CHAPTER

1

THE ROLE OF PES IN AGRICULTURE

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CONTENTS

INTRODUCTION

Since the Rio Earth Summit in 1992, agriculture has been recognised as a key multifunctional sector able to provide benefits, other than only food and fibres, particularly with regard to sustainable agriculture and rural development (UNCED, 1992). Clearly, the main goal of agriculture is to make food available to households and to ensure food security at the local, national and international levels. Activities aimed at ensuring food production involve in different ways the environmental, economic, social and cultural dimensions of the food system.

From the ecological perspective, agriculture has a substantial impact on ecosystem processes because it uses and modifies all components of the ecosystem, including air, soil, water and biodiversity. From the economic perspective, agriculture provides a foundation for local economies by giving income to rural communities and by promoting the value of agricultural products throughout the value chain. In particular, agriculture is usually considered an engine of economic growth in developing countries (World Bank, 2009). With regards the social and cultural aspects, agriculture constitutes an important source of employment, improving rural livelihoods, and an environment conducive to the transmission of farming knowledge and traditions. Payment for Ecosystem Services (PES) is a tool that easily applies to the agricultural sector, as any activity therein inherently interacts with all the dimensions of sustainability (i.e. environmental, social and economic). In fact, PES can provide positive incentives (additional income or in-kind payments) for alternative land uses or particular agronomic practices at the farm level. The payment is, or should be, economically comparable to the forgone opportunities of existing alternative land-use options (i.e. opportunity costs). This payment is given to support land-use or agronomic practices which are able to protect or restore natural ecosystem processes. PES is expected to work where ecosystem services are under some degree of present or future threat and where the opportunity costs for alternative land use or land practices are not very elevated (Wunder, 2007).

PES can work in agriculture where ecosystem services are under threat and the opportunity costs for alternatives are not very high

These situations are often found in human-modified agricultural ecosystems (such as degraded pastures, marginal croplands, hillside remaining forest patches), where the original natural capital has already been exploited, often in an unsustainable way, and the resulting ecologically-degraded ecosystems have lost their resilience and are found in a state of disequilibrium. These impoverished agro-ecosystems experience a shortage or imbalance of one or more regulating services and for this reason cannot deliver a sufficient degree of provisioning services, such as food, water and fibres. It is clear that when the ecological equilibrium of agro-ecosystems is disrupted, this seriously impacts not only the land productivity (economic dimension), but also the living conditions of the resident population (social dimension). Ecologically-degraded areas can be considered as 'poverty traps' because they cannot ensure any current or future food security and, without the restoration of ecosystem processes, any further attempts to exploit the remaining resources reduces their ability to supply of food and deliver functional ecosystem services. These ecologically-degraded areas offer also few rewarding activities and employment opportunities; resident people might even be forced to migrate elsewhere, loosing potential assets. Livelihoods can also be directly impacted by under-nourishment, diseases and sanitation problems directly arising from the disruption of basic provisioning ecosystem services, such as food and water supply.

Ecologically-degraded areas can be considered as 'poverty traps' as they cannot ensure any current or future food security

According to the MEA (2005), 60 percent of the world's ecosystems are being degraded or used unsustainably. It is estimated that 85 percent of cultivated lands contain areas that are degraded by soil erosion, salinisation, soil compaction, nutrient depletion or unbalance, pollution and the loss of biodiversity. Moreover, each year 12 million hectares (an area approximately the size of Greece or Nepal) are lost due to desertification; an area of this size would be able to produce 20 million tonnes of grain and annually feed over six million people (WBCSB and IUCN, 2008).

Given the current challenges faced by our present patterns of production that have already reached the ecological limit of the planet, an obvious priority is to use the cropland already under cultivation in a way that ensures the preservation of ecosystem processes, prevents land over-exploitation and, consequently, irreversible long-term land loss. The 'side-effect' of protecting the very basis of agricultural productivity is the conservation and enhancement of all types of ecosystem services and, hence, stewardship of global public goods for present and future generations.

AGRICULTURE AND ECOSYSTEM SERVICES

Agriculture is a multi-faceted concept that encompasses a wide range of productive systems. Agriculture can be entirely based on crop, animal, forestry or fishery production, or can involve mixed farming activities from these different sub-sectors. This leads to a huge variety in the types of agro-ecosystems, such as annual crop monocultures, temperate perennial orchards, tropical shifting cultivation systems, smallholder mixed cropping systems, rice production systems, tropical plantations (e.g. oil palm, coffee, tea, cacao, rubber), agroforestry systems, animal-based intense farming system and arid-land pastoral systems (Power, 2010). Potential benefits and/or detriments of agriculture to ecosystem services will be mainly shaped by the typology of the agro-ecosystem, which will be characterised by geographic attributes (country, ecoregion and local conditions of the agro-ecosystem), by the farm size, farming activities and farming management.

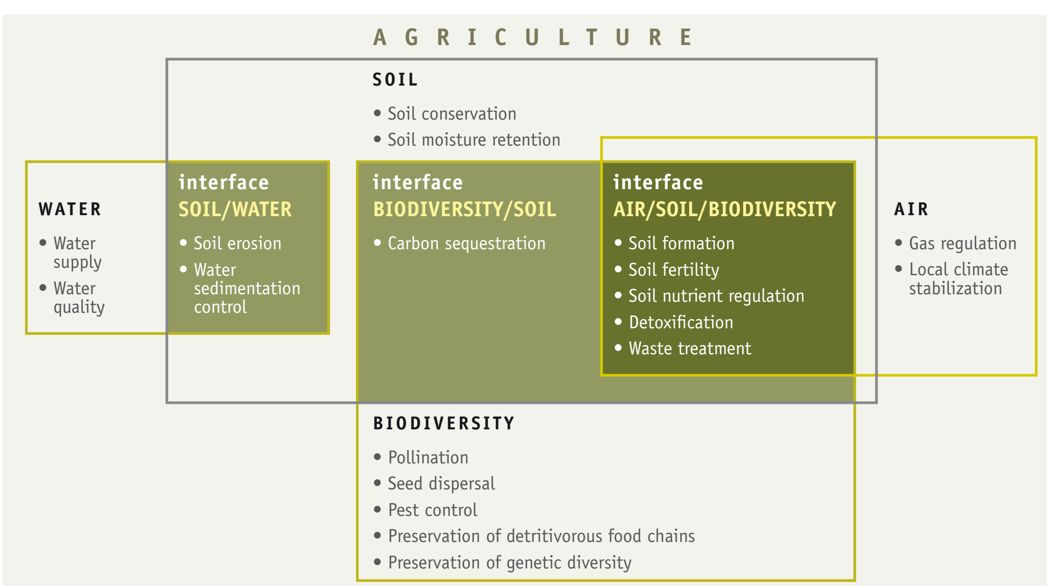
Without any specific in-depth analysis of any type of agro-ecosystems, a general framework of possible relationships between agriculture and ecosystem services is given in Figure 1.

This framework shows how agriculture, while delivering provisioning services (such as water, food, fibres and wood), operates at the intersection of different compartments, such as air, water, soil and biodiversity, let alone a myriad of socio-political compartments. In each of these compartments, agriculture influences key regulating services, such as gas regulation and local climate stabilisation (air compartment); carbon sequestration (at the interface between air, soil, and biodiversity); water supply and water quality (water compartment); soil erosion and water sedimentation control (at the interface between soil and water compartment); soil conservation, soil moisture retention (soil compartment); soil formation, soil fertility, soil nutrient regulation, detoxification and waste treatment (at the interface between soil and biodiversity); pollination, seed dispersal, pest control, preservation of detritivorous food chains, preservation of genetic diversity (biodiversity compartment).

Agriculture influences the habitat quality and consequently the diversity of species not only in each single compartment (air, soil, water and biodiversity), but also at the landscape level. Agriculture modifies natural ecosystems by eliminating and reducing natural habitats, and replacing them with cultivated areas.

Figure 1

Ecosystem services, occurring in different ecological compartments (air, soil, water and biodiversity) and their interfaces, can be enhanced or decreased by agricultural activities



This modification can produce an infinite number of possible spatial configurations of land uses. Sometimes this modification is a result of a historical process and can reflect cultural or aesthetic values. The spatial arrangement of remaining natural habitats and agricultural areas determines different landscape properties, such as the degree of fragmentation of natural habitats, the occurrence of different types of modified vegetation and the interspersion of these different elements in the agricultural matrix. These landscape characteristics will influence, in particular, which wildlife species will be found in the agro-ecosystem and at which population densities.

Relevant ecological scales for regulating services in agriculture

In the previous paragraph, the influence of agriculture on different regulating services has been described without any reference to their spatial scale. However, ecosystem services operate and are regulated at different spatial scales. For example, the control of nitrogen fixation by bacteria occurs in the soil, and soil compaction and soil moisture retention operates at a relatively reduced spatial scale (< 1 km). The regulation of pests and pathogens often occur at the margins of uncultivated areas. Pollination occurs at an ecological scale dependent on the foraging distance of pollinating species. In particular, honeybees and bumblebees usually forage in a range of 3 to 5 km, small bees cover shorter distances of about 1 km and large carpenter bees up to 6 km (Vaissiére *et al.*, 2010). Water quality, water supply, soil erosion and control of sediment load in the freshwater network are often strongly influenced by the management of agricultural practices at the watershed level. Considering larger spatial scales, the overall volume of superficial and subterranean water flows is regulated at the regional level — climate stabilisation, through the regulation of albedo, temperature and rainfall patterns is regulated at the global level.

However, several ecosystem services also occur at multiple spatial scales. For example, the sequestration of carbon dioxide related to the process of photosynthesis occur at the level of a single plant, the crop field, the farm, the landscape, the cultivated watershed, the biome and at the global level. Other ecosystem services are generated at a particular spatial scale, but are regulated at a wider spatial scale. For example, the control of sedimentation load in the freshwater system can be enhanced at the cultivated plot and the farm level, but the reduction of the sedimentation load will probably only be achieved when a significant number of farms in the watershed adopt agronomic practices that limit soil erosion (threshold effect).

In particular, the ecological conditions recorded at the farm level will be always dependent by the conditions found at the landscape level and vice versa. A preserved landscape can enhance the delivery of some ecosystem services at farm level. For example, the pollination of crops on a farm can occur through native pollinators whose main habitat can be found in remaining forest patches of the landscape. On the other hand, agronomic practices can be very successful to preserve soil fertility and soil conservation at farm level, but the disruption of regulating services at landscape level can trigger a major flood washing out the farm and causing the complete loss of topsoil on the farm fields.

Institutional scales for ecosystem services in agriculture

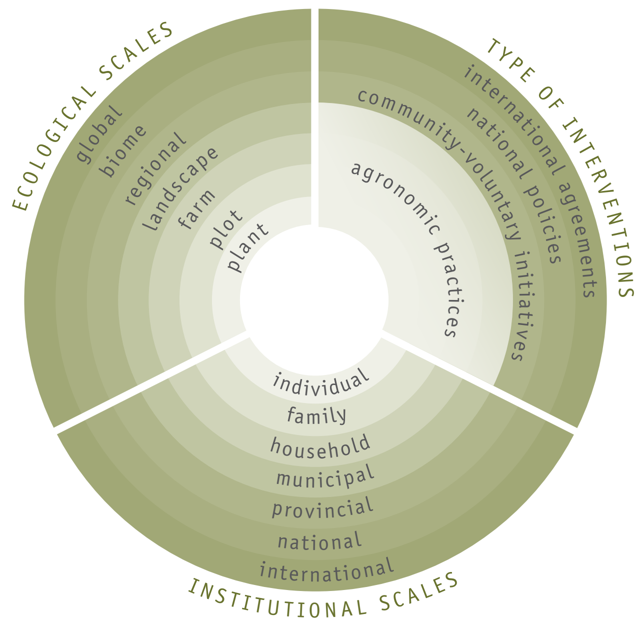
Given that different ecosystem services are delivered and regulated at multiple spatial scales, this also implies that the agricultural sector is involved in the provision of ecosystem services at different spatial scales. Each spatial scale will be characterised by a given ecological scale, a corresponding institutional scale and an appropriate type of intervention.

The conceptual diagram (Figure 2) shows that at least three different levels of interventions should be considered. The first level considers the agronomic practices that are implemented at the farm level. There are many different agronomic practices that can ideally enhance the delivery of ecosystem services in the air, soil, water and biodiversity compartments. However, the implementation of these agronomic practices often has many drawbacks, especially when dealing with major challenges of poverty alleviation in developing countries (see Viewpoint 1 "Challenges and solutions to the implementation of PES in smallholder farming systems in developing countries"). A second level of intervention refers to practices and interventions that occur at landscape level. These levels can be characterised by different types of management options. As an example, in an intensive monoculture crop agricultural system, if carbon emissions can be reduced at the farm level through the management of agriculture machinery, at the landscape level emission reductions can be achieved by preventing the burning of fallow fields and the conservation of remaining trees (FAO, 2007). The adoption of interventions at the landscape level requires a level of consensus and coordination amongst different stakeholders. This can be achieved by the occurrence of voluntary community initiatives (e.g. Landcare) or by the establishment of regulation that help to coordinate and direct environmental management options. Although voluntary community initiatives and local regulations can initially support the spread and the carrying out of a different way of managing agricultural landscapes, these initiatives are always highly dependent on enabling conditions shaped by market and national policies. The third overarching level with which agriculture can foster the protection and enhancement of ecosystem services is through sound policies at the national and international levels. Policies and consequent appropriate regulations will give a real push and provide the degree of harmonisation needed to up-scale this process from the local to the landscape, regional, national and global levels.

Ecosystem services are delivered at different spatial scales, requiring different institutional scales and types of interventions

Figure 2

Correspondence between different ecological and institutional scales and possible types of interventions for the preservation and restoration of ecosystem services



AGRI-ENVIRONMENTAL SCHEMES, CERTIFICATION AND PES

The public sector, acting on behalf of and in the interest of civil society, has a key role to play in the protection of ecosystem services as public goods by establishing standards and regulations for their use ('command-and-control' approach), by levelling the market prices and providing positive incentives (see also Chapter 8 "PES within the context of Green Economy").

In the food and agricultural sectors, there have been three main categories of interventions to protect the delivery of ecosystem services: agri-environmental policies, certifications schemes and PES schemes. The distinction between these three categories is not always well defined and there are many nuances by which the categories overlap with each other. By considering the most commonly-accepted definition of PES (Wunder, 2005)[1], several features characterising PES schemes can be identified (see Table 1).

1 PES is a voluntary transaction where a well-defined ecosystem service (ES) is 'bought' by a minimum of one ES beneficiary from a minimum of one ES provider if and only if the ES provider continually secures the ES provision (i.e. with an element of conditionality).

In particular, in the simplest version of a PES scheme, the provider of the ecosystem service is the seller and the beneficiary of the ecosystem service is the buyer. When the public sector enters a PES scheme in a democratic regime the government represents the public will and the interest of the majority of represented stakeholders. In all public PES schemes, there are several conditions that are weakened. In the public PES schemes, the role of the buyer (undertaken by the public sector) becomes distinct from the role of the beneficiary (constituted by a part or the whole of society). In particular, the public sector becomes in charge of setting up the PES scheme, negotiates the terms and conditions, as in the common role of the intermediary, but it also enters into the contractual agreement as the buyer. This means that the direct beneficiaries of the ecosystem services completely delegate the whole PES implementation to the public sector.

Moreover, if the public sector implements a PES scheme using a general budget fund for a service that is provided at a global scale (e.g. carbon sequestration), the whole society will benefit from its provision. On the contrary, if the public sector with the same budget fund implements a PES scheme for an ecosystem service delivered at a more reduced spatial scale (e.g. for the control of soil erosion in a particular watershed), not all the people paying will directly benefit for the provision of that ecosystem service. For this reason, when PES schemes are implemented using funds coming from taxes addressed for the provision of a specific ecosystem service (see Case Study 12 "PES for improved ecosystem water services in Heredia town, Costa Rica"), the profile of the payer matches with that of the beneficiary, as in the original PES condition. Similarly, PES schemes that are implemented with funds coming from donors are also specifically targeted for the delivery of an ecosystem service. Thus, PES implemented with specific funds or specific taxes are closer to the original definition given by Wunder (2005) than PES schemes arising from generic public budget funds.

PES and agri-environmental schemes

According to the OECD definition, agri-environmental schemes are payments that include implicit transfers, such as tax and interest concessions, to farmers to address environmental problems and/or provide ecosystem services (Tarek, 2010).

The main difference between PES and agri-environmental schemes is in the different degree with which payments target specific ecosystem services. Again, the difference, if any, can be subtle and can vary amongst agri-environmental schemes and among implementation in different countries (see also Chapter 2 "Relevance of OECD agri-environmental measures for PES"). The main distinction is that while PES targets ecosystem services, agri-environmental measures usually target specific farming practices. When farming practices are addressed to protect some ecosystem services, the difference between agri-environmental schemes and PES is narrowed.

Table 1
Main characteristics of the PES definition and accomplishments according to different funding schemes

PES is characterised by	Funds coming from a tax labelled for certain ecosystem services	Funds coming from international donors	Funds coming from a general public budget
Payment made for ecosystem service provision	Condition met	Condition met	Payment coming from general funds
Direct benefit of the beneficiary	Condition met	Condition met	Not all people paying for the ecosystem service directly benefit from it
Voluntary nature	Condition weakened	Condition weakened	Condition weakened
Contractual agreement	Condition weakened	Condition weakened	Condition weakened
Negotiated framework	Condition weakened	Condition weakened	Condition weakened
Conditionality of contract which requires continuous provision of the service from the provider	Condition weakened	Condition weakened	Condition weakened

As discussed by Wunder *et al.* (2008), governments may not always be in the best position to identify the need for protection or restoration of ecosystem services. Thus, agri-environmental schemes can have a broader and generic vision and be less tailored to local condition and needs than PES schemes. PES initiatives, on the contrary, being conceived more as a process of negotiation between stakeholders directly involved in the provision and use of ecosystem services, are expected to be characterised by a greater specificity of targets and efficiency of resource allocation. The other elements that can distinguish PES from agri-environmental schemes refer to the degree by which the voluntary nature, the negotiated framework and the conditionality (payment on compliance) of the contractual agreement is implemented. As to the voluntary characteristic of PES schemes, the adhesion of farmers or land subject to agri-environmental schemes under the EU legislation remains voluntary, while the implementation of agri-environmental measures is obligatory for EU member states — making the process only partially voluntary (Tarek, 2010).

Agri-environmental schemes can have a broader generic vision and be less tailored to local conditions and needs than PES schemes

As for the conditionality, which implies compliance to the actual enhancement of the delivery of ecosystem services, agri-environmental schemes often encourage some agronomic activities expected to bring a number of positive externalities without setting a target value for some measurements of ecosystem services delivery targets. There are clearly exceptions. In this respect, the current Farm Bill in United States of America (USA), which provides incentives for improved water and air quality, increased carbon storage and habitat for biodiversity conservation, has a more robust set of requirements than the EU Common Agricultural Policy (CAP) that, on the contrary, is expected to become further strengthened with the next CAP reform due after 2013 (see also Chapter 2 "Relevance of OECD agri-environmental measures for PES"). Thus, the direct linkage between the adoption of a certain agronomic practice and the delivery of ecosystem services can be of varying strength in different agri-environmental policies.

Another difference between agri-environmental schemes and PES schemes is that, in the former, the renewal of the contractual agreement is often linked to other factors, rather than simply addressing compliance. Agri-environmental schemes, as programmes supported by public funds, are particularly vulnerable to budget cuts. These can be influenced by international regulation, adjustments in the trade and market sector, national political instability, political pressures coming from particular lobbies, etc. This can also occur in the implementation of PES schemes from funds coming from a generic budget, but is less likely to occur in the case of funds coming from coming from a tax labelled for certain ecosystem services.

PES and certification schemes

If the features characterising PES schemes are used to compare an ideal PES scheme and certification schemes, it becomes evident that only some certification schemes are actually aimed at the delivery of ecosystem services. In particular, certification schemes usually address only a reduced number of ecosystem services mostly related to biodiversity conservation, bundled ecosystem services or carbon sequestration. For example, bird-friendly coffee[2] certification ensures biodiversity conservation particularly related to bird species and their healthy forest habitats. Rainforest Alliance[3] certifies farms that produce coffee under rigorous criteria that refer to a bundle of ecosystem services, including reduced water use and water pollution, reduced soil erosion, protection of wildlife habitat and improved working conditions for farmers. In this case, as per PES definition, there is a clear identification of the ecosystem service supported by the initiative.

2 http://nationalzoo.si.edu/scbi/migratorybirds/coffee/

3 http://www.rainforest-alliance.org/agriculture/crops/coffee

However, in certification schemes, the buyer of the service (in this case, the consumer) does not make direct use of this service, but usually pays for an option value[4] or a bequest value[5].

Although consumers can voluntary decide to buy a certified product and interrupt this consumption at any time, they are not bound by any contractual agreement, nor can they negotiate the 'right price' for that particular product. Moreover, if the consumer withdraws from buying the certified product, this is more than likely linked to market factors, rather than by conditionality related to the effective provision of the ecosystem service. The certification refers to the standard itself, while verification is the process whether a project or activity meets the targeted standard. As long as the product is on the shelf, it is assumed that the compliance of the standard for which the product is certified is met. Thus, certification schemes have some similarities with PES schemes, but are not specifically PES schemes and, as previously highlighted, they exist only for a few ecosystem services. In some cases, certification schemes are used in conjunction with cap-and-trade schemes, for example, in the certification of carbon offsets (see also Chapter 7 "Enabling conditions and complementary legislative tools for PES"). In other cases, certification schemes and PES schemes have been implemented in the same study area to target different needs in the ecosystem (see Case Study 1 "PES and eco-certification in the Kapingazi watershed, Kenya"). It has also been suggested to combine certification and PES schemes in a 'landscape labelling approach', with a view to increase the income-generating options of PES schemes, strengthen the social impact of PES schemes and increase their potential to be pro-poor (see also Chapter 6 "Landscape labelling approaches to PES: Bundling services, products and stewards").

Certification schemes usually only address ecosystem services related to biodiversity, bundled services or carbon sequestration

PES SCHEMES IN AGRICULTURE

PES projects are usually classified as PES for water, carbon sequestration, biodiversity and landscape beauty or as PES for bundled services (Landell-Mills and Porras, 2002), but there are no PES schemes that are classified as PES for agriculture. Why is this? Clearly, there are PES schemes in agriculture, but in some cases, as illustrated above, some of these initiatives are commonly found as agricultural policies or agri-environmental schemes. In other cases, some PES schemes, while strongly related to agriculture, appear to be classified as PES for water, landscape beauty, carbon sequestration and biodiversity.

4 The knowledge that ecosystem services will be available for one's own use in future (option use).

5 The assurance that ecosystem services will be passed on to descendants (bequest value).

Agriculture can be an entry-point in PES, as agriculture practices are a critical factor in conveying services or disservices

Agriculture is likely to be an entry-point in PES, as agricultural practices are a critical factor in conveying services or disservices. Moreover, different stakeholders are often involved in the provision and utilisation of ecosystem services and there are divergent economic and social interests, which entails some negotiation in order to avoid conflicts in the management, restoration or amelioration of ecosystem services' provision. To better illustrate this point, some examples of PES schemes are provided in the following section in which the agriculture is an entry point for the restoration of soil loss and erosion, water quality and supply, landscape beauty, carbon sequestration and biodiversity.

PES in agriculture and soil loss and soil erosion

A great number of PES schemes in developing countries are focused on the reduction of soil loss and soil erosion. For example, the silvo-pastoral PES schemes applied in Colombia, Costa Rica and Nicaragua were aimed at soil conservation by planting high densities of trees and shrubs in pastures, by feeding livestock on fodder, rather than natural vegetation, and by creating windscreens with shrubs and fast-growing trees (Pagiola *et al.*, 2007). Soil erosion is often caused by farming activities on sloping terrains that are carried out without using physical and vegetation barriers to control the loss of soil. In the PES scheme implemented in Sumberjaya (Indonesia), several physical barriers, such as sediment/litter pits, dead-end trenches and drainage ditches, were associated with the coffee plantations, as well as conservation of remaining forest patches and multi-strata coffee gardens (see Case Study 13 "PES and multi-strata coffee gardens in Sumberjaya, Indonesia"). In the PES project in the Uluguru Mountains (Tanzania), the use of bench terraces and traditional terracing (*fanya juu* and *fanya chini*[6]) was combined with the protection of different levels of vegetation (grass strips and tree cover related to reforestation of agroforestry activities) together with the adoption of agronomic measures that limit soil erosion (see Case Study 3 "PES in the Ruvu watershed of the Uluguru mountains, Tanzania").

A similar approach, involving traditional terracing and other soil conservation efforts, is presently under evaluation to be shortly adopted in a PES scheme in the Kapingazi watershed (Kenya) where the watershed services are hampered by intense deforestation, by the large coffee cultivation carried out without soil and water conservation practices, and by intense

6 Fanya is a traditional terracing technique whereby a ditch is made along the contour or on a gentle lateral gradient. Soil is thrown on the upper side of the ditch (fanya juu) or on the lower side of the ditch (fanya chini) to form the bund, which is often stabilised by planting fodder grass.

use of the riparian buffer area along the Kapingazi River for food and fodder production (see Case Study 1 "PES and Eco-certification in the Kapingazi Watershed, Kenya").

In the watershed of Kulekhani (Nepal), forests were traditionally managed by local communities for firewood, to collect fodder for animals and to raise free-roaming cattle. In the early 1960s, the nationalisation policy led to major deforestation in Kulekhani. Participatory watershed conservation programmes were subsequently implemented to control the high rate of soil erosion and the sedimentation rate in the Kulekhani reservoir measures. Adopted measures included: creation of control gullies, building sediment-traps and reforesting steep slopes (see Case Study 9 "Community-based PES for forest preservation and sediment control in Kulekhani, Nepal").

In all these four described cases, an initial deforestation carried out on the steep slope of the watershed and the adoption of agricultural activities, not particularly suited for water and soil conservation, have aggravated the natural soil erosion process with the resultant increased sediment load in the freshwater system. As a consequence, the disruption of watershed services in these areas has affected the functioning of hydroelectric power plants, which are located in the lower parts of these watersheds. Thus, although these PES schemes are normally classified as PES for water, agricultural activities are an entry point not only as an important driving factor in the establishment of the problem, but also as a key factor in the restoration of the watershed services.

Other PES schemes for watershed services do not implement physical and structural barriers against soil loss or improved agronomic practices, but focus specifically on afforestation programmes and conservation of the remaining forests.

In the case of the Nyando and Yala basins (Kenya), an increased rate of sediment load has been caused by the high deforestation rate and the production of cash crops (mainly tea) cultivated in the middle zone of each of these two watersheds. The sedimentation load coming from these two watersheds aggravates the ecological degradation and major eutrophication issue of Lake Victoria. Thus, a PES scheme has been implemented to launch an afforestation programme that seeks to engage farmers in the choice of the preferred tree species to plant in the two watersheds (see Case Study 7 "Farmers' perspectives on planting trees on their farms, in the Lake Victoria Basin, Kenya").

The conversion of natural forests and native Andean alpine grass (*pàramos*) to annual crops and pasture is the driver for a PES scheme that involves a farmer cooperative of 27 households as sellers of the watershed services and the citizens the town of Pimampiro (Ecuador) as the buyers (see Case Study 6 "PES for improved ecosystem water services in Pimampiro town, Ecuador"). Similarly to the PES scheme in Pimampiro (Ecuador) is one that is financed by the citizens of the town of Heredia (Costa Rica) that aims to secure water quality and supply by rewarding private landowners to protect existing forest patches in the upper parts of five watersheds surrounding the town (see Case Study 12 "PES for improved ecosystem water services in Heredia town, Costa Rica").

In at least one situation, agriculture was considered the major cause of ecosystem disservice and it was evaluated that, in such a highly degraded agro-ecosystem, further agricultural production would have been incompatible with the restoration of regulating services in the watershed, such as the reduction of sedimentation rate and flood control. In fact, in the Yangtze River Watershed (China), intensive farming on sloping terrains has certainly contributed to massive soil erosion and the subsequent large floods of the Yangtze River in 1999. The Government of China implemented a national PES scheme, known as the Sloping Land Conversion Program, to reward farmers to abandon their farming activities in the upper area of the watershed and to restore forests (Scherr *et al.*, 2006).

PES in agriculture and landscape beauty

Another category of PES schemes seeks to protect landscape beauty and some of these also related to agriculture in particular when the landscape aesthetics involved 'rural amenities' (FAO, 2007). Conversely, some agricultural landscapes, besides delivering provisioning services, can also deliver cultural services related to the pleasure that people gain in seeing, visiting or just knowing about the existence of these landscapes.

An example is agritourism where traditional agriculture activities have conferred some distinct features to the landscape that is appreciated for its historical value, attractive countryside and distinct agricultural products. For example, a PES scheme supported by the EU Common Agricultural Policy (CAP) rewards farmers to conserve a region of 6 000 hectares in Amfissa (Greece) where 150-year-old olive trees are grown (Vakrou, 2010). In Switzerland, Article 104 of the Federal Constitution of the Swiss Confederation clearly defines that part of the role of agriculture is also the maintenance of rural employment and cultural heritage. Areas eligible for ecological compensation include semi-natural habitats, such as extensively cultivated meadows and pastures, hedges and woods, traditional orchards, ponds and stonewalls. Farmers receive an ecological compensation for extensive meadow-land, natural field margins, permanent flowery meadows (mowing of grass has to be done at specific times to allow flowers to turn to seed) and rotated fields, hedges, wooded riverbanks and fruit trees (SFSO, 2007; Vermont, 2005). This is a case of a PES-like regulation as farmers receive annual payments in return for the adoption of specific agronomic practices on their land, but they are not bound by a contractual agreement. Farmers enrol and receive their compensation from the canton authorities, who in turn ask for federal funding.

Agricultural landscapes deliver cultural services related to the pleasure in visiting or knowing about beautiful rural landscapes

Another example of the protection agricultural scenic beauty is in the eastern part of The Netherlands where the landscape is characterised by a unique mosaic of small-size field plots which together creates a suggestive pattern appreciated by residents, as well as the many tourists attracted to this region. Therefore, the Dutch Government recently established a 'landscape fund' to reward farmers for the forgone income opportunities related to the preservation of the characteristics of this landscape (Almasi, 2005).

PES in agriculture and carbon sequestration

Agriculture also offers many possibilities to enhance carbon sequestration both in the soil and in perennial plants, as well as reductions in carbon and methane emissions (FAO, 2007). Carbon sequestration through perennial plants can be achieved with various types of conversion of agricultural land ranging from afforestation (from barren land to trees), to agroforestry (from crops to crops mixed with trees), to reforestation (from logged forest to replanted forest) and forest conservation.

An example of afforestation that encompassed the complete conversion of barren land, which was discontinuously used as a grazing area, into a 4 000 ha reforested area for carbon sequestration has been implemented in the Pearl River Basin in the Guangxi Zhuang Autonomous Region of China (Chen, 2010).

Examples of carbon sequestration through agroforestry are being implemented by Plan Vivo. This non-profit organization promotes a mixed system in which agricultural production is combined with carbon sequestration according to a 'plan vivo', designed at the farm level with a strong participatory approach that brings the farmers to decide on and draw the interspersion of cultivated plots and planted trees. The reduction of carbon emissions gained with this type of agricultural production are independently assessed and generate Plan Vivo Certificates, which are sold as carbon offsets for the conservation of ecosystems and poverty reduction of landholders (see Case Study 10 "Plan Vivo: A voluntary carbon sequestration PES scheme in Bushenyi district, Uganda"). A similar approach has been promoted by the joint initiative (SCC-Vi) of the Swedish Cooperative Centre (SCC) and Vi Agroforestry Programme (Vi) in Karawage district (Tanzania). This PES scheme remunerates small-scale farmers for carbon sequestration obtained through agroforestry and sells carbon off-sets to the voluntary carbon market (see Case Study 11 "PES and the Kagera Transboundary Agro-ecosystems Management Project, Eastern Africa").

Carbon sequestration can be achieved from the afforestation of abandoned lands, agroforestry, reforestation and forest conservation

Carbon credits can also come from the reforestation of areas of marginal farmland that are located in key locations to restore the ecological connectivity of the landscape. An example is the project bring promoted by PowerTree Carbon Company LLC[7], a multi-million dollar company

7 http://www.powertreecarboncompany.com

constituted by a voluntary consortium of 25 leading American electric power companies or their affiliates that aim to mitigate climate change through forest restoration in the Lower Mississippi Alluvial Valley (LMAV) in Louisiana. The project involves almost 4 000 acres that were replanted in 2004-2005 with 1.2 million trees. The forest restoration is expected to capture about 1.4 million tonnes of carbon dioxide from the atmosphere and, at the same time, recreate critical habitat for wildlife. The PowerTree Carbon Company LLC retains the rights to all emission reductions associated with the project and distributes the carbon offsets among its 25 member companies.

There are numerous examples of carbon sequestration projects aimed at the protection of native forests (Landell-Mills and Porras, 2002). In tropical areas, the conservation of native forest patches for carbon sequestration in agricultural landscapes often has high opportunity costs considering the possible revenues from timber extraction and conversion of the patches for other land uses. As an example, in Sumatra (Indonesia), a rough evaluation of forgone opportunity costs, which includes also the exploitation of timber species, ranges from USD 8.50 for community-based forest management, to almost USD 10 for oil palm, and nearly USD 16 per tonne for intensified rubber agroforests (Tomlich *et al.*, 2002). Forgone opportunity costs and potential benefits from ecosystem service preservation usually have a high degree of spatial variability (Naidoo and Ricketts, 2006; Wendland *et al.*, 2010) and should be always assessed through spatially explicit cost-benefit analysis (see also Chapter 4 "Cost-effective targeting of PES"). Although generalisations are not possible, the evaluation made by Tomlich *et al.* (2002) suggests that international carbon markets, which on average rewards a price of USD 25 per tonne of carbon, have the potential to shift incentives from forest conversion to conservation.

Agriculture also has a high potential for carbon sequestration in soils

In summary, when rural landholders participate in a carbon sequestration schemes, they can do so by providing available land for others to plant forests, by preserving existing forest patches on their land or by converting their crop fields into agroforestry systems. In addition, agriculture also has a high potential for carbon sequestration in soils through minimal mechanical soil disturbance (zero tillage and direct seedling), maintenance of the carbon-rich organic matter layer of soil, rotation and sequencing and associations of crops and tree cultivation, improved grassland management and controlled grazing (FAO, 2007; FAO, 2010). Since the early 2000s, farmers in Australia and the USA have been advocating for the recognition of 'carbon farming'[8] and 'carbon grazing activities'[9], even though there is not yet an active, functioning carbon market for carbon sequestration in soils.

8 http://soilcarboncoalition.org, http://carbonfarmersofamerica.com and http://www.carbonfarmersofaustralia.com.au

9 http://www.carbongrazing.com.au

PES in agriculture and biodiversity conservation

In agriculture, PES can enhance biodiversity in different ways: by protecting patches of native habitats, by running agricultural activities which provides suitable ecological conditions for species' occurrence in the soil, water and air compartments, and by providing adequate connectivity for wildlife amongst natural habitats. Thus, biodiversity conservation implies a triple action, which includes conservation, monitoring and sound environmental management at the farm level, but also at the landscape level.

An example of PES schemes for biodiversity which target specific management practices is found in the district of Bungo (Indonesia). Bungo is the third most important Indonesian province for rubber production, where traditional rubber agroforestry practices (in jungle rubber gardens) still survive next to wide expanses of rubber plantations. Rubber jungles are created by having a multi-generational rubber tree agrosystem with trees at different growing stages with a structure resembling the native forest. The biodiversity of trees, ferns and bird species in jungle rubber gardens is quite high and often comparable with that of native forest patches, although biodiversity is clearly expected to vary locally according to the development stages of the rubber jungle, rubber tree densities, management practices and proximity to remaining native forest patches. PES schemes seem promising to incentivise rubber production through traditional rubber jungles and reward farmers for contributing to biodiversity conservation (see Case Study 4 "PES and rubber agroforestry in Bungo district, Indonesia").

A different example, in which PES schemes have been targeted to restore the landscape connectivity and favour wildlife movement, is found in Costa Rica in the San Juan-La Selva Biological Corridor. PES contracts were made to cover 729 km² of the corridor, which extends from the Braulio Carrillo National Park (in Costa Rica) to the Indio Maìs Biological Reserve (in Nicaragua) and is constituted by an aggregation of private properties in a landscape mosaic of privately-owned forests, pastures for cattle grazing, sugarcane, bananas and pineapple crops (Morse *et al.*, 2009).

From PES to remuneration for positive externalities in the agriculture and food sectors

Although PES approaches are particularly suitable to promote the conservation and enhancement of ecosystem services in rural areas, their role has been greatly underestimated. The potential of PES in rural areas is related to the possibility of being able to trigger agronomic practices which are able to protect the proper functioning of ecosystem services and, thus, ensure the productive basis of long-term food security for local communities. PES schemes, characterised by a strong participatory approach, promote dialogue amongst different stakeholders, as well as negotiation amongst the various needs and perspectives until an agreement is reached and a PES contract is signed. The participation and community agreement/cohesion on decisions related to the local management of natural resources and production activities is a major driver in the long-term preservation of natural capital (see also Chapter 5 "Social and cultural drivers behind the success of PES").

PES schemes have an added value over agri-environmental schemes, as PES initiatives have the capacity to engage previously uninvolved stakeholders (beneficiaries of ecosystem services), including private enterprises. This results in better mapping of the social capital and in the potential to increase the financial resources to support initiatives aimed at sustainable development. Furthermore, PES schemes are conceived as payments released upon 'compliance' with the agreed actions (land use and agronomic practices) aimed at the preservation and restoration of ecosystem services. This adds to PES schemes an important component of monitoring activities on the status of ecosystem services. Despite this high potential, there are several misconceptions that have concurred to hide the potential of PES in agriculture. The first misunderstanding relates to the fragility of PES schemes to deal with the high complexity of agro-ecosystems. Several agro-ecosystems, especially in developing countries, can be characterised by a social network where strong social inequalities are found and where conflicting needs for the use of natural resources can be higher than less populated situations where production activities are scarce. If the criteria to adopt a PES scheme simply reflect an economic efficiency criteria (see also Chapter 3 "Opportunities and gaps in PES implementation and key areas for further investigation"), it is clear that implementing PES for agro-ecosystem services can be considered as a very challenging task. On the contrary, if the social dimension of PES schemes is fully integrated into PES design, PES can actually be considered as a viable tool for achieving a collective vision that also considers poverty alleviation.

The potential of PES in rural areas is in its ability to trigger agronomic practices that ensure long-term food security

A second limitation refers to the ability of PES schemes to obtain real participation of farmers in disadvantaged situations (Pagiola *et al.*, 2005). As recommended by several authors, PES schemes can be designed in such a way as to encourage genuine participation and stakeholders' engagements. However, the true strength of PES lies in trust-building, which requires time (Wunder, 2007). One of the major weaknesses of short-term programmes is that PES' usual 3-5-year time frame does not allow a detailed analysis of farmers' needs, nor the opportunities and constraints faced in their farm management. If there is no genuine participation of farmers, if the interests of the farmers are not put first and if farmers are not seen as part of the solution, as opposed to the actors creating the problem, PES schemes are unlikely to achieve any long-term improvement in the conditions of the agro-ecosystem (Hellis and Schrader, 2003).

A third commonly perceived limitation refers to the difficulty in measuring the provision of ecosystem services at the farm level. As a consequence, the payment schemes in PES have generally been based on the adoption of practices, rather than on achieved performance of ecosystem services delivery at the farm level. This can be considered as a limitation, especially when facing the need to demonstrate the additionality of contracting several or specific farms at different locations. In reality, the truth is that payment will ultimately be based on a negotiation process, rather than on a simple crude scientific quantification of ecosystem services at the farm level (Tognetti and Johnson, 2008).

What is highly needed though is scientific information that measures, in a quantitative way, the impact of incremental changes in some agronomic practices on ecological production functions (Tallis *et al.*, 2008). The knowledge of the ecological limits below which a sustainable use of agro-ecosystems can be carried out will be key information to avoid overexploitation and ecosystem services disruption.

A fourth limitation on the development of PES in agriculture is the strong interrelationship between different ecosystem services (Bennett *et al.*, 2009). This has probably diverted the attention by only focusing on a single ecosystem service, such as water, carbon sequestration, biodiversity and landscape beauty or bundling ecosystem services only as a sale mechanism (see Case Study 5 “PES in Costa Rica”).

However, a new generation of PES in agriculture could seek the potential of a specific set of ecosystem services that can be simultaneously enhanced through appropriate agricultural practices (bundling of ecosystem services in agriculture). In this new vision, a PES labelled as PES in agriculture would be aimed at ensuring the long-term delivery of food security, a condition that will be fulfilled only when at least the subset of ecosystem services that are particularly influenced by agricultural activities are managed under sustainable and ecological criteria. In particular, a new generation of PES in agriculture for food security should:

- **Be driven by a strong participatory approach**;
- According to a collective vision, **be implemented at community level**;
- Seek to promote a model of production based on the ecological **carrying capacity of agro-ecosystems**;
- **Consider a bundle of ecosystem services**, rather than a single one.

There is always the tendency of falling into the belief that there is a panacea, a single solution that will be able to solve complex problems. When PES was first conceived, it was believed that the market forces alone, applied to the simple structure of a PES mechanism would automatically deliver the desired outcomes. However, if there is one lesson to be learned that PES experience has been advocating, it is that it is crucial to design tools, including PES, that reflect the complexity of reality, that give voices to the plurality of stakeholders’ perspectives and that adapt to the multi-faceted challenges of sustainability.

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CHALLENGES AND SOLUTIONS TO THE IMPLEMENTATION OF PES IN SMALLHOLDER FARMING SYSTEMS IN DEVELOPING COUNTRIES

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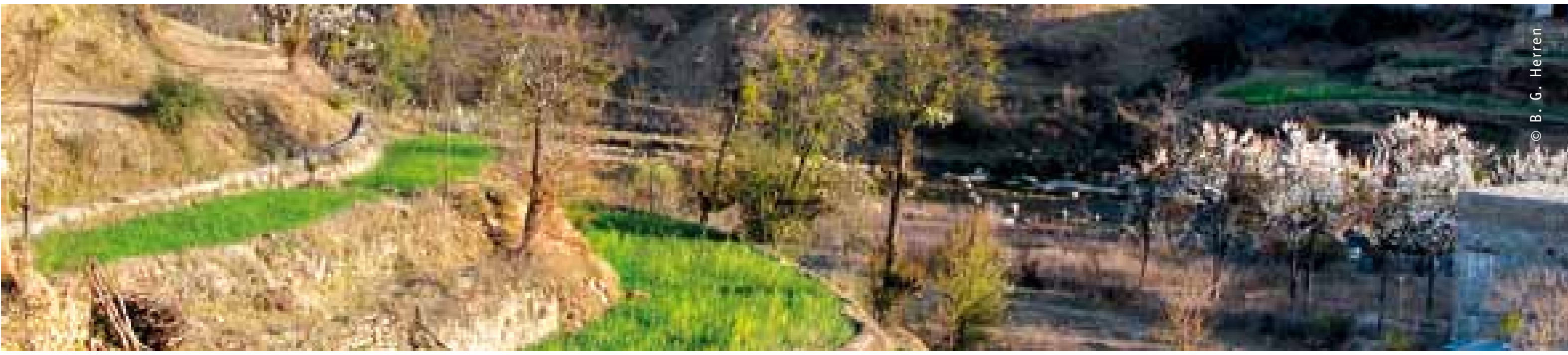

The resilience that is required to ensure food security will come from building agricultural systems that are more diverse, adopt ecosystem approaches and are more efficient in making use of inputs (FAO, 2010; IAASTD, 2008; Pinstrup-Anderson, 2010). Increasingly, it is recognised that smallholder systems can be more efficient than large-scale farms (Altieri *et al.*, 1998; Lele *et al.*, 2010; Pinghali, 2010). Smallholder farmers in developing countries are the appropriate focus for suggesting interventions for a more resilient, pro-poor agriculture in that these farmers cultivate about 85 percent of all agricultural lands and all suffer in varying degrees from similar problems associated with low yields and unpredictable exposure to markets (Morton, 2007). While they have the greatest need for yield increases, they also experience the greatest challenges in securing them. The potential for yield increases will primarily come from good agronomic practices applied to achieve maximum benefit from the efficient use of natural resources and ecosystem services. As such, the most critical inputs are knowledge and capacity-building; inputs that are presently poorly supported by the low levels of investment in extension services in many developing countries.

The suite of ecosystem services that have received the most attention under PES schemes have tended to those for which buyers are most evident: carbon sequestration, watershed functions and biodiversity conservation (FAO, 2007). The subset of ecosystem services that directly address *in-situ* sustainability of agricultural production — genetic resources, erosion regulation, water purification, pest regulation, pollination, disease regulation — has yet to receive commensurate attention. Yet, it is these very services that will ensure that agricultural production is carried out in a sustainable manner both in the present and the future, with food security being given central attention. Most of these services are showing worrisome and declining trends (MEA, 2005).


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If it can be accepted that sustainability in agriculture is a global public good, it is worthwhile addressing exactly what practices may be useful to preserve and increase both food production and the delivery of ecosystem services in smallholder farming systems in developing countries. Those agronomic practices that are believed to have an impact on ecosystem services directly related to food production can be grouped into five main categories:

a. Increasing and diversifying plantings at the farm level (use of crop margins, rotations, farm edges, fallow lands or strips within cultivated areas);
b. Applying soil and water conservation practices at the farm level;
c. Increasing efficiency in the application of external inputs at the farm level;
d. Making greater use of local agrobiodiversity;
e. Improving the management of uncultivated areas in farming landscapes.

It is not always self-evident that these practices immediately benefit farmers; for resource-poor farmers, working under conditions of insecure tenure or labour shortages, for instance, it may be more economical to mine the soil than to practice soil conservation. Challenges to securing these practices in smallholder agriculture in the absence of incentive schemes are described below:

a. **Increasing and diversifying plantings on-farm:** Given the extremely small size of most smallholder farm parcels, it is highly unlikely that farmers in developing countries are able to introduce set-aside land for biodiversity or allocate portions of their land to fallow or non-productive plantings, so long as the incomes and livelihoods they receive from farming are so marginal. Nonetheless, there is considerable evidence that on-farm diversity (through relay and intercropping, agroforestry and even selective weed control) delivers substantial services with respect to functions, such as pollination and pest control.

Previous page:

↖ Mixed cropping is practiced on terraces in Uttarakhand, India, as an important soil and water conservation tool.

Current pages (from left to right):

→ Limiting agricultural inputs through organic farming in Fulbari, Nepal, for the maintenance of several ecosystem services.

→ Rice is the most important crop in Sierra Leone and the establishment of resilient agricultural systems for successful rice inter-cropping requires proper training and support.

→ Training of farmers in rice fields near Lemakaya, Indonesia, for increasing efficiency in the application of external inputs.

b. **Applying soil and water conservation practices:** There is a long history of the successes and failures of soil and water conservation practices adopted in smallholder farming systems. Most of the challenges relate to the additional time, labour and material costs that cannot easily be borne by subsistence and small-scale farmers. Where soil conservation practices require that strips of land are removed from cultivation, the same constraints as with increasing and diversifying plantings occur.

c. **Increasing efficiency in the application of external inputs:** This is expected to be an area where win-win solutions might be more readily possible, in that increased efficiency of inputs could lead both to reduced costs and/or increased yields. However, small farm sizes often make farmers extremely risk-averse and inclined to overuse, rather than reduce, inputs, such as pesticides.

d. **Making greater use of local agrobiodiversity:** This particular cluster of interventions includes those practices that many smallholder farmers already apply in saving and selecting their own seeds and in keeping small fields with diverse cropping patterns that tend to favour natural enemies and pollinators. These practices are at imminent risk of disappearing under agricultural intensification.

e. **Improving the management of uncultivated areas in farming landscapes:** Farming communities generally do not have management control over the public areas of land or larger landscapes in which their farms are situated. Yet, many ecosystem services are generated at a landscape scale. Pollination services is a flagship example of a positive externality, since beekeepers — or those who encourage native bee populations — do not often get paid for the services they provide to other farmers and the bees they encourage cannot be

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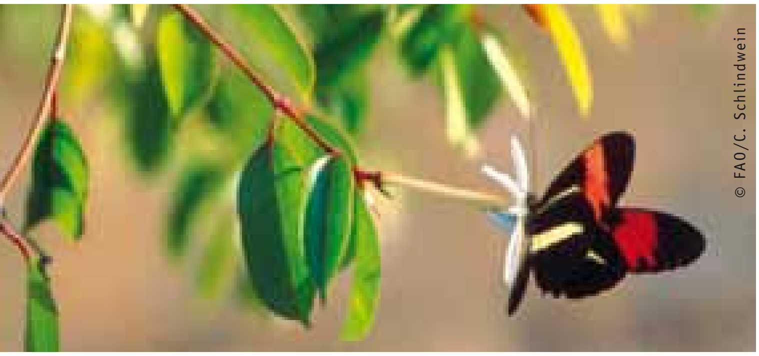
restrained from providing the service of pollination beyond the boundaries of any one farm. Small patches of forest and even roadside verges with flowering plants can be important habitats for pollinators in a cultivated landscape. Another example is the control of the newly-introduced fruit-fly (*Batrocera invadens*) in Africa, which requires management not on a field or farm scale, but on a 'pest-shed' scale, using measures to manage the pest on all vegetation within a landscape.

The challenges identified above, on the path to more resilient and sustainable agricultural systems, could be addressed by strategic incentive measures, including PES schemes, and it should be recognised that sustainable agriculture in and of itself is a benefit ultimately for the global good.



Examples of pollinators species.
From left to right:

→ The Asiatic honeybee (*Apis cerana*) is indigenous to Asia from Afghanistan and Japan, and from Russia and China in the north to southern Indonesia.

→ The squash bee (*Peponapis pruinosa*) is found throughout the USA, except in the northwest.

→ The longwing butterfly (*Heliconius* spp.) is spread from the southern United States throughout Central and South America and the West Indies, with the greatest diversity of species in the Amazon Basin.

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PES AND ECO-CERTIFICATION IN THE KAPINGAZI WATERSHED, KENYA

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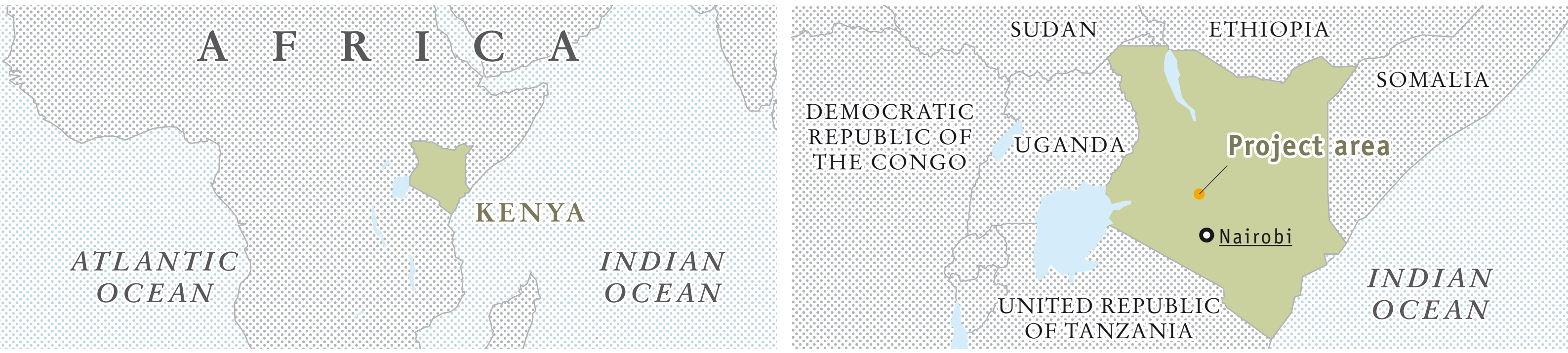


The catchment of the Kapingazi River forms part of a much larger Mount Kenya East or Upper Tana River catchment and covers an area of 61.2 km^2. The Kapingazi River feeds into the Rupingazi River, which then feeds into the Tana system, contributing water to the Seven Forks Hydropower Reservoirs. These hydropower stations provide 70 percent of Kenya's electricity.

The cropping pattern in the watershed is more or less stratified, with the three main sections managed through different land uses: (a) a tea zone in the upper part of the catchment, especially around Kiriari; (b) a transition zone where both coffee and tea are dominant, around Kairuri; and (c) a coffee zone in the lower part of the catchment (Figure 3). Subsistence farming is practiced mostly with beans and maize. In addition, 'zero grazing' is practiced.

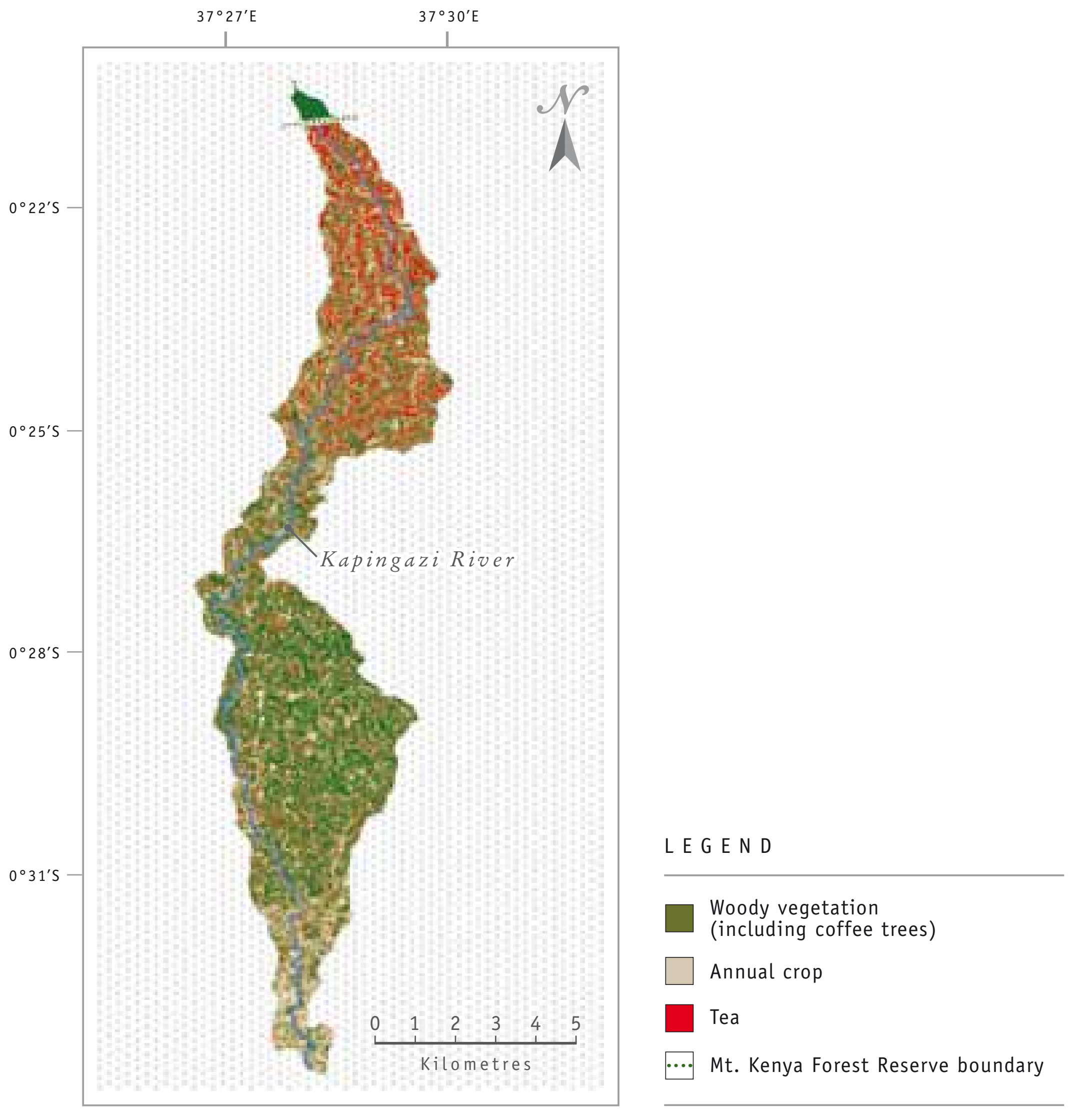
Tree cover is very low in the farming zones. Until 2003, the *shamba* system was in place. This regulatory system allowed farmers to use previously clear-cut forest areas for food production while taking care of newly-planted tree seedlings until the competition between trees and food crops would not permit further cultivation. In the long run, the *shamba* system appeared to fail in curbing deforestation because more land was being cleared for agriculture, resulting in a government ban. Since then, farmers living next to the forests are only allowed limited and controlled access to the gazetted forest to obtain fodder and firewood; the forest provides an important buffer for fodder and firewood supply during the dry season. There was an attempt to bring back the *shamba* system on a trial basis in 2008, but this was generally not accepted and it remains banned.

Increased deforestation associated with population growth (there are approximately 9 000 households in the Kapingazi catchment, with a population of 41 000 inhabitants) is also currently disrupting the ecosystem services associated with the watershed.

In the early part of the rainy season, the river carries a high sediment load due to soil erosion from several exposed areas before the annual crop cover is established. Other bare

Figure 3

Predominant land-use classes in the Kapingazi Watershed in 2005



Adapted from original map by Miika Mäkelä (ICRAF)

spots include roads, footpaths, homesteads, market centres and other public areas. The erosion risk is highest on the steep slopes of the coffee zone due to the neglect of soil and water conservation structures as a result of low coffee profitability during the 1980s and 1990s. The riverine corridor is used for production of food and fodder, especially during the prolonged dry season. This creates further riverbank erosion.

Dry season water flows are also becoming unreliable. As an example, in 2002, there was a total disruption of the water supply to Embu Town, causing an outbreak of typhoid, which claimed several lives and resulted in a public outcry.

Around Mt. Kenya, a number of initiatives are currently flourishing aimed at restoring ecosystem services and ensuring water supply at the watershed level. Two eco-certification initiatives supported by UTZ-certified (coffee) and the Rainforest Alliance (tea) reward farmers for environmental protection through soil and water conservation, prevention of water pollution, riverbank protection and tree planting. Approximately ten percent of the coffee farmers and all the tea farmers in the catchment are receiving premiums from the sale of eco-labelled coffee and tea.

MUNGANIA TEA FACTORY LTD.

The Mungania Tea Factory in the Kapingazi catchment is one of four factories in Kenya that were included in a pilot certification project by the Rainforest Alliance (the others are Momul Tea Factory Company in Kericho West District, Ngere in Thika, Nyansiongo in Kisii, and Mungania in Embu). They now sell tea at a premium in the international market and the increased income is passed on to the small-scale farmers who are its shareholders. The Rainforest Alliance requires that farmers protect the natural forests within their jurisdiction and plant indigenous trees to boost forest cover. It also obligates farmers and factories to produce tea ethically by avoiding child labour and protecting the health of workers both at the farm and factory levels.

Table 2
Income and payout of Mungania Tea Factory Ltd

Total factory income in million Ksh.	Total payout to farmers in million Ksh.	% of total payout to farmers to total income	Total rate* of green leaf per kg in Ksh.
1 032.0	794.8	77	48.88

Note: Ksh. = Kenyan Shilling
*initial payment plus bonus

There are 8 500 farmers bringing tea to this factory, of which approximately 60 percent of the farms are in the Kapingazi catchment. This would indicate that some 3 400 farmers bring tea to the Mungania Tea Factory. Over 80 percent of tea produced in Mungania is bought at a premium by Lipton. The factory was certified in 2009 and farmers in Mungania have started to obtain their payments.

RIANJAGI COFFEE FACTORY

The Rianjagi Coffee Factory is one of ten coffee factories in the catchment. It supports 1 500 farmers, of which about 800 are in the Kapingazi catchment. The factory was certified by UTZ Netherlands in 1997 and they have managed to successfully undergo their annual surveillance audits. However, the product premiums are dismal. Every year they pay Ksh. 170 000 for the audit by Africert Ltd. According to the farm manager, the premiums were their best in 2008 at Ksh. 200 000; generally though, they can go as low as Ksh. 20 000, meaning the cooperative has to maintain the certification status with their own funds. The factory produces one million kilograms of coffee cherries annually. The average annual production per tree is two kilograms; this is well below what well-managed coffee should produce (i.e. up to 18 kg/tree/year). As such, the farmers in Rianjagi are not any better off when compared to others who do not have

Previous pages (from left to right):

↖ An example of soil and water conservation practices in the Kapingazi catchment area, where crop cultivation has left a strip of natural vegetation along the river bank.

↖ Small cultivated plots on a slope showing signs of soil erosion in the Kapingazi catchment area.

Current pages (from left to right):

→ View of small-scale tea plantations east of Mount Kenya.

→ Coffee berries are washed at one of the coffee factories in the Kapingazi catchment area.

certification. The quality of their coffee is average and the prices fetched are lower (e.g. Ksh. 45 per kilogram, compared to peaks of Ksh. 60 per kilogram in the 2009/2010 coffee year). The main problems encountered so far include:

- The factory management claims that they have no knowledge or access to markets for UTZ-certified coffee. They only sell a small fraction to certified-coffee buyers; the rest is sold on the open market, like any other coffee.
- Production is very low because the farmers are not able to apply the recommended inputs due to the high cost and low returns.

These certification programmes constituted an important background for PES implementation because certification has already empowered small-scale farmers in the Kapingazi catchment area. Farmers have received training on better crop husbandry, as well as on best practices to employ in their farms and to stop riverbank encroachment.

PRO-POOR REWARDS FOR ENVIRONMENTAL SERVICES PROJECT (PRESA)

The IFAD-funded and ICRAF-implemented Pro-Poor Rewards for Environmental Services project (PRESA) is supporting farmers in the Kapingazi catchment to implement land-use technologies, such as terracing, grass strips, *fanya juu* and *fanya chini* (i.e. cut-off drains and diversion ditches to collect runoff from the hillside) and other soil conservation techniques. During the next project stage, these technologies will be further reviewed, based on certain criteria, such as: quality and quantity of biophysical services; social, financial and economic feasibility; effort per unit of service generated; opportunity costs; required duration to deliver services; potential for up-scaling; land tenure/availability; size; etc. In addition, predictive models will be used to assess the potential impacts of these and any new technologies on the ecosystem service compared to the baseline scenario.

PRESA further aims at implementing water PES schemes that could be associated with the existing eco-certification initiatives. The added value of water PES to eco-certification is that:

- Water payments provide a safety net for maintaining soil and water conservation even when prices slump or production drops due to other causes. For example, though apparently there is scope to reward farmers by linking them to markets for certified tea and coffee, it does not seem to be working well in the case of coffee.
- Eco-certification may not cover all the landowners in the watershed — most of the farms in Muthatari focal development area (the lowest part of the watershed, accounting for approximately 20 percent of total area) do not grow either tea or coffee. Thus, PRESA is investigating the potential for the land-use practices and technologies mentioned above to generate water service rewards for a broader section of farmers in the Kapingazi River catchment. PRESA is also engaging with the Kenya Electricity Generating Company Limited (KENGEN), a potential PES buyer, as the leading electric power generation company in Kenya, producing about 80 percent of electricity consumed in the country.

PRESA research is expected to generate lessons for up-scaling within the whole Upper Tana catchment.

So far, PRESA has conducted an assessment of erosion hotspots in the catchment and found that in the tea zone where rainfall is high and soils are relatively more erodible, any bare area is vulnerable to soil erosion. Other areas prone to erosion include steep slopes in the coffee zone. A hydrological assessment will be carried out to determine the impacts of land-use conversion from tea or coffee to annual crops, woodlots or agroforestry. This will be used together with the ongoing study on drivers of land-use change to understand what could happen in the future if these or similar conversions take place. Further insights about the relationship between land use, water balance and water quality will be obtained once the hydrological assessment

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Current pages (from left to right):

→ A section of the Kapingazi River with heavy sediment load.

→ Most residents in the Kapingazi catchment area lack piped water and have to carry water from local rivers and streams for home use, watering vegetables and raising livestock.

is complete. The assessment of soil erosion risk was completed in 2009 and is being revised with higher resolution data. The results of this work will be used in negotiating with potential buyers of ecosystem services and to assess their willingness to pay (WTP).

Technical studies on the willingness to accept (WTA) were completed in 2010. People with larger landholdings demanded greater payments in order to enter into land management contracts. Furthermore, people who were already part of the Mount Kenya East Pilot Project (MKEPP), funded by IFAD/GEF, were willing to enter into contracts for relatively lower payments, possibly because they were already benefiting.

The integration of PES and already existing eco-certification presents both challenges and opportunities. Opportunity associated with working with coffee and tea farmers is that the farmers are already organised. Various organizations, such as Technoserve, are also helping farmers to improve governance of the cooperative societies. Technoserve is also already working in the Kapingazi catchment on this initiative.

A major challenge would be the question of additionality for already eco-certified farmers, particularly whether they should also receive water payments for soil and water conservation practices already in place. Furthermore, from ongoing PRESA research in the East Usambaras, it was found that if the incentive is not large enough, the motivation to conserve is diminished; boosting the modest payments for eco-certification through PES would, thus, improve that motivation.

REFERENCES

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