PES AND COCOA

Securing future supplies and preserving biodiversity by paying cocoa farmers for Ecosystem Services

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1 GENERAL INTRODUCTION

1.1 Introduction

Cocoa production is under pressure worldwide[1]. The main causes are inefficient production methods, diseases and plagues, the tendency to switch to less laborious crops and political conflicts. At the same time, the demand for cocoa is growing rapidly. This leads to rising prices and increasing problems and uncertainty for cocoa processors and chocolate producers. It is vital to find ways to induce cocoa farmers to produce more (sustainable) cocoa. Sustainable production invariably means that cacao is grown under shade. In this report we therefore look at cocoa as an agroforestry system.

Cocoa farmers can make an important contribution to the preservation of biodiversity. Areas where cocoa is produced can for example act as a buffer for – or corridor between – nature reserves. Farmers do not receive a reward for such ecosystem services, however. This is a missed opportunity. Financial compensation for these services could possibly guarantee a better supply of cocoa and at the same time contribute to preserving biodiversity.

1.2 The project

Against this background the Dutch Ministry of Economic Affairs, Agriculture and Innovation has commissioned CREM BV and the Agro Eco – Louis Bolk Institute to research possibilities to pay cocoa farmers for their ecosystem services. In this project the following phases are distinguished (after each phase a go / no-go decision will be made). **This report deals with the results of phase A1.**

Phase A1. The objective of this phase is to identify:

- ecosystem services related to cocoa production;
- means to measure/valuate these ecosystem services;
- the most suitable financial mechanism(s) to pay for these ecosystem services.

The information for this phase is obtained by internet and literature search and expert interviews.

Phase A2. The objective of this phase is to identify:

- the support for the results of phase A1 among various stakeholders (private sector, NGOs, producing countries);
- the willingness of several parties to pay for the ecosystem services;
- 1-3 cocoa production sites that are suitable to execute pilot projects.

Phase B. Execution of 1-3 pilot projects to research how the PES-concept could work in practice.

[1] In this report we use “cacao” for the Cacao tree (*Theobroma cacao*) and all its parts (flowers, fruits, beans, etc.) and we use “cocoa” for the products extracted industrially from cacao beans (cocoa powder, cocoa butter).

1.3 Reader's guide

This report contains the results of phase A1 only.

Chapter 2 first gives a general introduction to the PES concept. What are environmental services? What kind of PES mechanisms can be distinguished? In general, how can environmental services be measured and valuated? What kind of examples exist?

Chapter 3 describes what specific environmental services related to cocoa production can be distinguished. How can these environmental services be measured/valuated? What indicators can be used?

Chapter 4 compares advantages and disadvantages of three types of financial mechanisms: (1) PES linked to certification schemes, (2) biodiversity credits and (3) a fund for environmental services.

Chapter 5 draws general conclusions and gives recommendations for the execution of phase A2 of this initiative.

2 A GENERAL INTRODUCTION TO PES

2.1 What are Ecosystem Services?

Ecosystem Services (ES) are the benefits people obtain from ecosystems: the goods and services that nature produces and that people use. Examples of ecosystem services are food production, water filtration, pollination and climate regulation. Unfortunately, with the worldwide rapid loss of biodiversity due to anthropogenic habitat disturbance, the world's ecosystem services are at stake. The Millennium Ecosystem Assessment (MA) in 2005 showed that 60% of ecosystem services are already degraded or used unsustainably[2]. Beneficiaries are thus the farmers themselves, the region (like for drinking water), and wider society ('the world').

The concept of ecosystem services has received significant attention since the appearance of the MA. The MA has subdivided ecosystem services into four categories:

- *provisioning* such as the production of food and water
- *regulating* such as the control of climate and disease
- *supporting* such as nutrient cycles and crop pollination
- *cultural* such as spiritual and recreational benefits

2.2 Payments for Ecosystem Services

PES stands for Payments for Ecosystem Services. PES-transactions generally include either an individual or a group of people who provide(s) services ('sellers') and an individual or a group of people who pay(s) or compensate(s) for the maintenance of these services ('buyers'). The key characteristic of these PES-transactions is that the focus is on maintaining, enhancing or restoring a specific ecosystem service[3]. Critical to a PES-transaction is that the payment causes the benefit to occur where it would not have otherwise. A definition for PES that has become accepted has been put forward by Sven Wunder[4] (see the box below).

A PES-transaction is:

- a voluntary transaction in which
- a well-defined ecosystem/environmental service, or a form of land use likely to secure that service
- is bought by at least one ecosystem services buyer
- from a minimum of one ecosystem services provider
- if and only if the provider continues to supply that service (conditionality).

In annex I an overview is presented of the steps to be taken when developing a new PES transaction (project).

2 See www.MAweb.org

3 Economy Backgrounder', The Katoomba Group, Ecosystems Market Place, 2007

4 'Payments for Ecosystem Services: Getting started', The Katoomba Group, UNEP, Forest Trends, 2008

PES primarily offers economic incentives to foster more efficient and more sustainable use of ecosystem services. Spin off effects can be various, ranging from reducing poverty to opening new markets and securing future supplies.

2.3 Types of PES

Existing PES-transactions have been set up for the following ecosystem services:

1. Carbon storage and sequestration
2. Water-related ecosystem services
3. Biodiversity conservation

The types of payments (financial mechanisms) in existing PES-transactions include[5]:

- Payments for biodiversity-conservation practices e.g. management contracts for habitat or species conservation on private farms or grazing lands.
- Tradable rights under cap & trade regulations e.g. tradable biodiversity credits – credits representing areas of biodiversity protection or enhancement, which can be purchased by developers to ensure they meet a minimum standard of biodiversity protection.
- Support of biodiversity-conserving business e.g. eco-labeling biodiversity-friendly products.
- Payment for access to species or habitat e.g. ecotourism use or bio-prospecting rights.
- Purchase of High-Value habitat such as private or public land acquisition.

In chapter 4 financial mechanisms are identified and discussed which could be specifically relevant for PES and cocoa.

Another aspect of PES includes the question who (what buyers) eventually pay for the ES. The buyer (groups) can be divided as follows:

- *Local users* such as local water companies paying for a higher water holding capacity of the soil and/or clean ground water (see example Vittel below);
- The *supply chain* by paying higher prices (price premium) for biodiversity friendly cocoa, wanting to secure cocoa future supplies, improve cocoa bean quality and/or improve their image;
- *Governments* by means of e.g. taxes on 'biodiversity unfriendly' products and/or subsidies for ES, wanting to promote biodiversity conservation;
- *Other interested parties*.

> Perrier Vittel (now owned by Nestlé) discovered it would be cheaper to invest in conserving the farmland surrounding their aquifers than to build a filtration plant to address water quality issues found in 1990. Accordingly, they purchased 600 acres of sensitive habitat and signed long-term conservation contracts with local farmers. Farmers in the Rhine-Meuse watershed in northeastern France received compensation to adopt less intensive pasture-based dairy farming, improve animal waste management, and reforest sensitive filtration zones[6].

5 Payments for Ecosystem Services: Getting started', The Katoomba Group, UNEP, Forest Trends, 2008

6 Payments for Ecosystem Services: Getting started', The Katoomba Group, UNEP, Forest Trends, 2008

2.4 Measurement and valuation of Ecosystem Services

Valuation of ecosystem services is key in determining appropriate payment schedules for use, maintenance or enhancement of ecosystem services[7].

Valuation studies can be done in great detail and at great length and costs, but they can also be applied in a very rapid and cost effective manner (from simple identification to full economic valuation); Several steps for measuring and valuating ecosystem services can be distinguished[8]:

- Step 1: Identification of the ecosystem services
- Step 2: Quantification of the ecosystem services or their indicators
- Step 3: Valuation of the ecosystem services

See annex II for more detailed information on steps for measuring and valuating ecosystem services.

Step 1: Identification of the ecosystem services
The simplest way of paying attention to ecosystem services is the qualitative listing of these services in studies. See annex II for more insights into methods for identifying ecosystem services.

Based on the ecosystem services identified in step 1, a selection of the relevant ecosystem services to be quantified can be made. The choice of the selection highly depends on the purpose of the study and can be part of a scoping process, where also the required level of detail can be defined.

Step 2: Quantification of the ecosystem services or their indicators
Ecosystem services can be quantified in units of measurement (indicators) directly linked to the service. Units of measurement have a very broad range. Some examples are:

- quantity of renewable water supply for an aquifer;
- annual sustainably harvestable fish, timber or fruits in a certain area;
- amount of agricultural produce per hectare;
- amount of carbon stored per hectare of forest;
- the number of scuba divers a coral reef can handle without unacceptable damage;
- the number of species occurring in a certain area;
- the percentage of the world population of a threatened bird species making use of a certain area[9].

Step 3: Valuation of the ecosystem services (societal and economic valuation)

Societal valuation
Society attaches a value to ecosystem services. The quantities in which ecosystem services are expressed can be translated into values for society. This does not necessarily mean that values have to be directly expressed in monetary terms. Values can also be expressed in social or ecological terms. Examples of social values are:

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7 Report 'Delen van ervaringen met ecosysteemdiensten', SKB Duurzame Ontwikkeling Ondergrond, 2010.

8 Report 'Valuation of Ecosystem Services & Strategic Environmental Assessment – Lessons from influential cases', MER Netherlands Commission for Environmental Assessment, 2008.

9 Report 'Valuation of Ecosystem Services & Strategic Environmental Assessment – Lessons from influential cases', MER Netherlands Commission for Environmental Assessment, 2008.

- number of households depending on a service
- number of jobs related to a service
- number of people protected against forces of nature

Ecological values can relate to:
- the number of threatened (red-listed) species in an area
- the importance of an area as living repository of wild ancestors of agricultural crops
- the contribution a certain area makes to the maintenance of other areas (e.g. marine fish reproducing in coastal wetlands; the importance of wetlands as stop-over locations for migratory birds)

Economic valuation

Different economic valuation methods exist to value (monetize) different ecosystem services. The selection of which method to use depends on a number of aspects. First, when planning a valuation study, it is necessary to balance the benefits of using the best scientific and analytic techniques with the financial, data, time and skills limitations to be faced. Realize that no single method is necessarily the best; for each application it is necessary to consider which method(s) is the most appropriate. Sometimes a number of different methods is used in conjunction in order to estimate the value of different services from a single ecosystem[10] (see Annex III).

10 The measurement of environmental and resource values: theory and methods. Resources for the future, Washington DC, Freeman, A.M, 1993.

3 QUANTIFYING ECOSYSTEM SERVICES IN CACAO AGROFORESTRY

3.1 Ecosystem services provided by cacao agroforestry

Cacao agroforestry systems can be found throughout the humid tropics, with Ivory Coast, Ghana and Indonesia being the most important exporting countries (ICCO 2008). Besides the production of cacao beans, these agroforestry systems provide several ecosystem services.
Ecosystem services are divided into several categories that are provided by cacao agroforestry as well (table 1). The biodiversity that is involved in providing ecosystem services from agricultural systems is called “agrobiodiversity” (agricultural biodiversity), which is the variety of life in agricultural systems and its surroundings. In this study we distinguish “trees & other plants”, “mammals”, “birds”, “amphibians & reptiles”, “insects”, and “soil fauna”.

Table 1: Ecosystem services provided by cacao agroforestry

	Products and processes	Provided by cacao agroforestry
Supporting services	▪ Primary production ▪ Nutrient cycling ▪ Soil formation	3.1.7 Soil protection and soil quality
Production services	▪ Food ▪ Fresh water ▪ Wood and fiber ▪ Fuel	3.1.6 Water quality and quantity 3.1.5 Food security & income diversification
Regulating services	▪ Flood regulation ▪ Disease regulation ▪ Water purification ▪ Climate regulation	3.1.4 Carbon storage & sequestration 3.1.3 Natural control of pest insects
Cultural services	▪ Educational ▪ Recreational ▪ Aesthetic	3.1.2 Natural habitats, buffer zones and corridors 3.1.1 Biodiversity conservation

Adapted from: Millennium Ecosystem Assessment 2005

3.1.1 Biodiversity conservation

Cacao beans are produced on 5-8 million hectares (estimated from ICCO 2008 and Clough et al. 2011) in tropical countries. Alarmingly, these tropical countries have lost half of their rainforests in the past 50 years as a result of agricultural expansion (MEA 2005). Because some forms of cacao agroforestry can still resemble natural forests in terms of tree cover, conservation biologists have assessed the potential of cacao agroforestry for biodiversity conservation.
For some biodiversity groups, cacao agroforestry systems can have levels of biodiversity comparable with that of rainforests, but management matters. Plantations with a shade cover of >40% provided by a variety of local and endemic tree species left after forest clearing for planting cocoa, can harbour biodiversity that is easily as high as or even higher than in nearby rainforests (mammals: Harvey et al. 2006; trees: Gradstein et al. 2007; other plants: Sporn et al. 2009, Pitopang et al. 2008; reptiles: Wanger et al. 2009; amphibians: Whitmore et al. 2007; butterflies: Schulze et al. 2004; other insects: Bos et al. 2009). However, when shade trees are thinned, replaced by only a few tree species, or even completely removed, biodiversity drops almost as dramatically as after deforestation. In the literature, there is consensus that shaded cacao agroforestry systems are an important tool for tropical biodiversity conservation.
Biodiversity is measured as taxonomic *richness* (e.g., numbers of species) or as *diversity* for which there are various formula to calculate. Quantifying biodiversity in tropical habitats can be extremely costly (Kessler et al. 2011), because high amounts of species are still poorly or not at all known to science. Because of the complexity of tropical ecosystems, including cacao agroforestry systems, there has to

date been no successful set of indicator species for assessing the preserved biodiversity of cacao agroforestry systems (Schulze et al. 2004; Kessler et al. 2010, 2011). This makes implementation of biodiversity assessments into practical and affordable control systems unrealistic for payment mechanisms to farmers.
Because the relation between shade management and biodiversity is well known and understood, we recommend using shade management (with parameters tree density, species, stem width, % canopy cover) as indicator for biodiversity.

Biodiversity and shaded cacao agroforestry

The transformation of cacao agroforests with 40-60% shade cover provided by a variety of diverse and native tree species to cacao agroforests with little shade by a few tree species has an effect on biodiversity that is almost as profound as deforestation.

From left to right: Cacao agroforestry with dense shade cover (>60%) provided by a diversity of trees that remain from the previous rainforest, cacao agroforestry with a shade cover (>40%) provided by various planted or secondarily grown timber and fruit trees, cacao agroforestry with open shade cover provided by few planted tree species, such as (photo) leguminous tree species.

Table 2: Biodiversity groups and cacao agroforestry

Biodiversity group	Agroforestry aspects & management	Literature
Trees	+ Conservation of natural shade tree stands + Promotion of fruit and timber trees for shade - Planting, pruning, logging (20-30 yrs) - Shade thinning	Gradstein et al. 2007; Bisseleua and Vidal 2008; Ruf 2001
Other plants	+ Conservation of natural shade tree stands - Weeding - Shade thinning	Kessler et al. 2009; Clough et al. 2009; Sporn et al. 2009; Haro-Carrión et al 2009; Zotz and Bader 2009
Mammals	+ Shade tree diversity + Shade tree density - Hunting - Forest distance - Habitat fragmentation	Harvey et al. 2006; Muńoz et al. 2006; Cassano et al. 2010; Vaughan et al. 2007; Weist et al. 2010; Faria et al. 2006 & 2007
Birds	+ Shade tree diversity (fruiting trees) + Shade tree density - Forest distance	van Bael et al. 2007a; Waltert et al. 2004; Clough et al. 2009
Amphibians/reptiles	+ branch piles + shrubs + ponds & streamlets - Leaf litter removal	Whitfield et al 2007; Wanger et al. 2009; Solé et al. 2009

Biodiversity group	Agroforestry aspects & management	Literature
	- Weeding	
Insects	+ Shade tree density + branch piles - Leaf litter removal - Shade thinning	Room 1971; Bos et al. 2007 & 2009
Soil fauna	- Leaf litter removal - Fungicides	Da Silva Moço et al. 2009; Norgrove et al. 2009

Cacao productivity vs shade tree density

The cacao tree is an understory tree, the dense shade of Amazonian rainforests is its natural habitat. Without shade, young trees will wither and dry. Productive trees benefit from the more balanced microclimate, the increased water retention and nutrients contained in the leaf fall of deeper rooted shade trees. Shaded systems need less nutrient input, as there is less erosion, leaching and volatilisation. Shadeless systems don't do well without regular external inputs.

However, a shade cover that exceeds 60% results in a decline in productivity. The extent of this decline depends on management (pruning, tree density, weeding) and shade tree quality. A recent study in non-certified Indonesian cacao agroforestry by Clough et al. (2011) revealed that the density of tall trees, including of trees that remained from previous forest cover have only little effect on productivity. For smallholder farmers that have limited access to, cannot afford, or have difficulty handling fertilisers, pesticides and herbicides, a shade cover of 40-60% by a variety of tall native tree species is considered optimal for yields, biodiversity and sustainability in cacao agroforestry.

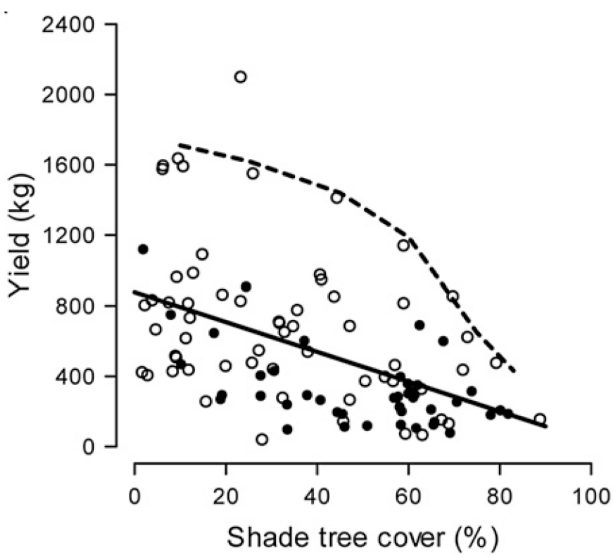

Figure 1: The relationship between shade cover (%) and productivity (Yield) in non-certified Indonesian cacao agroforestry by Clough et al. 2011. The solid line gives the statistical linear relation between shade cover and yield, the broken line gives the relation between shade cover and maximum observed yield. The study shows that yields of 1000 kg/ha are possible with 40-50% shade cover.

3.1.2 Natural habitats, buffer zones and corridors

The nearby presence of natural habitats is important for the conservation of biodiversity in cacao agroforestry systems. Particularly the diversity and presence of mammals in cacao plantations decreases with increasing distance from natural forests (Weist et al. 2010; Faria et al. 2006, 2007), which to a lesser extent has been found for birds and pollinating insects as well (Clough et al. 2010; Klein et al. 2003). This underlines the importance of conservation efforts at the landscape level.

Besides the conservation of biodiversity within the agroforestry systems, shaded cacao agroforestry is a proven tool for biodiversity conservation at the landscape level. Agroforests with intercropped taller tree species and remnants of forest cover can form corridors between fragments of natural rainforests (Faria et al. 2006; Harvey et al. 2006). Habitat fragmentation is a primary driver of local extinction, especially for larger animals such as mammals and birds. Most animals prefer to move around sheltered by dense vegetation. Establishing buffer zones, corridors, for example alongside streams is an excellent measure that allows the animals to migrate. Cacao agroforestry systems with multi-layered shade canopies can make up valuable buffer zones around protected nature reserves, thus increasing the stability of rainforest margins.

3.1.3 Natural control of pest insects

Insects provide several key functions in tropical (agro)ecosystems. Different insect species are known to feed on cacao trees, but even more species are their natural enemies (Entwistle 1972). The balance between pest insects and their natural enemies depends on habitat heterogeneity. Monocultures of cacao trees harbour relatively more pest insects and fewer natural enemies ("prey" and "predators" in Klein et al. 2002), which increases the chance of pest outbreaks. For example, the reduction of shade was the main cause for the African capsid to become a economical pest in cocoa in Ghana (Flood et al. 2004). Furthermore, insects are an important food resource for animals with conservation priority higher up the food-chain (Solé et al. 2009, Van Bael et al. 2007a). Heterogeneity is provided through a variety of shade trees, but also through the presence of buffer zones and/or conservation areas preferably alongside streams, as the continuous presence of water is important too for the natural balance in the field.

Cacao varieties can differ in production and flavour characteristics but also in tolerance/resistance to pest and diseases, and shade. New varieties are bred for quick and high production that must be sustained through the use of external inputs. This breeding goal is usually to the detriment of the plant's resistance to capsids, swollen shoot and black pod disease. There is a valid argument that resilient cocoa agroforestry systems should not be planted with a single variety. Farmers that have a certain variety of cocoa in their fields should be encouraged to maintain this variety.

3.1.4 Carbon storage & sequestration

Agroforestry is an acknowledged means of climate change mitigation. Cacao agroforestry systems contain 10 to 100 times as much carbon per hectare than arable land. Shaded cacao agroforestry contains up to 10 times as much carbon (up to 250 t/ha) compared to unshaded (20 t/ha) cacao agroforestry (Verchot et al. 2007; Bos et al. 2011).
Payments for this service will be discussed and applied in a separate project on carbon bundling, but cannot be seen independent from the other ecosystem services related to cacao agroforestry in which shade trees play a critical role.

3.1.5 Food security & income diversification

A biodiverse agroforestry system with intercropped fruit trees, timber trees and products such as cocoyam and vanilla can provide food, fuel and construction material, as well as a diversified income. Non-cocoa products from cacao agroforestry can make up over 40% of farmer's income (Gockowski et al. 2004) and include banana, small livestock, bush meat, palm oil, cassava, honey, avocado, citrus, mango, timber, pepper, vanilla and other spices, traditional medicines, and many others. Besides effects like feeding the family throughout the year with a diversity of foods, sustaining their health, this is an important resource for smallholder farmers. Traditionally Cocoa Boards and input suppliers promote mono-cropping. Nowadays, with the interest in sustainability, climate change and food security, resilience and total system productivity is more appreciated. Farmers need encouragement to provide this ecosystem service for themselves.
For fruit crops, crop pollination is a key ecosystem service. Pollination is carried out by insects that can be cultivated (honey bees) or by wild species. Also the cacao tree needs to be pollinated in order to produce fruits, but the small flowers are only pollinated by naturally occurring tiny midges (Entwistle 1972). Intercropped fruit crops are primarily pollinated by insects such as bees that naturally occur in the agroecosystem and its surroundings (Hoehn et al. 2008). The occurrence of pollinating insects in cacao

agroforestry depends on habitat quality (nesting sites, food resources) within the agroforestry system as well as habitat quality in the immediate surroundings.

3.1.6 Water quality and quantity

Shaded cacao agroforestry has a higher water-holding capacity in that shade trees retain rainfall, thereby reducing the run-off of water and loss of nutrients over the soil surface (Dietz et al. 2006). Moreover, soils under agroforestry undergo no tillage, which leads to increased soil organic matter contents (Verchot et al. 2007). On average, shaded agroforestry systems have an organic matter input of 5-10 tonnes of biomass per hectare through litterfall (Beer 1988), which helps building up high organic matter contents in soils that in turn lead to a higher water holding capacity of soils and less drought stress for the cocoa trees.

Shaded agroforestry can result in less use of agrochemicals. For example, shade reduces weed growth which leads to less usage of herbicides, as has been observed for the use of herbicides in Ghanaian cacao agroforestry systems. Herbicides like atrazine are found in drinking water (Samual Sey, pers comm.) Agroforestry can be used as an environmental buffer around important water bodies in order to preserve drinking water quality. Non-cocoa buffer zones alongside streams in the farms avoid runoff in the water bodies that in the end provide drinking water to urban centres.

In the humid tropics, trees play a crucial role in cloud formation and rainfall. Hence, deforestation affects the regional climate in that fluctuations in rainfall are changed. Some regions suffer from increasing drought, whereas others suffer from sharper fluctuations between wet and dry periods. Whether agroforestry in general and shaded cacao agroforestry in particular mitigate the adverse effects of deforestation remains unknown, although results by Falk et al. (2005) indicate meteorological effects from cacao agroforestry that may mitigate effects from deforestation.

3.1.7 Soil protection and soil quality

Agroforestry is a good and widely applied method of soil protection through soil stabilisation, particularly in mountainous regions. There is no or limited soil tillage by the farmer, which makes soils resilient against erosion, and the thick and deep roots of trees stabilize a soil which further reduces run-off and even the risk of landslides. This makes agroforestry a particularly valuable tool in adaptation to climate change in the humid tropics (Verchot et al. 2007).

Soil fertility is another important aspect of soil quality. Without external inputs, all cacao systems have a negative mineral balance (Hertemink 2005). For most smallholder cacao farmers, a lack of financial means to acquire external inputs leads to a gradual decline in output (yields, leaching, run-off). The lack of shade trees speeds up this process of soil degradation. The loss of soil fertility is the most important factor that causes farmers to abandon cacao plantations. Mostly, it is cheaper for cacao farmers to expand into rainforest than to invest in fertilizers (Ruf 1990). Shaded farms live longer.

Shade management affects the mineral balance in that shade trees protect soils against run-off (the loss of minerals by rainfall). Moreover, shade trees can take up nutrients that are leached to deeper soil layers and release them through litter fall. Although shade trees cannot fully replace external inputs (composts, manure, fertilizers), it reduces the need for them. Some shade trees (family Leguminosae) are able to fix atmospheric nitrogen and release up to 70 kg N/ha/year (Anhar 2005) in addition to the 5-10 tonnes of organic matter/ha/yr that is released through litter fall (Beer 1988).

The relation between shade trees and soil quality should be an important factor for farmers to decide which tree to preserve, and which to cut. Although detailed scientific information is not available, in most cocoa producing countries various organisations can advise on which shade tree species fit best to the local circumstances in relation to the nutrient cycle, root depth, canopy height and canopy density.

3.2 How can ES in cocoa farming be measured?

3.2.1 Indicators for ecosystem services

Ecosystem services can be quantified using a system of indicators based on the relations between biodiversity and ecosystem services. There are three different means of quantifying ecosystem services:

1. Quantifying the ecosystem products (for example fruits, drinking water, total species richness or that of “flagship” species, soil fertility, etc.)
2. Quantifying the ecosystem processes (for example pest predation, crop pollination, water filtration, carbon sequestration, etc.)
3. Quantifying the indicators (for example shade trees, presence of ponds and streamlets, % natural habitat, use of pesticides, etc.)

The biodiversity of species (animals, plants, fungi, bacteria) that are involved in tropical ecosystem services is immense. Analysing these ecosystem aspects is often complex and expensive, particularly in areas with poor infrastructure and low analysing capacity. In search for rapid assessments of ecosystem services, research has been focussed on using *indicators* for ecosystem services.

Indicators for ecosystem services can be biodiversity indicators (species richness or presence/absence of certain groups), management indicators and landscape indicators. The relation between indicators and the ecosystem services must have a scientific basis. By using a single indicator or a combination of some indicators, assessments can be cheaper and easier to carry out with local capacities.

In the table 3 we present some of the known indicators for each of the ecosystem services given in the chapter 3.1. The table illustrates that trees are good indicators for different ecosystem services. Only few of the existing certification schemes includes more than one of these indicators (annex V).

In the next paragraph an example is given on how landscape indicators were used for quantifying ecosystem services in cocoa.

Table 3: Biodiversity indicators, management indicators and landscape indicators for ecosystem services.

		Soil protection and quality	Natural control of pests and diseases	Water quality and quantity	Food security & income diversification	Biodiversity conservation	Natural habitats, buffer zones and corridors	Carbon storage & sequestration
Biodiversity Indicators	Mammals				Weak	Positive		
	Birds		Weak			Positive		
	Amphibians/reptiles					Positive		
	Insects		Positive		Positive	Positive		
	Trees	Positive	Weak	Positive	Positive	Positive	Positive	Positive
	Other plants	Positive			Weak	Positive		
	Soil fauna	Positive				Positive		
Management indicators	Shade thinning	Negative	Weak	Negative	Negative	Negative	Negative	Negative
	Shade tree density	Positive	Weak	Positive	Positive	Positive	Positive	Positive
	Shade tree planting	Positive	Weak			Positive	Positive	
	Intercropping (fruit, timber, etc)	Positive	Weak	Positive	Positive	Positive	Positive	Positive
	Leaf litter removal	Negative				Negative		Negative
	Weeding	Negative				Negative		
	Pesticide use	Weak	Negative	Negative		Negative		
Landscape indicators	Fruit & timber trees for shade			Positive		Positive	Positive	
	Local/endemic trees for shade			Positive	Positive	Positive	Weak	Positive
	Forest remnants for shade			Positive		Positive	Positive	Positive
	Legume trees for shade	Positive				Weak		Positive
	Ponds & streamlets	Positive				Weak		Positive
	Use of compost/manure	Positive						Positive
	Buffer zone around water bodies			Positive		Positive	Positive	

(blank) = No expected indication
(green) = Positive indication
(yellow/orange) = Weak positive or negative indication
(red) = Negative indication

3.2.2 Quantifying ecosystem services, an example from DR Congo[11]:

In the North Kivu province in eastern DR Congo, cocoa exports are sharply increasing. Most cocoa beans are locally bought by the ESCO Kivu Sprl. The ESCO management is seeking means for increasing the productivity of cacao agroforestry and incomes for farmers. The first step was to comply with sustainable production standards, such as Rainforest Alliance and UTZ Certified. By 2010, 5,000 smallholder farmers were certified. These farmers attended training programmes on management aspects of growing cacao

11 Source: Bos M.M., Luske B., Bodnar F., de Beule, H. 2011. Field observations on shade management and carbon stocks in cacao agroforestry in North Kivu, Democratic Republic of Congo. Agro Eco-Louis Bolk Institute 2011-009Int.

trees, such as planting, fertilizing, shade management and the fermentation of beans. In total, over 50 field officers and farmer trainers are involved in this programme.

In 2010, the Agro Eco - Louis Bolk Institute set up a rapid assessment mechanism of shade tree stands and quality to be carried out by ESCO field officers. Based on the literature, the assumption was that shade tree stands promote biodiversity conservation. The question was whether the rapid assessments could be used to quantify the ecosystem service of carbon storage as well.
First, an inventory of different categories of shade management was carried out with all field officers. Secondly, tree density, shade composition and tree biomass were quantified in randomly selected “benchmark sites” of 100 cacao agroforests, 60 other forms of agricultural land use and 50 natural forests (distributed in a region the size of the Netherlands and Belgium together!). A methodology was used that is recommended by the UNFCCC to quantify carbon stocks in tropical agroforestry. Simple tools were used by the ESCO field officers in a quick scan for visual scoring, like the graph below.12

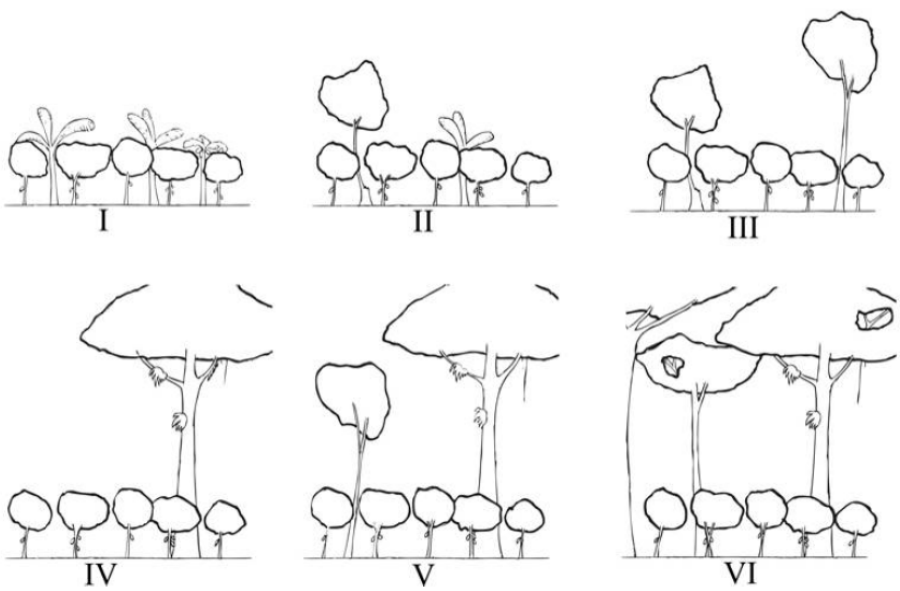

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Figure 2: Schematic representation of the six categories of shade tree management in cacao plantations.

I – Scarce, heavily pruned (for fuel wood) shade trees;
II – Various young, heavily pruned (for fuel wood) shade trees;
III – Young pruned as well as intact shade trees;
IV – Large, intact shade trees that remain from previous rainforest cover;
V – Large, intact shade trees that remain from previous rainforest cover, as well as smaller shade trees;
VI – Dense shade tree stands that remain from previous rainforest cover.

From 2010, benchmark sites of cacao agroforestry, other forms of land use and forest sites, the tree density and tree composition were quantified, and subsequently linked to carbon content.

Table 4: Six categories of shade tree management and their carbon content.

Trees per hectare	**Cacao I**	**Cacao II**	**Cacao III**	**Cacao IV**	**Cacao V**	**Other agric. use**	**Forest**
Cacao trees	570	450	562	400	358	0	0
Fruit trees	10	9	82	20	27	24	2
Fuel wood	100	103	272	183	171	218	674
Construction wood	53	59	124	132,8	50	35	240
Large trees (>100cm circumference at breast height)	16	25	26	29	49	24	112
Carbon content trees (tons C/ha)							
Total	26	56	61	63	96	47	267
Cacao trees	7	8	7	4	7	0	0
Large trees (>100cm circumference at breast height)	18	34	33	39	75	30	209

Result

Most plantations had shade category II, none had shade-category VI. The categorization of shade tree stands was reflected by actual densities of large shade trees. Most shade trees were categorized as “fuel wood”, leaving a potential for planting shade trees for timber and fruit production. The densities of large trees were in turn reflected in the ecosystem service “carbon storage” with on average 26 tons C/ha in shade-category I and 96 tons of C/ha in shade category V.

From this exercise it can be concluded that rapid assessments (“quick scans”) of shade tree stands in cacao agroforestry can be carried out by a network of local field officers, even in poorly structured regions like eastern DR Congo. These quick scans in combination with benchmark (“control”) sites are a fast and efficient alternative to full scale inventories.

A payment & control mechanism can be set up that rewards the farmers who perform better related to ecosystem services. That payment could have 3 levels: no price for shade-category I, the highest price for shade categories V-VI, and an intermediate price for shade-categories II-IV. A buyer like ESCO could be the vehicle for both the scoring and the pay-out. One way to proceed is to look at linking any PES to existing/emerging certification schemes.

3.3 Conclusions

- Biodiversity in cacao agroforestry can be extremely high, almost comparable with that of nearby rainforests. But the composition and density of shade trees matter. The current trend to remove old and diverse shade tree stands leads to biodiversity losses that are as drastic as the decline following deforestation.
- The biodiversity preserved in shaded cacao agroforestry provides several valuable ecosystem services that are important for:
    - Sustainable cocoa production in current production areas (no more need for expansion of production into pristine forests);
    - Biodiversity conservation *within* and *surrounding* the agroforestry systems;
    - Water protection;
    - Carbon storage.
- Shaded cocoa systems depend less on (expensive) external inputs, but still need attention for soil fertility.
- In most smallholder cocoa production, with current yield levels, there is scope for increase of shade while at the same time increasing cocoa production, when the right management practices are implemented.
- As biodiversity assessments are complicated and biodiversity is directly related to the shade tree stand, we recommend using a set management and landscape indicators that are rapidly assessable by local field staff:
    - Management indicators (number of shade trees / ha; Number of local tree species / ha; Basal area; Recycling organic waste for soil fertility management; Usage of pesticides)
    - Landscape indicators (Presence of ponds and streamlets; Other (non-productive) landscape elements)
- The relation between shade management and productivity is complex and depends on soil fertility and management practices. Scientific studies in non-certified smallholder agroforestry systems show that the optimum for sustainable productivity and biodiversity is between 40% and 60% shade cover. <u>In order to maintain optimal productivity under this level of shade, farmers must be trained in *best agroforestry practices* such as pruning, planting and soil fertility management.</u>
- None of the existing certification schemes (UTZ certified, Rainforest Alliance, Organic, FairTrade) includes all of the above mentioned management and landscape indicators. A set of “biodiversity-friendly” agroforestry practices based on these indicators can be a PES *add-on* to existing certification schemes.

4 FINANCIAL MECHANISMS

4.1 What financial mechanisms are potentially available?

Cocoa farmers providing ES should be financially rewarded for their efforts. But what financial mechanisms are most suitable to reward cocoa farmers on a structural base? Basically, three financial mechanisms can be distinguished:

1. linking PES to existing certification schemes
2. generating biodiversity credits
3. creating a fund for ES

In addition, a combination of the three systems might be possible.

Sub 1. Linking PES to existing certification schemes
Currently, most certification schemes for cocoa, such as UTZ Certified, Rainforest Alliance, Organic and Fairtrade already address biodiversity and cover one or more of the following themes: shade management, management of conservation areas and protection of natural habitats (see also Annex V). However, none of these schemes have developed a comprehensive view on PES. Rainforest Alliance seems most advanced, as they have developed a separate standard on Ecosystem Conservation, covering at least the themes mentioned above. However, the schemes do not require that e.g. 5% of the farm land should be taken out of production for the creation of buffer zones, but rather focus on not using chemical products in natural areas. Furthermore, the issue of carbon fixation is absent in all schemes and none of the schemes pay additional premiums to farmers for providing ES.

In the first place, an integrated PES approach can be linked to such existing certification schemes. This can become an extra premium (PES premium) as an add-on to the existing certification premiums. Some PES criteria for this add-on premium can be taken from the existing certification schemes (especially the Rainforest Alliance criteria), other criteria will need to be optimized or developed. In this way, the supply chain pays the PES premium. In general, the cocoa buyer organizes the control system and assures payment of the premium to the farmers that provide the ecosystem services.

In the second place, this PES module can also be used as a stand-alone module, also certifiable, but independent of the existing schemes.

Therefore, basically, two methods can be distinguished:

A. PES as an optional (voluntary) module as add-on in existing certification schemes:

- certification to either UTZ, Rainforest Alliance, Organic and/or Fairtrade is in place
- additional PES criteria are developed in the form of an add-on module to which already certified cocoa farmers could comply

B. PES as an independent module:

- certification to either UTZ, Rainforest Alliance, Organic and/or Fairtrade is not in place
- an independent PES module is developed allowing for certification to this module alone (and thus for payments of ecosystem services alone).

Sub 2. Generating biodiversity credits

A new type of system can be developed based on tradable (voluntary) 'biodiversity credits', similar to (the already existing) trade in carbon credits. The system will be based on the principle of green electricity, in which traceability is no longer required and the cocoa is not segregated throughout the supply chain. A control (coordinating) organization needs to be in place that allocates biodiversity credits to farmers that meet certain criteria. This organization quantifies, controls and sells the credits to various market parties on behalf of the cocoa farmers.

Sub 3. Creating a fund for ES

A fund, financed by various (market) parties, can be created for developing biodiversity friendly projects and/or for rewarding farmers that participate in these projects. The fund is coordinated by a (local) organization that quantifies and controls the ES. The fund can be used to support individual farmers that provide the services (for example as premium on the cocoa price), and/or to support groups of farmers. In the latter case, focused efforts can be made in specific areas, where high biodiversity gains are to be expected, such as rainforest margins and landscapes with habitat fragmentation. Also neglected (cocoa) fields offer great potential for biodiversity gains. Here an increase in biodiversity may go hand in hand with a higher productivity.

In Annex VI, the results of expert interviews with various stakeholders[13] of the cocoa supply chain are presented. The advantages and disadvantages of the proposed financial mechanisms brought forward by these parties have been evaluated based on the following criteria:

- expected income improvement for cocoa farmers;
- expected biodiversity gains;
- economic viability;
- inclusiveness for all (cocoa) farmers;
- visibility of the PES efforts (physical segregation);
- finance (who pays for the PES premiums/efforts);
- public/private support.

In the next paragraphs, the criteria will be discussed separately. This is followed by conclusions on the most suitable financial mechanism(s) in the final paragraph of this chapter.

4.2 Income improvement

Financially rewarding cocoa farmers for providing ES is a way of generating a better farm income. Consequently, if cocoa farmers enjoy better incomes, they will be stimulated to remain cocoa farmers (and not leave the cocoa fields in search for a better life in the city) and/or are less likely to convert to other cash crops. Additionally, if cocoa farming becomes an attractive

13 The following stakeholders and/or persons have been addressed and provided input: Alex Bruijnis (EL&I), Lucie Wassink (EL&I), Jetske Bouma (IVM/VU), Julia Jawtusch (FIBL), Daniele Giovannucci (COSA), Baerbel Weiligmann (Rabobank Foundation), Gijs Verbraak (Tropical Commodity Coalition), Willy Douma (HIVOS), John van Duursen (HIVOS), Rodney Nikkels (Just-Green), Yaw Osei Owusu (Conservation Alliance, Ghana), Peter van Grinsven (Mars), Jean Marie van Logtestijn (Baronie), Ton Baas (VBZ), Daan de Vries (UTZ Certified).

business, it might trigger abandoned farms to be replanted. Eventually, these developments will contribute to securing and preferably, enlarging cocoa future supplies. The latter is of concern to the cocoa industry, as global demand for cocoa is presently higher than supply and still rising, while expansion by cutting down rainforest is stigmatized or no longer possible for lack of remaining rainforests.

Paying farmers a correct price for their ES is crucial. This PES premium should trigger cocoa farmers to preserve and/or develop (more) ES on a long term base. If the premium is too low, it will not work as an incentive for maintaining/developing ES. On the other hand, if the premium is too high, it might lead to a short term incentive only, creating dependency on external financial inputs for preserving and/or developing ES (Jetske Bouma, IVM/VU). In addition however, it is not only the height of the premium which is relevant. In calculating the net gains in income, other costs and benefits from implementing ES should also be taken into account. These include certification costs, additional costs for compliance with the ES-criteria (such as taking e.g. 5% of the land out of production for the creation of buffer zones or the planting and/or not felling of trees), additional income from trees that provide food, timber and/or fuel, and cost savings (such as the lower use of agrochemicals) and/or higher yields as a result of best management practices (see also Annex IV: A case-study in Ghana: The costs of PES).

It is important to note that many perceive that the presence of shade trees reduces yields. However, the relation between shade management and productivity is often positive, especially in the case of smallholders, whereby the optimum for productivity and biodiversity is between 40% and 60% shade cover. The yields largely depend on whether farmers apply best management practices and have received training and the right inputs to do that (see also chapter 3.1.1).

When comparing the financial mechanisms, linking to certification schemes in which a voluntary add-on PES module is developed (option A) seems to offer most advantages with regard to income improvement: potentially over a longer period of time cocoa farmers receive an additional PES premium, which is easily transferred to them (PES payments are combined with the sales of the cocoa beans). In addition, the farmers are trained and will benefit from implementing best management practices. Furthermore, market premiums for certified cocoa are currently quite secure, as demand for cocoa exceeds supply (Mars/Peter van Grinsven). However, the PES premium may be comparatively low[14] and may not stimulate farmers to implement the desired ES. A PES fund also offers various advantages, however quick benefits (transfers of PES premiums) are not always in place (if the payment is not combined with the sales of cocoa beans). Apart from a fair remuneration system, trading in biodiversity credits mainly offers disadvantages with regard to income improvement: no quick transfers of PES premiums, no scope for structural income improvements and farmers depend on the efforts of others (the control organization) for returns on their PES efforts.

[14] This will be further researched in phase 1B of this initiative: analysis of the willingness to pay.

4.3 Biodiversity gains

Biodiversity can be maintained (preserved), restored and enhanced. The most benefits are to be expected in sensitive regions such as biodiversity hotspots, margins of rainforest reserves, landscapes with habitat fragmentation and neglected (cocoa) farms. Financial mechanisms that (structurally) allow for concentrating PES efforts in these regions obviously offer a higher scope for biodiversity gains than mechanisms that are limited to existing (and certified) cocoa fields. Certified cocoa fields are not necessarily located in biodiversity hotspots. Caution, however, should be taken, that the mechanism does not lead to a situation in which the financial benefits are at the expense of biodiversity gains (e.g. when new cocoa activities expand into virgin forests).

Especially with regard to neglected (cocoa) farms, additional benefits are to be expected. As already mentioned above, the relationship between cocoa productivity and biodiversity gains highly depends on the ability of farmers to apply best management practices. In other words, cocoa farmers are only likely to invest in ES when they expect an increase in yield. At the same time, if decreases in yields on existing cocoa fields occur, net biodiversity gains are put at risk: in order to continue to meet global demand, more (virgin) land is required to grow the same amount of cocoa beans. This so called ‘leakage’ can be minimized when starting biodiversity friendly cocoa activities on neglected (cocoa) fields. In this way, additional biodiversity benefits and a higher productivity can be obtained without competing with virgin/biodiversity-rich land.

All financial mechanisms but certification schemes in which a voluntary add-on PES module is developed (option A), allow for concentrating efforts in sensitive regions and/or neglected (cocoa) fields. In addition, PES funds may offer relatively long-term benefits with regard to biodiversity, as projects are usually funded for a number of years.

Presently, the number of certified cocoa farmers grows exponentially (especially under UTZ and Rainforest Alliance certification), pushing certified cocoa from a niche into a mainstream market (Mars/Peter van Grinsven). Correspondingly, the scope for biodiversity gains and income improvement under certified farmers also increases.

4.4 Economic viability

Aspects influencing the economic viability of financial mechanisms include (transaction) costs related to the development, maintenance, verification and, if applicable, certification of the system. With regard to biodiversity credits, a system for valuating and quantifying the credits also needs to be in place. In addition, the costs for compliance with the ES-criteria should also be calculated (see also Annex IV). Potential benefits include income improvements through PES payments, additional income from trees that provide food, timber and/or fuel, and cost savings (such as the lower use of agrochemicals) and/or higher yields as a result of best management practices. The economic viability is also influenced by factors such as the availability of existing marketing and distribution channels and the physical segregation of PES (certified) cocoa. Again, the complicated relationship between ES (shade management) and farm income plays a role and cocoa farmers are only likely to convert to more biodiversity friendly systems if they see (short term) benefits.
Financial mechanisms with low transaction costs generally score better in terms of economic viability. Independent of the financial mechanism, transaction costs can also be reduced e.g. by

implementing Internal Control Systems (group certification) and/or by a community based approach (COSA/Daniele Giovannucci).

Certification schemes in which a voluntary add-on PES module is developed (option A) and PES funds score best in terms of low costs. The former, as existing infrastructures and audits can be used; the latter basically because less costs for criteria development and thus verification and certification are involved. However, certified cocoa is segregated throughout the supply chain serving a niche market, which increases costs for marketing and distribution. In this regard, trade in biodiversity credits seems more attractive as mainstream marketing channels are used.

4.5 Inclusiveness

The accessibility of PES mechanisms increases if the mechanism is not limited to a certain (well-defined) group of farmers. It also increases with low entry level requirements (no, few or less stringent social, environmental and or PES requirements). The more farmers can join, the higher the scope for income improvements and biodiversity gains. In the case of cocoa farming, it is also interesting to specifically address the (unorganized) small holder cocoa farmers, which is around 90% of all cocoa farmers. In general, joining certification schemes is challenging for them.

A way to trigger certified cocoa small holders to also certify against the add-on PES module, is to fully integrate PES criteria into existing schemes (by ‘improving’ the existing criteria). In this way, the extra efforts farmers have to make are reduced to a minimum. However, when fully integrating PES criteria into the existing programmes, PES efforts will not be visible and similarly, not lead to higher premiums (as the market is not prepared to pay for ‘invisible efforts’)(UTZ Certified/Daan de Vries).

All financial mechanisms but certification schemes in which a voluntary add-on PES module is developed (option A), allow all farmers, both certified and non-certified and farmers that grow other crops but may be willing to convert to sustainable cocoa production, to join. This increases both the scope for income improvement and biodiversity gains. Certification schemes and PES funds are generally also more accessible to cocoa small holders, as the farmers directly participate in the system: the certification scheme and PES project respectively.

4.6 Visibility

The aspect of visibility is of importance with regard to communicating sustainability claims on product level. When marketing products, these claims often justify higher retail prices. In this way, eventually the consumer pays for the PES premiums. However, in order to communicate certain claims on product level, the PES (certified) cocoa needs to be segregated throughout the supply chain, which is costly.

Communicating PES efforts on product level is a possibility both in certification schemes and in case of PES funds. With regard to certification schemes, the physical segregation of cocoa throughout the supply chain is a certification requirement. With regard to PES funds, a physical segregation might be in place in case of direct trade relations between the farmer groups and buyer.

4.7 Finance

Who is willing to pay for the biodiversity efforts made by the cocoa farmers? Is it the supply chain alone, or are also other public and private stakeholders willing to pay? With regard to certification schemes, the supply chain pays the PES premium. This premium is presently quite secured, as demand for cocoa is higher than supply. In addition, the supply chain has largely committed itself to buying certified cocoa. In the case of trade in biodiversity credits and a fund for PES projects, more (both public and private) stakeholders are willing to pay, broadening the base for PES payments.

In case of certification schemes, the supply chain bears the extra costs for the PES premium, solving the question of finance. However, PES premiums are expected to be low and it is uncertain whether they will lead to the desired PES efforts of farmers. Compared to certification schemes, the trade in biodiversity credits and a PES fund may offer a broader base for finance as also other public and private stakeholders can be approached to financially contribute. However, in these mechanisms other issues play a role, such as the question of pre-finance and the absence of long-term commitments respectively.

4.8 Public/Private support

The concept of PES is still quite new in the market. On the other hand, certification schemes such as UTZ Certified, Rainforest Alliance, Organic and Fairtrade are already widely known and accepted and have created their own (niche) markets.

However, in case biodiversity friendly production does not contribute to higher future supplies, parties in the supply chain may be less willing to support this system, as supply is already a major problem. In that case, most support can be expected for cocoa production on currently degraded/abandoned lands or for systems that support farmers' training in best management practices. This will be further analysed in phase 1B of this project.

Certification schemes already enjoy commitments from large chocolate manufacturers and other supply chain players. PES as a concept alone is not yet known in the market, so additional efforts need to be made to market this concept.

4.9 Conclusions

With regard to the themes discussed above, linking with certification schemes (with an add-on PES module) combined with the creation of a PES fund seems to offer most potential as a financial mechanism. If ways are developed in which biodiversity friendly cocoa production could be directed into neglected (cocoa) fields, biodiversity gains are optimized without putting cocoa future supplies at risk.

Certification schemes with an add-on PES module offer advantages with regard to the scope for income improvement, economic viability, visibility and public/private support. The great advantage of certification schemes is the fact that the system already exists and that the intended financial mechanism can benefit from existing control and audit infrastructures and public/private support (such as commitments of large chocolate manufacturers). Another important advantage of certification schemes is the fact that farmers receive training in best management practices, which could substantially increase their yields (and thus income).
With regard to public/private support, the current commitments could be even better secured in case PES efforts (shade management) do not form a threat to cocoa future supplies. Apart from farmers' training, incentives could be developed to start biodiversity friendly cocoa activities on neglected (cocoa) fields. This also creates opportunities for farmers that presently grow other cash crops, to step into the cocoa business. In this way, a win-win situation is created: additional biodiversity benefits can be combined with higher/new cocoa harvests without competing for virgin land. In short, developing incentives for directing ES into neglected (cocoa) fields would be an asset for any financial mechanism. This is an important research question for the pilot testing phase (phase B).
At the same time however, with regard to biodiversity gains, certification schemes are limited to already certified cocoa fields. These fields are not necessarily located in sensitive regions where the highest biodiversity gains can be realized. In theory, this could be solved by allowing certification to the PES module alone, thereby also increasing opportunities to start biodiversity friendly cocoa farming on neglected lands. However, a single PES certification would disproportionately increase verification and certification costs. This is therefore not considered feasible.

Another challenge of certification schemes might be the question of finance: although the supply chain pays for the PES premiums and the payment of price premiums for cocoa is presently secured (demand is higher than supply and supply chain has largely committed itself to buying certified cocoa), it is questionable whether the PES premiums can become high enough to stimulate farmers to implement the desired PES efforts. In this regard, the financial base for PES investments could be broadened by creating a fund for PES projects/activities. Hereby, the advantages of both mechanisms are complementary: apart from offering a more secure base for financing PES efforts (in addition to the supply chain, other public and private stakeholders can pay), PES funds are inclusive (all farmers, certified and non-certified cocoa farmers and farmers that currently produce other crops but who may be willing to convert to (sustainable) cocoa production can join), offering great potential for biodiversity gains, both in sensitive regions and on abandoned/degraded (cocoa) fields. A PES fund alone could potentially suffer from a lack of public/private support, as the concept is not yet widely known and accepted. If combined with certification schemes, it can benefit from the commitments of the chocolate sector towards certification. In addition, the costs for verification and certification can be kept low, as existing audit and control infrastructures can be used.

Both certification schemes and PES funds also offer advantages with regard to small farmer inclusiveness and long term commitments as the farmers directly participate and are structurally involved in the financial mechanism: i.e. the certification scheme and PES project respectively.

A system of trading in biodiversity credits is not considered feasible (if exclusively related to cocoa), at least not in the short run. First of all, biodiversity credits do not yet exist, so a complete new system/methodology needs to be developed, also with regard to measuring (quantifying) and valuating biodiversity credits. This is costly and needs time. However, lessons could be learnt from the trade in carbon credits e.g. in coffee and, the Cam(bio)2 project[15], the first experience in valuating and quantifying ES (claims with regard to water and carbon) in (organic) agriculture. In the Cam(bio)2 project, a fund is combined with the sales of (carbon/water) credits to (Spanish) consumers who wish to compensate for their climate impact. If, in the near future, a framework for biodiversity credits is considered, it should not be geared at cocoa production alone. It is a potentially interesting concept for all kinds of production processes (e.g. agriculture, aquaculture, forestry, tourism). Such an initiative should therefore be taken in a much wider context.

Secondly, a system of trading in biodiversity credits is not a system of its own, but depends on the availability of (accredited) ES from certified PES farms and/or (funded) PES projects. Therefore, a system of biodiversity credits would always have to be linked to either a certification scheme or a PES fund. In the latter case, a fund could also solve the question of pre-finance and finance investments before the ES are actually delivered. Eventually, however, if a framework for biodiversity credits is in place, it allows for additional income generation to cocoa farmers who have either joined a certification scheme or a PES project.
Other bottlenecks of trading in biodiversity credits include the fact that farmers depend on the efforts of others (a control organization) for returns on their PES efforts. In addition, no structural improvements are to be expected in the field of income and biodiversity gains, as the PES payments will depend on single deals.

15 Cam(Bio)2 is a fund that is currently financing the startup of the Standard and Seal for the accreditation of Environmental Service payments. The Cam(bio)2 Standard determines and accredits the Environmental Services that are generated by organized organic farmer groups of sugarcane, vegetable, coffee, cacao and banana growers in four regions of Costa Rica. Cam(bio)2 certifies organic farms that: reduce emissions of greenhouse gases from the soil, are more efficient in their energy usage, have stored carbon in soil and biomass and conserve bio-diversity. In the years 2008-2010 pilot tests on the model have been carried out in two regions of Costa Rica: Jaris de Mora and Talamanca. Currently a process of negotiation with Civil Society and Private Enterprise is initiated in developing countries, for installing Environmental Services and financing strategies for mitigation in regions with ecological production. At the same time, Cam(bio)2 is approaching businesses and organizations (in Spain) interested in mitigating their climate impact, by buying ES credits. (www.cambio2.org).

5 OVERALL CONCLUSIONS AND RECOMMENDATIONS

5.1 Overall conclusions

As described in chapter 1, phase A1 of this project had the objective to identify:

- ecosystem services related to cocoa production;
- means to measure/valuate these ecosystem services;
- the most suitable financial mechanism(s) to pay for these ecosystem services.

Chapter 3 of this report shows that several ecosystem services can be related to cocoa production. The interests in these ecosystem services have different scales. Some have direct local benefit for farmers (e.g., soil fertility), others have regional benefits (e.g., clean and sufficient drinking water). Most of the ecosystem services have global benefits. For example, biodiversity conservation and carbon sequestration are of global interest, and soil fertility contributes to permanent production in current production areas to avoid expansion into pristine forests. The most important global benefits from the conservation of ecosystem services that are related to cocoa production are:

- avoiding further deforestation as a result of agroforestry expansion (permanent production in current production areas);
- maintaining and enhancing biodiversity, also surrounding curent production areas (general biodiversity, biodiversity hotspots, corridors, bufferzones);
- carbon sequestration (in soils and trees);
- waterregulation (avoiding erosion, preserving clean and sufficient drinking water).

Chapter 3 also describes how these ecosystem services are related to agroforestry management. The presence of shade trees positively contributes to, for example, biodiversity conservation (including possibilities to establish buffers around – or corridors between – nature reserves), carbon storage and sequestration, income diversification and water quality and quantity.

In chapter 3 we used scientific literature to identify a set of management and landscape indicators that can be used in *quick* scans by local field officers to assess the suitability of agroforestry systems for certain ecosystem services.

Management indicators:

- Number of shade trees / ha
- Number of local tree species / ha
- Basal area
- Recycling organic waste for soil fertility management
- Usage of pesticides

Landscape indicators:

- Presence of ponds and streamlets
- Other (non-productive) landscape elements

For shade management, a recent study in Indonesiaregarding small-scale cocoa production showed that a shade cover of 40% to 60% is ideal for biodiversity and productivity. In order to reach satisfying productivity in such systems, involved farmers should attend training in good agricultural practices, such as pest management, soil fertility management and tree pruning.

Only few of the above mentioned indicators are part of existing certification schemes (Annex V). None of the existing certification schemes includes all. Thus, this set of indicators can be a valuable “add on” to existing certification (UTZ, Rainforest Alliance, Organic).

Chapter 2 presents methods of how environmental services can be valuated. A general distinction is made between societal and economic valuation. For the valuation of environmental services related to cocoa production, a combination of these methods is most appropriate.

However, it is important to note that this PES project on cocoa will focus on both buyers of the environmental services in the cocoa/chocolate supply chain and on other external stakeholders (with no physical presence in the production areas). Their willingness to pay will be investigated in phase A2 of this project (see paragraph 5.2). In contrast to, for example, local drinking water companies that have a direct economic interest in clean and sufficient ground and surface water, external parties have no or little direct economic interest in the ecosystem services. For these potential buyers, the value of the services and their ‘willingness to pay’ can be related to:

- an improved corporate image;
- an improved product image;
- increased cocoa production and stability of the supply (in case payments for ecosystem services will go hand in hand with increased yields, for example if that leads to more production on degraded/abandoned lands);
- direct benefits for other parties in production areas (tourism, drinking water, etc.).

These business cases can be used to assess the ‘willingness to pay’ for PES.

The actual price paid for the desired ecosystem services will depend on the willingness to pay (to be determined in phase A2) and the willingness of specific farmer communities to maintain, enhance or restore the desired ecosystem services (to be determined in phase B for a number of pilot projects).

In chapter 4 the most suitable financial mechanisms are analysed. We conclude that linking with existing certification schemes (as an add-on “PES module”) and a “PES fund” construction are the most effective and efficient. The main advantage of linking with existing certification schemes is that this can be implemented easily because existing infrastructures and a wide support of the supply chain can be built upon. A major advantage of such existing certification schemes is also that farmers already receive training on better farm management (the main effect of certification is the increase of production as a result of training and not the payment of price premiums).

The main advantages of a “PES fund” are that other stakeholders than supply chain parties can be approached to donate to the fund, that potentially all farmers can benefit (not just certified farmers) and that the investments can be directed to biodiversity hotspots and/or to neglected areas (abandoned/degraded lands, in order to increase or restore sustainable production).

The precise criteria for both the add-on PES module and the PES-fund can be specified in the context of phase B of this project. Also the costs related to these mechanisms will be estimated in phase B.

5.2 Recommendations for follow-up

Based on the positive findings in phase A1, it is recommended to continue with phase A2. The general objectives of phase A2 are to identify (see also the CREM-AE/LBI proposal of 9th February 2011):

- the support for the results of phase A1 among various stakeholders (private sector, NGOs, producing countries);
- the willingness of several parties to pay for the ecosystem services (both supply chain parties and other 'external' stakeholders);
- identification of cocoa production sites that are suitable to execute pilot projects.

For both the analysis of the support for the results of phase A1 and the willingness to pay, an abstract of this report will be prepared along with an illustrated PowerPoint presentation. This abstract will be shared and discussed with a maximum of 35 stakeholders in the Netherlands and several production countries. These stakeholders will be selected in consultation with the Ministry of Economic Affairs, Agriculture and Innovation and other members of the steering committee.

In the project's phase A2, we will use a combination of environmental and economic reasons for paying for ecosystem services in discussions with potential "buyers". These buyers will be sought for in the Dutch and International cocoa processing sectors.

	Environmental reasoning in the "willingness to pay'	Economic reasoning in the 'willingness to pay'
1.	Ecosystem Services related to cacao agroforestry facilitate permanent production in current production areas to avoid land abandonment and expansion into rainforests.	• product and/or corporate image • secure long term cocoa supplies • direct benefits for other parties in production areas (tourism, drinking water, etc.)
2.	Ecosystem Services related to cacao agroforestry contribute to biodiversity conservation in production areas and surroundings. For example by corridor-functions and buffer zones in tropical biodiversity hotspots.	• product and/or corporate image • direct benefits for other parties in production areas (for example ecotourism)
3.	Ecosystem Services related to cacao agroforestry contribute to carbon storage and sequestration.	• product and/or corporate image
4.	Degraded and abandoned caoao agroforestry can be revived through sustainable agroforestry management.	• product and/or corporate image • secure long term cocoa supplies • direct benefits for other parties in production areas (for example ecotourism)

The first business case is an important incentive for existing certification schemes such as UTZ Certified and Rainforest Alliance. A "PES add-on" can enhance sustainability of these certified production systems. However, for phase A2 ("willingness to pay" and the proposal for PES-pilots) we propose to focus more on the remaining three business cases as these are hardly covered by existing certification schemes. The second and third business cases are suitable for specific production areas (biodiversity hotspots, degraded and abandoned production areas), for example by means of a PES-fund. The third business case of carbon storage and sequestration will be discussed with the "carbon bundling" project of IDH (Dutch initiative for sustainable trade).

At least one pilot will be set up to implement an add-on “PES-module” to an existing certification scheme and group of smallholder farmers. Further, at least one pilot will be set up and implemented with a PES fund concentrated on production in a tropical biodiversity hotspot. At least one of the pilots will pay extra attention to restoring productivity in degraded/abandoned lands.

REFERENCES

Literature list:

Ariyanti N.S., Bos M.M., Kartawinata K., Tjitrosoedirdjo S.S., Guhardja E. and Gradstein S.R. 2008. Bryophytes on tropical tree-trunks: Effects of forest disturbance and cacao agroforestry in Central Sulawesi, Indonesia. Biological Conservation 141: 2516-2527.

Anhar A. 2005. The role of biological nitrogen fixation in the cacao agroforestry system in Central Sulawesi Indonesia. Ecology and Development Series 27. ZEF Bonn. 93 pp.

Andersson M. And Gradstein S.R.. 2005. Impact of management intensity on non-vascular epiphyte diversity in cacao plantations in western Eciador. Biodiversity and Conservation 14:1101-1120.

Asare R. 2006. Learning about neighbour trees in cocoa growing systems: a manual for farmer trainers. Forest & Landscape Development and Environment Series no. 4-2006. Danish Centre for Forest, Landscape and Planning, Hørsholm.

Asare R, Ashley R. 2008. A participatory approach for tree diversification in cocoa farms; Ghanaian farmers' experience. STCP Working paper series, issue 9. IITA Accra, Ghana.

Beer J., Muschler R., Kass D. and Somarriba E. 1998. Shade management in coffee and cacao plantations. Agroforestry Systems 38: 139-164.

Beer J.. 1988. Litter production and nutrient cycling in coffee (Coffea arabica) or cacao (Theobroma cacao) plantations with shade trees. Agroforestry Systems 7: 103-114.

Bisseleua D.H.B. and Vidal S. 2008. Plant biodiversity and vegetation structure in traditional cocoa forest gardens in southern Cameroon under different management. Biodiversity and Conservation 17: 1821-1835.

Boakye, K.A., Baffoer, K.A, 2006, Trends in forest ownership, forest resource tenure and institutional arrangements; case study from Ghana. Resource Management Support Centre, Forestry Commission of Ghana, Accra.

Bos M.M., Tylianakis J.M., Steffan-Dewenter I. & Tscharntke T. 2008. The invasive Yellow Crazy Ant in Indonesian cacao agroforests and the decline of forest ant diversity. Biological Invasions 10: Pp. 1399-1409.

Bos M.M., Steffan-Dewenter I., & Tscharntke T. 2007. The contribution of cacao agroforests to the conservation of lower canopy ant and beetle diversity in Indonesia. Biodiversity and Conservation 16: Pp. 2429–2444.

Bos M.M., Höhn P., Saleh S., Büche B., Buchori D., Steffan-Dewenter I. & Tscharntke T. 2006. Insect diversity responses to forest conversion and agroforestry management . In: The stability of tropical rainforest margins: linking ecological, economic and social constraints of land use and conservation (eds Tscharntke, T., Leuschner, C., Guhardja, E. & Zeller, M.). Springer, Berlin, Heidelberg, New York.. Pp. 279-296.

Bos M.M., Luske B., Bodnar F., de Beule, H. 2011. Field observations on shade management and carbon stocks in cacao agroforestry in North Kivu, Democratic Republic of Congo. AgroEco-Louis Bolk Institute 2011-009Int.

Cassano C.R., Kierulff M.C.M., Chiarello A.A.G. 2010. The cacao agroforests of the Brazilian Atlantic forest as habitat for the endangered maned sloth Bradypus torquatus. Mammalian Biology in press.

Clough Y., Putra D.D., Pitopang R. and Tscharntke T. 2009. Local and landscape factors determine functional bird diversity in Indonesian cacao agroforestry. Biological Conservation 142: 1032–1041.

Clough Y., Barkmann J., Juhrbandt J., Kessler M., Wanger T.C., Anshary A, Buchori D., Cicuzza D., Darrasi K., Putra D.D., Erasmi S., Pitopang R., Schmidt C., Schulze C.H., Seidel D., Steffan-Dewenter I., Stenchly K., Vidal S., Weist M., Wielgoss A.C. and Tscharntke T. 2011. Combining high biodiversity with high yields in tropical agroforests. PNAS in press.

Cocoa Research Institute of Ghana (CRIG), 2010. Cocoa manual, a source book for sustainable cocoa production. Accra.

Da Silva Moço M. K., da Gama-Rodrigues E. F., da Gama-Rodrigues A. C., Machado R. C. R. and Baligar V. C. 2009. Soil and litter fauna of cacao agroforestry systems in Bahia, Brazil. Agroforestry Systems 76: 127-138.

Dietz J., Hölscher D., Leuschner C. and Hendryanto. 2006. Rainfall partitioning in relation to forest structure in differently managed montane forest stands in Central Sulawesi, Indonesia. Forest Ecology and Management 237: 170-178.

Entwistle P.F. 1972. Pests of Cocoa. First edn. Longman, London.

Estrada A. and Coates-Estrada R. 2005. Diversity of Neotropical migratory landbird species assemblages in forest fragments and man-made vegetation in Los Tuxtlas, Mexico. Biodiversity and Conservation 14: 1719–1734.

Falk U., Ibrom A., Oltchev A., and Kreilein H. 2005. Energy and water fluxes above a cacao agroforestry system in Central Sulawesi, Indonesia, indicate effects of land-use change on local climate. Meteorologische Zeitschrift, 14: 219-225.

Faria D., Laps R.R., Baumgarten J. and Cetra M. 2006. Bat and bird assemblages from forests and shade cacao plantations in two contrasting landscapes in the Atlantic Forest of southern Bahia, Brazil Biodiversity and Conservation 15:587–612.

Faria D. and Baumgarten J. 2007. Shade cacao plantations (Theobroma cacao) and bat conservation in southern Bahia, Brazil. Biodiversity and Conservation 16:291–312.

Fish D., Soria S. 1978.Water-holding plants (Phytotelmata) as larval habitats for ceratopogonid pollinators of cacao in Bahia, Brazil. Revista Theobroma 8: 133–146.

Flood J.. Guest D, Holmes K.A., Keane P., Padi B., and Sulistyowati E. 2004. Cocoa under attack. Pp 33-53. In: J. Flood and R. Murphy. (Eds.). Cocoa Futures: A source book of some important issues facing the cocoa industry. Chinchina, Colombia.

Gradstein SR, Kessler M, Pitopang R. 2007. Tree species diversity relative to human land uses in tropical rain forest margins in Central Sulawesi. In: Tscharntke T, Leuschner C, Guhardja E, Zeller M (eds) The stability of tropical rainforest margins: linking ecological, economic and social constraints of land use and conservation. Springer, Berlin, Heidelberg, New York, pp 321–334.Hainmueller, J., Hiscox, M.J., Tampe, M. 2011. Sustainable Development for Cocoa Farmers in Ghana. Baseline Survey. MIT and Harvard University (in press)

Hartemink A.E. 2005. Nutrient stocks, nutrient cycling and soil changes in cocoa ecosystems: A review. Advances in Agronomy 86: 227-253.

Harvey C.A., Gonzalez J. and Somarriba E. 2006. Dung beetle and terrestrial mammal diversity in forests, indigenous agroforestry systems and plantain monocultures in Talamanca, Costa Rica. Biodiversity and Conservation 15: 555–585.

Hoehn P., Tscharntke T., Tylianakis J.M. and Steffan-Dewenter I. 2008. Functional group diversity of bee pollinators increases crop yield. Proceedings of the Royal Society: Biological Sciences 275: 2283–2291.

Millennium Ecosystem Assessment. 2005. Ecosystems and human well-being: synthesis. Island Press, Washington,DC.

Molina-Murguía J.F.F., García-Calderón N.E. and Martín G.A. 2009. Cocoa Industrial Debris Composting in Soil and Earthworm Breeding. Compost Science & Utilization 17: 197-204.

Moreno, I. 2011. Certified cocoa production in Nyinahini, Ashanti region, Ghana; Farm characterization, farmers' perceptions and scenario assessment. MSc thesis, WUR Wageningen.

Muńoz D., Estrada A., Naranjo E. and Ochoa S. 2006. Foraging ecology of howler monkeys in a Cacao (Theobroma cacao) plantation in Comalcalco, Mexico. American Journal of Primatology 68:127–142.

Norgrove L., Csuzdi C., Forzi F., Canet M. and Gounes J. 2009. Shifts in soil faunal community structure in shaded cacao agroforests and consequences for ecosystem function in Central Africa. Tropical Ecology 50: 71-78.

Kessler M., Abrahamczyk S., Bos M.M., Buchori D., Putra D.D., Gradstein S.R., Höhn P., Kluge J., Orend F., Pitopang R., Saleh S., Schulze C.H., Sporn S., Steffan-Dewenter I., Tjitrosoedirdjo S. and Tscharntke T. 2011. Cost-effectiveness of plant and animal biodiversity indicators in tropical forest and agroforest habitats. Journal of Applied Ecology In press.

Klein A-M., Steffan-Dewenter I., Tscharntke T. 2002. Predator–prey ratios on cocoa along a land-use gradient in Indonesia. Biodiversity and Conservation 11: 683-693.

Klein A.-M., Steffan–Dewenter I. and Tscharntke T. 2003. Fruit set of highland coffee increases with the diversity of pollinating bees. Proceedings of the Royal Society of London – Biology series 270: 955-961

Krauss U. and Soberanis W. 2001. Rehabilitation of diseased cacao fields in Peru through shade regulation and timing of biocontrol measures. Agroforestry Systems 53, 179–184.
Myers N., Mittermeier R.A., Mittermeier C.G., da Fonseca G.A.B. & Kent J. 2000. Biodiversity hotspots for conservation priorities. Nature 403, 853-858.
Ramadhanil, Tjitrosoedirdjo S.S. and Setiadi D. 2008. Structure and composition of understory plant assemblages of six land use types in the Lore Lindu National Park, Central Sulawesi, Indonesia. Bangladesh Journal of Plant Taxonomy 15: 1-12.
Rice R.A. & Greenberg R. 2000. Cacao cultivation and the conservation of biological diversity. Ambio 29: 167-172.
Room P.M. 1971. The relative distribution of ant species in Ghana's cocoa farms. Journal of Animal Ecology 40: 735-751.
Ruf and Schroth 2004. Chocolate forests and monocultures: A historical review of cocoa growing and its conflicting role in tropical deforestation and forest conservation. In: Agroforestry and biodiversity conservation in tropical landscapes (eds. Schroth G., da Fonseca G.A.B., Harvey C.A., Gascon C., Vasconcelos H.L. and Izac A.-M. N.). Island Press, Washington DC. Pp 107-134.
Ruf F. 2001. Tree crops as deforestation and reforestation agents: the case of cocoa in Côte d'Ivoire and Sulawesi. In: Agricultural technologies and tropical deforestation (eds. Angelsen A. and Kaimowitz D. pp 291-316. CABI Publishing, Oxon, New York.
Ruf F. 2011. The myth of complex cocoa agroforests: the case of Ghana. In Huma Ecology DOI 10.1007/s10745-011-9392-0. Springer Verlag, Germany.
Sambuichi R.H.R. and Haridasan M. 2007. Recovery of species richness and conservation of native Atlantic forest trees in the cacao plantations of southern Bahia in Brazil. Biodiversity and Conservation 16:3681–3701.
Schulze C.H., Waltert M., Veddeler D., Mühlenberg M., Gradstein S.R., Leuschner C., Steffan-Dewenter I., Tscharntke T., Kessler P.J.A., Pitopang R. and Shahabuddin. 2004. Biodiversity indicator groups of tropical land-use systems: comparing plants, birds, and insects. Ecological Applications 14: 1321-1333.
Seeberg-Elverfeldt, C. et al (2007) Payments for carbon sequestration services; a solution to stop deforestation of the Lore Lindu National Park in Indonesia. Proceedings Tropentag 2007, Universität Göttingen, Germany
Solé M., Dias I.R., Rodrigues E.A.S., Marciano-Jr E., Branco S.M.J., Cavalcante K.P. and Rödder D. 2009. Diet of Leptodactylus ocellatus (Anura: Leptodactylidae) from a cacao plantation in southern Bahia, Brazil. Herpetology Notes 2: 9-15.
Sonwa D.J., Nkongmeneck B.A., Weise S.F., Tchatat M., Adesina A.A. and Janssens M.J.J. 2007. Diversity of plants in cocoa agroforests in the humid forest zone of Southern Cameroon. Biodiversity and Conservation 16: 2385-2400.
Sporn S.G., Bos M.M., Hoffstätter-Müncheberg M., Kessler M. and Gradstein S.R. 2009. Microclimate determines community composition but not richness of epiphytic understory bryophytes of rainforest and cacao agroforests in Indonesia. Functional Plant Biology 36: 171–179.
Urquhart D.H. 1955. Cocoa. First edn. London, Longmans.
Van Bael S.A., Bichier P., Ochoa I. and Greenberg R. 2007a. Bird diversity in cacao farms and forest fragments of western Panama. Biodiversity and Conservation 16: 2245-2256.
Vaughan C., Ramírez O., Herrera G. and Guries R. 2007. Spatial ecology and conservation of two sloth species in a cacao landscape in limón, Costa Rica. Biodiversity and Conservation 16: 2293-2310.
Verchot L.V., van Noordwijk M., Kandji S., Tomich T.P., Ong C.K., Albrecht A., Mackensen J., Bantilan C., Anupama K.V. and Palm C.A. 2007. Climate change: linking adaptation and mitigation through agroforestry. Mitigation and Adaptation Strategies for Global Change 12: 901-918.
Waltert M., Mardiastuti A. and Muehlenberg M. 2004. Effects of land use on bird species richness in Sulawesi, Indonesia. Conservation Biology 18: 1339-1346.
Wanger T.C., Saro A., Iskandar D.T., Brook B.W., Sodhi N.S., Clough Y., Teja Tscharntke T. 2009. Conservation value of cacao agroforestry for amphibians and reptiles in South-East Asia: combining correlative models with follow-up field experiments. Journal of Applied Ecology 46: 823–832.
Weist M., Tscharntke T, Sinaga M.H., Maryanto I., Clough Y. 2010. Effect of distance to forest and habitat characteristics on endemic versus introduced rat species in agroforest landscapes of Central Sulawesi, Indonesia. Mammalian Biology 75: 567-571.

Whitfield S.M., Bell K.E., Philippi T., Sasa M., Bolaños F., Chaves G., Savage J.M. and Donnelly M.A. 2007. Amphibian and reptile declines over 35 years at La Selva, Costa Rica. Proceedings of the National Academy of Sciences of the United States of America 104: 20 8352-8356.

Young A.M. 1982. Effects of shade cover and availability of midge breeding sites on pollinating midge populations and fruit set in two cacoa farms. Journal of Applied Ecology 19: 47-63.

Zotz G. And Bader M.Y.. 2009. Epiphytic plants in a changing world-global: Change Effects on Vascular and Non-vascular epiphytes. In: Luettge U. et al. (eds.) Progress in Botany 70: 147-170.

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Dennis Oppong (Agro Eco LBI Ghana)
Ton van der Zon (NL embassy Ghana)
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ANNEX I: STEPS FOR DEVELOPING A PES TRANSACTION

Steps for PES:

Step 1: Identifying Ecosystem Service Prospects & Potential Buyers
- Defining, measuring, and assessing the ecosystem services in a particular area
- Determining marketable value
- Identifying potential buyers who benefit from the service
- Considering whether to sell as individuals or as a group

Step 2: Assessing Institutional & Technical Capacity
- Assessing legal, policy, and land ownership context
- Examining existing rules for PES markets and deals
- Surveying available PES support services and organizations

Step 3: Structuring Agreements
- Designing management and business plans to provide the ecosystem service that is the focus of the PES deal
- Reducing transaction costs
- Reviewing options for payment types
- Establishing the equity and fairness criteria for evaluating
- payment options
- Selecting a contract type

Step 4: Implementing PES Agreements
- Finalizing the PES management plan
- Verifying PES service delivery and benefits
- Monitoring and evaluating the deal

ANNEX II: STEPS FOR MEASURING AND VALUATING ECOSYSTEM SERVICES[16]

Step 1: Identification of ecosystem services

How

- Identification of ecosystem services involves experts with knowledge of the area.
- Preliminary identification of potential ecosystem services is checked with local stakeholders or representative bodies for these stakeholders.

Who

Most important is to have people with the right "mind set" to recognize ecosystem services. More often than not, sector-oriented experts tend to overlook the effects their plans may have on ecosystem services linked to other sectors.

- A mix of natural resources management experts and ecologists with good local knowledge works well.

Data needs

- Maps indicating main ecosystems and types of land-use;
- overview of main economic activities in the area;
- population data;
- field reconnaissance.

Time required

For the actual study only several days. The decision to actually give attention to ecosystem services may take longer as competent authorities or proponents need to be convinced of its usefulness.

Step 2: Quantification of ecosystem services

How

Quantify an ecosystem service in units of measurement relevant to the service.

Who

Full quantification may involve experts supported by computer models (hydraulic, population, harvest, preferences). Proxies can be obtained from national or regional statistics, local stakeholders, narrative information, data from similar services elsewhere.

Data needs

- National or regional statistics often provide good information;
- remote sensing information may provide relevant information on surface areas and productivity.
- Research institutes may provide access to computerized models.
- A reality check with people on the ground is always recommended.

16 Report 'Valuation of Ecosystem Services & Strategic Environmental Assessment – Lessons from influential cases', MER Netherlands Commission for Environmental Assessment, 2008.

Time required
From a week to several months, depending on the level of detail required, number and complexity of the services to be assessed, the surface area, availability and reliability of statistical data, and presence of local (scientific) information.

Step 3(a): Valuation of ecosystem services: Societal valuation

How
Quantify the societal value of an ecosystem service in units of measurement relevant to the value.
Non-economic approaches to valuing ecosystem services involve the use of deliberative techniques to explore public opinion or make decisions, such as citizens juries and citizens panels, deliberation processes, consensus groups and
multi-criteria decision processes. Here, participants consider different arguments, possibly listen to evidence and, after group discussion, may come to a reasoned conclusion about the best way forward. Deliberative techniques are often used where the issue is more complex, facts are uncertain, stakes are high (requiring high legitimacy through participative processes), and where values are disputed and competing interests have to be balanced[17].
Some values may be difficult to quantify in their own terms; examples are the religious or historical value of certain ecosystem features. Contingent valuation may in such cases provide estimates of economic value (see 'economic valuation')[18].

Who
For full quantification detailed questionnaires may be needed, with significant time expenditure by interviewers. Sampling with good statistical analysis provides a means to reduce workload, but requires experts in statistical analysis.

Data needs
Proxies can be obtained from national or regional statistics on population size, economic activities, agricultural outputs, fisheries and forestry productivity, etc.

Time required
From a week to several months, depending on the level of detail required,

[17] Report 'Conservation of biodiversity and ecosystem services in Europe: from threat to action, P.A. Harrison and the Rubicode consortium, 2010 (?).

[18] Report 'Valuation of Ecosystem Services & Strategic Environmental Assessment – Lessons from influential cases', MER Netherlands Commission for Environmental Assessment, 2008.

number and complexity of the services to be assessed, the surface area, availability and reliability of statistical data, and presence of local (scientific) information.

Step 3(b): Valuation of ecosystem services: <u>Economic valuation</u>

How

- In the context of ecosystem services, it is crucial to start identifying the providers and the beneficiaries of the relevant ecosystem services.
- Next, valuation techniques need to be selected. This choice is context specific and dependent on a number of factors, including whether or not the environmental service is traded directly or indirectly in a market, the stakeholders that hold values for the service, the available budget for conducting a valuation study, and the availability of existing information on the value of similar resources.

Who

It is advisable to have at least one environmental economist in the team who is properly trained to conduct economic valuation studies. The actual implementation of surveys and interviews can be conducted by a non-economist as well. However, for the design and analysis of the data, thorough economic knowledge is essential.

Data needs

In economic valuation, there are broadly three main types of data that will be used: (a) market prices that can be found from private sector sources, government statistics or international organizations;
(b) local social, environmental and economic information that can be found through local surveys, or government statistics where they exist; and
(c) preference data generated by asking people through questionnaire surveys.
The categories are described in detail in Van Beukering et al. (2007)[19].

Time required

Depending on the comprehensiveness of the study, a valuation exercise may vary from a few months to two years or more. Obviously, the data availability present at the start of the study is a major factor in this regard.

[19] Valuing the environment in small islands – an environmental economics toolkit, Joint Nature Conservation Committee (JNCC), Peterborough, p.128 (ISBN 978 1 86107 5949), Van Beukering, P., Brander, L., Tompkins, E. and McKenzie, E. 2007.

ANNEX III: A SUMMARY OF THE REGULARLY APPLIED ECONOMIC VALUATION METHODOLOGIES[20]

Market-based valuation: goods traded in an open market have a price, which serves as the basis for valuation. Similarly, the effect of services can be priced in line with market prices. For example, coastal mangroves or dunes protect the inland and thus avoid damage to infrastructure and economy. Valuation techniques that commonly apply market values are *replacement cost, net factor income approach* and *the production function approach.*

Revealed preference methods: people's behaviour can reveal the value attached to a service. For example, waterfront houses in the Netherlands are 1,4 times more expensive than similar houses elsewhere, or people spend money to travel to certain places of special interest, such as national parks. Examples of commonly used revealed preference techniques are *hedonic pricing* and *travel cost*.

Stated preference methods: value non-market resources, such as environmental preservation or the impact of contamination. While these resources do give people utility, certain aspects do not have a market price as they are not directly sold. For example, people receive benefit from a beautiful mountain view. *Contingent valuation* and *choice modelling* are techniques used to measure these aspects.

Value Transfer: A special case of valuation is the value transfer. Values obtained from studies in comparable areas and/or comparable situations can be transferred to another situation. Although value transfer avoids time-consuming data collection efforts, the accuracy of the estimates is generally limited. Valuation transfer is typically applied to determine the value of particular ecosystems (e.g. wetlands, coral reefs), as well as the economic importance of specific ecosystem services (e.g. provision of drinking water provision, flood protection)[21].

[20] The measurement of environmental and resource values: theory and methods. Resources for the future, Washington DC, Freeman, A.M, 1993.

[21] Report 'Valuation of Ecosystem Services & Strategic Environmental Assessment – Lessons from influential cases', MER Netherlands Commission for Environmental Assessment, 2008.

ANNEX IV: A CASE-STUDY IN GHANA: THE COSTS OF PES

Introduction

In this paragraph an overview is given of the costs for cocoa farmers in the maintenance, restoration and enhancement of ecosystem services. Additionally, costs are given of a local control mechanism and the potential contribution of PES-premiums to farmer income. This overview is hypothetical and can be used as basis for possible PES-pilots. The data are based on either Rainforest Alliance (RA) or Utz certification of cocoa production in Ghana. See the table at the end of this annex for a summary.

Baseline situation

In the following calculations we will use data from a Ghanaian farmer group of approximately 2,000 farmers. These farmers have on average 3 acres of cacao (1,2 ha), leading to a total of 6,000 acres (2,430 hectares). For a PES-pilot, the farms should form a continuous block, such as adjacent villages. In Ghana, these farmers produce on average 150 kg of cocoa beans per acre (2,3 bags per acre, or 370 kg/ha). The cacao trees are 20-30 years old. This situation is representative for the majority of cocoa farmers in Ghana, who hardly use any fertilizer (CRIG, 2010, Hainmueller 2011). The farms are sprayed 1-2 times a year with pesticides in the government's mass spraying programme. Weed control is manual. It is this situation that the government, the buyers and the certification schemes are challenged to improve. The farms have few shade trees, the minimum to become Utz or Rainforest Alliance certified is 8 shade trees per acre. Some of these trees are just recently planted. There is little pruning of the cocoa, or shade trees. Thus, the farmer-trainings that are part of the certification scheme are expected to result in higher yields. Training includes issues like pruning, removal of black pods, and replanting of old cacao trees.

The farmers sell their beans to different buyers, but the majority to one buyer who has a market for the certified beans. This buyer is responsible for the entire intervention (training, inputs, verification, output, payments). This intervention is financed from 50% of the current export premium of US$ 150/mt. The farmers receive the other 50% of the export premium as an extra income. Without certification, the average farmer earns US$ 960 per year from the cacao and with the certification, with the same production, US$ 984. These levels of income from cocoa beans are not unusual for smallholder cacao farmers in Ghana. In two to three years, close to a doubling of production is possible, still with very few off-farm inputs. (Gross) income will increase with an extra U$ 811. The main input required is active involvement of the farmer; labour. The cost of family labour and possibly hired labour has not been quantified.

To maintain these higher yields, farms/farmers should access the government's subsidized fertilizer scheme. This has to be organised by the buyer as there is no local farmer's organisation. The farmers would also benefit from the deployment of a team of trained cocoa tree pruners but the farmers have to pay for that themselves and are so far resisting the idea. The result of good pruning is shown in demonstration farms, at least one per village. It is expected that when the farmers observe the benefit of cocoa tree pruning, they will pay for it.

The certified group is supported by a field team consisting of one Field Officer, employed by the buyer, and in total 100 Farmer Field Workers (1 FFW for 20 farmers). During internal audits, FFWs perform the internal audit (swapping area with a colleague) They are mostly farmers themselves, lead farmers, and their farms are used as meeting place and for demonstration purposes. The total cost of this team is US$ 31,800/year. For example RA certification itself costs US$ 3,850/year.

The buyer has a margin of US$ 11,600/year for organising and managing the group. From this, the buyer pays the training and supervision of the field officers, contact with the auditor, the certifier, etc. The buyer has a series of such farmer groups in the country, managed from its head office where there are also a Documentation Officer and Certification Manager (titles may vary). Those costs are spread over different groups, and are to be compensated from the earlier mentioned US$ 11,600. In the early years, the cost of getting the farmers certified is likely higher. However, when yields increase per hectare, the margin increases without a linear increase in the cost of the field team and certification. The buyer would then profit from certification besides securing a market position.

Payments for Ecosystem Services

In discussion with the farmers the ecosystem services are identified, quantified and agreed upon. In this hypothetical case these are:

- Maintenance of existing good shade trees
- Planting more useful and/or valuable shade-timber trees
- Creation of buffer zones alongside waterways, for biodiversity

In a first year of a PES pilot, the existing trees are identified on each cocoa farm. It is agreed which trees should be removed when and determined when the commercial tree species are ready for felling. To become certified, farmers must have 8 trees per acre, or 18 per hectare. The ownership of trees on agriculture land is often not so clear in Ghana (Boakye 2006). Officially, timber concessions are given out by the Forestry Commission. 40% of the stumpage fee stays with the Commission, 60% goes to the traditional (stool) landowner. In that case the farmers are paid per cocoa tree that is destroyed, but not for the value of the timber. Farmers (are allowed to) sell individual trees, for example when the tree harbours mistletoe which infects cocoa trees as well. Or when they need timber for construction, or when they need money. Some farmers are ringing trees to kill them, and then sell them off. The value of a full grown (shade) tree is between 20 (soft wood) and 40 Ghana Cedi (hard wood), or on average 14 €. Also the local chief can sell individual trees, with or without informing the farmer. In that case the farmer sometimes receives part of the proceeds. Since 2002 farmers can register their ownership of newly planted trees but its legality has been questioned as it contradicts the constitution in which ownership is with the government and local chief.
Under a PES regime, the concessions are better controlled and better planned with all parties (Forestry Commission, stool landowners and farmers), and the registration of trees planted and their ownership by the farmer encouraged. To discourage illegal felling, farmers receive an annual compensation. As soon as they illegally sell a tree, they loose the compensation for one year per tree. Considering that farmers may illegally sell 1 tree/acre a year (there are not many left), the compensation is set at the value of 1 tree per acre, or 14 € a year. This is not seen as an extra income as it compensates income lost. The cost for the group of 2000 farmers is US$ 120,000 or € 86,000.

In a cocoa agroforestry system, far more trees need to be established then 8 per acre or 18 per hectare, to arrive at the required 50-60% shade, the optimum for productivity and biodiversity. Per region a suitable definition must be elaborated, for example 900 cocoa trees of 3 varieties, and 200 shade trees comprising of 10% fruit trees, 30% nitrogen fixing trees, 30% medium high fuel wood and 30% high shade, future timber trees. All trees are to be indigenous and at least 12 different species per hectare. To be able to plant more shade trees, the farmers are provided with seedlings of the right types of shade trees. These are provided at cost price by the buyer, or for a slightly higher cost by local nursery committees. The farmers are willing to pay for the seedlings as they believe that production of the farms will improve with the right type of shade trees. Also, when the trees are mature they provide an income, when the farmers are recognised as the owners. A potential income from selling full grown timber trees is 1 tree/acre per year at a price of 25 U$ a log, or 75 U$ per farmer per year, once there are full grown trees to harvest. The farmers are responsible for planting and maintaining the seedlings. This can be seen as extra work but as this is done outside the cocoa labour peaks this is done by the farmer or within the family. The Farmer Field Workers provide training on the right planting distance and seedling maintenance (see later). Tree maintenance is reviewed in the internal audits.

As shade management needs specialised equipment and is a bit of a risky job this is done by a shade management team. This team makes sure that shade is not too thick and that there is aeration in the field, especially at the start of the rainy season. Such a gang is thought to consist of a foreman and two workers, equipped with ladders, chainsaws, protective gear and lighter equipment. Shaping the existing shade trees is done over a period of three years while at the same time younger shade trees are form pruned. It is estimated to require less than a day per average farm per year. The annual cost is US$ 51,667 or € 37,000.

For the movement of wildlife, to avoid run-off into the streams that run through the farms (usually constituting a border), a strip of 5 meters on both sides of the stream are taken out of cocoa production. This constitutes a loss of production on approximately 100-200 sqm per acre, or 2,5-5,0 % and that loss of cocoa income needs to be compensated. The cost is US$ 32,000 or € 23,000/year for the 6.000 acres of the group.

The farmers need training on the topic of ecosystem services and on its management. This is provided by the existing field team (who in their turn need to receive a master training). This is budgeted to require 25% extra time. This results in an extra cost of US$ 8,000 or € 5,700 per year only.

The internal audit is expanded to include scoring related to the ecosystem services. It is expected that the cost of external certification increases with 30% for a PES component, assuming that Rainforest Alliance and Utz Certified are willing to add-on ecosystem services to their original scheme. That cost is minimal, US$ 1,155 or 825 € per year for the group.
This is an important advantage when working in a situation that is already certified.

Within the remit of this study it has not been possible to obtain formal quotes for the cost of valuation (accreditation) of the results coming out of the internal audit. It depends on the requirements of the payer of the ecosystem services (see next chapter). One can assume a cost of U$ 150,000 every three years, or U$ 50,000 per year. This valuation is used by the same buyer for 5 of these groups. The cost would then be U$ 10,000, or € 7,140 for the group per year.

The total cost for ecosystem enhancement for 2,000 farmers growing cocoa on 6,000 acres or 2,430 hectares, is US$ 222,700 or € 160,000 per year. This is US$ 111 or 80 € per farmer and US$ 37 per acre, or € 92 per hectare, per year. The costs are summarised in a table in Annex IV.

The cost of ecosystem enhancement would result in increased awareness of farmers of the ecosystem services they provide and physically, a stop on illegal felling in the farms. On the contrary, the establishment of a robust, well managed shade system will improve production, biodiversity and climate change resilience through measures that are easily monitored/scored in an addendum of the annual internal audit. The string of 5 adjacent villages can be situated around (as a buffer) or between the scattered National Parks and Forest Reserves (as a corridor) and can thus contribute to maintain biodiversity. That can be monitored by scoring different biodiversity indicators.

The potential contribution of PES to farmer income
As the farmers are only recently been certified, the impact of the certification on the farmers practices and income is not yet seen. However, it is expected that within three years time, based on improved farming practices, without too much use of expensive farm inputs, average production level will almost double from the current 150 kg/acre to 270 kg/acre. The main input is labour, largely family labour. It is the increase of production that leads to an increase of income, not the certification premium. Interestingly, the buyer also benefits from an increase of production, as it will directly increase premium income but not the cost of intervention per farmer. This hopefully motivates the buyer to provide the farmers with, for example, subsidized fertiliser or cocoa seedlings, at cost price.

The work on PES will again provide additional income, besides what can be attributed to certification. One can expect a positive effect on soil fertility, that less nutrients are leached from the farms because they are pumped back into the cocoa through the deeper rooting shade trees. The effect of extremes in weather, especially droughts, is better balanced. The occurrence of pests is reduced. The presence of shade trees will improve the permanency of the cocoa farm. One can assume an additional increase of productivity and/or income of 20%. That the effect of enhanced ecosystem services are perhaps difficult to separate from that of certification is a disadvantage of working with certification schemes.

In this example, the expected increase of gross income is U$ 348 (€ 248) per farmer, or U$ 120 per acre (€ 204 per hectare). Compared with the cost of the intervention (see above) this is a good cost/benefit ratio.

Other benefits, like reduced manual labour for weed control, are not calculated. As this is encouraged, there may be an increased production of cocoyams under the cocoa, some more plantain. These are mainly for home consumption, some for sale. This potential benefit is not calculated either. The better quality of the water, the provision of fire wood and perhaps some bush meat from the buffer, are not calculated as well. Societal effects like better penetration and retention of rainfall and thus more constant feeding of rivers with good quality drinking water are not calculated. These benefits could be quantified later..

Other payment mechanisms?
The great advantage of the above scenario is that the group is already part of a certification scheme; the PES is a fairly simple add-on using an existing field staff that is already engaged with the farmers, there is already a certification and pay-out mechanism, all managed by the cocoa bean buyer-exporter. ES enhancing activities can also be implemented by other actors. Especially when there are already interventions related to nature or biodiversity conservation, tree planting and the like, NGOs, from Community Based Organisations to international conservation NGOs, could take on the task of implementing the Ecosystem enhancement activities. The role of the buyer can be played by a farmers association or a cooperative when these are present and competent. The advantage of their involvement construction is that

NGOs and farmers organisations are usually better in engaging all farmers in the community while the farmers can continue to sell to a number of different bean buyers.

The cost of the ecosystem enhancement would be higher, as some of the activities of the certification scheme, like employment of the field staff and training of farmers are no longer paid for by the certification premium. Roughly, the premium paid for certification should become part of the PES.

Provided that similar training is provided as for certification the main benefit for the farmer is the increase in yield. That is based on the assumption that PES should focus on ‘traditional’ smallholder cocoa farmers, the majority in Ghana, who do not use much external inputs. The PES is an eco-intensification of existing, perhaps older cocoa plantings. Especially in the beginning higher payments need to be made to put the Ecosystem enhancement in place. It can be simplified to a singular activity, like shade tree planting. That appears to be an activity that can be easily implemented by local NGOs, farmer groups, or the government for that matter. It is recommended though to couple the ES with an increase of production. For that mainly training is required as an input.

The NGO/coop should have a good track record to convince the provider of the ecosystem payments that it is competent to handle the funds and implement the activities. A separate organisation would be responsible for the verification.

In the table below a summary is presented of the costs and benefits of PES. Magnitude of monetary effects (in USD) related to the implementation of a certification scheme and the add-on of ecosystem services, for buyer and farmers, based on a hypothetical case of a group of 2000 farmers, growing 3 acres of cocoa with a starting production level of 150 kg/acre.

Buyer's economy, certification			
	yr 1	yr 3+	
Premium income	47,250	94,500	
Field staff cost	31,800	31,800	
Certification cost	3,850	3,850	
Input provision	@ cost price	@ cost price	
Management cost	11,600	11,600	
Margin	---	47,250	
Farmers' economy, certification yr 1			
	group	per farmer	per ha
Premium income	47,250	24	19
Labour costs	not quant.	not quant.	not quant.
Farmers' economy, certification yr 3+			
	group	per farmer	per ha
80% higher yield	1,536,000	768	632
Premium income	85,050	43	35
Labour costs	not quant.	not quant.	not quant.
ES costs & loss of income			
	group	per farmer	per ha
Loss income illegal felling	120,000	60	49
Loss income to buffer zones	32,000	16	13

Shade pruning	51,667	26	21
ES training	7,950	4	3
ES verification add-on	1,155	0.6	0.5
Results valuation	10,000	5	4
Input costs	@ cost price	@ cost price	@ cost price
Labour costs	not quant	not quant	not quant
PES & additional income			
	group	per farmer	per ha
Compensation illegal felling	120,000	60	49
Compensation buffer	32,000	16	13
Income from timber trees	150,000	75	62
20% higher yield	384,000	192	158
Extra premium	9,450	5	4

Conclusions

- The main effect of certification is the increase of production (and not the payment of price premiums) as a result of the associated training. This would lead to an increase of income of the average farmer from U$ 960 to U$ 1,795 from the third year of certification onwards, or from € 564 to € 1,055 per hectare.
- The cost of the certification scheme is paid for through the export premium.
- The main input from the farmer's side is labour, including some hired labour, which could not be quantified as part of this study.
- The intensification of production can be sustained only when farmers start to access the government's subsidized fertiliser scheme, or return nutrients to the farms otherwise.
- In the hypothetical case, the ecosystem services enhancement is on top of the certification. It then costs U$ 111 per farmer, or € 66 per hectare - plus extra labour and the cost of inputs like the fertilizer, but results in a benefit of the farmer of U$ 348, or € 204 per hectare. This is without any income from carbon sequestration. This is considered a significant increase of income in the Ghanaian context.

ANNEX V: SHADE MANAGEMENT, MANAGAMENT OF CONSERVATION AREAS AND THE PROTECTION OF NATURAL HABITATS IN CURRENT CERTIFICATION STANDARDS[22]

Table 1: Shade management, management of conservation areas and protection of other natural habitats in current certification standards.

	UTZ certified	Rainforest Alliance	Eko/organic	Fairtrade
Shade management	Maintain or plant at least 18 trees/ha. Plant diverse and native tree species, tree program organized by certificate holder.	At least 40% canopy density. Tree canopy comprises at least two strata and at least 12 native species per hectare.	Shade management must be promoted.	..
Conservation of natural areas/habitats	No production in protected areas. No production in the immediate vicinity (2km) of a reserve or certificate holder is in contact with the park authorities. Degradation and deforestation of primary forest is prohibited. Producers do not plant new cocoa on land that is not classified as agricultural land and/or approved for agricultural use.	All existing natural ecosystems, aquatic and terrestrial, must be identified, protected and restored through a conservation plan. There must be a minimum separation of production areas from natural terrestrial ecosystems where chemical products are not used.program. Implement a plan to maintain or restore the connectivity of natural ecosystems.	No use of agro-chemicals.	Planting in virgin forest areas is prohibited. Buffer zones are maintained as required to protect water bodies and watershed recharge areas, virgin forests, and/or other protected areas. The organization pursues research into and promote the implementation of agricultural diversification within its members' farms.
On-farm conservation of habitats	The certificate holder identifies all natural habitats in the production area together with relevant stakeholders, such as national environmental organizations or experts. The certificate holder has a conservation plan or participates in a regional management plan.	Dedicate at least 30% of the farm area for conservation or recovery of the area's typical ecosystems.	Maintain soil fertility through the humus balance.	Producers are expected to maintain and enhance the fertility and structure of soil. Water resources are managed with the objectives of conservation and non-contamination.

Field observations on shade management and carbon stocks in cocoa agroforestry

22 Field observations on shade management and carbon stocks in cacao agroforestry in North Kivu, Democratic Republic of Congo Authors: Merijn Bos, Boki Luske, Ferko Bodnar, Hilde de Beule (Agro Eco- LBI, 2011)

ANNEX VI: ADVANTAGES AND DISADVANTAGES OF FINANCIAL MECHANISMS

1. Linking PES to existing certification schemes

A: PES as an optional (voluntary) module as add-on in existing certification schemes

	Advantage	**Disadvantage**
Income improvement	• Additional PES premium • Easy pay-out (PES payments are combined with the sales of the cocoa beans) • Potentially long-term income improvements (PES premiums are part of the comprehensive certification scheme to which the farmers have committed themselves) • Farmers are trained (farms are better managed, which leads to higher yields and thus income)	• PES premium is expected to be relatively low[23] (an incentive for implementing ES is therefore not secured)
Biodiversity gains	• Long-term commitments of farmers towards improving biodiversity (PES is part of the comprehensive certification system, so farmers are less likely to drop out than in cases whereby PES depends e.g. on single deals)	• Limited to the areas of certified cocoa farmers which are not necessarily located in biodiversity hotspots • Participation limited to those farmers willing to engage in certification only; scattered farms. • An incentive for implementing ES is not secured (in case PES premium is too low)
Economic viability	• Relatively low costs for developing and maintaining this financial mechanism and for verification and certification of the PES criteria (existing infrastructures and related audits can be used)	• Distribution and marketing is relatively expensive (niche/segregated channels are used) • Productivity depends on whether the farmers have received training in and are implementing best practices
Inclusiveness	• PES premium potentially reaches the	• PES premium is limited to certified

23 See also annex IV: an example of a certification premium from Rainforest Alliance (RA) certified farmers in Ghana may further illustrate this: the current RA export premium is US$ 150/mt. 50% of the export premium is spent on training, inputs, verification, output and payments to the buyer. The farmers receive the other 50% of the RA export premium as an extra income. In short, without RA certification, the average farmer (with an average yield of 370 kg/ha) earns US$ 960 per year from the cacao and with the RA premium US$ 984, only US$ 24 difference. The effect of PES on income (and productivity) is difficult to separate from the effect of certification. The highest effect on income, however, is expected from farmer's training resulting in higher yields (thus from certification as a whole) and not the premium. The additional increase of income from PES above that of certification is estimated at 20%.

	Advantage	Disadvantage
	cocoa small holder and thus 90% of all cocoa farmers (PES payments are part of the comprehensive certification scheme to which the small farmer belongs and has access) • The PES system can easily spread among a high number of farmers (certified farmers are often organized in large farmer groups)	cocoa farmers, excluding both non-certified farmers and farmers that currently produce other crops like oil palm, cassava.
Visibility	• PES certified cocoa is physically segregated in the supply chain allowing for communication on product level	
Finance	• The supply chain bears the extra costs for the PES premiums	
Public/Private support	• Large chocolate manufacturers and other supply chain players have already committed themselves to certain certification schemes	• Support is maintained as long as future supplies are not at risk (correct shade management leads to increase of production)

B: PES as an independent module

	Advantage	Disadvantage
Income improvement	• Additional PES premium • Easy pay-out (PES payments are combined with the sales of the cocoa beans) in case buyers are interested in (single) certified PES cocoa • Farmers are trained (farms are better managed, which leads to higher yields and thus income)	• PES premium is expected to be relatively low[24] (an incentive for implementing ES is therefore not secured) as the cost is relatively high as it includes costs that are otherwise paid for by the certification premium
Biodiversity gains	• PES activities can be more directed towards biodiversity hotspots and other sensitive regions[25] in which the highest and/or additional biodiversity benefits are to be expected (not limited to the sites of certified cocoa farmers)	• Possibly no long-term commitments (farmers are less involved, do not have to undergo full certification) • An incentive for implementing ES is not secured (in case PES premium is too low)

24 See also annex IV: an example of a certification premium from Rainforest Alliance (RA) certified farmers in Ghana may further illustrate this: the current RA export premium is US$ 150/mt. 50% of the export premium is spent on training, inputs, verification, output and payments to the buyer. The farmers receive the other 50% of the RA export premium as an extra income. In short, without RA certification, the average farmer (with an average yield of 370 kg/ha) earns US$ 960 per year from the cacao and with the RA premium US$ 984, only US$ 24 difference. The effect of PES on income (and productivity) is difficult to separate from the effect of certification. The highest effect on income, however, is expected from farmer's training resulting in higher yields (thus from certification as a whole) and not the premium. The additional increase of income from PES above that of certification is estimated at 20%.

25 Such as margins of rainforest reserves, landscapes with habitat fragmentation and neglected cocoa farms

	Advantage	Disadvantage
Economic viability		• Verification and certification costs can be relatively high if farmers are only audited against the PES module • Distribution and marketing is relatively expensive (niche/segregated channels are used) • Productivity depends on whether the farmers have received training in and are implementing best practices
Inclusiveness	• Open to all farmers that preserve ES, including non-certified farmers and farmers that currently produce other crops like oil palm and cassava • Easier accessible to farmers (farmers do not have to meet the environmental and social criteria of the certification scheme) • PES premium potentially reaches the cocoa small holder and thus 90% of all cocoa farmers (PES payments are part of the comprehensive certification scheme to which the small farmer belongs and has access)	
Visibility	• PES certified cocoa is physically segregated in the supply chain allowing for communication on product level	
Finance	• The supply chain bears the extra costs for the PES premiums	
Public/Private support		• No large public and/or private parties have committed themselves (yet) to (single) certified PES products • Support is maintained as long as future supplies are not at risk (correct shade management leads to increase of production)

2. Generating biodiversity credits

	Advantage	Disadvantage
Income improvement	• A fair remuneration system: the more effort a farmer makes in the field of implementing ES, the higher the (potential) rewards are (i.e. the more credits are allocated)	• No quick transfers of PES returns (payments not combined with the sales of cocoa beans; sales of the credits are only possible once the ES has been delivered which may take years after the service was initiated) • No structural income improvements (PES payments often depend on

	Advantage	Disadvantage
		single deals) • Farmers depend on the control organization for returns on their PES efforts
Biodiversity gains	• PES activities can be more directed towards biodiversity hotspots and other sensitive regions[26] in which the highest and/or additional biodiversity benefits are to be expected (not limited to the sites of certified cocoa farmers)	• No structural incentives for providing ES (PES payments depend on single deals)
Economic viability	• Distribution and marketing is relatively cheap (no segregated but mainstream channels are used)	• A new system/methodology needs to be developed which is costly (quantifying and valuating credits are expensive and will initially depend on foreign expertise) • The system of trading in biodiversity credits depends on the existence of (certified) PES initiatives/projects (is not a system of its own) • A potential imbalance between ownership and responsibility of the credits: the farmers that initially own the credits are eventually not the ones responsible for the sales of the credits • Productivity depends on whether the farmers have received training in and are implementing best practices
Inclusiveness	• Potentially open to all farmers that preserve ES and sell biodiversity credits, including non-certified farmers and farmers that currently produce other crops like oil palm and cassava	
Visibility		• PES efforts of (cocoa) farmers cannot be communicated on product level (no physical segregation in the supply chain) • Cocoa is not traceable (it is sold and re-sold many times)
Finance	• Potentially financed by a wide range of stakeholders (not only the supply chain)	• A system of pre-finance should be in place to bridge the conversion period to biodiversity friendly practices (credits cannot be sold based on future claims, can only be sold once the ES is implemented)

26 Such as margins of rainforest reserves, landscapes with habitat fragmentation and neglected cocoa farms

	Advantage	Disadvantage
Public/Private support		• No (large) public and/or private parties have committed themselves yet to buying biodiversity credits (the concept of biodiversity credits is not yet known in the market) • Support is maintained as long as future supplies are not at risk (correct shade management leads to increase of production)

3. Creating a fund for ecosystem services

	Advantage	Disadvantage
Income improvement	• Relatively long-term income improvements are possible (projects are funded for a number of years)	• Possibly no quick transfers of PES returns to farmers (in case payments are not combined with the sales of cocoa beans)
Biodiversity gains	• Relatively long-term commitments of farmers towards improving biodiversity (projects are funded for a number of years) • PES activities can be more directed towards biodiversity hotspots and other sensitive regions[27] in which the highest and/or additional biodiversity benefits are to be expected (not limited to the sites of certified cocoa farmers)	
Economic viability	• Less costs for criteria development, certification and/or auditing (projects are valuated/audited as a whole, flexible/no fixed criteria) • A more flexible way of spending financial means (a wide range of biodiversity projects can be funded, flexible/no fixed criteria)	• A fund needs to be developed and maintained which may be costly • When on single issue, like shade tree planting only, limited increase in yield. • Productivity depends on whether the farmers have received training in and are implementing best practices
Inclusiveness	• Open to all farmers meeting the project requirements, including non-certified farmers and farmers that currently produce other crops like oil palm, cassava. • Easier accessible to farmers (farmers do not have to meet fixed environmental and social criteria)	

27 Such as margins of rainforest reserves, landscapes with habitat fragmentation and neglected cocoa farms

	Advantage	Disadvantage
	• PES premium potentially reaches the cocoa small holder and thus 90% of all cocoa farmers (PES projects can be developed that specifically address the needs of cocoa small holders)	
Visibility	• Direct trade relations are possible between farmer groups (belonging to the same project) and buyers, allowing for communication on product level	
Finance	• Potentially financed by a wide range of public (governments) and private bodies (e.g. water-using companies) (not only the supply chain)	• Long-term finance by project partners is unreliable (stakeholders may be enthusiastic at the start but not on a long term base)
Public/Private support	• Attractive for local NGOs	• No (large) public and/or private parties have committed themselves yet to the concept of PES • Support is maintained as long as future supplies are not at risk (correct shade management leads to increase of production)