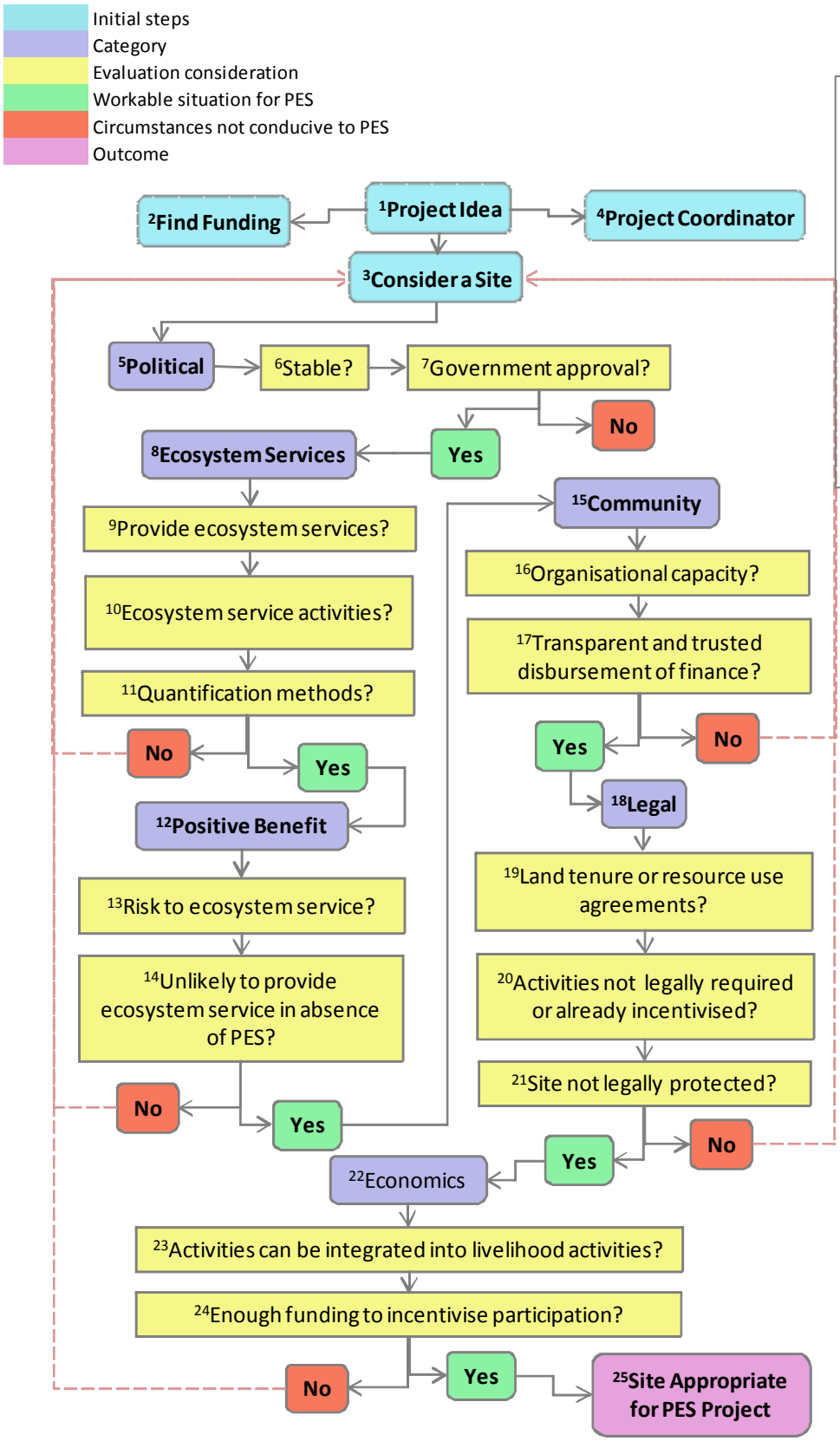
After the initial steps of drawing up a project idea, finding funding, and identifying the project coordinator, and identifying potential project sites, a process can be followed to design the PES mechanism.

The main points to consider when designing a PES mechanism are:

- Targeting payments (maximise benefits from ecosystem services)
- Conditionality (link payments to the delivery of ecosystem services)
- Selecting the form of payment (incentives may be in cash or in kind)
- Equity (ensure stakeholder and community involvement to reach equitable distribution of benefits)
- Transaction costs (make the payment mechanism efficient

Once all of these points have been considered and a PES mechanism has been designed, pilot activities may be implemented. If pilot activities are successful, activities can be scaled up to include additional sites or additional activities. Actions in aggregate make a difference.

Figure 5: Site selection process



Starting with the project idea, follow the arrows of the flow chart through site evaluation criteria. If the site does not have attributes desired for PES projects (No), follow the arrow back to the project idea or beginning of the site selection process, if it does have desired attributes (Yes), continue.

Table 15: Site selection process

No.	Box title	Description
1	Project idea	The initial project idea may be from the developer, co-ordinator, or community.
2	Find funding	For some projects, a known source of funding already exists. For other projects, funding must be found after the idea, plan, and site evaluation has been done.
3	Consider a site	Consider a potential site as the location of a PES project.
4	Project coordinator	The project coordinator is usually an existing local or national organisation. The Co-ordinator engages with the community, drawing on their experience and understanding of the community. A co-ordinator must have a clear governance structure and transparent record keeping.
5	Political	Political context for the PES project at the site under consideration.
6	Stable	The region should be sufficiently stable to host a long-term PES project.
7	Government approval	Government approval of the project is an enabling condition.
8	Ecosystem services	Ecosystem services which can be generated and quantified at the site under consideration.
9	Provide ecosystem services?	Does or will the site generate ecosystem services? Potential ecosystem services include: carbon sequestration, watersheds, biodiversity conservation, and landscape beauty.
10	Ecosystem service activities?	What are the existing land uses and land cover types? Is the site appropriate for the ecosystem services identified?
11	Quantification methods	Are there methods to cost-effectively quantify the ecosystem services identified? Will proxies be used to as an indicator of the ecosystem services? If so, is there sufficient evidence of a link between the proxy (or land use) and ecosystem service? Rapid biophysical assessment methods can help to reduce costs of setting baselines. Where economically possible, more precise proxies should be developed to target areas generating the most valuable ecosystem services, particularly in terms of biodiversity benefit to achieve higher efficiency.
12	Positive benefit	Would the PES project bring added benefit above what is planned in absence of the project?
13	Risk to ecosystem services	What is the risk of losing the ecosystem services? If there is a threat to the ecosystem services, the project would likely bring additional benefits.
14	Unlikely to provide ecosystem services in absence of PES?	Are land managers likely to provide ecosystem services in the absence of PES?
15	Community	Community capacity at the site under consideration for a PES project.
16	Organisational capacity	Organisational capacity within the community is necessary for a PES project to function efficiently and equitably. Have community members organised into groups such as farmers' cooperatives or resource management groups?
17	Transparent and trusted disbursement of finance?	Has the community had experience with finance? Transparent and trusted disbursement of finance is necessary for a PES project to function efficiently and effectively.
18	Legal	Legal context for the site under consideration for a PES project. For scaling-up, it is helpful when the legislative framework to recognises the importance of ecosystem services.

No.	Box title	Description
		Are there any restrictions on what public funds may be used which could constrain PES payments? Are there legal restrictions about how private or public finance can enter the country?
19	Land tenure or resource use agreements?	Project participants must have clear, long-term undisputed land-tenure or resource use agreements.
20	Activities not legally required or already incentivised?	If ecosystem service-generating activities are legally required or already incentivised, it may be difficult to demonstrate the additional positive benefits of a new PES project at this site.
21	Site not legally protected?	If the site is already legally protected, it may be difficult to demonstrate the additional positive benefits of a new PES project at the site.
22	Economics	Economic context at the site under consideration.
23	Activities can be integrated into livelihood activities?	Is it possible to integrate ecosystem system-generating activities into existing or future livelihood activities?
24	Enough funding to incentivise participation?	Is there enough funding to incentivise participation (i.e. Does the payment level offered exceed opportunity costs?)
25	Site appropriate for PES project	If all of the factors above have been answered positively, the site is likely acceptable as a PES project location.

Starting with the project idea, follow the arrows of the flow chart through the PES mechanism design process. If the steps require further consideration (No), follow the arrow back to the project co-ordinator.

Figure 6: PES mechanism design process

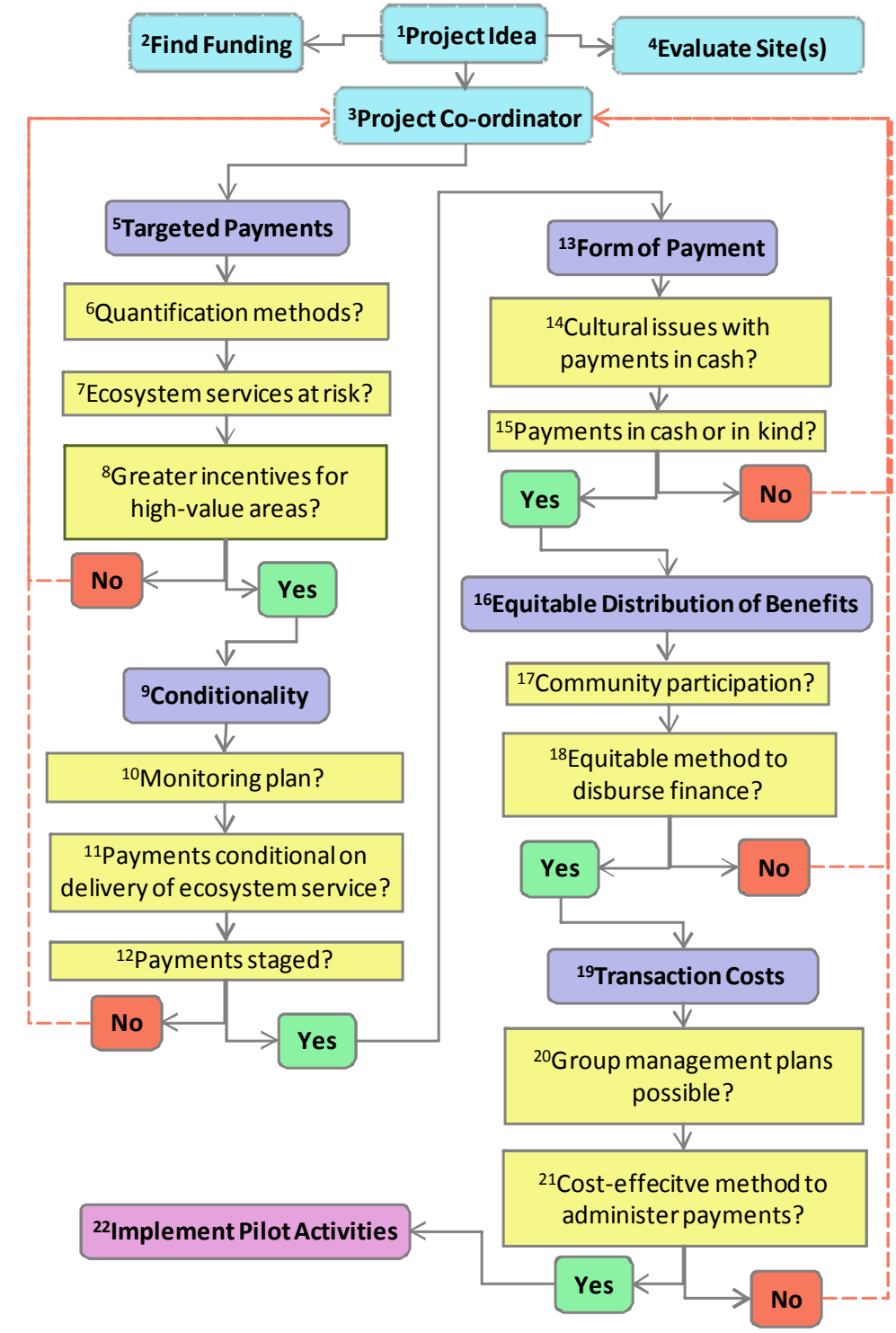


Table 16: PES mechanism design process

No.	Box title	Description
1	Project idea	The initial project idea may be from the developer, co-ordinator, or community.
2	Find funding	Service users, or an organisation on their behalf (e.g. government) must recognise the benefit of the service and be willing to pay for the service. Service users, particularly governments, may be more willing to pay for schemes with co-benefits, particularly poverty reduction and community development.
3	Evaluate site(s)	See the site evaluation process flowchart.
4	Project co-ordinator	The project co-ordinator is normally an existing institution that has experience working with the service providers. The project co-ordinator uses sound and transparent record keeping and is able to adapt to socio-economic changes. The project co-ordinator has the capacity to enter into and negotiate long-term contractual agreements. Setting up a project co-ordinator involves a consultation with stake holders and consideration of how different stakeholders can be represented in the co-ordinator.
5	Targeted payments	The ability to target payments may depend on the capacity of the project co-ordinator. PES scheme developers should avoid creating perverse incentives (e.g. cutting down forest to access reforestation payments).
6	Quantification methods?	The ability to target payments may depend on the sophistication of the proxy to measure ecosystem services.
7	Ecosystem services at risk?	Are incentives targeted to areas where ecosystem services are at high risk (e.g. threatened natural forest)? Payments should be targeted to areas where the ecosystem service is under threat and payments can change behaviour, to ensure services paid for are additional to what would have been delivered without the project.
8	Greater incentives for high-value areas?	Are targets weighted to target maximum delivery of ecosystem services? Are greater incentives offered to land-owners in high-value areas (e.g. areas of high biodiversity value?)
9	Conditionality	Link payments to the delivery of ecosystem services.
10	Monitoring plan?	Is there a monitoring plan to track to progress of the project?
11	Payments conditional on delivery of ecosystem service?	Are sanctions employed with monitoring targets are not met?
12	Payments staged?	Are payments staged over a period of time? Over what length of time are payments made? Payments may be weighted to early stages help to cover start-up costs (e.g. tree-planting).

No.	Box title	Description
		Payments should be staged over a long period to create ongoing incentives and continue for the duration of the PES contract, although finance may be weighted to the beginning of the contract.
13	Form of payment	What form of payment do service providers want? The level of finance available should be considered when designing the payment mechanism and levels of payment.
14	Cultural issues with payments in cash?	Does the community have experience managing money? In designing the payment mechanism, the scheme developer should consider whether cash payments are culturally appropriate.
15	Payments in cash or in kind?	Payments may be made in cash, technical support, tenure rights, and products from ecosystem services (e.g. honey, timber).
16	Equitable distribution of benefits	Distribute benefits in a fair manner. Key stakeholders should meet as early as possible in a scheme's development to discuss benefit sharing structures.
17	Community participation?	Engage communities in participatory discussions to determine equitable distribution of benefits. The project co-ordinator conducts continuing consultation, resolves potential disputes, and aids resolution of land-right disputes.
18	Equitable method to disburse finance?	How will groups disburse payments? Who receives payments - individuals or groups?
19	Transaction costs	How can transaction costs be minimised?
20	Group management plans possible?	Can service providers aggregate their efforts (e.g. submit a group management plan)? Aggregating efforts can reduce transaction costs.
21	Cost-effective method to administer payments?	What is the most cost-effective mechanism to administer payments? Projects require a cost-effective mechanism for engaging participants, such as template agreements.
22	Implement pilot activities	Once a PES mechanism has been designed, implement pilot activities. Implementation of national PES programmes is likely to require significant start-up funding to develop infrastructure. Pilot projects can play a significant role in providing lessons.

8 Glossary

Ecosystem:

An ecosystem consists of the biota (plants, animals, microorganisms) within a given area, the environment that sustains it, and their interactions. It can be a spatial unit of any size, from a micro site to a large-scale and biome-based ecosystem, like a tropical rainforest (Society for Ecological Restoration, 2004).

Ecosystem services:

Ecosystem services are the benefits provided by ecosystems (Millennium Assessment, 2005).

- Provisioning services
- Supporting services
- Regulating services
- Cultural services

Natural ecosystem:

Natural ecosystems and the biodiversity they contain – living species and ecosystems - are considered renewable natural capital (Aronson, 2008).

Managed ecosystem:

A managed ecosystem is managed to meet both ecological and human needs – the ecosystem is viewed as a natural resource (Green Facts, 2009).

9 References

Alipizar, F., Blackman, A., and Pfaff, A. (2007) *Payments for Ecosystem Services: Why Precision and Targeting Matter,* Resources 165, Spring 2007

Anoka Natural Resources. *Wetland banking. Accessed Online Dec 2009.* http://www.anokanaturalresources.com/wetlands/banking/introduction.htm

Aronson, James Blignaut & James. (2008) *Getting serious about maintaining biodiversity.* Policy perspective. 2008, February.

Avoided Deforestation Partners.org. *"Methods for stratification of the project area", REDD Methodological Module. Version 1.0*. April 2009

Barton, D., N., et al (2009) *Assessing the role of economic instruments in a policy mix for biodiversity conservation and ecosystem services provision: a review of some methodological challenges.* Munich Personal RePEc Archive

Bond, I., Grieg-Gran, M., Wertz-Kanounnikoff, S., Hazlewood, P., Wunder, S., Angelsen, A. (2009*) Incentives to sustain forest ecosystem services: A review and lessons for REDD*, Natural Resource Issues No. 16. International Institute for Environment and Development, London, UK, with CIFOR, Bogor, Indonesia, and World Resources Institute, Washington D.C., USA.

Boyd, J., and Wainger, L. 2003. *Measuring Ecosystem Service Benefits: The Use of Landscape Analysis to Evaluate Environmental Trades and Compensation.* Resources for the Future. Discussion Paper 02-63

Carpenter, S.R., Mooney, H.a., Agard, J., Capistrano, D., DeFries, R.S., Díaz, S., Dietz, T., Duraiappah, A.K., Oteng-Yeboah, A., Pereira, H.M., Perrings, C., Reid, W.V., Sarukhan, J., Scholes, R.J., Whyte, A. (2009) *Science for managing ecosystem services: Beyond the Millennium Ecosystem Assessment.* Proc Natl Acad Sci USAm, vol. 106, no. 5, pp 1305–1312

Castano, M.T.B. Meulenberg and Van Tilburg. *A new method of measuring the adoption of soil conservation practices; theory and applications*. Netherlands Journal of Agricultural Science 50 (2002) 95-114

Department of Environment, Climate Change and Water. 2008. Environmental Issues - Glossary. *New South Wales Government, Department of Climate Change and Water.* [Online] New South Wales Government, December 2008. [Cited: 6 August 2009.] http://www.environment.nsw.gov.au/salinity/glossary.htm.

Department of Environment, Climate Change and Water. 2009. Overview of the Biodiversity Credit Market. BioBanking Biodiversity and offests scheme. New South Wales Government, December 2008. [Cited: 15 December 2009.] http://www.environment.nsw.gov.au/resources/biobanking/099335creditmo.pdf

European Commission, Directorate-General for Agriculture and the Common Agricultural and Rural development. *Europe's agriculture and the Common Agricultural Policy (CAP) – Frequently asked questions.* April, 2009. Available online: http://ec.europa.eu/agriculture/faq/faq_en.pdf

European Commission, Directorate-General for Agriculture and the Common Agricultural and Rural development. *Agriculture and the environment. Accessed online Dec 2009 (A).* http://ec.europa.eu/agriculture/envir/index_en.htm

European Commission, Directorate-General for Agriculture and the Common Agricultural and Rural development. *Agri-Environment Measures. Accessed online Dec 2009 (B).* http://ec.europa.eu/agriculture/envir/measures/index_en.htm

Engel Stefanie, Pagiola Stefano, Wunder Sven. *Designing payments for environmental services in theory and practice: an overview of the issues.* Ecological economics 65 (2008) 663 – 674

Giller, Witter, Corbeels, Tittonell. *Conservation agriculture and smallholder farming in Africa: The heretics' view.* Field Crops Research, Volume 114, Issue 1, 1 October 2009, Pages 23-34

Greenhalgh S. Selman M, and Guiling, Paying for Environmental Performance: Investing in Farmers and the Environment. **WRI, World Resources Institute**, July 2006.

Haapoja, M. *Conservation easements: are they for you?* American forests. Jan-Feb 1994.

Hawn, A. *Malua Wildlife Habitat Conservation Bank Launches in Sabah, Malaysia. New Business Model Generates Innovative Product to Support Wildlife Conservation.* http://www.maluabank.com/20080814_malua_biobank_release.pdf Malua Biobank,. 2008.

IPCC. *Good Practice Guidance for Land Use, Land-Use Change, and Forestry*. 2003. Website: http://www.ipcc-nggip.iges.or.jp/public/gpglulucf/gpglulucf_contents.html

Jack, B.K., Koushy, C., Sims, R.e. (2008) *Designing payments for ecosystem services: Lessons from previoud experience with incetnvie based mechanisms.* Proc Natl Acad Sci USA. Vol. 105: 9465-9470

Jennings Steve, Nussbaum Ruth, Judd Neil, Evans Tom. *The High Conservation Value Forest Toolkit.* Edition 1. ProForest, 2003.

Jindal, R., Kerr, J., Dillaha, T., Colby, M. *(2007)USAID PES Sourcebook: Lessons and best practices for pro-poor payment for ecosystem services.* Available at: http://www.katoombagroup.org/details.php?id=56

Johst, K., Drechster, M., Watzold, F. 2002. *An ecological-economic modelling procedure to design compensation payments for the efficient spatio-temporal allocation of species protection measures.* Ecological Economics 41 (2002) 37–49

Kaimowitz, D. (2000) *Useful Myths and Intractable Truths: The Polotics of the Link between Forests and Water in Central Amercia.* San Jose, CIFOR.

Karlen, D.L., Mausbach, M.J., Doran, J.W., Cline, R.G., Harris, R.F., Schuman, G.E., 1997. *Soil quality: a concept, definition and framework for evaluation*. Soil Sci. Soc. Am. J. 61, 4–10.

Krupnick, A., J., and Siikamaki, J., (2007*) How People Value What Nature Provides,* Resources 165, Spring 2007

K:TGAL. Project team Kyoto: Think Global, Act Local. *A Field Guide for Assessing and Monitoring Reduced Forest Degradation and Carbon Sequestration by Local Communities. Part 2: for trainers,* 2009.

MacDicken K.G. *A Guide to Monitoring Carbon Storage in Forestry and Agroforestry Projects*. Winrock, 1997.

Malua Biobank. Malua Biobank website: http://www.maluabank.com/ MWHCB Inc., 2009.

Markit. *Markit Environmental Registry*. Website**: http://www.tz1market.com/market.php** Markit, 2009.

Millenium Ecosystems Assessment (2005) *Ecosystems and human wellbeing.* Millenium Ecosystems Assessment. Washington : Island Press. Available at: http://www.millenniumassessment.org/en/Synthesis.aspx

Moen, J.E.T., Cornet, J.P., Ewers, C.W.A., 1986. *Soil protection and remedial actions: criteria for decision making and standardisation of requirements.* In: Assink, J.W., van den Brink, W.J. (Eds.), Contaminated Soil. Martinus Nijhoff Publishers, Dordrecht, pp. 441–448.

Nortcliff Stephen. *Standardisation of soil quality attributes. Agriculture, Ecosystems and Environment* 88 (2002) 161–168

O'Dea, N. Watson, J and Whittaker, R. *Rapid assessment in conservation research: a critique of avifaunal assessment techniques illustrated by Ecuadorian and Madagascan case study data.* Diversity and Distributions, A journal of conservation biogeography Volume 10 Issue 1, Pages 55 – 63. 2004.

Pagiola, S. (2002) *Paying for Water Services in Central America: Learning from Costa Rica.* In **Pagiola, S., Bishop, J., and Landell-Mills, N. (ed)** *Selling Forest Environmental Services, Market-based Mechanisms for Conservation and Development*. Earthscan 2002

Pagiola, S., Agostini, P., Gobbi, J., De Haan, C., Ibrahim, M., Murgueitio, E., Ramírez, E., Rosales, M., Ruíz, J.P. (2004) *Paying for Biodviserisity Conservation Services in Agricultural Landscapes,* ENVIRONMENT DEPARTMENT PAPER NO. 96, Environmental Economics Series

Pearson T, Walker S, and Brown S. *Sourcebook for Land Use, Land-Use Change and Forestry Projects.* Winrock International, 2005.

Porras et al. (2008) *All that glitters: A review of payments for watershed services in developing countries.* Natural Resource Issues No. 11, 2008. International Institute for Environment and Development. London, UK.

Richards, M., and Jenkins. (2007) *Potential and Challenges of Payments for Ecosystem Services from Tropical Forests*, Forest Policy and Environment Programme, Forestry Briefing 16, Dec. 2007.

Sanchirico, J., N. & Siikamaki, J., V., (2007) *Natural Resource Economics and Policy in the 21st Century: Conservation of Ecosystem Services*, Resources 165, Spring 2007

Scottish Natural Heritage. *Natural Care Strategy*. **Accessed Online Dec 2009.** http://www.snh.org.uk/about/ab-pa08b.asp

Society for Ecological Restoration. (2004) The SER International Primer. *Society for Ecological Restoration International.* [Online] Society for Ecological Restoration, 2004. http://www.ser.org/content/ecological_restoration_primer.asp#5.

Tallis, H., Kareiva, P., Marvier, M., and Chang, A. (2008) An ecosystem services framework to support both practical conservation and economic development. Proc Natl Acad Sci USA 105:9457–9464.

TEEB – *The Economics of Ecosystems and Biodiversity for National and Intetnational Policy Makers – Summary: Responding to the Value of Nature* **(2009).**

ten Kate K., Bishop J., Bayon R. (2004) Biodiversity offsets: Views, experience, and the business case. IUCN,

UF, University of Florida. Conservation easements, Living Green. Accessed Online Dec, 2009. **http://livinggreen.ifas.ufl.edu/natural_history/conserv_easements.html**

University of Leeds. *Participatory Methods Training Workshop Manual*. 2008.

VCS. Voluntary Carbon Standard. *Guidance for Agriculture, Forestry, and Other Land Uses.* 19 Nov 2007.

Wunder,S. (2005) *Payments for environmental services: some nuts and bolts.* Occasional Paper No. 42. Bogor, CIFOR.

Wunder, S. (2008) *Necessary Conditions for Ecosystem Service Payments.* Conference Paper, Economics and conservation in the Tropics, Jan 31 – Feb 1, 2008.

Wunder S and Alban M. *Decentralized payments for environmental services: The cases of Pimampiro and PROFAFOR in Equador*. Elesevier, 2007.

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

Wunsher Tobias, Engel Stephanie, Wunder Sven. *Spatial targeting of payments for environmental serices: a tool for boosting conservation benefits*. Ecological economics 65 (2008) 822-833. Elsevir.

A. Appendix: Examples of PES schemes. Source: Wunder et al. 2008

No.	Case, country	Environmental services provided	Activities paid for	Land use - service link	Additionality	Leakage	Permanence
1	Los Negros, Bolivia	Watershed and biodiversity protection	Forest and páramo conservation	Assumed, not proven	Probably low, as low-threat areas are enrolled	Low; some at farm level	Not secured beyond contract period
2	Pimampiro, Ecuador	Watershed protection	Forest and páramo conservation/restoration	Assumed, not proven - likely in part	High, for land use: clear trend change towards conservation	Zero; no effect displaced within watershed	Not secured beyond contract period
3	PROFAFOR, Ecuador	Carbon sequestration	Re- and afforestation	Explicit	High (visa-a-vis baseline)	Low - some livestock substitution	Not secured beyond contract period
4	Vittel (Nestlé Waters), France	Water quality	Best practices in dairy farming	Explicit at plot level	High, clearly improved water quality	Zero	Not secured beyond contract period
5	Sloping Land Conversion Program (SLCP), China	Watershed protection	Cropland retirement, conversion to grasslands, re- and afforestation	Assumed so far - ongoing research to quantify	High for land retirement; lower for reforestation	Basrely studied, one survey suggests leakage does occur	Not secured beyond contract period, but estimated at 60%
6	Payments for Environmental Services (PSA), Costa Rica	Water, biodiversity, carbon, scenic beauty	Forest conservation, timber plantations, agroforestry	Explicit, good research on aliens on water runoff	Unclear - studies give widely divergent results	Low	Not secured beyond contract period
7	Payments for Hydrological Environmental Services (PSAH), Mexico	Watershed and aquifer protection	Conservation of pre-existing forest area	Extensive research, but not explicitly modelled	Unknown - evidence that some low-threat areas are offered	Not yet tested. Within villages, depends on % of area under contract	Scheme renewal uncertain; hoped-for transition to timber forestry + some local PES

No.	Case, country	Environmental services provided	Activities paid for	Land use - service link	Additionality	Leakage	Permanence
8	Conservation Reserve Program (CRP), USA	Water, soil, wildlife protection (also air, carbon)	Benign agricultural practices and agricultural land retirement	Explicit, thresholds well-documented	Not researched	For CRP, estimates vary from small to 21%	Not secured beyond contract period - but estimated at 49% for CRP
9	Environmental Quality Incentives Program (EQIP), USA	Water, soil, wildlife protection (also air, carbon)	Benign agricultural practices and agricultural land retirement	Modelled, service provision estimated	Not researched	For CRP, estimates vary from small to 21%	Not secured beyond contract period - but estimated at 49% for CRP
10	Environmentally Sensitive Area (ESA) and Countryside Stewardship Scheme (CSS), United Kingdom	Biodiversity, recreation, watershed protection	Benign agricultural practices and agricultural land retirement	Modelled, service provision estimated	Significant effect on agricultural margins - little on prime agricultural lands	some on-farm leakage; little in the larger landscape	Low (CCS: two thirds recipients reapply)
11	Northeim model project, Germany	Agrobiodiversity	Agricultural practices that raise species richness	Explicit, thresholds well-documented	Probably high, as participants extensive agricultural practices decline	Not available	Not secured beyond pilot phase, but targeted at CAP
12	Wimmera, Australia	Groundwater salinity control	Land-use changes reducing ground water recharge	Modelled - ES provision estimated	Designed high: ES outcome- oriented targeting	Negligible risk predicted	Not secured beyond contract period - but some changes may last
13	CAMPFIRE, Zimbabwe	Hunting, landscape beauty, biodiversity conservation	Conservation of/ access to natural landscapes	Explicit: wildlife habitat dependence	Marked rise in wildlife population and hunting revenues	Limited, since prime wildlife areas are targeted	Not secured, but changed local attitudes to wildlife

No.	Case, country	Environmental services provided	Activities paid for	Land use - service link	Additionality	Leakage	Permanence
14	Working for Water (WfW), South Africa	Watershed protection, biodiversity	Clearing alien invasive plants	Extensive research, but not explicitly modelled	High, demonstrated improved runoff	None	Not secured beyond contract period, but some lasting changes

No.	Case, country	Buyers	Beneficiaries	Intermediaries	ES provider / seller	Payment (US$/ha/yr)	Timing of payment
1	Los Negros, Bolivia	Pampagrande Municipality, US Fish and Wildlife Service	Local water users, mostly irrigators	Fundación Natura (NGO)	Santa Rosa farmers (46 landowners)	1.5–3.0	Annual, ex ante
2	Pimampiro, Ecuador	Metered urban water users (20% fee)	Unmetered water users, irrigators	CEDERENA (NGO)	N. América Coop. (81% of members)	6–12	Monthly, post monitoring
3	PROFAFOR, Ecuador	FACE (Electricity consortium)	Climate change mitigation beneficiaries	PROFAFOR (buyer organ)	Communal and individual landholders	100–200 (up front)	Years 1–3 plus tree harvests
4	Vittel (Nestlé Waters), France	Vittel	River basin agency	Agrivair (buyer-created agricultural extension agency)	Dairy farmers — all 27 farms enrolled	300 for 5 yr up to 225,000/farm cost reimbursements	NA
5	Sloping Land Conversion Program (SLCP), China	Central government	Downstream water users, timber consumers	Village, township and county governments	Rural households	Cash: 36; Total cash equiv. 217–308 (2005); de facto lower and highly variable	Annual, normally
6	Payments for Environmental Services (PSA), Costa Rica	FONAFIFO (autonomous state agency)	Tourism industry, water users	FONAFIFO (autonomous state agency), with support from SINAC, NGOs, private forest engineers	Private landholders, indigenous communities	45–163	Annual, after monitoring compliance

No.	Case, country	Buyers	Beneficiaries	Intermediaries	ES provider / seller	Payment (US$/ha/yr)	Timing of payment
7	Payments for Hydrological Environmental Services (PSAH), Mexico	CONAFOR (state forest agency)	All water users in watershed and those using aquifers	Water Commission collects, Finance Ministry transfers, Forestry Commission administers	Communal and individual landowners	27–36	Annual, ex post
8	Conservation Reserve Program (CRP), USA	US government	Natural resource users (e.g. Water users, recreation)	None	Farmers	Variable	Annual
9	Environmental Quality Incentives Program (EQIP), USA	US government	Natural resource users (e.g. Water users, recreation)	None	Farmers	Variable	Annual; post adoption (EQIP)
10	Environmentally Sensitive Area (ESA) and Countryside Stewardship Scheme (CSS), United Kingdom	UK government+EU	Natural resource users (e.g. recreation, water users)	Government agency (DEFRA)+ NGOs	Farmers in targeted areas	ESA: 20 (2003) CSS: 16 (2003)	Share of initial capital costs; annual payments
11	Northeim model project, Germany	Private foundation (targeted at CAP)	Recreational beneficiaries of regional biodiversity	University of Göttingen, with district authorities	Farmers in model region	Variable	Annual, ex post
12	Wimmera, Australia	Australian government	Downstream water users	Wimmera Catchment Management Authority	Landholders in Steep Hill Country	Variable	Large upfront payment
13	CAMPFIRE, Zimbabwe	Private safari operators and international	Global conservation community	RDCs (in part representing communities)	Communities through Rural District Councils	Cash to RDC; mostly in-kind to	NA

No.	Case, country	Buyers	Beneficiaries	Intermediaries	ES provider / seller	Payment (US$/ha/yr)	Timing of payment
		donors			(RDCs)	communities	
14	Working for Water (WfW), South Africa	Central government (85%) and water users (15%)	Landowners whose land productivity increases	WfW (buyer organ)	WfW, by employing workers	Not area-based	Paid ex post, contract-based

No.	Case, country	Monitoring	Conditionality	Obstacles to implementation
1	Los Negros, Bolivia	Yearly site inspection	High in principle — but de facto still untested	Trust building slow, low water-user payments
2	Pimampiro, Ecuador	Quarterly site inspection — now deteriorating	High, lately some decline	Monitoring costs, free riders, link land use–service
3	PROFAFOR, Ecuador	Yearly site inspection + aggregate model	High for individual owners, lower for communities	Fires, grazing — constraints in communal capacity and incentives
4	Vittel (Nestlé Waters), France	Farm inspection (at unknown frequency)	High	Integrating non-agricultural sector (golf course, etc.)
5	Sloping Land Conversion Program (SLCP), China	Frequent by village officials, less by township/ county, random by upper-level government	High for area retired, lower for successful forest plantation	Local government administration overburdened; local governments retain farmer payments
6	Payments for Environmental Services (PSA), Costa Rica	Compliance monitored by private forest engineers, with sample audited	High	Funding availability, knowledge of land use–service links
7	Payments for Hydrological Environmental Services (PSAH), Mexico	Forest cover: yearly satellite image analysis; random (few) site visits	High compliance wrt. forest-cover conservation (water service not monitored)	Rent seeking by communities with timber firms

No.	Case, country	Monitoring	Conditionality	Obstacles to implementation
8	Conservation Reserve Program (CRP), USA	CRP: Annual inspection of 5% contract sample	Conservation work needs be completed before payment, but low inspection rate	Links land use– service little researched; political factors reduce efficiency
9	Environmental Quality Incentives Program (EQIP), USA	EQIP: 17% nonfull compliance	Conservation work needs be completed before payment, but low inspection rate	High admin. costs and transactions cost of customized schemes
10	Environmentally Sensitive Area (ESA) and Countryside Stewardship Scheme (CSS), United Kingdom	By DEFRA, universities, etc. — low annual sample (5%)	Low risk for non-compliers of getting caught	Not available
11	Northeim model project, Germany	Annual full inspection	High	Service property rights/metric; monitoring costs; risk of reducing other incentives
12	Wimmera, Australia	Random (audit style approach) — results publicized (accountability)	Designed as such — but reduced by large upfront payments and low sanction risk	Not available
13	CAMPFIRE, Zimbabwe	Wildlife ground counts, aerial and satellite imagery	Apparently high compliance	Power struggles, RDC nondevolution, recentralisation
14	Working for Water (WfW), South Africa	Works self supervised by WfW	Clear: payment provided only if clearing work is done	High cost of clearing