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Abstract

PES is but one of many different instruments that can complement and stimulate an enabling policy environment for sustainable agricultural development. Currently the role of PES programmes in supporting sustainable agricultural development is quite limited. Recent surveys of the literature documenting PES experiences highlight three main features of such programmes as they are currently being implemented: (1) most do not demonstrate additionality and suffer from a lack of appropriate targeting; (2) most are designed with multiple objectives; and (3) most remain primarily or entirely funded by the public sector. In this paper, we argue that a public-sector-driven process of building PES programme readiness, which includes building partnerships with the private sector, is key to realizing the potential of this policy instrument to support sustainable agricultural development. Our analysis indicates three important areas where public-sector involvement could improve the capacity of PES programmes to support sustainable agricultural development: (1) reducing transaction costs and fostering replication; (2) providing an enabling policy environment; and (3) ensuring equity and capturing multiple benefits. While there is considerable potential for changes within agricultural production systems to generate environmental services, to realize their benefits, in most cases, PES programmes will need to be implemented across large numbers of producers and areas to realize economies of scale in transaction costs and risk management. At the same time they must be designed to support flexibility required in livelihoods and equity issues in rural communities.

Key Words: environmental services, sustainable agricultural development, economic incentives

JEL:

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1 The role of payments for environmental services (PES) in sustainable agricultural development

The agriculture sector is developing countries needs to grow to meet the challenges of feeding a growing global population and reducing food insecurity (Bruinsma 2009). Given the increasing scarcity of natural resources and the growing awareness of environmental degradation costs, developing and implementing sustainable agricultural growth strategies is essential. Experience with agricultural growth and intensification over recent decades has indicated the importance of policies and institutions in enabling and shaping the transformation and growth of agricultural production systems. Until recently, accounting for the value of natural resources and environmental goods – within and external to agricultural production systems in developing country agricultural policy making and institutions – has been largely absent or ineffective (FAO 2007a; TEEB 2010). Consequently, agricultural growth and development has been accompanied by extensive and expensive depletion of natural resources and environmental degradation (Tillman et al 2002; MEA 2005). Promoting sustainable agricultural development has seen renewed interest, together with a search for policy and institutional innovations to support it. PES is a relatively new policy instrument designed to provide incentives for the provision of positive environmental externalities.[1] The focus of this paper is on assessing the experience and potential of PES programmes in supporting sustainable agricultural development.

FAO estimates that the number of chronically hungry people in the world has reached a total of 925 million (FAO 2009a). About 75% of the worst-affected people reside in rural areas of developing countries, their livelihoods depending on agriculture for food and income (FAO 2009b). Global population levels are expected to reach about 9.2 billion by 2050. Projections indicate that agricultural production has to increase above year-2000 levels by about 70% globally and 100% in developing countries, to meet global food demands (Fischer et al. 2002; Bruinsma 2009). Increasing the productivity and returns to smallholder agriculture is the key means to reducing food insecurity and poverty in agricultural-based economies (World Bank 2008; de Janvry and Sadoulet 2010).

Recent decades have seen considerable success in agricultural growth in many developing countries, due in part to the broad adoption of “green revolution” technologies, including improved varieties, fertilizers and pesticides. However, this success has come at the price of serious environmental degradation. The Millennium Ecosystem Assessment (2005) reported that about 60% of the ecosystems studied were being degraded or used unsustainably, with pressure on land resources being intensified by continued human population growth and climate change environmental degradation associated with agricultural development gives rise to both private and public costs. Examples of the former include reductions in farm productivity and input efficiency (e.g. Ali and Byerlee 2000), while water pollution and greenhouse gas emissions are examples of the latter (FAO 2007; Molden 2007; FAO 2009c).

The combination of food price spikes in 2008 and increasing concerns about climate change impacts have resulted in renewed interest in promoting sustainable agricultural development, e.g. agricultural growth that is ecologically sound, financially rewarding and socially just, and one that aims to produce the food, and/or the incomes needed to achieve

[1] Externalities are defined as third party effects arising from the production and/or consumption of goods and services for which no appropriate compensation is paid.

food security (FAO 2002a; FAO 2009a). Attaining this goal requires investments into an enabling institutional environment, as well as the provision of incentives to farmers to make changes in their production practices. While there is no consensus on a specific definition for sustainable agricultural development and intensification, it will clearly involve increasing positive and reducing negative environmental externalities associated with production systems (FAO 2007a; Tillman 2002).

There are several examples of systems, practices and technologies currently being implemented which generate benefits to both agricultural production[2] and environmental public goods (FAO 2007a). Sustainable crop and livestock practices maximizing synergies with ecosystem functions governing water and nutrient cycling, nitrogen fixation, and pest management can improve soil quality and make more efficient use of available water, increase resilience to climate change and improve food production and income, while providing or protecting environmental services. (Royal Society of London 2009; Godfray et al. 2010; FAO 2007b; Molden 2007; Pretty et al. 2006; PASOLAC 1999; WOCAT 2007; FAO 2009c). Sustainable land management (SLM) is one broad category of such practices. These practices[3] aim to reduce soil disturbance and maintain permanent soil cover, increase water retention and minimize the use of synthetic inputs by resorting to integrated pest management and plant nutrition systems (FAO 2002b). Their goal is to maintain long-term productivity of ecosystem functions (land, water, biodiversity) and increase productivity (quality, quantity and diversity) of agricultural goods and environmental services (TerrAfrica 2006, cited in FAO 2008a).

Aside from changes within agricultural production systems, changes in land-use practices – such as reduced expansion of agricultural lands and/or conversion of agricultural lands to non-agricultural uses – constitutes another set of activities that could be included in overall sustainable agricultural development strategies.

The question then becomes: to what extent has, and could, PES help foster the adoption of any of these sustainable agricultural management practices? The World Bank, in its World Development Report on Agriculture, considers the emergence of PES programmes to be a promising approach that should be pursued by local and national governments as well as the international community (World Bank 2008). The Scientific and Technical Advisory Panel (STAP) of the Global Environment Facility (GEF) stated that "As the only multilateral committed to the sustained flow of global environmental benefits, the GEF should consider longer-term funding of PES payments" (GEF 2008). In GEF and World Bank portfolios, PES is

[2] Practices that reduce soil disturbance and maintain cover have been shown to increase yields (Altieri 1999; Kaumbutho et al. 2007) as well as soil carbon sequestration (Follett et al. 2001; IPCC 2007). Such practices can also reduce water evaporation and increase rainwater infiltration, while reducing soil erosion and siltation of water courses (Hunink et al. 2010). SLM can enhance biodiversity and reduce water and air pollution by lowering the use of synthetic inputs and relying on natural pest management methods – pest resistant varieties, bio insecticides, crop rotations – and integrated plant nutrient systems such as recycling of vegetable and animal wastes and the use of legumes to fix nitrogen (Edwards 2000; Hine and Pretty 2008; Parrot and Marsden 2002; Scialabba and Hattam 2002). Pasture restoration and rotation can improve productivity, and if coupled with stocking rate management can also reduce methane and nitrogen emissions as the number of animals is reduced (FAO 2006). At the same time, improvements in pasture production can lead to an increase in carbon sequestration in soils and biomass and in preventing emission from avoided grassland degradation (VCS 2008a).

[3] FAO (2002b) considers the following four major groups of sustainable agriculture technologies:
a) no-till/conservation agriculture: reduction of soil disturbance, maintenance of permanent soil cover, crop rotation;
b) integrated pest management: pest resistant varieties, bio insecticides, crop rotations and improved fertilizer use and irrigation, minimum toxicity and careful application of chemical pesticides;
c) integrated plant nutrient systems: recycling of vegetable and animal wastes and the use of legumes to fix N; improved use of external nutrients;
d) organic agriculture: techniques to enhance biodiversity and restore the natural ecological balance through, among others, intercropping, crop rotations and soil and water conservation, and minimal use of external inputs.

increasingly being integrated into wider rural development and conservation projects, as a component to bring in a source of sustainable financing (Wunder et al. 2008). The FAO report The State of Food and Agriculture (SOFA) 2007 focuses on assessing the experience and potential of PES programmes to support sustainable agricultural development and poverty reduction. The report concluded that demand for environmental services from agricultural landscapes will increase and PES could be an important means of stimulating their supply. However, to be effective there is a need for enabling policies and institutions at local as well as international levels and, in most cases, these are not currently in place (FAO 2007a).

Multi-lateral environmental agreements (MEAs) such as the Convention on Biological Diversity (CBD), the United Nations Convention to Combat Desertification (UNCCD) and the United Nations Framework Convention on Climate Change (UNFCCC) are looking to PES – and other incentive-based mechanisms – as an innovative financing tool for biodiversity conservation (CBD 2010) and sustainable land management (UNCCD 2005). Payment options for avoiding forest land conversion to agriculture are currently being discussed in developing countries in the context of the UNFCCC as part of the Reduced Emissions from Deforestation and Degradation (REDD) discussions. Since 2005, the UNCCD has been supporting the integration of PES mechanisms into the National Action Plans (NAPs) of its Parties as a resource-mobilization instrument and continues to advocate for such innovative financing sources and mechanisms to be explored in its 10-Year Strategic Plan and Framework to Enhance the Implementation of the Convention (2010-2018) (UNCCD GM 2008).

The Organisation for Economic Co-operation and Development (OECD) in 2010 noted the proliferation of PES programmes across developed and developing countries, mobilizing increasingly greater amounts of finance and supporting international dialogues on efficient means of improving ecosystem services. Governments – especially in developing countries – look to PES as a potential means of capturing additional and long-term financing from the private sector to support improved natural resource managment (NRM) programmes, employing both “user-pays” and “benefit-sharing” motivations. In Brazil, a national PES policy and federal programme is currently under discussion in Congress (Câmara dos Deputados do Brazil 2010), and the State of São Paulo has approved a state law to allow for its application at state level (Governo do Estado de São Paulo 2010). The national law will allow for payments to be made to farmers who engage in sustainable cropping systems, including silvopastoral, agroforestry and forest conservation, all of which are identified as Nationally Appropriate Mitigation Actions (NAMAs) in the Brazilian submission to the UNFCCC (2009).

Although there is widespread interest in PES, it remains unclear that the tool can deliver cost-effective combinations of environmental and development benefits, despite more than a decade of experience (Pagiola et al 2005; FAO 2007a; Engel et al. 2008). FAO 2007a concluded that the tool has the potential to contribute to sustainable agriculture and rural development (SARD), but only as one element in a range of potential instruments, and requiring an enabling policy and institutional environment. Analytical frameworks and better empirical evidence is required to understand when and where the PES tool is most likely to be effective in achieving environmental and/or social objectives (GEF 2008; Pattanayak et al. 2010). In this paper we focus primarily on analyzing PES experience and potential in changing agricultural production systems, as opposed to changing land uses. There is less

work done on PES experience in this context, and the analysis has significant differences to those involving land-use change.

2 PES in the agricultural sector: from theory to practice

Payments for environmental services (PES) refers to a system whereby beneficiaries of environmental services enter into voluntary agreements with land managers to support the adoption of practices expected to result in an increased supply of positive environmental externalities over a baseline, or "business-as-usual", case. PES deals have so far focused on four main groups of regulating and cultural services. Schemes aiming to generate carbon benefits generally support activities that can help mitigate climate change through carbon sequestration or GHG emission reduction or avoidance.[4] One of the main sources of demand for such services is carbon offset markets under cap and trade systems. While many agricultural mitigation activities are not eligible for offset trading in global regulated markets, such as the Clean Development Mechanism (CDM), there are examples of pilot activities in voluntary and regional exchanges such as the Chicago Climate Exchange (CCX), Alberta's Carbon Offset System and the Voluntary Carbon Market (VCM). Watershed management PES deals generally aim to protect water quality by reducing pollutant and sediment inputs into water courses, or to improve water quantity by increasing infiltration and improving water-use efficiency. Typical buyers in these markets are hydropower and municipal water facilities. PES covering the costs of biodiversity conservation often aim to increase earmarked investments from NGOs and the private sector into improved management of protected areas or for preserving non-designated areas of important biodiversity (e.g. on-farm islands of native vegetation or riparian strips). This latter category is often bundled with PES for scenic beauty conservation, drawn from tourism revenues.

In theory, PES is a tool to add a voluntary but contingent, incentive-based additional layer of NRM investment over an appropriate regulatory base. Key principles of PES design that distinguish the tool from other NRM mechanisms are: (i) additionality of PES investments: payments or in-kind contributions are only targeted at land managers that can deliver environmental benefits additional to a baseline or "business as usual" scenario; (ii) conditionality: payments are only released following appropriate verification of adoption and maintenance of the agreed practices; and (iii) permanence of interventions: a special important condition when dealing with regenerating ecosystem functions that requires extended time frames (Wunder 2005; GEF 2008). Depending on the scheme, requirements for Measurement, Reporting and Verification (MRV) of performance on these three indicators, may be more or less rigorous. MRV standards are a key determinant of transactions costs—one of the key barriers to PES implementation (FAO 2007; Cacho and Lipper 2005). For example, monitoring of mitigation could be achieved through field-based sampling, or the establishment of indices of environmental service supply associated with specific activities together with the monitoring of activity implementation, or forest cover monitoring using remote sensing. Each of these will have different levels of precision and certainty, as well differences in costs (FAO 2007; FAO 2009b; Wunder and Börner 2011).

[4] Activities currently eligible for compensation, beyond afforestation and reforestation allowed in CDM, include: improved crop and grassland management or set-aside of productive land to perennial grasslands and improved forest management (http://www.v-c-s.org/afl.html)

PES schemes can be divided into two major categories: working lands and land diversion (Zilberman et al. 2009). In the former, the environmental service is generated jointly with agricultural products, while in the latter environmental services are substituted for agricultural production. The adoption of sustainable land management (SLM) practices in agricultural crop and livestock systems is an example of the first, and avoiding the expansion of agricultural activities onto forest lands an example of the second.

In FAO 2007 it is argued that, for cases falling into the first category, PES could be used as a means of overcoming barriers to adoption of sustainable agricultural practices which, in the long run, generate higher agricultural incomes than current practices and thus eventually require no payment to ensure their permanence. For example, in Peru (Quintero et al. 2009) it is estimated that switching from burning-maize-pastures cycle to shade-grown coffee would more than double farmers' incomes, while cutting the amount of sediment arriving to drinking water sources downstream by 18%, as well as avoid deforestation. However, farmers would require initial capital investments of US$268/ha over two years; after that, the new system would be more profitable than the previous – assuming the market for coffee remains viable – thus farmers would maintain the new, and more profitable farming system without requiring additional compensation. SLM practices are not adopted due to a variety of barriers, including financing as well as problems with property rights, collective action, unfavorable input and/or output prices, lack of information and concerns about risk management (Giller et al. 2009; Pattanayak et al. 2010; FAO 2010a; FAO 2009b; FAO 2008b; FAO 2007a; Graff-Zivin and Lipper 2008). Changing production systems often involves a transitional period which can extend over several years, while incomes can decrease and risks multiply. Lack of financing to support these transitions and provide income insurance is thus a major barrier to their adoption. PES programmes could be designed to address specific barriers to adoption e.g. by providing investment finance, insurance and extension services, among others.

In general the "productivity" of environmental services per hectare or farm household is low in these types of systems, especially when compared to land diversion programmes. This, coupled with the generally low prices paid for environmental services, results in relatively small returns to environmental service (ES) provision at farm level.[5] This suggests that aggregating benefits across large numbers of producers and using them for group investments to overcome barriers to adopting sustainable practices such as financing extension services or shared machinery and equipment purchases could be more effective than trying to deliver individual payments. Whether payments are individual or collective, building PES schemes to augment and supplement wider investments in sustainable agricultural development will also be important to improve effectiveness in this context.

One of the main features of small-scale agricultural livelihoods is the need for flexibility in managing the production system in response to variations in climate, markets, family health or composition, etc. (World Bank 2008). Maintaining flexibility in the context of a PES programme can be quite challenging, particularly for services which require long-term commitments to a given land-use practice, such as the case with soil carbon sequestration. Reconciling the need for conditionality and permanence for PES and flexibility in the management of resources on the household's part is a key design challenge. One way to

[5] In the context of the four major ES currently being marketed. For pollination, pest control or maintenance of specific agrobiodiversity this may not be so.

overcome this problem is by developing programmes to reduce the risk of non-compliance by diversifying the types of participants and activities, and through the establishment of buffers,[6] committing more land to a specific activity to ensure against non-compliance or reversals. Scaling up can have dual benefits of spreading risk as well as reducing fixed transactions costs and is thus likely to be important for these types of PES programmes.

For PES programmes that fall in the second category of land diversion, potential ES suppliers will demand a perpetual payment for the opportunity costs of foregoing land management options that would reduce ES delivery. In these cases there are generally higher levels of ES supply per producer or per hectare, and lower monitoring costs (e.g. capacity to use geo-spatially referenced data) which contributes to higher returns from ES provision.

3 Experience with PES programmes in agricultural landscapes

Recent surveys of the literature documenting PES experiences highlight three main features of such programmes as they are currently being implemented: (1) most do not demonstrate additionality and suffer from a lack of appropriate targeting; (2) most are designed with multiple objectives; and (3) PES programmes remain primarily or entirely funded by the public sector (Engel et al. 2008; GEF 2008; Stanton et al. 2010).

Most PES schemes are presently not able to demonstrate additionality. Generally PES schemes, as well as other conservation ventures, rarely consider the counterfactual when evaluating impacts, so it is difficult to know whether a certain investment was really responsible for registered improvements (Ferraro and Pattanayak 2006; Pattanayak et al. 2010). There is little evidence of impact, especially in water-related investments. Porras et al. (2008) report examples where evidence of watershed management impacts are based on actual monitoring, at least of the adoption of practices expected to deliver the expected hydrological benefits, but note that in many cases the only information available is based on local perceptions.

Yet progress is being made, and there are some encouraging examples. In Ecuador, Quintero et al. (2009) found that PES has supported cost-effective water quality improvements, with the implicit price of PES-avoided sedimentation at a cost of US$3.1/ton of sediment. In Peru, the same authors find that willingness to pay from drinking water users would cover the investment needed to change from degrading annual cropping to shade coffee, in only two months. In France, the Vittel water bottling company invested around EUR 978/ha/year for the first seven years (scheme is ongoing since 1993), with benefits equivalent to EUR 1.52/m^3 of bottled water produced (Perrot-Maître 2006). Considering that each Vittel bottle of 75cl sells for EUR 1, the returns to investment are considerable, particularly as one hectare of well-managed pasture is estimated to produce 3000m^3 of mineral water annually (INRA 1997 cited in Perrot-Maître 2006). The requirement to build a “business case” to justify private-sector investment as a basis for the CARE-World Wildlife Fund (WWF) Alliance PES initiatives in East Africa (Lopa and Ellis-Jones 2007) is an example of increased attention to additionality, and has achieved the commitment of two major water users (the Dar es

[6] For example, VCS usually requires withholding a percentage that can vary from 10 to 60% of carbon credits generated by the approved project activity to be deposited into the Agriculture, Forestry and Land Use (AFOLU) pooled buffer account to cover non-permanence related project risks (VCS 2008b).

Salaam water utility and the water bottling company Coca Cola) to begin phased investment in SLM upstream (Branca et al. 2009).

PES programmes suffer from a lack of effective targeting. The capacity and costs of supplying environmental services are heterogeneous, yet most PES programmes do not reflect this variability in their payment schemes, especially when it comes to different provision costs. In fact, one of the main recommendations from a recent OECD workshop on increasing the cost-effectiveness of PES programmes was to better target suppliers of such services and discriminate in payment levels, using tools such as the reverse-auction approach (OECD 2010).

The difficulties in ensuring additionality and appropriate targeting are also related to the fact that most PES schemes are designed with multiple objectives. In particular, many PES programmes combine poverty reduction with environmental goals. While some argue that PES is not a poverty alleviation tool and will lose its value if it compromises its efficiency (Alix-Garcia et al. 2008; Wunder et al. 2008), others argue that PES should incorporate other equity objectives (Rosa et al. 2004; Swallow et al. 2007). Considering that most PES schemes are in fact publicly funded (Stanton et al. 2010; Porras et al. 2008), multiple goals are embedded in its design and rules of operation (Pascual et al. 2010), unintentionally compromising the scheme environmental efficiency in targeting of participants (Muñoz-Piña et al. 2008; Wunder and Santiago 2010; Alix-Garcia et al. 2008). This may include using poverty rates as a criteria to select providers or relaxing type and terms of payment to forego conditionality when enforcement would be politically sensitive (Pattanayak et al. 2010).

To the extent that PES programmes are designed to overcome an investment constraint to the adoption of a new system that generates higher financial returns over the long run, there is a rationale for targeting poorer landowners who are most likely to fall into this category, and the loss of efficiency in this type of targeting should be relatively low. However, there are few examples of this type of targeting—the GEF-funded Regional Integrated Silvopastoral Approaches to Ecosystem Management Project (RISEMP) is one example.[7] Wider issues of fairness also arise here. Targeting only "bad" land managers for payments, and excluding those who have adopted sustainable practices is often not acceptable in rural communities, albeit required to achieve efficient delivery of environmental services (FAO 2007a). In addition, enforcing conditionality in cases where payments involve fixed investments is not really viable in either a political or practical sense. Ultimately, when the poor are not in the best position to deliver additional environmental services, compromising environmental outcomes by using poverty as the main criteria for targeting of participants and lowering contingency of payments can be main causes of poor environmental performance of PES programmes (GEF 2008).

Clearly, balancing efficiency with wider equity and fairness concerns is a major question in PES development (Pascual et al. 2010), and one that needs to be explicitly clarified in PES design. Noordwijk and Beria (2010) have addressed this issue by defining three categories of PES where the level of conditionality and efficiency in the targeting of the participants

[7] RISEMP specifically targeted only small and medium ranchers, and provided them with technical assistance and financial incentives to support adoption of silvopastoral packages, designed to improve the sustainability of the system and deliver biodiversity and carbon environmental services (Pagiola et al. 2004).

ranges from pro-poor to market-like schemes: from (i) co-investment in NRM practices that can improve both farm productivity and ES delivery; through (ii) compensating opportunity costs of NRM use restriction; to (iii) contingent payments[8] for ES delivery without pro-poor requirements.

Most PES schemes are funded by the public sector. While public financing of PES schemes is not necessarily a problem, the high reliance on public sector funding does raise some concerns about their long-term viability in supporting sustainable agricultural development. First, it indicates that so far PES programmes have largely been unable to capture additional private-sector funds, one of the main arguments for PES as a new instrument to increase earmarked investment in NRM. Secondly, the idea of better linking demand and supply for environmental services through PES programmes can be lost if public sector financing is dependent on general funds without any specific earmarking mechanisms from water-use fees or fuel taxes. Thirdly, the problems of a lack of long-term sustainability with public financing is an issue, as is overall capacity of the public sector in developing countries to support such programmes.

The GEF notes the lack of effective incentives to engage the private sector in supporting up-front investments by land users (GEF 2006; GEF 2008). The World Bank also places high hopes on PES to attract additional private funds for improved NRM without depending on government or donors and ensuring efficiency, as buyers will only contribute if the benefits they get outweigh their investment (World Bank 2008). Despite the multiplication of these initiatives, few schemes have been able to secure commitment from direct beneficiaries of improved ES delivery (Porras et al. 2008). PES capacity to capture additional and sustainable funding from ES users remains weak, with most schemes continuing to depend on reallocation of government funding (Porras et al. 2008; Stanton et al. 2010).

Even the most mature programmes still depend heavily on donor funding to cover its payment commitments to ES providers. Two of the most mature national PES programmes – in Costa Rica (since 1997) and Mexico (since 2003) – still rely substantially on World Bank loans to honour payments to ES providers. Of the World Bank loan of US$32 million to the first phase of the Ecomercados Project in Costa Rica (2001-2005), US$14 million was allocated to “Programmed ESP contracts” (World Bank 2000). Ecomercados II (2006-2012) assigned the entire US$30 million loan to payments (Project Component 2D: Contracting landholders to provide environmental services) even as this was matched in the same amount by national funds (World Bank 2005). Similarly, in the Environmental Services Project (2006-2011) supporting the development of the Mexican national PES scheme in a total amount of US$149 million, a World Bank loan was provided to cover half of the payment commitments (project component VI). The other half was covered by public funds (US$41 million) and water users’ contributions (US$33 million) (World Bank 2006a).

This analysis points to a sort of dilemma in whether, and how to move forward with PES to support sustainable agricultural development. Experience with the instrument indicates that lack of efficiency is a major problem, both in terms of actually delivering the environmental service and in terms of attracting additional and sustainable financing. It has also indicated that, while PES programmes often do include poverty reduction concerns, this can result in

[8] For example, in the World Agroforestry Centre (ICRAF)-led River Care Program – where payments to ES providers are conditional on reduction in sediment load – sanctions include the possibility of revoked tenure (Suyanto 2007; Widodo et al. 2006).

lower efficiency of ES delivery (Pascual et al. 2010). At the same time, PES impacts on promoting the adoption of sustainable agricultural systems is unclear, but likely to be small given their limited use in the context of changing agricultural production systems. Suggestions for how to improve PES programme performance focus on improving targeting, differentiating payments and conditionality, but these are proposed to improve the efficiency of the ES provision, and not to improve the potential effectiveness of PES to support sustainable agricultural development. While there is overlap, these are not the same, particularly in the context of promoting the adoption of sustainable agricultural practices amongst smallholder agricultural producers.

A key barrier to realizing the potential of PES in this regard is the need for scaled-up programmes to overcome problems of high negotiation and MRV costs relative to per-unit ES supply and to generate a sufficiently large supply of ES to act as a non-permanence buffer to support flexibility among participants. Other barriers include the tension between additionality and fairness, with the former necessary for environmental efficiency of ES supply and the latter a concern where only those with unsustainable management practices are targeted for receiving payments with no benefits going to those who have already adopted sustainable practices.

The combination of these factors indicates that positioning PES to support sustainable agricultural development will require strong linkages with ongoing agricultural development initiatives – thus public-sector involvement – and, at least initially, financing. However, private-sector involvement and financing could still eventually be captured for such programmes, if the public-sector involvement is designed as a "readiness" process e.g. as a process to build the necessary conditions to facilitate private-sector engagement. This type of approach can be very effective where the readiness process involves much of the same institution building required for sustainable agricultural development, such as clarification of property rights, improving extension services, and facilitating community networks and farmers' organizations for collective management of resources or marketing.

Much is being learned from the REDD experience in building readiness, which includes the difficulties in building the necessary technical and institutional environments for achieving payment programmes for reduced emissions from deforestation and degradation and the importance of the process, as much as the outcome (REDD). In particular, building readiness to achieve reduced costs and increased capacity for scaling up and replication, stimulating the development of an overall enabling policy environment, ensuring equitable and multiple benefits and creating conditions for the development of targeted private-sector supported schemes are key benefits that may be obtained from such an approach.

4 Capturing the potential of PES for sustainable agricultural development: building readiness and securing private-sector involvement

Our analysis indicates three important areas where public-sector involvement could improve the capacity of PES programmes to support sustainable agricultural development:
(1) reducing transactions costs and fostering replication; (2) providing an enabling policy environment; and (3) ensuring equity and capturing multiple benefits. The following section provides more analysis of public-/private-sector roles in achieving these objectives. It is important to note that the capacity and desirability of achieving a nested public-private

approach to PES programmes to support sustainable agricultural development will vary considerably depending on specific circumstances e.g. the costs and benefits of ES supply in agricultural production systems, the overall development and institutional environment of the country, the potential demand for the environmental service and the degree to which ES supply is site specific (e.g. watershed benefits or biodiversity conservation) versus those with a wider supply base such as carbon sequestration and emissions reductions.

4.1 *Reducing transaction costs and fostering replication*

Public initiatives to provide a framework for private-sector investment in PES schemes can help reduce start-up project costs and lift a major obstacle to wider replication (GEF 2008; Wunder et al. 2008), and reduce private-sector risks through experience and institution building gained during early action phases (Stanton et al. 2010). These could reduce future PES project design and implementation costs through the development of methodologies, data and experience, avoiding duplication of investments in research, technical and managerial tasks (Porras et al. 2006), and using existing government channels for aggregation and investment in capacity building. Governments can channel technical assistance for NRM technologies to targeted areas, develop rules for standard contracting and invest in capacity building for communities to better understand their own ES provision (and use), contribute to programme design, negotiate payments and contracts. An example of this type of readiness process comes from Kenya, where two IFAD-funded PES projects – Programme for Pro-poor Rewards for Environmental Services in Africa (PRESA) and Green Water Credits (GWC) – have been building a scientific basis for investment in watershed management using green water management techniques and agroforestry, and facilitating policy dialogue for improved land and water management and greater engagement from water users into watershed management. Currently, their strategy for mainstreaming their work into government policy and replication is through the development of a joint technical package with the Kenyan Agriculture Research Institute (KARI), as an annex to the manual the Water Resources Management Authority (WRMA) uses to develop its Water Resources Users' Association (WRUA) catchment plans. Until now, these included only technical advice on management options along the riparian strips of main river channels, with little involvement of farmers in the upper parts of the subcatchment.

MRV costs could be reduced by using government structures to aggregate information from providers, including building on existing community-based NRM projects which may already be collecting required information (Lipper et al. 2010). The economies of scale achievable can justify investment in developing activity-based protocols to facilitate replication of programmes for watershed improvement, climate change mitigation or biodiversity conservation. For example, the Chicago Climate Exchange has been trading carbon credits from conservation tillage, grass planting and rangeland management activities using a simplified methodology that allocates carbon benefits based on broad land management options and soil types. The amount of carbon benefits produced is calculated using protocols based on research by the United States Department of Agriculture (USDA).[9] Similarly, in Canada, the Alberta Offset System built its protocols on consensus between leading scientists (both in research institutes and in government) initially with the support of and approval by the Alberta Government. Both schemes allow for aggregation of carbon credits

[9] http://www.chicagoclimatex.com/docs/offsets/CCX_Soil_Carbon_Offsets.pdf

over large areas within eligible regions. However, both are also built on an existing body of research and data relevant to agro-ecology and production systems in the area and thus allow for high confidence in environmental service delivery through use of such protocols. In most developing countries there is a lack of data and research related to agricultural production and environmental outcomes, which is a major barrier to the establishment of relatively low-cost monitoring protocols. The public sector – including national agricultural research and extension services – could play an important role in meeting this gap. However, given the limited public resources in developing countries for such activities, it will be important to prioritize work based on the potential returns of the environmental services over different farming systems and agro-ecologies. Linking to international research initiatives such as CGIAR programmes or GEF-supported activities could also be a way to address this gap.

Finally, facilitating "learning by doing" through fostering the development of localized schemes can also stimulate greater local investment in participatory processes and negotiated solutions (Wunder and Santiago 2010). Building lessons from this type of experience into wider replication models can be an important way of reducing transaction costs.

4.2 *Stimulating the development of an enabling policy environment*

PES programmes cannot reach their potential to support sustainable agricultural development without an overall enabling public policy environment. Fortunately, there is a high degree of overlap between policies to support sustainable agriculture and rural development (SARD), and those to enable PES. For example, clarifying formal or informal rights over assets such as land and water that deliver ES is needed to provide incentives for the investments required (FAO 2009b; Gong et al.2010). Stanton et al. (2010) note that regulation can act as a strong driver for market development, signalling price and using existing government payment programmes to develop and test performance-based metrics for land-use changes—they cite the United States Farm Bill and Chinese subsidy programmes as examples. Another key component of an enabling policy environment is avoiding perverse incentives, such as fertilizer and pesticide subsidies, which encourage overuse (CBD 2010).

The combination of institutions – including NGOs, public and private – can also allow for mutual re-enforcement, building "resilience and checks in the system that ultimately may make the programs more effective and sustainable"(Berkes 2007 cited in Clements 2010). In some cases, it can also fill an institutional void left by limited government presence in a region and demonstrate the capacity for PES to complement the deficiencies in existing enforcement regimes (Sommerville 2009). In addition, partnerships can stimulate and complement the collection of social and environment baseline data that is normally not collected in national statistics (e.g. sediment load and water treatment costs versus health impacts).

PES programmes could increase the effectiveness of public NRM policies and regulations by helping to cover the opportunity costs of compliance. While this notion may appear to clash with the requirement for additionality, overlapping regulatory requirements may cause an unworkable burden to landowners that PES could help address. In the municipality of Extrema, Brazil, various environmental regulations overlap and require substantial land set

aside that, without specific technical assistance, would effectively remove entire farms from production. With financial contributions from the end users of this environmental protection (currently donor funded but in the future by water users in the city of Sao Paulo), land users have received technical assistance to zone their farms to comply with the laws with minimal land loss, and have received compensation for residual loss of grazing grounds (Revista Saneas 2008).

4.3 *Building equitable programmes with multiple benefits, without compromising additionality*

To address equity concerns without undermining ES delivery and manage the risk of leakage, a publicly supported PES-readiness process could be designed to allow for the participation of a wider group of participants under the scheme, albeit for different reasons. One option is to design a range of payment levels and forms where some are made for their social dimension with lower contingency, while others are higher and more conditional. Experience with emerging PES schemes in Asia and Africa[10] has shown that, to ensure long-term buy-in to PES, it is vital to invest in building a sense of fairness in communities hosting these initiatives—paying only farmers in environmental priority areas and excluding others may hamper the schemes' viability. An incremental process of overlaying private payments in publicly funded agricultural development schemes is one potential way to address both equity and efficiency concerns. In many cases, agricultural development initiatives (including projects aimed at supporting community-based NRM) involve the collection of baseline information, community consultations, network building and collective action, and delivery of services or other types of rewards to community members to adopt sustainable agricultural practices that engender both private benefits and positive environmental externalities. At present, there is little development of potential PES components in these schemes although, as noted above, there is considerable interest on the part of funding agencies to do so. Explicitly including the potential future development of a privately funded PES component in the initial stages of such public project implementation could reduce the costs associated with PES development by building them directly into ongoing project design and implementation activities. It would also address the equity issue; by providing some activities to be designed with poverty reduction objectives to be overlaid by additional activities based on an environmental efficiency criteria. Eventually, pooling more funds will allow schemes to operate at a larger scale and overcome possible biophysical threshold effects,[11] this may also leave room for the private sector to focus on priority areas with more stringent rules for participation (even if still voluntary) and higher contingency of payment.

One of the key recommendations for improving environmental efficiency of PES instruments is to capture spatial differentiation in the targeting mechanism to allow for highest ES delivery, highest risk of ES loss/additionality and costs of adopting ES (Wünscher, et al. 2008). This type of targeting scheme could be applied as an overlay to an existing public funded scheme and supported by private sector participation. This is the case in the Costa Rican national PES scheme, where hydropower companies contribute to the national fund in

[10] in Rewards for, Use of and shared investment in Pro-poor Environmental Services (RUPES) and Pro-poor Rewards for Environmental Services in Africa (PRESA) networks (http://rupes.worldagroforestry.org/news/detail.327 and http://presa.worldagroforestry.org/)

[11] For example, in the case of PES for hydrological benefits, including enough of a subcatchment in the scheme is critical to actually cause hydrological change and, more importantly, address situations within the same hydrological system that would otherwise undermine localized interventions.

return for allocation of PES contracts to farmers in their areas of activity[12]. In the South African Working for Water national scheme, some local authorities have earmarked *additional* shares of the water use and protection fees being collected, specifically to support the programme's efforts of removing alien invasive plants in their sub-catchments[13]. However there can be problems with moving towards a more efficient targeting scheme for PES even under this type of arrangement. Blackman and Woodward (2010) question the degree to which private sector involvement in the Costa Rica PES scheme has actually contributed towards increasing efficiency, since improved community relations was cited as a key motivation for participation as well as actual ES provision.

An eventual addition to funding streams from the private sector may then release funds from the government budget to invest in other public rural development investments**.** For example, a recent FAO PES feasibility assessment in Bhutan (Neves and Vallée 2009) shows that the government's support for forest protection and reforestation is about 1/3 of the budget allocated to the Ministry of Agriculture under the 10th five-year plan, around Nu 1 billion (US$22 million). The specific watershed management activity focuses on plantation and assigns half of its funding to this activity (GNHC 2009). Were more of this investment responsibility shifted to the companies that directly benefit from forest protection, additional public funding could be released for livelihood-fuelling activities under the mandate of the Ministry of Agriculture, such as crop diversification, livestock improvement and sustainable land management, capable of halting land degradation and improving farm productivity, food security and nutrition and increasing resilience to climate change vulnerability, on which investment is still limited. Pooling in more funds[14] will allow existing government programmes to invest in wider complementary activities such as developing alternatives off-farm that reduce pressure on the resource (Wilkes et al. 2010), improving extension services for improved NRM, or lack of access to credit is preventing farmers from adopting privately profitable practices all of which strengthen ES delivery.

5 Conclusions

PES is but one of many different instruments that can both complement and stimulate an enabling policy environment for sustainable agricultural development: but PES cannot substitute it. Currently the role of PES programmes in supporting the adoption of sustainable agricultural production systems is quite limited. In this paper, we argue that the public sector involvement will be necessary to make this link, through provision of an institutional and policy environment that facilitates low transactions costs and capacity to replicate, as well as enabling conditions for investments. We note that there is considerable overlap between policies and institutions required for sustainable agricultural and rural development and those as base enabling conditions for PES. Building a "readiness" process into ongoing agricultural development activities to capture future potential to access private sector financing for positive environmental externalities could not only open the door to future additional funding schemes, but may also stimulate the development of a broader institutional and policy framework to support sustainable agricultural development. Addressing the key issues that have so far limited private sector involvement in PES

[12] FONAFIFO website, Convenios locales, http://www.fonafifo.com/paginas_espanol/invierta_bosques/e_ib_convenios.htm
[13] http://www.watershedmarkets.org/casestudies/South_Africa_Working_for_water.html
[14] This is also in line with the UNCCD GM (2008) thinking on integrated financial strategies that highlight the complementary roles of different sources of financing to establish the enabling environment required for resource mobilization for sustainable land management (SLM): bilateral and multilateral funding, national budgets and investments by households, communities and private sector entities.

programmes will be key. Building a solid understanding of agricultural environmental interactions and targeting key production systems and locations for interventions will help build good business cases for investment. In addition, developing low cost MRV protocols that allow for replication, and supplementing them with public sector support to address issues of flexibility, equity and fairness could generate benefits to both public and private sectors. Of course, the nature and scope of an appropriate 'readiness" process will vary between countries and locations, depending on their capacity and costs of supplying environmental services from agricultural production systems. However, what is clear is that public sector agricultural agencies are key to involve in this process.

In cases where there is potential to generate a significant value from environmental service provision from the adoption of sustainable agricultural practices, then a relatively broad readiness process may be justified. This would include not only the establishment of an appropriate regulatory and policy environment but also include the development of information and institutions to establish baselines and generate economies of scale to reduce project design, negotiation and MRV costs, as well as cover the cost of investment in co-benefits and allow greater environmental targeting. Even in cases where the ability to replicate PES programmes is limited, a locally driven readiness process linked to national level policy and institutional developments could be an effective means of eventually bringing in private sector support. In either case, involving potential private sector purchasers in the readiness process will be important to secure their eventual participation. As Engel et al (2008) also conclude, instead of either seeing PES as purely public or private financed, the more relevant question is how best to combine these two self-reinforcing approaches in a twin track.

Adopting a readiness approach to PES programmes could also prevent the core novelty of the PES paradigm from being entirely diluted into regular NRM public policy as argued by Muradian et al (2010: 1205) when the authors argue that: "PES, at least in developing countries, should be considered explicitly as part of a portfolio of rural development programmes and projects, instead of as an economic tool only used to guarantee environmental protection in the most efficient way" and effectively helps "local and regional institutional frameworks that can cope with complexity and diversity, and that can integrate PES within existing regimes of rural development and other policy instruments for environmental protection. ". If these schemes are ever to attract private funds and be any different from public interventions, they must be stronger on their claims for efficiency and effectiveness and avoid being diluted into business as usual publicly funded and short-lived initiatives.

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