Assessing the potential of payment for environmental services in livestock inclusive agricultural production systems in developing countries
Greening livestock: Assessing the potential of payment for environmental services in livestock inclusive agricultural production systems in developing countries

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<th>Description</th>
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<tr>
<td>AnGR</td>
<td>Animal Genetic Resources</td>
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<tr>
<td>C</td>
<td>Carbon</td>
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<tr>
<td>CCAFS</td>
<td>Climate Change, Agriculture and Food Security</td>
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<td>CDM</td>
<td>Clean Development Mechanisms</td>
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<tr>
<td>CO₂eq</td>
<td>Carbon dioxide equivalent (CDE)</td>
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<tr>
<td>CSR</td>
<td>Corporate Social Responsibility</td>
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<td>ES</td>
<td>Environmental Services</td>
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<tr>
<td>FONAFIFO</td>
<td>Fondo Nacional de Financiamiento Forestal</td>
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<tr>
<td>GEF</td>
<td>Global Environment Facility</td>
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<td>GHG</td>
<td>Greenhouse Gas</td>
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<td>HBWAs</td>
<td>High Biodiversity Wilderness Areas</td>
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<td>HEP</td>
<td>Hydro Electric Power</td>
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<td>IPES</td>
<td>International Payment for Environmental Services</td>
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<td>IPCC</td>
<td>Intergovernmental Panel on Climate Change</td>
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<td>KWS</td>
<td>Kenya Wildlife Service</td>
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<td>LG</td>
<td>Livestock and Grassland systems</td>
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<td>LiAPS</td>
<td>Livestock inclusive Agricultural Production Systems</td>
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<td>LPS</td>
<td>Livestock production systems</td>
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<tr>
<td>MMNR</td>
<td>Maasai Mara National Reserve</td>
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<tr>
<td>Mt</td>
<td>Million tonnes</td>
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<tr>
<td>NAMA</td>
<td>National Appropriate Mitigation Actions</td>
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<tr>
<td>NGO</td>
<td>Non-Governmental Organization</td>
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<tr>
<td>NNP</td>
<td>Nairobi National Park</td>
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<td>N₂O</td>
<td>Nitrous Oxide</td>
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<td>OOC</td>
<td>Olare Orok Conservancy</td>
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<tr>
<td>PACS</td>
<td>Payments for Agro-biodiversity Conservation Services</td>
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<td>PES</td>
<td>Payment for Environmental Services</td>
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<tr>
<td>PSA</td>
<td>Pagos por Servicios Ambientales</td>
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<tr>
<td>PSAH</td>
<td>Pago por Servicios Ambientales Hidrológico</td>
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<tr>
<td>PWS</td>
<td>Payment for Watershed Services</td>
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<tr>
<td>REDD</td>
<td>Reducing Emissions from Deforestation and Forest Degradation</td>
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<td>RISEMP</td>
<td>Regional Integrated Silvo-pastoral Ecosystem Management Project</td>
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<tr>
<td>SALM</td>
<td>Sustainable Agricultural Land Management</td>
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<td>SLCP</td>
<td>Sloping Land Conversion Program</td>
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<tr>
<td>SLM</td>
<td>Sustainable Land Management</td>
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<tr>
<td>SWOT</td>
<td>Strengths, Weaknesses, Opportunities and Threats</td>
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<tr>
<td>TLU</td>
<td>Tropical Livestock Unit</td>
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<tr>
<td>TNC</td>
<td>The Nature Conservancy</td>
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<tr>
<td>TWF</td>
<td>The Wildlife Foundation</td>
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<tr>
<td>UNFCCC</td>
<td>United Nations Framework Convention on Climate Change</td>
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<td>US</td>
<td>United States</td>
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<td>VCC</td>
<td>Voluntary Carbon Credits</td>
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<td>VCS</td>
<td>Verified Carbon Standard</td>
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<td>VER</td>
<td>Verified Emissions Reductions</td>
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<td>WLP</td>
<td>Wildlife Lease Program</td>
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Acknowledgements

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Executive summary

Livestock are considered pathway out of poverty for poor smallholder farmers in the developing world. The production of livestock in mixed extensive and intensive crop–livestock and pastoral grazing systems worldwide generates both positive and negative impacts on the environment. This creates a challenge to promote livestock production systems which can concurrently provide economic benefits that foster social development while ensuring environmental sustainability.

In the developing world there is increasing interest in payment for environmental services (PES) as an instrument for environmental management that can also generate impact on poverty reduction particularly in rural areas.

To date, there are few examples of PES targeting livestock keepers. This report, Greening livestock: Assessing the potential of payment for environmental services in livestock inclusive agricultural production systems in developing countries, assesses the potential of payments for environmental services (PES) in various livestock inclusive farming systems in the developing world.

Report overview

This report is organized as follows:

Introduction gives an overview of the importance of livestock for smallholder farmers in developing countries and provides the rationale and policy context for this report.

Livestock inclusive agricultural production systems: Environmental services and disservices describes the role of livestock in various agricultural production systems and reviews the literature on social benefits and environmental impacts of livestock production.

Design and institutional arrangement in PES schemes provides a general description of payment for environmental services including their design and institutional arrangements.

Application of PES to livestock inclusive agricultural production systems describes examples of emerging and operational PES in livestock inclusive agricultural production systems. This includes PES for climate regulation, watershed management and hydrological services, and biodiversity conservation.

Enabling factors and constraints for PES implementation: legislation, property rights and land tenure addresses a number of issues to consider in the development and implementation of PES, including property rights and land tenure.

What scope for equity in PES schemes? analyses synergies and trade-offs in PES and poverty alleviation and the gender equity implication of PES.

PES implementation into livestock sector: key findings and recommendations: includes a strength, weakness, opportunities and threats (SWOT) analysis and looks into the potential and limitations of implementing PES in livestock inclusive agricultural production systems. This chapter also summarizes key findings and recommendations emerging from this assessment and highlights some research questions still open.
Key findings and recommendations

Environmental services provision in livestock inclusive agricultural production systems (LiAPS)

- Although livestock are widely distributed across agro-ecosystems of the developing world, there are still very few PES schemes that specifically involve livestock keepers. Besides, there are opportunities for livestock keepers to benefit from PES for climate regulation, watershed and biodiversity conservation.

- Increased demand and scarcity of some environmental services generated from livestock production create opportunities for implementing PES schemes in livestock inclusive agricultural production systems but currently methods and tools for measurement and verification of environmental services are not well developed.

- Although there is considerable potential for private markets in PES, experience shows that public funding remains essential for public and quasi-public goods such as biodiversity conservation, particularly at national and global scales.

Climate regulation services

- In pastoral or grazing systems, the access to PES opportunities for livestock keepers can be driven by payments for restoration of degraded lands and for sustainable grazing land management, both of which presents the potential for carbon sequestration.

- In mixed crop–livestock systems, access to PES opportunities for livestock farmers can be driven by: adoption of improved feed supplement that can lead to GHG emissions reduction; adoption of improved pastures with high density trees and fodder banks that reduce land degradation; the use of organic fertilizer to increase the capacity of carbon sequestration; and integrated livestock and manure management.

Watershed and hydrological services

- In extensive or pastoral systems, PES schemes involving livestock keepers can promote watershed conservation by controlling undesirable land use change caused by extensive cattle grazing in dryland forest because this can cause soil erosion and soil compaction and lead to forest degradation which is thought to diminish water quality and quantity thereby increasing the risks of landslides and flooding.

- In mixed crop–livestock systems, livestock farmers can participate in PES and be paid to grow trees and forest in the upper catchment of the watershed.

- PES schemes that involve livestock keepers in highly intensive production systems could include payments to the farmers to limit water contamination associated with livestock production through nutrients loading.

Biodiversity conservation services

- In pastoral or grazing systems, positive biodiversity outcomes in PES schemes that involve livestock keepers are achievable by: reducing livestock stocking density or restricting grazing; maintaining open the wildlife migration corridors and seasonal dispersal areas; controlling wildlife poaching; protecting natural vegetation on land and avoiding fencing or subdividing land.

- In mixed crop–livestock systems, positive biodiversity impacts are achievable by: reducing stocking densities; applying sustainable management practices to reduce environmental degradation and protecting natural vegetation on land; trees planting and sustainable soil management (zero grazing and fodder and manure production).
Livelihood improvement opportunities

- PES schemes offer a diversification potential to livestock farmers for improving their livelihoods and for poverty alleviation. The cash flow generated through PES schemes produces multiple benefits including: poverty reduction, store of wealth, income diversification and multiple social and cultural gains.

- PES is a tool to consider for promoting agricultural transitions towards a green economy. PES schemes have the potential to stimulate a green livestock sector, allowing farmers to adopt sustainable agricultural land management (SALM) practices that reduce the impact on the environment and help conserve biodiversity and ensure sustainable use of natural resources. This could provide a triple win: provision of environmental services, biodiversity conservation and livelihood improvements.

Addressing barriers to livestock farmers participation in PES

- Anecdotal evidence from existing PES schemes and programs shows that the landless poor are excluded especially from land-based schemes. There is also limited involvement of women across land-based and other PES schemes.

- Livestock keepers face challenges to tap into PES markets because of limited market information.

- Effective implementation of PES schemes requires well defined property rights over natural resources, including land tenure. In most cases property rights are clearly defined under mixed crop–livestock production systems, however, this differs in pastoral or grazing systems, thus making the implementation of PES in these last systems more challenging.

Recommendations

- Develop robust measurement and verification tools for environmental services produced by the livestock sector in livestock inclusive agricultural production systems.

- Develop policies to promote PES implementation in LiAPS to enable livestock farmers to diversify their income and to improve their economic situation.

- Provide support to livestock farmers to access the emerging environmental service markets.

- Implement capacity building activities (training, information provision to mention but a few) to increase the awareness of PES among smallholder households and to enable collective action processes needed for livestock farmers to access and participate in environmental service markets.

- Establish pilot climate change mitigation PES projects to demonstrate their benefits to livestock keepers and to explore the potential to link PES to climate change adaptation funds.
Introduction

Livestock are considered a pathway out of poverty for poor smallholder farmers in the developing world (Thornton and Herrero 2001). Consequently many development interventions aim at enhancing the income from livestock, such as through improved market access, development of value chains and intensification of livestock production (Herrero et al. 2010). The production of livestock in mixed extensive and intensive crop–livestock and pastoral grazing systems generates both positive and negative impacts on the environment. While the positive impacts are desirable, there are concerns that the negative environmental impact of the livestock sector would aggravate with the forecasted increase in the demand for animal proteins in the developing world (FAO 2007; Tarawali et al. 2011).

This creates a challenge to promote livestock production systems that can concurrently provide economic benefits to foster socio-economic progress while ensuring environmental sustainability (FAO 2009). Statutory regulations and subsidies represent important policy instruments to achieve this balance, especially in the developed world. In the developing world there is increasing interest in the use of market based economic instruments such as payment for environmental services (PES) which are increasingly being adopted for environmental management with the additional objective to realize poverty reduction particularly in the rural areas. There are many small-scale PES schemes that are operational in the developing world, while larger scale national PES programs have been established in a few countries in economic transition such as China, Mexico, Costa Rica, and South Africa. These PES schemes and national programs are a means through which the implementing countries can meet their national environmental and poverty reduction goals as well as obligations of environmental conventions and development goals at the international level.

As more and more PES schemes are implemented, there is an on-going debate regarding the effectiveness of PES as an environmental management tool, and also the role of PES in poverty reduction in developing countries and countries in transition (Pagiola 2005; Wunder et al. 2008; Lipper et al. 2009). This debate has become more pertinent with the current focus to promote a green economic growth to address poverty and achieve sustainability (Barbier 2011a; UNEP 2011), both key elements of the agenda for the Rio+20 United Nations Conference on Sustainable Development in Brazil in June 2012.¹

Although PES is highlighted prominently as a tool for promoting a green economic growth and poverty reduction (TEEB 2009), there are polarized views regarding PES potential to achieve the dual objectives. One school of thought considers PES capable of yielding a win–win or even a triple win situation in which the PES revenues deliver environmental services and positive socio-economic outcomes (Miles and Kapos 2008). An alternative school stresses that there are number of complications inherent to PES schemes which limit their effectiveness in environmental management and in resolving the needs of the poor (Wunder 2008; Vira and Adams 2009). Notwithstanding this debate, there is currently a surge in the implementation of PES schemes in the developing world.

Until now, PES attention has been focussed on the environmental services provided by forests and trees, while some attention has been paid to the role of PES in agriculture in general (e.g. FAO 2007) and food security in particular (FAO 2011a). Little attention has been paid to the role of PES in the livestock sector despite the fact that animal proteins are crucial for a well-balanced nutrition worldwide. Even more surprising is the fact that PES has so far not been an attractive policy tool in pastoral and grazing systems (Dutilly-Diane et al. 2007) which are inhabited by an estimated 301 million of the world’s 987 million ‘extremely’ poor people that depend on livestock (Neely and Bunning 2008). It is thus worthwhile to explore the potential role of PES in the livestock sector and within livestock production systems that occur in a variety of tropical ecosystems including rain-fed agriculture, wetlands, rangelands, and forests.

In the developing world, livestock are widespread and critical to socio-economic development. It is estimated that livestock contribute up to 80% of agricultural Gross Domestic Product (GDP) and about 675 million rural poor depend on livestock for their food, income and livelihoods. A further 20 million pastoral families rely on livestock as their sole source of income (IFPRI and ILRI 2000; Thornton et al. 2002; FAO 2005; LEAD 2005). Additionally, livestock are also an important asset as well as an indicator of social status and means of establishing social ties (Birner 1999). In drought prone areas, livestock are a type of insurance that provide resilience against drought and other shocks and also serve as a source of savings (Lybbert et al. 2004; Ericksen et al. 2011).

PES can potentially play a significant role in mediating the complex relationship between livestock production and environmental services to balance economic and environmental objectives. On the one hand livestock generate benefits to people such as nutrition and income while on the other hand livestock production creates negative environmental externalities complicating the delivery of ecosystem services, other than human nutrition (FAO 2009). These environmental externalities are particularly prominent when livestock keepers strive to optimize the direct benefits from livestock such as income without regulations or incentives to mitigate livestock’s negative impacts on the environment.

Given the widespread environmental degradation and poverty in the developing world, it would be useful to understand the potential of PES to address environmental externalities and enhance the welfare of poor livestock keepers in what we call Livestock Inclusive Agricultural Production Systems (LiAPS). We suggest that PES in livestock production systems should be sought in order to address both social development and environmental sustainability goals. This raises a number of questions for practitioners and policymakers involved in the development of the livestock sector: What experiences exist with PES in LiAPS? How effective are existing PES schemes in addressing the environmental management and socio-economic development agendas? How are these PES schemes organized? What potential exists to draw on the lessons learnt to upscale PES over larger areas to benefit a wider group of people? Thus far, there has been no assessment of these issues and the current paper aims to fill this knowledge gap.

Our aim here is to assess the potential of payments for environmental services (PES) in various livestock inclusive farming systems in the developing world. We first describe the role of livestock in various agricultural production systems and review the literature on social benefits and environmental impacts of livestock production. We then provide a general description of payment for environmental services including their design and institutional arrangements. Subsequently, we provide examples of emerging and operational PES in livestock inclusive agricultural production systems. This includes PES for climate regulation, watershed management and hydrological services and biodiversity conservation. Next we address a number of issues to consider in the development and implementation of PES, including property rights, poverty and gender factors.

The final chapter looks into the potential and limitations of implementing PES in livestock inclusive agricultural production systems. This chapter includes a strength, weakness, opportunities and threats (SWOT) analysis and summarizes key findings and recommendations emerging from this assessment and highlights additional research questions.
Greening livestock: Assessing the potential of payment for environmental services in LiAPS in developing countries

I Livestock inclusive agricultural production systems: Environmental services and disservices

1.1 Classification of livestock production systems

Livestock production systems (LPS) have been classified into three main categories based on the degree of livestock integration with crops and its relation to land (Thornton et al. 2007; Robinson et al. 2011): pastoral or grazing, mixed extensive and intensive crop–livestock and industrial.

- In pastoral or grazing systems the animals forage in rangelands, pastures and grasslands (there is little or no integration with crops). These systems are also characterized by low stocking rates (< 10 TLU\(^1\) per hectare) and are traditionally managed by pastoralist communities. In these systems natural resources are constrained and people and their animals adopt adaptation strategies to meet these constraints. They are most favoured in arid, semi-arid, or other areas of marginal value for crop-based agricultural production (Figure 1).

- In mixed crop–livestock systems the animal production is integrated with crop production and livestock are primarily fed on pastures, crop residues and fallows.\(^2\) This system includes two sub-systems: mixed intensive and extensive crop–livestock systems. In the former, livestock are primarily fed on crop residues, with supplementary effort being made to integrate the cultivation of forage species in the cropping, to supplement the crop residues with higher quality forage. In this sub-system natural resources can be managed to intensify the productivity of the system. In the latter, livestock food intake rely on crop residues and on forage derived from pastures in a context where natural resources are most likely to be extensively managed. Both of these systems are managed by settled farmers and flourish in temperate, sub-humid, humid, and some highland climates (Figure 1) (Herrero and Thornton 2010).

- In industrial production systems the animals are fed in stalls, pens and feedlots (‘landless’), and occur in very high stocking rates. Unlike the pastoral or grazing and mixed crop–livestock systems, the industrial production system is less tied to the local natural resource base. A significant part of the fodder is brought in from elsewhere. Industrial livestock production systems are restricted to the developed world and middle income economies in transition.

In this publication, our focus is on pastoral or grazing systems and mixed crop–livestock system. In the latter, we consider both extensive and intensive crop–livestock systems. We focus on these systems because these are the most dominant and significant livestock production systems in the developing world. Additionally, it is in these systems that benefit-sharing between livestock production systems and environment is most prevalent and offers the potential for enhancement through policy interventions (Mearns 1996). Thus, in this study, we refer to these systems when speaking about livestock inclusive agricultural production systems (LiAPS).

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1. A Tropical Livestock Unit (TLU) is an animal unit used to aggregate different classes of livestock. One TLU equals an animal of 250 kg live weight.

2. Silvo-pastoral systems are mixed-systems generally not included in studies on global livestock production systems. They are based on raising livestock on pastures grown in association with trees.
Figure 1. The global distribution of livestock inclusive agricultural production systems (from Notenbaert et al. 2009).
In LiAPS opportunities for PES are mainly driven by livestock species such as cattle, goats and sheep (shoats), especially in the pastoral and agropastoral systems. For this reason the examples provided in this publication have a bias towards cattle and shoats.

### 1.2 Environmental services and disservices in LiAPS

LiAPS are heterogeneous and differ widely in terms of intensity of the production and the use of resources (Bernues et al. 2011). They also present environmental challenges, issues and options that vary significantly according to climate and land capabilities (de Haan et al. 1997). LiAPS generate environmental services that deliver benefits to humans and contribute to human well-being, through the interaction with different ecosystems and their components (Figure 2). Furthermore, LiAPS produce a series of environmental services as a result of how they are managed by people, and these include: production of food and other products (leather, bone meal fertilizers, and manure), draught power for small farmers, biodiversity conservation (Herrero et al. 2009; Steinfeld and Gerber 2010), nutrients cycling and the provision of social benefits (Janzen 2011). They may also generate intermediate services such as soil fertility, reduced run-off and thus sedimentation and conservation of water.

While people draw benefits from the environmental services associated with livestock production in LiAPS, this process also generates negative environmental externalities or disservices, primarily represented by land use change, land degradation, excess water use, nutrient loads, fossil energy use, competition for food and emission of greenhouse gasses (Steinfeld et al. 2006; Steinfeld and Gerber 2010). For example, increasing demand for livestock commodities
is intensifying the competition for land with crop and also drives habitat loss and degradation (FAO 2009; Alkemade et al. 2012). Livestock are a major consumer of water that is used to produce forage and fodder (Descheemaeker et al. 2009). The livestock sector cycles and excretes volumes of nutrients which leads to significant eutrophication of aquifers, surface waters and the oceans (Steffen et al. 2011). Finally, the livestock sector is a driver of climate change as it is a major user of fossil non-renewable energy and a major emitter of greenhouse gasses.

The environmental disservices listed above pertain to livestock production globally with significant parts of these externalities prominent in the developed world and in middle-income countries in transition. It is, however, foreseeable that these negative impacts will expand in the developing world given the forecasted growth in population and urban expansion, leading to increased demand and production of livestock in the developing world.

Table 1 describes the environmental services and disservices in pastoral or grazing and mixed-extensive and intensive systems and presents a summary of services and disservices that could be generated by the different LiAPS with respect to soil, water, biodiversity, landscape and air. These specific components of the environment have been chosen for illustration because most existing PES programs and schemes are focused on one or more of the following services: carbon sequestration, emissions avoidance and climate regulation; protection and allocation of water; maintenance of landscape beauty; and conservation and management of biodiversity (Landell-Mills and Porras 2002; Wunder 2005).

The spatial delivery of environmental services (ES), such as where the service is produced and where it is used is essential to determine where and at what scale incentives measures such as PES can be applied and subsequently to guide management interventions (Naidoo and Ricketts 2006). Furthermore, establishing where and when the benefits from environmental services occur and are captured is fundamental to understanding their demand and establishing opportunities for payments. Due to the importance of the spatial component in the delivery of environmental services and disservices, Table 1 also shows the geographical scale at which these services are captured: local, regional and global.
Table 1. Environmental services and disservices provided by different livestock inclusive agricultural production systems with respect to soil, water, biodiversity, landscape and air. The geographical scale at which the services are provided is also shown: L (local), R (regional) and G (global).

<table>
<thead>
<tr>
<th>Environmental services</th>
<th>Environmental disservices</th>
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<tbody>
<tr>
<td><strong>Soil</strong></td>
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<tr>
<td><strong>Pastoral systems</strong></td>
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<tr>
<td></td>
<td>Improving soil fertility (L)</td>
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<tr>
<td></td>
<td>Role of carbon sink in improved savannahs (G)</td>
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<td></td>
<td>Soil erosion, degradation and compaction (as a consequence of overgrazing) (L, R)</td>
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<tr>
<td></td>
<td>Decreasing soil fertility (through loss of nutrients as consequence of overgrazing) (L)</td>
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<tr>
<td><strong>Mixed extensive systems</strong></td>
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<td></td>
<td>Maintaining soil fertility (animals play an important role in harvesting and relocating nutrients, they increase the provision of manure; making the best use of crop residues: when they are not used as feed, stalks may be incorporated directly into the soil, where, for some time, they act as a nitrogen trap) (L)</td>
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<td></td>
<td>Minimizing soil erosion (perennial forage crops prevent erosion) (L, R)</td>
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<td></td>
<td>Soil fertility—Nutrient depletion (as a consequence of increase in human population pressure and use of arable land) (L)</td>
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<td></td>
<td>Soil fertility—Nutrient surplus (soil and water tables overloaded with nitrogen and phosphorus) (L)</td>
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<tr>
<td></td>
<td>Soil erosion (as consequence of increased population pressure a change of the crop/grazing land ratio can lead to overgrazing) (L, R)</td>
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<tr>
<td><strong>Mixed intensive systems</strong></td>
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<td></td>
<td>Soil fertility—reduction of nutrient losses (e.g. by promoting stall feeding) (L)</td>
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<td></td>
<td>Improvement of soil cover (e.g. through the use of alternative crops for mulching) (R)</td>
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<td></td>
<td>Prevention of erosion (through plantation of perennial forage crops) (L, R)</td>
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<td></td>
<td>Soil fertility—Nutrient surplus (soil and water tables overloaded with nitrogen and phosphorus) (L)</td>
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<td><strong>Water</strong></td>
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<tr>
<td><strong>Pastoral systems</strong></td>
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<tr>
<td></td>
<td>Reduce evaporation, run-off and sedimentation (L, R)</td>
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<td></td>
<td>Decreasing water infiltration (as a consequence of overgrazing) (L, R)</td>
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<tr>
<td><strong>Mixed extensive systems</strong></td>
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<td>Helping to conserve water (increased organic matter in the soil increases water-holding capacity) (L)</td>
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<td>Decreasing water quality/water pollution (by nutrient loading) (L, R)</td>
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<tr>
<td><strong>Mixed intensive systems</strong></td>
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<td></td>
<td>Helping to conserve water (increased organic matter from manure added to the soil increases water-holding capacity) (L)</td>
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<td></td>
<td>Decreasing water quality/water pollution (by nutrient loading) (L, R)</td>
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<tr>
<td></td>
<td>Reducing water supply (where water is scarce, the diversion of water to sustain livestock and to irrigate crops used as feed, potentially limits its availability for other purposes)</td>
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</table>
## Biodiversity

| Pastoral systems | • Invasion control (livestock grazing in forest plantation is used to control the invasion of native and exotic grasses, reducing also the management costs of the plantations) (G)  
• Flora biodiversity preservation (by removing biomass, which otherwise might provide the fuel for bush fires, by controlling shrub growth and by dispersing seeds through their hoofs and manure; complex ecosystems need gentle continual disturbance to flourish) (G)  
• Fauna biodiversity preservation: Mixed livestock–wildlife systems result in a greater variety of species than wildlife only (G)  
• Stimulation of grass tilling, improvement of seed germination, break-up hard soil crusts (G) | • Flora biodiversity loss (as a consequence of overgrazing, which leads to a change in plant composition: annual plant, with less nutritive value as fodder, become more abundant; disappearance of palatable species) (G)  
• Diseases spread to wildlife (G)  
• Competition with wildlife for fodder or water (L) |
| --- | --- | --- |
| Mixed extensive systems | • Maintain soil biodiversity (G)  
• Providing suitable habitats for birds (G)  
• Fauna and flora biodiversity preservation (more than what would be the case if food demands were to be met by crop and livestock activities undertaken in isolation; when livestock are used to reduce dependence on chemical methods to control weeds and insect pests; helps to reduce crop pests since less pesticide is normally used) (G) | • Fauna and flora biodiversity loss (as a consequence of increased pressure of human population; wildlife may be threatened when wild lands are converted to mixed farming use) (G) |
| Mixed intensive systems | • Improvement of feed production and quality (reducing the pressure on grazing areas and improving nutrient transfer) (G) | • Fauna and flora biodiversity loss (especially through habitat change, increased population pressure and the accompanying increase in livestock. The increase in livestock may lead to the replacement of local livestock breeds by a small number of exotic breeds and may threaten wildlife when wild lands are converted to mixed farming use) (G) |
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### Landscape and air

| Pastoral systems | • On optimally grazed lands carbon accrual is greater than on ungrazed or overgrazed land (G) |
|                 | • Greater livestock density reduces need for biomass removal by fires (L, G) |
|                 | • Deforestations and fragmentation of native ecosystems |
|                 | • Overgrazed lands allow for less accrual of carbon (G) |
|                 | • Releases to the atmosphere of CO\(_2\), \(\text{CH}_4\) and \(\text{N}_2\text{O}\) (G) |
|                 | Deforestations and fragmentation of native ecosystems |
|                 | Overgrazed lands allow for less accrual of carbon (G) |
|                 | Releases to the atmosphere of CO\(_2\), \(\text{CH}_4\) and \(\text{N}_2\text{O}\) (G) |
|                 | Aesthetic landscape can be compromised in populated and developed mixed farming areas |

| Mixed extensive systems | • Livestock induced savannah improvement, as well as forestation, enables carbon-sink (G) |
|                         | • Manure provides biogas, source of energy, recovering methane at the same time (L, G) |
|                         | • Mixed farming systems allow for improving feeding practices that reduce enteric emissions (G) |
|                         | • Releases to the atmosphere of CO\(_2\), \(\text{CH}_4\) and \(\text{N}_2\text{O}\) (G) |
|                         | • Aesthetic landscape can be compromised in populated and developed mixed farming areas |

| Mixed intensive systems | • Livestock induced savannah improvement, as well as forestation, enables carbon-sink (G) |
|                         | • Manure provides biogas, source of energy, recovering methane at the same time (L, G) |
|                         | • Mixed farming systems allow for improving feeding practices that reduce enteric emissions (G) |
|                         | • Releases to the atmosphere of CO\(_2\), \(\text{CH}_4\) and \(\text{N}_2\text{O}\) (G) |
|                         | • Aesthetic landscape can be compromised in populated and developed mixed farming areas (L) |

Sources: Mearns (1996), de Haan et al. (1997), Steinfeld et al. (2006), Smith et al. (2008), Descheemaeker et al. (2009), Janzen (2011).

a. As highlighted in Descheemaeker et al. (2009) ‘...the impact of livestock on land and water resources across various livestock systems, agro-ecology and land characteristics is not fully understood’. In addition, so far, the link between livestock and water has been investigated more from the perspective of the drinking water and the run-off in relation to grazing pressure.
2 Design and institutional arrangement in PES schemes

Although Payment for Environmental Services (PES) is gaining popularity, there is no commonly agreed definition of what constitutes a PES scheme. In a widely cited definition, Wunder defines PES as: ‘(1) a voluntary transaction in which (2) a well-defined environmental service (or land use likely to generate that service) (3) is “bought” by a (minimum of one) buyer (4) from a (minimum of one) provider (5) if and only if the provider continuously secures the provision of the service (conditionality)’ (Wunder 2005; 2007).

In practice, very few PES schemes conform to this narrow definition as most schemes meet some, but not all the five conditions. The scope of PES is wide, with many variations in the structure such as the form of incentive or payment, the services that are provided, the nature and type of providers and intermediaries and whether incentives are given to individuals or communities, the eligibility rules for participation, and how the payments are funded (Jack et al. 2008). Thus, some of the existing incentive schemes that meet some but not all five criteria are considered as ‘PES-like’ schemes. Indeed this is a grey area as posited by Wunder and colleagues: ‘...it becomes a judgment call as to whether several individual programs should be considered “PES with qualifications,” or “non-PES with PES-like characteristics”... Even among us three editors, there is thus some disagreement over where exactly the line between PES and non-PES should be drawn’ (Wunder et al. 2008: 839).

Box 1: Ecosystem services or environmental services?

The terms ‘environmental’ and ‘ecosystem’ services are used interchangeably in the PES literature and this leads to some confusion as to what the ‘E’ in PES refers to. In this report, we use the term ‘environmental’ services following Muradian et al. (2010). They consider ‘ecosystem services’ as a sub-category of ‘environmental services dealing exclusively with the human benefits derived from natural ecosystems’, which includes the provisioning services that are considered as ‘ecosystem goods’. The term ‘environmental services’ is more appropriate within the scope of this publication because it also encompasses benefits associated with different types of actively managed ecosystems, such as sustainable agricultural practices in rural landscapes (Muradian et al. 2010, 1202). Consequently, where we use ‘ecosystem service’, it is understood as making reference to a subset of ‘environmental service’. Nevertheless, we acknowledge that there are different interpretations and diverse views on the ‘environmental’ vs. ‘ecosystem’ terminologies (e.g. Shelley 2011 for a review).

The actual implementation of PES among farmers may entail land-use restrictions or the so called ‘land-diversion’ programs where lands are diverted from agricultural production (crop and livestock) to other uses and land-use modifications or the so called ‘working-lands’ programs where agricultural production (crop and livestock) activities are modified to achieve environmental goals (Zilbermann et al. 2008). Land diversion programs entail the application of technologies that restrict allowable uses, such as land retirement, reducing agricultural expansion, rehabilitation, reduced deforestation, reforestation of degraded lands and forest set-aside conservation. Working lands programs entail land use-modification based on improved cropping or land-use technology and practices such as reduced logging, afforestation and reforestation programs such as the Clean Development Mechanisms (CDM) and the Reducing Emissions from Deforestation and Forest Degradation (REDD+) initiatives, agro-forestry silvo-pastoral initiatives), and improved/conservational agricultural practices including no-tillage, no-burn, and organic agriculture (Boerner and Wunder 2008; Bettram 2011).
The operationalization of PES schemes follows different institutional arrangements and program design models. Institutions are required to monitor ecosystem health, resolve conflicts, co-ordinate individual and institutional behaviour, and allocate and enforce rights and responsibilities over time. The design of PES programs include identification of the environmental service providers and buyers, type and level of payments, desired environmental service or land use required to generate the service, monitoring, and associated costs and benefits distributed among providers, intermediaries and users (Engel et al. 2008).

The development of institutional arrangements and design in PES may present difficulties especially as it relates to the different types of services. Table 2 illustrates the step by step process along with inherent difficulties in PES implementation by type of service involved (water services, carbon sequestration and biodiversity conservation).

Table 2. Level of difficulty of implementation of PES for watershed services, climate regulation and biodiversity conservation

<table>
<thead>
<tr>
<th>Steps</th>
<th>Watershed services</th>
<th>Climate regulation</th>
<th>Biodiversity conservation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Understanding the science</td>
<td>High</td>
<td>Medium/low</td>
<td>Medium/low</td>
</tr>
<tr>
<td>Charging service users</td>
<td>Medium/low</td>
<td>High/medium</td>
<td>Very high</td>
</tr>
<tr>
<td>Paying providers</td>
<td>Depends primarily on local conditions</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: Adapted from Pagiola and Platas (2007).

We briefly highlight several aspects and characteristics of the institutional arrangements and design schemes in PES programs below.
2.1 Who should be paid and what should they be paid for?

In PES schemes, payments are made either for each unit of land on which land users adopt specified practices, or per unit of environmental benefits produced, for instance, per tonne of carbon sequestered (Diagana et al. 2007). Typically, payments are made to resource managers within a targeted area, and the recipients may be individual land users, cooperatives, and local communities (Wunder et al. 2008). In Figure 3, we present a flowchart to illustrate how the design of PES schemes can be applied in LiAPS.

Figure 3. Example of flow chart for PES scheme design where the recipients of the payment are farmers

Source: Modified from FAO (2007).

In PES schemes for carbon sequestration, two types of payments are anticipated: (i) payments for carbon capture that entail an upfront payment, and (ii) payments for carbon storage that entail annual payments proportional to average size of carbon stock over the year (Richards 2004). PES projects that pay livestock keepers for bundled services such as biodiversity and carbon sequestration jointly incorporate bulk payments with different components assigned to each ecosystem service (Pagiola et al. 2004). While it is common in many PES schemes to pay farmers for each hectare of land on which they adopt specified practices (a per hectare contract), Antle et al. (2003) have shown that it is more efficient to pay farmers per unit of environmental benefit produced (e.g. a per tonne of C contract) rather than per unit area of land. In general though, targeting is critical in PES schemes and the weakness of most PES programs, leading to their ineffectiveness is the lack of targeting especially for schemes that are based on undifferentiated payment systems (Wünscher et al. 2008).
2.2 Who should pay?

In PES schemes, the users or buyers that are the presumed beneficiaries of ecosystem services are supposed to pay ecosystem service providers (Wunder 2005). In practice, two types of distinctions can be made regarding who provides payments in existing PES schemes. First, in ‘user-financed’ schemes, the ecosystem service (ES) buyers are actual service users, and in ‘government-financed’ schemes; the ES buyers are a third party entity, usually the government. Some PES schemes involve a hybrid of ‘user’ and ‘government’ financed models (Engel et al. 2008).

In both of these models, payments come from different sources including government and inter-governmental agencies, local municipalities, electricity and water utility companies, private sector and the non-profit sector which includes non-governmental organizations (NGOs) and private foundations. The source of payment is also dependent on the nature of ecosystem service and the geographical scale at which the benefits are captured. It is common that governments and other public institutions (national and international) act as the buyer in PES schemes where the ES delivered are considered as public goods such as biodiversity and climate change regulation that provide benefits that are captured on and off-site by a diffused group of users (Kemkes et al. 2010). In most watershed management PES schemes in which the benefits of the ES are captured locally and regionally, the users are usually the downstream water consumers who pay upstream providers (Porras et al. 2008).

2.3 How much should be paid?

Estimating the amount that ES buyers should pay to providers remains one of the most challenging aspects of PES implementation. Based on economic theory, the amount paid in land-based PES schemes should be no less than the land users’ opportunity cost (otherwise farmers may not participate in the scheme) and should be no more than the value of the benefit provided (otherwise the users may not be willing to pay) (Pagiola et al. 2005).

In practice, the amounts paid in PES schemes are commonly determined in three ways. First, the payment rate can be based on the value of ES which may be determined through contingent valuation studies, or by the market which sets the actual price of a unit of ES being traded (World Bank 2005; Barbier 2011a). This is the case for PES for carbon sequestration where payments are fixed based on the prevailing market price of one tonne of CO$_2$ equivalent, which varies depending on whether the carbon is sold in the voluntary or regulated market (Kossoy and Ambrosi 2010).

Second, payment rate can be based on the opportunity cost of the land-use or alternative returns to land, in which case the farmer or livestock keeper is compensated through PES (e.g. Rodriguez et al. 2011). Lastly, payment rates can be determined through bids and auctions whereby farmers are provided with several bid prices to select the most suitable from their perspective thus making the providers to reveal the true cost they are likely to incur to provide the service on the assumption that they are equipped with full information (Jack et al. 2008).

2.4 What is the form of payment?

Many PES schemes involving farmers provide monetary incentives as the form of payment. However, there are examples of PES schemes where providers prefer non-monetary forms of rewards or payments, or even a combination of monetary and non-monetary payments. Non-monetary payments may include the use of vouchers which are redeemable for farm and livestock inputs as is the case in a payment for water scheme (PWS) in Naivasha, Kenya (Boonstra 2010), provision of beehives as is the case of a PES for biodiversity scheme in Los Negros in Bolivia (Asquith et al. 2008) and in-kind support such as land-use rights, access to markets, access to training and information, and access to protected areas (Swallow et al. 2007). It is therefore prudent that the actual form and nature of payments are negotiated and agreed upon based on consultation among providers, buyers and intermediaries.

When payments involve cash provision, cost-effective means of cash transfer to participating households should be used to keep transaction costs involved low. In some PES schemes, the money is deposited in the landowner bank accounts. This has advantages such as safety and can encourage savings among participating households but it may also increase transactional costs for the recipients. Recently, the emergence of mobile telephone banking technologies in rural Africa has eased transaction to mobile pastoral PES recipients in remote areas.¹

¹ Osano, personal communication.
2.5 How long should the payments last?

Ideally payments in a PES scheme should be on-going rather than finite as an end to payments may create the risk that land users will revert to their previous land use practices (Pagiola and Platais 2007). It is argued that the voluntary nature of PES renders the idea of permanence redundant, because in practice, PES contracts can be cancelled, or renegotiated (Wunder et al. 2008). Nevertheless, it is recognized that permanence is dependent on the availability of funding (linked to demand for ES) necessary to continue payments (Ferraro 2001) and to the nature of the outcome of environmental service provided.

The availability of funding depends on whether the source of funding is from public/government sources or from private sector sources. Public/government funding is common when the desired environmental service provides benefits to a diverse and dispersed group of beneficiaries as is common with services that are public goods in nature. Government and public funded PES schemes are implemented for a time-limited period hence PES programs that fall in this category are considered as potentially not financially sustainable (Wunder et al. 2008). On the other hand, PES programs that tap into market funds from the private sector are likely to be self-sustained as long as the demand for the services exceeds the supply creating a continuous market exchange in the process (Pagiola and Platais 2007).

A separate issue linked to how long payments should last relates to the concept of ‘permanence’, that is the ability of PES to achieve long-term improvements in environmental service provision, including beyond associated payment horizon (Engel et al. 2008). Permanence is dependent on the nature of the outcome of the environmental services provided: whether the outcome is completely determined by the activities implemented by providers (i.e. ‘deterministic’) or if the outcome is influenced by natural processes such as climate (i.e. ‘stochastic’) (Meijerink 2008).

The stochastic nature of the provision of environmental services includes a certain amount of risk because it is possible that certain land use activities implemented through PES at a certain cost can have their outcomes reduced by natural processes such as fires (Meijerink 2008).

2.6 What are the financial costs of PES implementation?

Two aspects of costs are incurred during the setting up and implementation of a PES scheme. The first aspect of costs is the start-up costs that are usually borne before the PES scheme is functioning and involve search costs (e.g. finding interested partners, communication and price information), negotiation costs (e.g. developing agreements and contracts) and approvals costs (e.g. by government agency) (Engel et al. 2008).

The second aspect of cost is the transaction costs of implementation, which involves the costs of monitoring, enforcement and insurance (Jindal et al. 2008). The experience with PES implementation shows that in general, PES schemes have a high start-up costs and low transaction costs (Engel et al. 2008). However, transaction costs increase substantially when many smallholders and multiple actors are involved, when institutions and property rights are weak, and when costs of getting baseline information and of monitoring land use and service provision are high (Wunder 2007; Jack et al. 2008).

2.7 Monitoring and verification in PES scheme

Monitoring of PES effectiveness should be undertaken at three levels: first, to check if the land users undertake the contracted land use or the desired change in resource management; second to establish if the changes in land use or resource management generate the desired services; lastly to ascertain the social impact of PES on participants (Pagiola et al. 2005).

Apart from carbon sequestration schemes, few PES programs have clear, explicit frameworks for monitoring and evaluating their impacts (Ferraro and Pattanayak 2006; Wunder 2007). Monitoring PES schemes encounters several challenges. First, many environmental services are intangible and thus difficult and costly to measure (Barbier 2011b), hence most PES programs rely on observable proxies as indicators of environmental service such as tree planting for
carbon sequestration (Jack et al. 2008). Second, it is often difficult to demonstrate the biophysical link between land uses promoted and the environmental service outcomes (Naidoo et al. 2008) particularly because of lack of suitable methods and tools for measuring and monitoring ES outcomes. As a result, many current PES programs are based on beliefs that are not scientifically proven (Meijerink 2008). It is therefore ‘...quite likely that, at least in some areas, PES programs are promoting the wrong land uses for the environmental service they desire, for example, by increasing forest cover in areas with water deficits’ (Wunder et al. 2008: 846).

In general for PES programs to be environmentally effective, their design should account for how environmental service benefits change with different configurations of participants (Wunsch et al. 2008). This is important because ecosystems such as forests and rangelands have been shown to exhibit non-linear threshold effects, which means that their marginal environmental benefits are not constant. Consequently, it is expected that the differences in biophysical characteristic means that services generated in a given locality will vary from one point to another. In such a complex situation, a PES program that fails to account for how benefits change with configurations may not be environmentally effective (Jack et al. 2008).

### 2.8 Baseline, additionality, leakage and perverse incentives

The establishment of a baseline is a necessary precondition for attaining efficiency in any PES scheme (Wunder 2007) to be able to demonstrate ‘additionality’, which requires that payments should yield environmental benefits that would not have been realized in the absence of payments. Lack of clarity regarding additionality may result in paying for practices that would have been adopted without the payment, leading to financial inefficiency (Engel et al. 2008). Additionality depends on the nature of the baseline, which can be ‘static’, ‘deteriorating’ or ‘improving’ (Wunder 2005; 2007). Since environmental services are provided over time, one would need to have some understanding of what would hypothetically happen without the PES program (i.e. construct some counterfactual service baseline (Ferraro and Pattanayak 2006).

An easily measurable and observable unit for PES in crop and livestock system can be the number of livestock of a certain breeds or land area or seeds associated with a certain crop species or varieties (Narloch et al. 2011). Recent reviews indicate that very few PES programs have incorporated a detailed and systematic effort to quantify ‘additionality’ of environmental services provided using ex ante scenarios (Wunder et al. 2008; Pattanayak et al. 2010). The Regional Integrated Silvo-pastoral Ecosystem Management Project (RISEMP) is an exception in this case (Box 5). In principle, measuring additionality may be easier in PES schemes that undertake explicit land use changes (Pattanayak et al. 2010) but it remains difficult to assess ‘additionality’ in PES schemes which lack a baseline for establishing a counter-factual scenario. This is an area that calls for further research.

Additionality in PES schemes can also be compromised by leakages. ‘Leakage’ arises when the conservation problem being addressed by PES is shifted elsewhere, for instance, when a land owner receiving payment shifts the activity causing the environmental problem to another piece of land that is not under the contract (Meijerink 2008). The implementation of a PES scheme can also create perverse incentives, such as in the case in which land users are paid to maintain existing trees on their land which can lead to a situation where farmers that do not receive payments for pre-existing trees in their land decided to cut all the pre-existing trees (Pagiola et al. 2004).
3 Application of PES to livestock inclusive agricultural production systems

This chapter provides a review of emerging and operational PES for climate regulation, watershed conservation and hydrological services and biodiversity conservation in livestock inclusive agricultural production systems. PES is seen as having a great potential to play a catalytic role in the emerging context of a green economy (FAO 2010a). In pursuant of this objective, two thematic areas identified in an on-going global dialogue to support sustainable livestock sector development4 are linked to PES interventions: (1) greening livestock sector growth by closing the efficiency gap in natural resource use; and (2) grassland soil carbon restoration through supporting soil carbon, ecosystem health and productivity restoration with climate finance. Opportunities are therefore emerging to support PES in the livestock sector at local, national and global levels that include the possibility of developing an International Payment for Environmental Services (IPES) scheme (Barbier 2011b).

This chapter is organized in three subsections each of which is arranged as follows: we first describe the environmental challenges prior to analysing the three environmental services namely, climate regulation, watershed and hydrological services, and biodiversity conservation; second, we evaluate the potential demand and supply of these services; lastly, we review the dynamic of implementations of PES with a focus on livestock. We include a few case studies of PES that involve cattle and shoat production to further illustrate the points and issues raised, and support some of our initial observations regarding the implementation of PES in LiAPS.

3.1 Climate regulation

Livestock production systems contribute about 18% of global anthropogenic greenhouse gas (GHG) emissions (Steinfeld et al. 2006). The main sources and types of GHG from livestock systems are: carbon dioxide (32% from land use and its changes—feed production, deforestation), methane (25% mainly from enteric fermentation) and nitrous oxide emissions (31% from manure and slurry management) (Thornton and Herrero 2010). Nitrous oxide (N₂O) is comparatively less important in grazing systems than in mixed crop–livestock systems (Steinfeld et al. 2006), where even grazing can decrease rather than increase N₂O emissions (Wolf et al. 2010). The carbon footprint of livestock varies considerably among production systems, regions and commodities, mainly due to associated aspects of feed production (cultivation, transport, chemical fertilizer production and deforestation among others) and animal production (enteric fermentation and methane and nitrous oxide emissions from manure) (FAO 2010b).

Demand for climate regulation services

Global carbon markets trade products that relate to GHG emissions allowances, offsets and reduction (Forest Trends, The Katoomba Group, Ecoagriculture Partners, Climate Focus 2010).5 Markets for buying and selling carbon credits are expanding rapidly and are linked to two types of markets; voluntary and non-voluntary markets (World Bank 2011).

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5. The term carbon trading is used as an umbrella to indicate the trading of all greenhouse gases, therefore reduction in carbon dioxide, methane and nitrous oxide can be traded on carbon trading markets.
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- Non-voluntary or regulatory markets. This category includes among others6 the Clean Development Mechanism (CDM), a market-based flexibility mechanism developed under the Kyoto Protocol, which allows project participants to implement emissions reduction projects in non-Annex I (developing) countries7 with financial and technical support from developed countries. The CDM has stringent rules and regulations. All projects need to utilize specific baselines and monitoring methodologies approved by the CDM Executive Board.

The CDM procedures fulfill PES criteria as they are conditional and based on measurable additional emission reductions (Sommerville et al. 2009). Some projects that are eligible under the CDM and are relevant to the livestock sector include8 the reduction of GHG emissions from animal waste; the replacement of fossil fuel with biogas; waste management; biofuel production; and afforestation and reforestation projects (IPCC 2007).

- The voluntary carbon markets. This market category generally applies to private companies, individuals, and other entities and activities not subject to mandatory limitations that wish to offset GHG emissions. The voluntary markets mainly in Verified Emissions Reductions (VERs) that do not qualify for regulatory compliance. Voluntary carbon credits (VCC) may be purchased by the private sector interested in increasing their corporate social responsibility or promoting their image as part of public relations exercise.

Climate mitigation activities can also be funded by the public sector. For example the Global Environmental Facility (GEF) does provide funds for carbon sequestration from sustainable land management. Other opportunities are emerging in the current United Nations Framework Convention on Climate Change (UNFCCC) negotiations, including the REDD+ initiative (Lipper et al. 2010).

Since carbon credits for storing carbon in agricultural systems are not tradable under CDM, the majority of the payment schemes associated with terrestrial carbon have been tapping into voluntary markets. Voluntary carbon markets have uniquely fertile ground for land-based projects (Hamilton et al. 2009).

A challenge in LiAPS is likely to be the high transaction costs associated with aggregating sequestered carbon from a large number of small plots to create a marketable contract and verify compliance with contracts, hence deterrence to brokers, traders and potential service suppliers (Perez et al. 2007). The future of voluntary markets will depend on national legislation as well as agreements on post-Kyoto mechanisms for climate change mitigation. Currently, there is stalemate in some of the voluntary markets, such as the Chicago Climate Exchange, which closed in 2011 (Gronewold 2011).

Supply of climate regulation services

Suppliers of climate regulation services access to payment schemes by reducing or avoiding GHG emissions. They are landholders and resources managers that deliver ecosystem services and commodities that are translated into carbon (C) credits. Developing countries are considered to have a competitive advantage in climate regulation services because they are considered low-cost producers of carbon sequestration due to low opportunity cost of labour and land (Lipper et al. 2009).

The Fourth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) identifies several climate change mitigation measures, some of which are applicable to LiAPS as (i) grazing land management, (ii) restoration of degraded lands, (iii) livestock production management, and (iv) manure management (IPCC 2007). For example, improved pastures offer significant sequestration potential for the livestock sector (FAO 2006). In rotational grazing,

6. Non-voluntary or regulatory markets include: European Union Emissions Trading Scheme (EU ETS) applied in 30 European countries, some national schemes, such as Japan’s voluntary Emissions Trading System, some state level markets, particularly in US, Canada and Australia and the Kyoto Protocol’s compliance carbon markets.

7. Annex I is an Annex in the United Nations Framework Convention on Climate Change (UNFCCC) listing countries which are signatories to the Convention and committed to emission reductions. The Non-Annex I countries are developing countries, and they do not have legally binding targets to reduce or limit their greenhouse gas emissions during the first commitment period. Source: http://www.tfsgreen.com/glossary.php.

8. Among the approved small-scale agricultural CDM project methodologies specifically livestock related and applicable to developing countries are listed (http://cdm.unfccc.int/methodologies/index.html): AMS III D—Methane recovery in animal manure management systems (applicable for project activities involving the replacement or modification of existing anaerobic manure management systems in livestock farms to achieve methane recovery and destruction by flaring/combustion or gainful use of the recovered methane); AMS III R Methane recovery in agricultural activities at household/small farm level (applicable to projects dealing with recovery and destruction of methane from manure and wastes from agricultural activities that would be decaying anaerobically).
livestock move from one pasture to another at frequent intervals, giving plants time to recover and thus preventing desertification and soil carbon loss. Proper pasture management can potentially store from 0.11 t of CO₂eq⁹ per hectare per year in drylands to 0.81 t of CO₂eq/ha in humid lands (Smith and Martino 2007).

The amount of carbon that can be sequestered via restoration of degraded pastures in livestock and grassland (LG) systems¹⁰ in tropical Central and South America can reach 53.6 Mt CO₂eq and 96.7 Mt CO₂eq in sub-Saharan Africa (Thornton and Herrero 2010). In semi-arid lands silvo-pastoral practices, with 50 trees/ha, can store 110 to 147 t of CO₂eq/ha in the soil alone (Nair et al. 2009). For example, sustainable grazing in the Three Rivers Project (Box 3) is expected to generate a reduction of some 500,000 t of CO₂eq over 10 years. Different management activities can generate different sequestration rates and in the target area for this project, it has been estimated that restoring moderate degraded land by enclosure could lead to sequestration of 13 t of CO₂eq/ha per year while sustainable grazing on moderate degraded grassland can sequester up to 3 t of CO₂eq/ha per year.

Opportunities for reducing GHG emissions can also come from adoption of sustainable agricultural land management (SALM) practices. In the Western Kenya Smallholder Agricultural Carbon Project, the implementation of practices, which include livestock production management in the form of upgrading, fodder and forage management is estimated to have sequestered 10,500 t of CO₂eq in 7000 ha of land in 2009 (Shames and Scherr 2010).

Cattle manure can also be used in bio-energy offset projects. For example, in the Bagepalli Biogas Clean Development Mechanism (CDM) project in India, the use of cattle manure to produce biogas for cooking is expected to reduce about 19,800 t of CO₂eq/year leading to reductions in the use of non-renewable biomass for cooking and reductions in fugitive emissions from cattle manure (Peskett et al. 2010).

In the pastoral grazing systems in tropical rangelands, especially in Africa, the potential for climate change mitigation is high but remains untapped (FAO 2004; Reid et al. 2004). For example, although the actual amount of carbon that can be sequestered in pastoral drylands in Africa estimated to range between 0.05 to 0.70 t of C/ha per year is small relative to other regions of the world, or other management systems (Tschakert 2004; Woomer et al. 2004), the aggregate carbon that could be sequestered across Africa’s dryland covering an area of 1.297 billion hectare would be considerably large (Perez et al. 2007).

Permanence is also an issue of concern in the supply of climate regulation services. Suppliers of carbon emission reduction offsets from carbon sequestration are disadvantaged with respect to stochastic processes such as natural bush fires in tropical systems which affect the carbon cycle. In fact, carbon stored as a result of a sequestration can be released back into the atmosphere as a consequence of a reversal in the land use change that generated the sequestration (Lipper et al. 2010).

Payment for climate regulation services

In climate change PES schemes, two types of carbon payments are anticipated: (i) payments for carbon capture, and (ii) payments for carbon storage. Payments for carbon capture entail an upfront payment, whereas payments for carbon storage entail annual payments proportional to average size of carbon stock over the year (Richards 2004). Therefore, the implementation of carbon markets is strongly linked with mitigation from agricultural sources, which represents an opportunity for LiAPS.

Consequently, there are many opportunities in LiAPS for the livestock sector to reduce GHG emissions and increase carbon sequestration through different management practices (Herrero et al. 2009). This can open the possibility for livestock farmers to access schemes for rewards and/or compensation for environmental services, and result in win–win outcomes, such as in the RISEMP project where the increase in carbon sequestration happened concurrently with an increase in milk production (Sanchez 2002; Bationo et al. 2007).

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⁹ While potential carbon emission reductions are generally measured in carbon metric tonnes, payments for carbon emission offsets are generally based on tonnes of carbon dioxide equivalents; conversion from carbon to carbon dioxide equivalents requires multiplication by a factor of 44/12 (Lipper et al. 2010).

¹⁰ LG indicates a subset of solely livestock systems, grassland-based systems, in which more than 10% of the dry matter fed to animals is farm produced and in which annual average stocking rates are less than 10 livestock units per hectare of agricultural land.
Greening livestock: Assessing the potential of payment for environmental services in LiAPS in developing countries

The effectiveness of carbon markets presupposes the existence and integration of many factors, namely (i) the technical capacity to enhance carbon storage in production systems; (ii) the capacity for resource users to adopt and maintain land resource practices that sequester carbon; (iii) the ability of dealers or brokers to monitor carbon stocks at a landscape level; (iv) the institutional capacity to aggregate carbon credits; (v) the financial mechanisms for incentive payments to reach farmers; and (vi) transparent and accountable governance structures that can ensure equitable distribution of benefits (Perez et al. 2007).

Two of the already mentioned factors are currently posing a challenge to PES implementation in the livestock sector across LiAPS: lack of tools and methods to effectively measure and monitor carbon stocks; and the financial mechanisms for incentives vis-à-vis opportunity costs from alternative land use options.

In the first case, rapid, feasible, and cost-effective methods and tools to measure soil carbon, model carbon offsets, and monitor land management systems that contribute to carbon sequestration are needed to establish well-functioning carbon credit PES schemes (Perez et al. 2007). These methods are currently lacking to support mitigation in the agricultural sector broadly (Lipper et al. 2010).

Yet, it is commonly accepted that the feasibility and sustainability of carbon credit schemes will depend on appropriate measurement and monitoring schemes. There is some progress in developing tools and methods for carbon measurement and monitoring. For example, the RISEMP project uses an index for carbon sequestration and payments are made based on incremental point of carbon sequestered, with 0.1 points assigned per tonne of carbon sequestered (Pagiola et al. 2004). Recently the sustainable agricultural land management (SALM) carbon methodology piloted in Kenya as part of the Western Kenya Smallholder Agriculture Carbon Finance project has been approved by the Verified Carbon Standard (VCS). The methodology quantifies the GHG emission reductions of sustainable land management practice activities that apply enhanced aboveground, belowground and soil-based carbon stocks of agricultural areas. Specifically relevant to livestock, the Three Rivers Project has also submitted a methodology on sustainable grazing management to the Verified Carbon Standard (VCS).

On the latter pertaining to financial mechanism for incentives, two issues are pertinent. First, the prices paid for carbon emission reduction credits vary widely based on the source of demand and the type of offset. Cap and trade markets such as the CDM have in general higher prices than voluntary market payments (Lipper et al. 2010). In the Biocarbon Fund of the World Bank, a reference price of USD 4/t of CO₂eq for sequestration sources of offsets is applied. In the RISEMP project carbon stored and sequestered carbon was paid for at a rate of USD 2/t of CO₂eq. Overall, the price of carbon especially in voluntary markets is too low (Lipper et al. 2010).

Second, the existence of biophysical potential and market opportunities alone are not sufficient to ensure that low income producers of carbon in dryland systems will adopt soil carbon enhancing technologies (Perez et al. 2007). This is especially true for nomadic, highly mobile pastoral livestock keepers that dominate pastoral grazing systems. While the income or profits from carbon payments are important to households, it is also critical to consider the opportunity cost of adopting carbon—enhancing land use practices as well. This is because resource users are likely to invest in practices that increase carbon pools when the latter promise benefits that exceed those from alternative uses of their land, labour and capital (Diagana et al. 2007).

Tscharkert (2007) observes that livestock keepers appraisal of the profitability of carbon enhancing techniques (relative to existing practices) will largely determine their willingness to adopt them and to commit to implementing them over time. Attention should therefore be paid to individual land holders and their ability to adopt different land uses for PES. The costs of adapting techniques such as those for carbon-enhancing practices are different for households due to the significant variation that exists among resource managers. For example in Senegal, it was shown that the costs of adapting carbon enhancing management practices were higher for poor farmers than for middle and higher income farmers. In addition to social differentiation, spatial variation in resources availability requires the development of specific adaptation strategies for outscaling payments (Tschakert 2004).

The foregoing discussion suggests that a key factor to assess carbon sequestration potential therefore is the opportunity cost of changing practices which varies across landscape due to the spatial variation in productivity and in

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11. The approved VCS Methodology is available online at: http://www.v-c-s.org/sites/v-c-s.org/files/VM0017%20SALM%20Methodology%20v1.0.pdf.
carbon accumulation rates (Diagana et al. 2007) and transaction costs which are also are highly variable for carbon PES programs in the tropics, ranging from 6–45% (Wunder et al. 2008). Given its reliance on complex global agreements, and contractual commitments which increase the transaction costs, carbon trading will not be able to function without governments backing in form of technology development and transfer, extension service provision, subsidies and incentives, regulating and certification, and even in terms of mobilization of environmental service providers (Perez et al. 2007).

PES programs should therefore be designed to minimize transaction costs, and a common method to achieve this in practice is by designing programs so as to have single contracts with multiple providers, or use of intermediary organizations. In addition, the ability to engage in carbon trading will depend on aggregating small amounts of carbon sequestered in large numbers of small plots to scales large enough to be tradable on carbon markets and this will depend on the capability to aggregate farmers so that pools of carbon mitigation in tradable amount are formed, an action which requires some form of collective action (Swallow and Meinzen-Dick 2009).

Many developing countries have prepared and submitted Nationally Appropriate Mitigation Actions (NAMAs) 'in the context of sustainable development, supported and enabled by technology, financing and capacity-building, aimed at achieving a deviation in emissions relative to “business as usual” emission in 2020' (UNFCCC 2011). Specific NAMA actions could include payment for environmental services for climate regulation linked to the livestock sector and livestock production in LiAPS. A wide range of NAMA actions in fact have great potential as they deal with mitigation; adaptation resilience building; agriculture development and food security.
Greening livestock: Assessing the potential of payment for environmental services in LiAPS in developing countries

Table 3. Linking environmental services and disservices provided by livestock to opportunities from payment for environmental services schemes in LiAPS

<table>
<thead>
<tr>
<th>Production systems</th>
<th>Payment schemes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Climate regulation</td>
</tr>
<tr>
<td>Pastoral or grazing systems</td>
<td>Access to PES can be driven by restoration of degraded lands and implementation of sustainable grazing land management, which presents the potential for stocking carbon. On optimally grazed lands carbon accrual is greater than in ungrazed or overgrazed. Greater livestock density also reduces biomass removal by fires</td>
</tr>
<tr>
<td>Mixed crop–livestock systems (extensive and intensive)</td>
<td>Access to PES schemes can be driven by: adoption of improved feed supplement that can lead to emissions reduction; adoption of improved pastures with high density trees and fodder banks that reduce land degradation; switching to organic fertilizer to increase capacity of stocking carbon; integrated livestock and manure management</td>
</tr>
</tbody>
</table>

While PES for climate regulation has focussed on climate change mitigation, it is also being recognized that PES can also contribute to climate change adaptation (Wetz-Kanounnikoff et al. 2010; van de Sand 2012). Efforts to establish the role of PES in climate change adaptation in pastoral rangelands are currently underway in Kenya. Preliminary analysis show that PES schemes in rangelands are a source of diversification providing an income stream that can enhance the adaptive capacity of participating pastoral herders helping them to cope with drought (accidental co-benefit); lead to the formation and strengthening of local level institutions that are relevant towards adaptation; and when designed to keep rangelands open, PES schemes also enhance benefits for climate change adaptation (natural adaptation co-benefits) (Osano 2011; Birner and Osano 2012). There is, in general, a lack of documentation on the role of PES in climate change adaptation, and developing country policymakers have recognized this as a priority for future research to support policy (Government of Kenya 2010).

Current opportunities for farmers in payments for environmental schemes for climate regulation are summarized in Table 3, while additional enabling factors and constraints for the implementation of PES for climate regulation in livestock inclusive agricultural systems are highlighted in chapter 4.
Box 2 illustrates an example of application of PES under voluntary carbon market scheme.

**Box 2: The Three Rivers Project in China: Sustainable grazing and carbon credit**

The Three Rivers Project, situated in Qinghai province of Northern China is a pilot project that uses carbon financing to promote: grassland rehabilitation by controlling land degradation and preserving water cycle and biodiversity; emission removal through soil carbon sequestration; emission reduction (per unit of product) through greater efficiency and productivity; food security through improved livestock management practices. The project was formulated in view of the increasing degradation of agropastoral landscapes and the associated loss of ecosystem services, such as carbon sequestration, nutrient cycling and biodiversity conservation.

Carbon finance from a voluntary scheme will be used to compensate costs and foregone income during a transition period and to increase productivity.

The pilot includes a combination of grassland restoration zoning and stocking-rate management in an incentive-based system. Considerable reductions in income are expected during the first years of the project, due to the current overstocking rates of about 45%. Herders will receive compensation for that. In the following years, as incomes are expected to grow in response to increased livestock productivity (and possibly other small business support measures), compensation will decrease progressively until year ten. After the first decade of the project, households are expected to have fewer but more productive livestock. From years 10–20, herds can be increased beyond the level of the first 10 years, without the risk of overgrazing. Increased availability of forage will enable higher incomes and higher levels of production over the long-term, this last one will be strengthened by the development of processing activities and marketing associations.

The project is expected to generate a reduction of approximately 500,000 t of CO₂eq over 10 years. It also aims to address some of the key barriers to smallholder access to carbon finance, which include the lack of appropriate baseline methodologies and cost-effective measuring, reporting, and verification (FAO 2010c).

### 3.2 Watershed conservation and hydrological services

Environmental services derived from watersheds include: regulating the timing and extent of runoff; storing water recharging aquifers; reducing salinization; controlling erosion; preventing landslides; reducing the risk of flooding; and filtering and decomposing organic material, thereby purifying the water flowing from a catchment. The link between land use and watershed services is still not well understood and the direction and magnitude of the relationship is still a subject of debate (Calder 2005; Brauman et al. 2007).

Livestock production activities have an effect on watershed conservation and the delivery of hydrological services. On one hand these activities may lead to the reduction of run-off and sedimentation in grazing systems, and could lead to increase in water-holding capacity when livestock manure is added to soil in mixed crop–livestock systems. On the other hand extensive cattle grazing in dryland forests can be the cause of forest degradation which diminishes water quality and quantity and increase the risk associated with landslides and flooding. Also, extensive cattle ranching can affect cloud forests leading to livestock-induced deforestation that can cause reduction of water supply. In intensifying systems livestock impacts can be extended to contamination of water mainly determined by nutrients loading.

**Demand for watershed conservation and hydrological services**

In the case of watershed conservation services, markets can be established, where beneficiaries, usually downstream water users, pay to providers, usually upstream land users, for activities that promote improvement in water quality and quantity (Brauman et al. 2007; Richmond et al. 2007; Bond and Mayers 2010). For example, the services demanded in the local Payment for Watershed Services (PWS) scheme in Pimampiro in Equador are improved water quantity and quality (Wunder and Alban 2008), while in the local PWS scheme in Los Negros valley in Bolivia the
service demanded is improved water quantity (Asquith et al. 2008). In the national PWS in Costa Rica (Pagos por Servicios Ambientales—PSA) together with the provision of hydrological services, the other services demanded are mitigation of greenhouse gases, biodiversity conservation, and provision of scenic beauty for ecotourism (Pagiola et al. 2002; Pagiola et al. 2008).

The demand for water supply (quality and quantity) in a watershed is from both small- and large-scale consumers, and the common users include: water utility companies, hydro-electric power (HEP) companies, domestic consumers, and irrigation farmers. The most common sources of payment are from revenue generated through users fees; private sector which includes payments by industry to meet statutory obligations or in form of voluntary contributions as part of corporate social responsibility (CSR); international and bilateral donors that often fund start up and sometimes transaction costs which include feasibility studies and stakeholder building programs.

In developing countries, a complex mixture of funding for PWS scheme is in place (Bond et al. 2009; Secretariat of the Convention on Biological Diversity 2011): in Los Negros valley in Bolivia the ecosystem buyers are the US Fish and Wildlife Service (Asquith et al. 2008); in Pimampiro in Ecuador the source of the payment is the local government through revenues derived from fees paid by 1331 water users (Wunder and Alban 2008); and in the PSA in Costa Rica the FONAFIFO, an autonomous state agency, manages the 20% of the funds collected through the charges applied to water users.

### Supply of watershed conservation and hydrological services

The suppliers of watershed services in most PES schemes are landowners located in the upper catchment zones of a watershed holding de jure or de facto rights to land. The suppliers are paid for making changes to their land-management practices in order to minimize negative or undesired impact on watershed services affecting downstream users (Porras et al. 2008). The public-good characteristics of watershed services provide little incentive for land users to consider the downstream effects of their land-use decisions necessitating the introduction of PES payments.

In contrast to the difficulties of working with large numbers of people on communally-owned lands with no clearly defined individual rights (Swallow and Meinzen-Dick 2009), individual private land owners can secure control over their land by excluding others from practices that affect the supply of environmental services if they are paid directly.

According to Porras et al. (2008), other categories of suppliers in PWS schemes include the following: informal occupiers of public lands often represented by farmers that live in protected and non-protected public lands. These farmers may in some cases have long-standing informal rights to the land and be in dispute with the government; communal landholders are farmers living or drawing their livelihoods from communal land. An example here is the Mexico National PSAH, where forestland is mostly communally owned through the ejidos (communal lands) (Box 6): government or NGO managing protected areas, cases where a national park receives payment or where user fees are also used to help administer protected areas located in the upper parts of the watershed.

### Payment for watershed conservation and hydrological services (PWS)

In PWS schemes, the evidence of regarding the delivery of environmental services remains unclear and the reported PES impacts on water flow and quality in many of the schemes are based on the views of the users, local people or the schemes’ administrator, rather than on on-site measurements and modelling of land use and water relationships (Porras et al. 2008). In most cases PWS follow a land based approach due to the challenges in measuring and attributing changes in the provision of watershed services to PES interventions.

Providers of watershed services are paid for changes to their land management practices that are believed to have a high probability of resulting in the desired impact on watershed services. These changes may include: improved land practices (improved agricultural and ranching practices, agroforestry, and sustainable forest management); conservation and protection of existing ecosystems; reforestation; rehabilitation of degraded ecosystems for protection (Porras et al. 2008).
In Los Negros valley in Bolivia for example, livestock farmers are paid not to cut trees or clear forest on enrolled lands, to conserve the cloud forest that if not conserved, can cause damages to a downstream dam generating the risk of siltation and reducing the dam’s lifespan. In Pimampiro, Costa Rica, farmers are paid for the conservation of paramo grassland and natural forests, and for the adoption of some improved agriculture measures. In the SLCP (Sloping Land Conversion Program in China) farmers are paid based a unit of land area (hectares) of cropland they convert to forest and the area of barren wasteland they afforest (Bennet 2008).

A summary of the opportunities for LiAPS in payments for watershed schemes are illustrated in Table 3 on page 24.

The evidence of benefits to sellers of watershed services is mixed. In general, cash payments appear to be relatively insignificant, working more as support or a bonus than a real incentive for land-use change (Malvasi et al. 2003; Kosoy et al. 2007). Descheemaeker et al. (2009) highlighted that non-financial benefits play the role of incentive in watershed payment schemes: farmers are probably keen in participating in such schemes since they can benefit from the strengthening of property rights, capacity building, and improvements in social organization and in quality of life.
Box 3 illustrates an example of the feasibility of using PWS for the restoration of grazing lands in a large watershed ecosystem.

**Box 3: Payments for ecosystem services (PES) to improve watershed catchment management in the Maloti-Drakensberg Grassland in South Africa**

The Maloti-Drakensberg mountain range is a fire-prone grassland ecosystem of which 25,000 km² is protected as a World Heritage Site. This mountain range is South Africa's largest and most strategic source of fresh water and it depends on the integrity and health of the grassland ecosystem to protect this source of water. While occupying less than 5% of the country’s surface area, it produces 25% of the country’s water runoff, and is supplying water to much of the southern African sub-continent through rivers and inter-basin transfers.

A threat to this water source, however, is the fact that a remaining 25,000 km² is not protected and is subject to varying intensive and extensive forms of agriculture by both commercial and subsistence farmers. This portion of the mountain is exposed to degradation in the form of vegetation loss (bare soils) and soil erosion resulting from incorrect fire management, as well as the combination of inappropriate cattle grazing management regimes and improper stocking rates. The combination of these factors is affecting both the quality and quantity of water runoff and base flow.

Past efforts, through regulations, to improve fire and grazing management regimes and stocking rates have been largely unsuccessful as the level and spread of degradation is currently still on-going.

Recent feasibility studies suggest that under certain conditions, PES is economically, financially and institutionally viable. The development of payment for flows of ecosystem goods and services, following appropriate management and restoration of natural capital can also benefit local communities, the commercial sector and the environment. It is also desirable from both a rural development and a social equity perspective as opposed to regulatory-based approach towards land use management.

Measured against the current intensive management, restoration actions through a PES scheme provide potential returns in terms of several services, which include water supply and quality, carbon, tourism and cattle.

Source: Blignaut et al. (2010); Bullock et al. (2011).

### 3.3 Biodiversity conservation

Payment programs for biodiversity conservation are in various phases of development around the world, addressing components of biodiversity from the genetic to the ecosystem level and including both agricultural and wild biodiversity (FAO 2007; Milne and Nieste 2009; Narloch et al. 2011). These schemes may entail the protection of a single species, several groups of species or an entire ecosystem.

Biodiversity conservation can positively and negatively be affected by livestock production. On one hand livestock may enhance biodiversity: complex ecosystems as grasslands need gentle continual disturbance to flourish (Hampicke and Plancher 2010) and these benefits are extended to other species that thrive therein (Collins and Barber 1985; Spasojevic et al. 2010).

Grazing can stimulate grass tilling, improve seeds germination and dispersion (through hoofs and manure) and it can control shrub growth. Grazing can also be a favourite fauna biodiversity preservation: mixed livestock–wildlife systems result in a greater variety of species and yet, pastoral land use may protect wildlife biodiversity in savannah landscapes (Maestas et al. 2003). In addition, mixed crop–livestock systems can provide a suitable habitat for birds. Yet, positive impacts occur when livestock production is more efficient (Herrero et al. 2009).
On the other hand livestock have some negative impacts on biodiversity. Livestock can directly affect biodiversity through heavy grazing and soil compaction and erosion (Harvey et al. 2005), contamination of water and aquatic ecosystems, diseases spread to wildlife with whom livestock also compete for water and forage. Livestock can indirectly affect biodiversity through land use change and deforestation motivated with the aim of creating pasture (Alkemade et al. 2012).

Demand for biodiversity conservation services

The demand for biodiversity conservation services may be assumed to be dispersed reaching from local farmers and communities, to consumers all around the world and society in general (Narloch et al. 2011). Although the buyers for biodiversity services in the developing countries include private corporations, international NGOs, national governments and private individuals, Balmford and Whitten (2003) argue that governments of the developed countries should take the largest responsibility of paying for biodiversity conservation in the tropics through financial transfers from north to south, a process that can be achieved through an International PES schemes for biodiversity (IPES) (Barbier 2011a).

The buyers of biodiversity services are motivated by different interests. Private sector corporations may participate in PES schemes as part of corporate social responsibility (CSR) programs, or to meet regulatory obligations for biodiversity offset targets to mitigate negative impacts on biodiversity generated by their operations; government agencies, development banks, and non-government entities (such as NGOs) may take the role of service buyers, especially in the case when marginal commercial value of biodiversity conservation is not high enough to activate industry to fund large-scale on-farm conservation efforts; and private individuals can participate in PES through existing agricultural markets where users are willing to pay for services and products certified against environmental standards.12

The ‘users’ of biodiversity and landscape services tend to be many and widely dispersed, thus creating problems of collective action in securing payments in PES schemes (Swallow and Meinzen-Dick 2009). For this reason, most PES programs targeting biodiversity, which is a global good that delivers global benefits, are funded mainly through national and global public agencies such as the Global Environment Facility (GEF) and private non-profit environment agencies including conservation NGOs. For example, in a PES scheme for wildlife conservation in the dispersal area of Nairobi National Park in Kitengela, Kenya, financing for paying livestock farmers are generated from a mix of local and global government and non-governmental sources (Box 4), while in a separate similar PES initiatives around the Maasai Mara National Reserve in southern Kenya, payments are done by a group of tourism operators that lease land for wildlife based tourism on private land (ASARECA/ILRI/Egerton University/IUCN 2012). In the RISEMP project (Box 5), the global benefits generated by biodiversity conservation and carbon sequestration are paid for by the Global Environmental Facility (GEF), the World Bank and the Food and Agriculture Organization of the United Nations (FAO).

Supply of biodiversity conservation services

Markets for biodiversity conservation are expanding rapidly (Jenkins et al. 2004) through which land users are paid directly to adopt practices that improve biodiversity conservation (Ferraro and Kiss 2002; Milne and Niesten 2009). In fact, theoretically farmers could be contracted to provide biodiversity, but in practice it is quite unrealistic to ask farmers to deliver biodiversity. The solution is then to offer to pay farmers not for biodiversity itself, but for land uses that are hospitable to biodiversity (Pagiola et al. 2002).

12. Local and global consumers of agro-biodiversity services may pay through such mechanism as eco-labelling, certification or denomination of origin schemes when niche product markets are developed. In eco-labelling consumers of eco-labelled goods pay a premium on their purchase to ensure a higher standard of environmental care from the conventional production of goods (Veisten 2009).

A recent concept developed by Ghazoul et al. (2009) is the one of ‘landscape labelling’ that proposes that rural landscape that are managed in the way to deliver valuable ecosystem services should be awarded of a kind of ‘Landscape label’ useful to identify products produced from the landscape. According with the authors, this label may represent an opportunity for the farmers to improve market recognition, secure premium payments and gain access to niche markets. In particular this concept could ensure participation to PES schemes to landless people and smallholders for whom the participation in most PES schemes could have been compromised by lack of capability or because they are excluded due to insufficient size.
In terms of conservation mechanisms, two aspects of biodiversity are apparent: conservation that focuses on preservation of wild biodiversity, mostly in landscapes with little human modification, and the conservation of biodiversity in human dominated and highly modified landscapes, commonly referred to as agro-biodiversity.

The 'providers' of such biodiversity services are most likely to be found in less intensive agricultural systems. They are, in particular, local communities located in remote areas in developing countries where small-scale farmers are managing species, varieties or breeds that are characterized by unique adaptive traits such as resistance to diseases and drought tolerance, generated over many years of domestication across a wide range of environments (Smale 2006; Kontoleon et al. 2009; Narloch et al. 2011).

The seller is typically a local resource user (farmer, local community, indigenous custodian, government department). A study by Milne and Niesten (2009) on payment for biodiversity conservation in developing countries, funded by international donors, noted that the majority of the schemes involve communities as service providers, while agreements with government are less frequent.

The spatial overlap between areas of conservation priorities and ecosystem services, and areas of extensive livestock production can create positive synergies whereby PES for biodiversity conservation can also support livestock production indirectly through conservation of grasslands (Naidoo et al. 2008). Much of the areas of global priority for biodiversity conservation in the tropics are dominated by pastoralism and mixed crop–livestock systems. This raises the prospect that implementation of PES schemes for biodiversity in these priority sites are likely to involve and benefit livestock keepers. For example, the Wilderness Areas’ cover the tropical humid forests, the tropical dry forests and tropical grasslands (Mittermeier et al. 2003), all of which have a high level of livestock production.

Similarly, PES is suggested as having potential to promote crop and livestock species conservation through Payments for Agro-biodiversity Conservation Services (PACS) in production landscapes (Narloch et al. 2011). However, many of the pilot initiatives in this area are still limited to crops but a promising area of future PES application could be related to create incentives for maintaining livestock genetic resources. In this case, the Weitzman-type prioritization tools could be used to identify specific livestock breeds that should be the focus of ‘livestock diversity’ PES support (Simianer et al. 2003).

**Payment for biodiversity conservation services**

Although payments for the provision of biodiversity services have received increasing attention (Pagiola et al. 2002; Ferraro and Kiss 2002; Milne and Niesten 2009), it is difficult to estimate the actual value of the benefits provided through biodiversity conservation (Pagiola et al. 2004). Currently, agreements involving buyers and sellers in biodiversity markets cover a wide spectrum (Scherr et al. 2003; Jenkins 2004), which include:

- Conservation easements: where a land owner is paid to use and manage a defined piece of land only for conservation purposes; restrictions are usually in perpetuity and transferable upon sale of the land.

- Conservation land lease: where a land owner is paid to use and manage a defined piece of land for conservation purposes, for a defined period of time. For example, payments for wildlife conservation in the Olare Orok Conservancy, Kenya, are based on conservation land leases (landowners are paid to vacate their land and agree to certain land use restrictions). In Simanjiro plains in northern Tanzania 3500 pastoralists are paid an annual fee of USD 4500 in exchange for the village to formally exclude agricultural cultivation or permanent settlements in a concession area of 9300 ha of land (Nelson et al. 2010).

- Community concession in public protected areas: individuals or communities are allocated user rights to a defined area of forest or grassland, in return for commitment to protect the area from practices that harm biodiversity.

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13. Globally, a number of contrasting priority schemes has emerged to aid in the conservation of wild biodiversity. Three prominent ones are Biodiversity hotspots (Myers et al. 2000), the Wilderness Areas (WA’s) and the High Biodiversity Wilderness Areas (HBWAs) (Mittermeier et al. 2003), and the Global 200 Ecoregions (Olston et al. 1998).

Management contracts for habitat or species conservation on private farms, forests, grazing lands (contract that
details biodiversity management activities and payments linked to the achievement of specified objectives). For
example in La Vieja in Colombia landholders are paid from GEF for reforestation with native species in order
to increase biodiversity conservation together with carbon sequestration. The scheme includes 80 livestock
ranchers and offers direct payments up to USD 6500/year depending on the type of reforestation package adopted
(Secretariat of the Convention on Biological Diversity 2011).

Conservation performance is most easily monitored using proxy indicators that monitor human behaviour with
respect to different land uses: presence or absence of wildlife snares, occurrence or not of forest clearing or
accomplishment of conservation management activities (Sommerville et al. 2011). In very few cases conservation
performance is measured using biological indicators as is done in the RISEMP project, where counts of birds species is
used as main indicator of biodiversity, complemented by studies of butterflies, ants and mollusc (Pagiola et al. 2004).

The land use approach has the advantage that it is a simple method, but it fails to recognize the very different levels of
services that different land uses can provide, for example the location matters and biodiversity conservation practices
in proximity to protected areas might be more valuable by helping to buffer protected areas. In the RISEMP project a
biodiversity conservation index has been developed with a scale from zero for the most biodiversity-poor land
use (annual crop) to 1 for the most biodiversity-rich land use (primary forest). An incremental point in biodiversity
generated by the farmers is compensated with USD 75/year over a four-year period, up to a maximum of USD 4500/
farm (Pagiola et al. 2004).

Box 4 illustrates an example of PES for biodiversity conservation targeting wildlife conservation in pastoral grazing
lands in Kenya. This case shows an example of conservation land lease that allows for livestock grazing complementing
wildlife conservation.

**Box 4: Biodiversity conservation services: Payment for wildlife conservation (PWC) in Kitengela, south of the Nairobi National Park in Kenya**

The Wildlife Lease Program (WLP) involves direct monetary payments to pastoral Maasai landowners living to the
south of Nairobi National Park (NNP). The PWC scheme was started in 2000 to maintain the seasonal wildlife
dispersal areas and migration corridor in Kitengela to ensure the viability of the Nairobi National Park ecosystem
and its biodiversity; and to enhance the economic security and quality of life of local pastoral landowner households
(Gichohi 2003). The scheme is co-ordinated by The Wildlife Foundation (TWF), a local non-governmental
organization (NGO) which acts as an intermediary between pastoral land users and ecosystem services buyers.
The scheme started in 2000 with 86.6 ha of land provided by two landowners and had 375 households enrolled in
2010 providing a total of 16,500 ha of land.

Funding for the scheme is from voluntary national and international buyers and the main funders are the Kenya
Wildlife Service (KWS), the state agency responsible for wildlife management, the Global Environment Facility
(GEF) through the World Bank and The Nature Conservancy (TNC). Participating households sign a one-year
lease, and are paid USD 10/ha per year (with a 5% base annual inflation factor), an amount that is competitive
to returns from livestock grazing, which is not precluded as a land use for participants. Pastoral landowners
have a double benefit: they get income from PES payments and are still able to continue with pastoral livestock
production. In turn, land users in the program are required to allow free movement of wildlife on their land, refrain
from poaching wildlife, report poaching by others, protect natural vegetation on their land, and avoid fencing or
sub-dividing their land.
Box 5 illustrates an example of payment for environmental schemes that targets a bundle of services which include biodiversity conservation and climate regulation through carbon sequestration.

**Box 5: Biodiversity conservation and carbon sequestration: grazing systems in Central America**

The *Regional Integrated Silvopastoral Ecosystem Management Project (RISEMP)* has been implemented to promote the development of silvo-pastoral systems in Colombia, Costa Rica and Nicaragua, in areas highly deforested and fragmented and characterized by unproductive and degraded pastures. The aim of the project was to rehabilitate degraded pastures to protect soils, store carbon, and foster biodiversity. It also aimed to develop incentives and mechanisms for payment for ecosystem services (PES) that would result in benefits for farmers and communities. The project would also distil lessons for policymaking on land use, environmental services and socio-economic development.

For the demand side, international demand for carbon and biodiversity benefits was covered by the GEF, World Bank and the FAO. From 2003 to 2006, cattle farmers received between USD 2000 and USD 2400/farm, representing 10 to 15% of net income to implement the program silvopastoral systems.

During the initial four years, the high investment costs of implementing a silvopastoral scheme reduced the economic benefits drawn by the farmer (for example live fencing, planting trees etc.). Once the trees were grown sufficiently to provide *benefits*, due to the greater availability of high quality fodder and shade from the trees, milk production was expected to increase and expenses for fertilizers and pesticides, as well as irrigation water use and soil erosion were expected to fall. The project also aimed to provide PES, to get the profitability of the silvopastoral systems up to the level of the traditional ones by the second and to increase profits by 50% by the fifth year.

The project resulted in 60% reduction in degraded pastures in the three countries, and the area of silvopastoral land use (e.g. improved pastures with high density trees, fodder banks and live fences) increased significantly. The environmental benefits associated with the project included a 71% increase in carbon sequestered (from 27.7 Mt of CO₂eq in 2003 to 47.6 Mt in 2006), increases in bird, bat and butterfly species and a moderate increase in forested area. Milk production and farm income also increased, by more than 10 to 115% respectively. Herbicide use dropped by 60%, and the practice of using fire to manage pasture is now less frequent. Other demonstrated environmental benefits of Silvopastoral systems included the improvement of water infiltration; soil retention; soil productivity; land rehabilitation, and the reduction of fossil fuel dependence (e.g. substitution of inorganic fertilizer with nitrogen fixing plants).

The project has successfully demonstrated the effectiveness of introducing payment incentives to farmers and in increasing the awareness of the potential of integrated ecosystem management for providing critical environmental services including the restoration of degraded pasture.

Source: [http://www.watershedmarkets.org/casestudies/Silvopastoral_Central_America.html](http://www.watershedmarkets.org/casestudies/Silvopastoral_Central_America.html).
4 Enabling factors and constraints for PES implementation: Legislation, property rights and land tenure

A supportive legal framework and clearly defined property rights are necessary to support the establishment and functioning of PES schemes for different environmental services (Greiber 2009). The establishment of PES schemes in LiAPS may therefore be enabled or faced with different challenges relating to the existing legal framework, property rights and land tenure regimes.

4.1 Legislative frameworks

The existing legislative frameworks, consisting of laws and policies are important in PES because they define the institutional arrangements, responsibilities, requirements, contracts, recourse and mechanisms for resolving conflicts or disputes (Bracer et al. 2007). The importance of the legal framework differs depending on the nature of PES schemes. Private PES schemes, where both the buyers and sellers of environmental services are private entities such as private companies, individuals, or groups of individuals do not require a specific legal framework beyond the basic law of contract.

Exceptions are made, however, if the PES interventions are to be scaled up. In such cases, specific legal frameworks are required in PES trading schemes, which involve the establishment of markets in which rights or permits and/or quotas can be exchanged, sold or leased, and in public PES schemes which involve at least one public utility as a contracting party (Greiber 2009). Other important legal and institutional factors that promote pro-poor and equitable PES include the governance role of stakeholders, government oversight, sectorial legislation such as for land, water, agriculture, forest and wildlife management, contract law governing transactions, legislation governing smallholder and farmer organizations and tenure rights (Bracer et al. 2007).

4.2 Property rights and land tenure

Property rights and especially land tenure play an essential role in PES because environmental services emanate from land use. Payments are also made for specific land uses that may also require collective action among land user’s involved in the PES scheme (Swallow and Meinzen-Dick 2009). Environmental service providers must possess the authority, ability, and willingness to restrict access and use of resources on contracted land and these will differ by tenure regimes (Bromley 1991; Barrett et al. 2001).

Broadly, four possible regimes can be identified, namely: (i) state property regimes, (ii) private property regimes, (iii) common property regimes, and (iv) non-property (open access) regimes, each of which relates to different tenure arrangements (Bromley 1991). The implementation of PES in common property and non-property (open-access) regimes are thought to be more challenging because governance and enforcement require collective action in the former and may be completely lacking in the latter due to absence of well-defined property rights (Swallow and Meinzen-Dick 2009).
In common property regimes, identifying who holds right and control to the production of ecosystem services is more complex than in private and state property regimes. In a common property regime, property rights over environmental resources are shared by a group of interdependent users who control access to these resources and exclude outsiders. In turn, the ability of a member of the group to extract direct or indirect benefits from the use of environmental resources derives from a bundle of existing formally or informally-acquired rights that are regulated by common property institutions (Corbera et al. 2007). While emphasis is placed on privatization and titling in PES programs, it should be noted that property rights do not need to be individual to allow environmental service mechanisms to proceed as contracts with groups of farmers may be more effectively secured with group rights (Swallow and Meinzen-Dick 2009).

Land tenure and property rights can therefore serve as an enabler or as a constraint to PES implementation (Greiber 2009). First, they can enable PES because they encourage the adoption of improved land management practices (Zbinden and Lee 2005) and tenure security can be ensured under different tenure systems and not necessarily the allocation of land titles only (Migot-Adhola et al. 1991).

Second, tenure security is particularly crucial in the implementation of carbon sequestration projects. Without clear and defendable rights to land, forest or the sequestration service itself, suppliers cannot make a credible commitment to supply carbon offsets (Jindal et al. 2008). Unfortunately, many potential suppliers (land users) in the tropics do not have formal land titles and sometimes, may not control access to land (Wunder 2007; Engel and Palmer 2008).

Third, PES can empower local communities, to secure and reinforce property rights and land tenure claims (Grieg-Gran et al. 2005; Pagiola et al. 2005). In the Virilla watershed, Costa Rica for example, PES contracts were found to help increase tenure security (Miranda et al. 2003; Grieg-Gran et al. 2005). This aspect is especially critical for livestock production by mobile herders in extensive pastoral systems where land is mostly communally owned and managed collectively often with overlapping and fuzzy claims. In these systems, PES may have the effect of increasing the value of common property land, much of which is currently considered ‘marginal’ because of its low agricultural potential.

Land tenure and property rights can also serve as a constraint to PES. First, insecure land tenure can deny the poor accessibility to PES programs, as for example, in Costa Rica, where proof of a legal title deed was initially a requirement prior to enrolment in the national PES program ”PSA” (Pagiola 2008). Second, local communities including livestock farmers have perceived PES programs as threats to expropriation of grazing land, thus undermining tenure rights in common property lands. In Uganda for example, a 50-year concession owned by Tree Farms AS of Norway to raise commercial plantations and generate carbon offsets from 5160 ha of land in Bualeba reserve led to exclusion of the local poor people who were barred from using forest for farming, collection of timber and non-timber forest products, cattle grazing and fishing (Jindal et al. 2008).

Third, in situations of multiple tenure systems such as in most of the pastoral grazing lands in Africa, the lack of defined rights or ownership of land, the disconnect between customary and statutory land rights, legal pluralism, tree planting as a land claim, expansion of areas planted with trees in smallholder land use systems, and the difficulty of using the ‘abandoned’ land category may lead to serious challenges for PES implementation (Unruh 2008). In addition, if land resources are subject to multiple, and often competing land use claims by diverse stakeholders, then PES may intensify tensions among stakeholders that loose or gain from the new institutional arrangements (Bracer et al. 2007). Significant issues may arise where land property rights are not formalized, which is the case in many parts of the developing world, where farmers have user rights established by lineage or given by village authorities, and these can change over time, leading to higher uncertainty for both farmers as sellers of carbon and for buyers of carbon contracts (Diagana et al. 2007).
Box 6: The common property collective systems: the example of Mexico’s ‘ejidos’

In common property collective systems, such as Mexico’s ‘ejidos’, internal rules concerning natural resource management critically influence participation. These rules establish a set of norms for social behaviour and contribute to balance individual rights and collective responsibilities (Kosoy et al. 2008). In Mexico where more than 70% of forests are classified as common property, case studies on the distributional arrangements after a PES contract show that communities chose a range of options: some communities used all the Pagos por Servicios Ambientales Hidrológico (PSAH) income to invest in public goods; others divided the payment equally among members, while others had a mixed strategy. Furthermore, PES enrolment by type of property showed that most contracts were with common property owners, ejidos and comunidades compared with individual providers (Munoz-Pina et al. 2008).
5 What scope for equity in PES schemes?

The impacts of PES on local community development can be considered in terms of its overall contribution towards meeting economic, social, human, institutional, and cultural aspirations of a community (Locatelli et al. 2008) and this can involve aspects such as poverty reduction and gender equity (Grieg-Gran et al. 2005; Pagiola et al. 2005; Wunder 2008). This chapter reviews the potential for PES for poverty reduction and gender equity.

5.1 Synergies and trade-offs in PES and poverty alleviation

PES impact on poverty is of practical interest because implementation of PES can potentially benefit, or harm the poor both in the short and long-term (Scherr et al. 2007). On one hand, PES can benefit the poor providers directly, through the provision of cash flow, as a fungible store of wealth, and as a means of promoting household income diversification, and indirectly through social and cultural gains (Grieg-Gran et al. 2005; Pagiola et al. 2005; 2008; Turpie et al. 2008).

On the other hand, concerns have been raised that barriers such as (1) high transaction and investment costs, (2) weak co-operative institutions and bargaining power among poor providers, (3) low awareness, education and technical capacity, and (4) insecure and ill-defined property rights can limit the participation and PES benefits among poor providers.

PES implementation may also generate risks and lead to negative impacts on the poor such as loss of security and control of land, unemployment, and restrictions to resource access (Kerr 2002a; Ifikhar et al. 2007; Lee and Mahanty 2009). It is also recognized that a spectre of a win–win–win scenario may exist whereby PES delivers the provision of ecosystem services, biodiversity protection and livelihood improvements (Miles and Kapos 2008).

The links between PES and poverty are summarized into four sequential questions (Wunder 2008: 287): (1) to what extent do poor people participate in PES schemes as buyers and sellers of environmental services? (Participation filters); (2) if the poor become service sellers, does this make them better off? (Effects on sellers); (3) Do poor service buyers (and non-paying poor service users) become better off from PES? (Effects on users); and (4) how are other, non-participant poor affected by PES outcomes? (Derived effects).

Participation filters

The benefits from PES payments typically accrue to households that are eligible, willing and able to participate in the schemes. This raises the question of whether the poor who are eligible and willing are actually able to participate in PES programs (Pagiola et al. 2005; Wunder 2008). In most programs, the participation of the poor households are limited by high transaction costs, institutional and technical barriers, lack of information, and weak capacity for negotiation (Zbinden and Lee 2005; Ifikhar et al. 2007; Kosoy et al. 2008).
In carbon projects for example, the transaction costs associated with aggregating land units to create marketable contracts could be relatively high per unit of land under contract because of the need to negotiate with large numbers of landholders managing small amounts of land. These high costs can inhibit contract participation and reduce the attainable carbon-sequestration potential in pastoral rangelands (Diagana et al. 2007).

The nature and the size of the landholding is also a key element in the participation in PES. Most local and national initiatives involve private landowners and groups that depend on communal land for their livelihoods are not well represented in PES initiatives. Majority of the PES schemes for watershed management do not specifically target poor people; rather mainly target conservation of areas thought to be critical for the provision of watershed services which in some cases are areas close to population centres, while poorer groups tend to be located in remote areas (Porras et al. 2008). Despite these reservations, in some PES schemes in LiAPS such as the RISEMP project that promotes silvo-pastoral land use to benefit livestock production (Box 5), poorer households were equally able to participate as much as their wealthier counterparts (Pagiola et al. 2007; Pagiola et al. 2008).

**Effects on sellers**

Environmental service sellers benefit directly from PES through the income derived from payments. Although there are few PES schemes that directly target livestock keepers, some of the existing schemes show high potential for benefiting livestock farmers in extensive pastoral systems. In Kenya, for example, PES payments to pastoral households constitute a high proportion of their gross income that ranges from 30–46% during periods of drought. As such, they serve as a critical buffer for income because the payments are stable and predictable (Osano 2011). In mixed intensive and extensive production systems, the evidence is also emerging that PES can provide benefits to livestock farmers, by enabling them to build up livestock assets. This has been shown in one of the largest PES programs in the world, the Sloping Land Conversion Project (SLCP) in China. It has stimulated a significant increase in livestock asset ownership among participating households compared to non-participants thereby leading to positive effects on income from livestock activities (Uchida et al. 2007).

Despite this emerging evidence of PES benefits to livestock farmers, it is generally noted that so far, for the majority of the existing PES schemes that involve crop and livestock farmers, the income from PES provides only a small share of household income, compared to profits from farm production. This could be due to the fact that in some cases, such as for carbon payments, the price of carbon is low. In other cases, the environmental service payments are low relative to the opportunity costs of switching land management (Tschakeart 2004; FAO 2007).

The transaction costs may also be prohibitive for small-scale livestock farmers. For carbon markets specifically, poor farmers cannot participate without a proper institutional arrangement to support their participation. This takes place despite the fact that carbon trading related payments to farmers and pastoralists have the potential to act as an important incentive for the land users to adopt land management practices that build soil carbon pools (Perez et al. 2007). In Africa, where close to half of the pastoralists earn less than a dollar a day (Reid et al. 2004), it is estimated that even modest improvements in natural resource management in the drylands may yield gains of 0.5 t C/ha per year, which translates into USD 50/year, that can bring about a 14% increase in income for the pastoralist (Perez at al. 2007).

**Effects on users**

The assessment of equity and specifically poverty impacts of PES on the poor has focussed on poor environmental service sellers or providers and less on other groups, including environmental service buyers, and non-participants (Wunder et al. 2008). Among environmental service buyers or users, implementation of PES focussed on maximizing rates of payments to upstream sellers may have little poverty-alleviation effect on poor downstream urban water users whose welfare benefits from PES accrue through reducing drinking water fluctuation and pollution (Wunder et al. 2008). For poor non-participants, PES effects are likely to be neutral. However, cases may arise where some are significantly affected through the effect PES schemes have on land, labour, capital and output markets (Wunder et al. 2008; Zilbermann et al. 2008).
There is a practical constraint for the inclusion of poor people in PES initiatives because to benefit directly from the sale of ecosystem services, people have in most cases to own or hold rights to land, so the distribution and ownership patterns of land are critical (Pagiola et al. 2005). Consequently, the landless may not benefit directly from PES, unless their informal access to the resources is recognized and retained.

Evidence is also emerging that in mixed intensive and extensive systems, payments for agro-biodiversity conservation services (PACS) can achieve some conservation goals with a pro-poor impact (social equity) (Narloch et al. 2011), but even in these systems, challenges remain on balancing the trade-offs between economic efficiency and equity (Pascual et al. 2010).

**Derived effects**

Implementation of PES in LiAPS may generate some derived effects on participating and non-participating households alike. A case in point is the PES to promote wildlife conservation corridors that is common in both mixed intensive (e.g. Kaiser 2001), and in extensive pastoral systems (e.g. Gichohi 2003; Nelson et al. 2010). It may lead to increased cases of human-wildlife conflicts through livestock predation as well as disease transmissions from livestock to wildlife and vice-versa. In this situation, livestock farmers may receive payments for both providing a land use supporting wildlife but also for wildlife–livestock disease control (Horan et al. 2008).

In other cases, PES contracted land may be managed through restrictions on land uses that are economically and culturally beneficial to livestock keepers such as livestock grazing. However, the opposite may also be true whereby PES contracted land may be managed in a way that undermines livestock farming. For example, in ‘user-financed’ PES schemes in extensive pastoral systems, restrictions are imposed on livestock grazing by pastoral herders and in extreme cases, even on settlements.

For livestock farmers, participation in such PES schemes will require trade-offs among livelihood choices to balance PES income, settlements and stock management (see for example the PES scheme in Olare Orok Conservancy (OOC) in Box 7 where in order to protect wildlife and promote tourism, the conservancy has put in place a strict livestock grazing policy to allow controlled livestock grazing predominantly in the tourism low season and during periods of drought but settlements are permanently excluded.

**5.2 Gender equity and implication for PES implementation**

The role of gender in agriculture and development is critical but is currently hampered by a ‘gender gap’ in which women are faced with more severe constraints than men in accessing productive resources, markets and services. Closing the ‘gender gap’ in agriculture would produce significant gains for society by increasing agricultural productivity, reducing poverty and hunger and promoting economic growth (FAO 2011b). In many developing countries, gender roles put women in direct contact with natural resources including forests, water, land and wildlife, and these gendered relationships which shape poor people’s access to, and use of valuable natural resources (Cleaver 1998; Agarwal 2000).

Women use and safeguard natural resources to fulfil household food security needs and are also involved in both crop and livestock production at subsistence and commercial level. In pastoral and mixed-farming systems, women are heavily dependent on livestock for financial income and food security. Although women’s contribution to food production and household welfare in developing countries is significant, it often goes unrecognized. The unequal distribution of power between men and women, also referred to as the ‘feminization of poverty’, results in gender inequalities that limit women’s participation in and benefit from agricultural and natural resource management initiatives including Payments for Environmental Services (PES). Overlooking the role of women in PES may undermine

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15. For the purposes of this study, gender refers to the socially constructed differences and relations between men and women that vary according to situation, place, time and context, and which influence the structural and decision-making dynamics within communities, institutions and households.
the conservation of natural resources, food security and livelihoods in rural areas. Conversely, adopting a gendered approach to PES design and implementation may generate positive poverty outcomes in rural areas of developing countries.

Box 7: Payments for wildlife conservation through conservation land leases: The Olare Orok Conservancy, Mara region, Kenya

The Olare Orok Conservancy (OOC) is an innovative conservation model to protect wildlife, promote ecotourism, and benefit pastoral Maasai landowners living to the north of the Maasai Mara National Reserve (MMNR) in southern Kenya. OOC involves a partnership between a group of Maasai pastoral landowners who lease their land to tourism operators and receive a guaranteed fixed monthly land rental payment. In return, the landowners must move their settlements out of the conservancy land and agree to certain land use restrictions. Land in this area of the Mara is now privately owned, after communal group ranches were subdivided and land allocated to individual group ranch members.

In the OOC, 154 landowners agreed to put their land into conservation and make up a 9720 ha conservancy. Together they leased their land to four tourism operators who finance the land lease payment through Olpurkel Ltd, a not-for-profit company which manages the conservancy and whose shareholders are the tourism operators. These tourism operators have exclusive access to the conservancy and have set-up high-end ecotourism facilities. In 2006 the first lease payment was initiated, at a rate of USD 20/ha per year. This payment has increased annually and currently stands at USD 40/ha per year. With each landowner owning on average 60 hectares of land, a typical monthly payment is approximately USD 200, and can be an important part of household income. Under the latest lease contract, landowners are required to lease their land by choosing between a 5 year or a 15 year contract.

Once the land is leased, landowners face restrictions that apply to settlements, livestock grazing, cultivation, fencing, any development of the land, or collection of natural resources. The management enforce a strict grazing policy, allowing controlled livestock grazing predominantly during the tourism low season. As principally livestock keepers, landowners as a result can face considerable constraints on their livestock grazing, and are required to graze their livestock in areas outside of the conservancy, which may include illegal grazing inside the reserve and this may likely lead to leakage effects in the area.

Since the inception of the OOC this model has gained popularity in the Mara and expanded to include additional six conservancies providing an area covering 108,000 ha of conservancy land, thus securing large areas for wildlife and tourism and preventing these rangelands from further fragmentation following land subdivision.

Women comprise 43% of the agricultural labour force in developing countries (FAO 2011c). They also represent 70% of the world’s poor (DFID 2000) and constitute two-thirds of poor livestock keepers estimated at 400 million people worldwide (Thornton et al. 2002). It is therefore necessary to identify the gender dynamics that enable or constrain the participation of women in PES schemes.

Although one would expect that the recognized role of women in natural resource management and agriculture and their high representation amongst the world’s poor would elicit interest pertaining to the rapid implementation of PES schemes in the developing world, there are surprisingly few studies that empirically assess the impacts of PES schemes on women including the extent of women’s participation as suppliers of environmental services (Porras et al. 2008). For example, a review of 200 references of PES schemes in the literature noted that less than 5% of these dealt with gender specific aspects or impacts of PES and as the authors put it ‘This fact obviously calls for concern!’ (Ravnborg et al. 2007: 17).
So far, there have been very few attempts to incorporate a ‘pro-gender-balance approach’ in PES implementation. Projects that report on gender outcomes such as the Costa Rica’s national PES scheme typically do so only in relation to women’s increased enrolment which for the case of Costa Rica, is attributed to promotional measures attached to an environmental marketing initiative rather than to initial program design (Ortiz Malavasi et al. 2003).

The integration of gender issues at all stages of design and implementation of programs and policies in the livestock sector is critical if sustainable improvements in livestock and agricultural production systems are to be achieved (van Hoeve and van Koppen 2005). It should also be a high priority for PES schemes in LiAPS. Gender integration in PES schemes is likely to be faced with some constraints that may limit the positive impacts of PES on women. These include:

**Land ownership and use rights**

Lack of ownership and access to land by women is highly prevalent in developing countries (FAO 2011c) and this can serve to exclude women from land-based PES schemes. Household asset ownership and control is unevenly distributed and mostly skewed towards men. With respect to land ownership, the gender asset gap in many developing countries is significant (Deere and Leon 2003; Deere and Doss 2006a; FAO 2011b, c). In most cases, women manage land and other assets despite their weak ownership rights of productive and physical assets. The gender-based differences in access to productive resources can therefore be considered a feature of poverty (van Noordwijk 2005). Interventions targeting the improvement of women’s benefits from the resources they manage, but do not own, may have positive consequences for household welfare and the wellbeing of society (Deere and Doss 2006).

As PES is a tool for natural resource management, its outcomes and impacts are gender-differentiated (Kevane 2011). For example, enrolment in most land-based PES schemes requires a land title as proof of land possession but this requirement often excludes the majority of women in extensive pastoral systems because few women own land, and even fewer have title deeds. For example, women comprised only 3.6% of contract holders in the Olare Orok Conservancy (OOC) PES scheme described in Box 7. Second, women may suffer due to restrictions to land use generated by PES schemes, which may bar women from access to and use of natural resources such as gathering firewood, water and cropping (Kerr 2002b).

**Exclusion from participation in and decision-making on natural resources**

Gendered differences in participation and decision-making are also factors that can limit women’s involvement in and benefits from PES schemes. Despite evidence that illustrates the potential livelihood benefits such as income and food security that can be derived from participation in community-based ecosystem management (Smith and Scherr 2003), the integration of gender aspects in the decision-making and implementation of PES is still lacking. Several factors separate women and men in the decision-making arena, including but not restricted to social norms and perceptions under which gendered dynamics operate and women’s lower level of endowments and attributes in comparison to their male counterparts (Agarwal 2001).

Decision-making in the management of natural resources is often patriarchal. For example, Corbera et al (2007) found that in a carbon sequestration PES scheme in Mexico women were marginalized by the project due to a local male-dominated system of decision-making concerning the management of the forest commons. In a separate case in south Asia, women were excluded from participating in community forestry committees due to several factors including exclusive rules that restrict women’s access, the culture of gender segregation in public spaces, social perceptions that led to men downplaying women’s contributions and weaker personal endowments and attributes which undermined the credibility of women’s opinions in public spaces (Agarwal 2001).

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Within households, women’s subordination is also a manifestation of socialized gender norms and can be a further challenge to women’s participation in PES schemes. Gender discrimination and dominance at the intra household level can determine the choice of plant species to be conserved (Pascual and Perrings 2007) leading to neglect of tree species with high domestic use value that are preferred by women in favour of income-generating varieties that are preferred by men (Hobley 1996; Dasgupta 2000).

Inequities in household income control

A gendered understanding of the poverty implications of PES payments can contribute towards ensuring equity in the socio-economic outcomes of PES. Research shows that men and women have different preferences in income allocation meaning that PES could affect the welfare of household members differently (von Braun 1995). Generally, women have been found to spend a greater proportion of the income under their control on family needs such as food (Conelly and Chaiken 1993), while men have been found to spend money on bulkier expenditures such as investments and housing and on luxury items such as smoking and drinking (Thomas-Slayter and Bhatt 1994; IFAD 2000; Quisumbing 2003). For example, male recipients of PES payments to households for forestry conservation in south Asia used the cash income on gambling, alcohol and personal items (Agarwal 2001). In contrast, female recipients of PES payments in carbon projects were more likely to use the money in ways that generated positive household welfare outcomes with greater effect on poverty and equity (Blomley and Richards 2011). Both men and women have been reported to spend a significant share of their incomes on school fees (Conelly and Chaiken 1993).

The risk of elite capture

While elite capture does impact all community members, there is evidence to suggest that the effects may vary according to gender. To minimize the negative impacts of elite capture on women and promote equitable distribution to PES payments both at the household and community level, payments, and the channels through which they are made should not only be assigned to the person living in and managing the property (Porras et al. 2008), but considerations should be made to also pay the persons whose activities/workloads are most affected by PES established land restrictions.

In view of the gendered nature of PES, we propose some actions to integrate gender in the implementation of PES in LiAPS as follows:

- **Gender analysis.** Gender analysis is a useful approach to integrate gender in PES schemes. It can increase the understanding of how cultural, institutional, demographic, historical, socioeconomic and ecological factors influence relations between women and men of different groups, and determine decision-making around natural resources (Meinzen-Dick et al. 1997). Failing to conduct a gendered analysis and taking into account the findings can influence locally driven processes of gender exclusion (Murdiyarso and Herawati 2005; CARE 2011; CIDA 2011; ILRI 2012). Results from a gendered analysis may lead to the identification of appropriate and locally relevant strategies to ensure women’s participation in and benefits from PES schemes. Overall outcomes from conducting a gendered analysis should link women’s participation to benefits.

- **Capacity building.** Generally there are low capacities in terms of skills in gender and the institutional barriers to mainstream gender in PES programs. Specialized training is required to ensure gender considerations are correctly and effectively integrated into PES program implementation delivery. This will enable the design of gender-focussed, rather than women-focussed activities and improve the likelihood of achieving equitable participation and benefits in PES schemes (IUCN 2006; ILRI 2012). Empowering women by enhancing their capacity can also enable them overcome institutional barriers to participation. For example, the Costa Rica’s national PES program charges a special fee that is then used to support women to acquire land to enable their participation in the PES scheme.\(^\text{17}\)

Collective action and social capital. Collective action refers to the voluntary action taken by a group of people to achieve common interests (Marshall 1998) and it can contribute to building women’s social capital which is an effective way to improve information exchange and resource distribution, to pool risks and ensure that women’s voices are heard in decision-making at all levels (FAO 2011b, c). Women’s relationships with natural resources are likely to be affected by the land management practices enforced by PES initiatives. Achieving scale through pooling resources can help women farmers overcome some of the constraints as individuals. For example, groups of women involved in a PES for carbon scheme in Kenya are planting thousands of trees while undertaking land restoration to be able to capture 375,000 t of carbon by 2017 (Bechtel 2010).

Monitoring and evaluation of gender outcomes. Monitoring and evaluation of program performance will help assess the quality and impact of PES programs in terms of equity and can improve efficiency and effectiveness over time (CIDA 2011). It can ensure that gender aspects are assessed in both PES implementation and outcomes.
6 PES implementation in the livestock sector: Key findings and recommendations

This report seeks to assess the potential of payments for environmental services (PES) in various livestock inclusive farming systems in the developing world.

Table 4 presents a strengths, weaknesses, opportunities and threats (SWOT) analysis from a policy perspective for implementing PES schemes in the livestock sector. Strengths and Weaknesses relate mainly to present advantages and disadvantages, whereas the Opportunity and Threats segments relate to future possibilities to be exploited and potential future pitfalls that need to be taken care of respectively.
Table 4. SWOT analysis from a policy perspective for implementing PES schemes in the livestock sector

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<tr>
<th>Strength</th>
<th>Weaknesses</th>
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<tr>
<td>Income diversification</td>
<td>The concept of PES still not well known and fully understood</td>
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<tr>
<td>Triple-win outcome to ensure the provision of environmental services, biodiversity protection and livelihood improvements</td>
<td>Presence of barriers that limit participation of poor households</td>
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<tr>
<td>Promotion and adoption of sustainable agricultural land management (SALM) practices</td>
<td>Limited involvement or total exclusion of landless poor, including women, in PES schemes</td>
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<tr>
<td>Wildlife conservation (human–wildlife conflict)</td>
<td>Wide disparity that exists in land managers ability or willingness to invest in resources in order to adopt new technologies and respond to market incentives</td>
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<tr>
<td>Reduction of greenhouse gas (GHG) emissions</td>
<td>Lack of clearly defined tenure in rangelands</td>
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<tr>
<td>Potential for bundling of environmental services across the landscape</td>
<td>Inadequate laws and policies on PES</td>
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<tr>
<td>Potential to secure and reinforce property rights and land tenure claims</td>
<td>Exclusion of soil carbon from compliance markets</td>
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<tr>
<td>Increase in the value of land to generate high returns for land users</td>
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<tr>
<th>Opportunities</th>
<th>Threats</th>
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<tbody>
<tr>
<td>Growing potential of carbon market</td>
<td>Monitoring effectiveness remains difficult</td>
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<td>High sequestration potential of some practices in LiAPS</td>
<td>Difficulty in guaranteeing equity</td>
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<tr>
<td>Emerging efforts for the inclusion of PES in national policy framework</td>
<td>Limited understanding of how environmental services are connected to human well-being</td>
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<td>Funding potentially available for pilot projects</td>
<td>Difficulty in understanding the value of environmental services</td>
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<tr>
<td>Potential link of PES to climate change adaptation</td>
<td>PES may intensify tensions and conflicts among stakeholders that loss or gain from the new institutional arrangement</td>
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<tr>
<td>PES networks and research institutes catalysing policy support, private sector participation and farmers involvement</td>
<td>Carbon credit payments may increase the value of common property land and attract powerful players (land grabbing)</td>
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<tr>
<td>Potential of development of IPES (International Payment for Environmental Schemes)</td>
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<tr>
<td>Increased role of PES in ‘green economy’; PES is an economic tool through which farmers can enter the green market</td>
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Key findings and recommendation of this publication are summarized below:

Environmental services provision in LiAPS

- Although livestock is widely distributed across agro-ecosystems of the developing world, there are still very few PES schemes that specifically involve livestock keepers. Besides, there are opportunities for livestock keepers to benefit from PES for climate regulation, watershed and biodiversity conservation.

- Increased demand and scarcity of some environmental services generated from livestock production create opportunities for implementing PES schemes in livestock inclusive agricultural production systems but currently methods and tools for measurement and verification of environmental services are not well developed.

- Although there is considerable potential for private markets in PES, experience shows that public funding remains essential for public and quasi-public goods such as biodiversity conservation, particularly at national and global scales.

Climate regulation services

- In pastoral or grazing systems, the access to PES opportunities for livestock keepers can be driven by payments for restoration of degraded lands and for sustainable grazing land management, both of which presents the potential for carbon sequestration.

- In mixed crop–livestock systems, access to PES opportunities for livestock farmers can be driven by: adoption of improved feed supplement that can lead to GHG emissions reduction; adoption of improved pastures with high density trees and fodder banks that reduce land degradation; the use of organic fertilizer to increase the capacity of carbon sequestration; and integrated livestock and manure management.

Watershed and hydrological services

- In extensive or pastoral systems, PES schemes involving livestock keepers can promote watershed conservation by controlling undesirable land use change caused by extensive cattle grazing in dry land forest because this can cause soil erosion and soil compaction and lead to forest degradation which is thought to diminish water quality and quantity thereby increasing the risks of landslides and flooding.

- In mixed crop–livestock systems, livestock farmers can participate in PES and be paid to grow trees and forest in the upper catchment of the watershed.

- PES schemes that involve livestock keepers in highly intensive production systems could include payments to the farmers to limit water contamination associated with livestock production through nutrients loading.

Biodiversity conservation services

- In pastoral or grazing systems, positive biodiversity outcomes in PES schemes that involve livestock keepers are achievable by: reducing livestock stocking density or restricting grazing; maintaining open the wildlife migration corridors and seasonal dispersal areas; controlling wildlife poaching; protecting natural vegetation on land and avoiding fencing or sub-dividing land.

- In mixed crop–livestock systems, positive biodiversity impacts are achievable by: reducing stocking densities; applying sustainable management practices to reduce environmental degradation and protecting natural vegetation on land; trees planting and sustainable soil management (zero grazing and fodder and manure production).
Livelihood improvement opportunities

- PES schemes offer a diversification potential to livestock farmers for improving their livelihoods and for poverty alleviation. The cash flow generated through PES schemes produces multiple benefits including: poverty reduction, store of wealth, income diversification and multiple social and cultural gains.

- PES is a tool to consider for promoting agricultural transitions towards a green economy. PES schemes have the potential to stimulate a green livestock sector, allowing farmers to adopt sustainable agricultural land management (SALM) practices that reduce the impact on the environment and help conserve biodiversity and ensure a sustainable use of natural resources. This could provide a triple win: provision of environmental services, biodiversity conservation and livelihood improvements.

Addressing barriers to livestock farmers participation in PES

- Anecdotal evidence from existing PES schemes and programmes shows that the landless poor are excluded especially from land-based schemes. There is also limited involvement of women across land-based and other PES schemes.

- Livestock keepers face challenges to tap into PES markets because of limited market information.

- Effective implementation of PES schemes requires well defined property rights over natural resources, including land tenure. In most cases property rights are clearly defined under mixed crop–livestock production systems; however, this differs in pastoral or grazing systems, thus making the implementation of PES in these last systems more challenging.

Recommendations

- Develop robust measurement and verification tools for environmental services produced by the livestock sector in livestock inclusive agricultural production systems.

- Develop policies to promote PES implementation in LiAPS to enable livestock farmers to diversify their income and to improve their economic situation.

- Provide support to livestock farmers to access the emerging environmental service markets.

- Implement capacity building activities (training, information provision etc.) to increase the awareness of PES among smallholder households and to enable collective action processes needed for livestock farmers to access and participate in environmental service markets.

- Establish pilot climate change mitigation PES projects to demonstrate the benefits to livestock keepers from PES payments and to explore the potential to link PES to climate change adaptation funds.
There are some gaps in knowledge with regard to implementation of PES in LiAPs and these will require further research to address the questions listed below:

- What are the benefits of applying PES compared to the opportunity cost of other forms of land use in LiAPs?
- What are the schemes of payments that will work on highly variable and fragmented socio-economic and natural environments?
- How can PES be implemented to fit different farming and livestock production systems in light of environmental conservation and pro-poor development?
- How can PES schemes be designed to incorporate livelihood options?
- What role does PES play in climate change adaptation among livestock keepers in the developing world?
- What are the opportunities of using PES to conserve animal genetic resources (AnGR) in the context of the agro-biodiversity conservation?
- Future trends foresee an increase in production of cattle and consumption of meat and milk products, under what has been called 'Livestock revolution', driven by population growth, urbanization and income growth. To what extent can agricultural transitions and green economic progress be facilitated by PES?
- Private sector can support the development of technologies for improving feed practices that can lead to both increased livelihood production and reduced GHG emissions. How can private sector’s involvement be actualized in PES schemes in the livestock sector?
- What kinds of policy and property rights regimes are compatible with effective implementation of PES schemes in LiAPs in developing countries?
- What are the opportunities for PES schemes to address gender inequalities?
- How can practitioners develop gender sensitive payments and reward mechanisms in PES schemes that involve livestock farmers to take into account the different preference of men and women with regard to in-kind payments or cash payments?
- What tools, methods and processes can demonstrate the biophysical links between PES, promoted land uses and environmental services?
- What are the out- and up-scalability conditions for a PES to be effective and gain interest from investors?
- How can livestock sector and the environmental services generated in LiAPs be better integrated in national mitigation action plans (NAMAs) and national adaptation action plans (NAPAs)?
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