FINANCING BIODIVERSITY

a private sector approach

Veragua Rainforest, Costa Rica

Written by Ir. Georges Beukering

August 2010, The Hague (The Netherlands)

Title Master Thesis: FINANCING BIODIVERSITY - *a private sector approach*

ERASMUS UNIVERSITY ROTTERDAM

Faculty of Economics of Business

Department of Economics

Name: Ir. Georges Beukering

Thesis conductor: Dr. Herman Vollebergh

Co-reader: Dr. Hans de Kruijk

Abstract

Certain developing countries, host of most of the remaining biodiversity on earth, are in their pursuit to spur economic development faced with a trade-off between growth in national income and a decline in biodiversity and ecosystems. In this thesis, first the market failures will be explored that lead to the continuing decline of biodiversity and the related provision of ecosystem goods and services. Secondly, two types of markets will be analyzed that have started to emerge recently bringing certain sustainably produced ecosystem goods and services to market, leading to the partial absorption of market failures and the inclusion of certain social costs that would be neglected otherwise. These markets are considered to be interesting for the private sector to invest in in terms of financial performance, but also in terms of environmental and social sustainability. Thirdly, it will be explained why development banks are suited to reduce certain market failures and to further develop the markets for ecosystem goods and services. Fourthly, based on a conceptual framework, two real case studies will be presented, each a private sector undertaking, which will be analyzed in terms of their financial, environmental and social performance. Finally, conclusions and recommendations for new policy and further research will be given.

Table of content

1. Introduction to the thesis "Financing Biodiversity"

1.1. Subject Thesis

Not until the latter half of the previous century economists started to expand traditional economics into the realm of ecology and the natural environment. Natural resources had until then always been, or were assumed to be, available in abundant quantities and the negative effects of economic growth on the natural environment were often neglected or regarded as temporary inconveniences to disappear with the advancement of technology. After decades of continuous decline in and insisting pollution on the natural environment, some economists fundamentally broadened the scope of research by extending the definition of capital. The traditional classical approach defines labor and capital as the primary factors of production, however, environmental, natural resource and ecological economics include natural capital into the production function. From that moment, ecosystems such as forests, rivers, oceans and the atmosphere gradually started to become a scarce input in the economy.

The subject of this thesis is built on the premise of the existing trade-off faced by many developing countries: the trade-off between growth in national income and decline in biodiversity and ecosystems. To foster growth in national income (and fight poverty) agricultural, industrial and urban developments are promoted. This requires large quantities of scarcely available land and to make more land available, natural vegetation, often valuable both in economic and biological terms, is converted for human use. This results into the decline of pristine natural capital of high conservation value, ecosystems and biodiversity. In this thesis we will use biodiversity as a first indicator of the presence of different (valuable) ecosystem goods and services.

In the discussions about the conversion of 'nature' into development, natural capital, ecosystems and biodiversity are often used interchangeably. These terms are indeed closely linked, but have different interpretations and not always inter-exchangeable. *Natural capital* is a term used in economics to refer to the stock of available natural resources under, on or above the surface of the earth. *Biodiversity* forms the foundation for ecosystems and nowadays mostly associated with and mentioned in discussions about the decline of the quality of the natural environment. It is a term used to indicate the diversity of ecosystems, the variability or species richness in a certain area and appeals to the imagination of many when the extinction of flora and fauna is discussed. *Ecosystems* is a biological term and denotes a (semi) independent, dynamic complex of plants and animals functioning as one unit. Ecosystems provide humans with goods and services to make living on earth possible (*ecosystem goods and services or EGS*).

In pursuit of economic growth, pristine natural capital is sacrificed for human-interfered natural capital in order to extract benefits of one specific ecosystem good (mainly in the form of mono plantations for example to produce palm oil), as the result of which biodiversity in one or more ecosystems and the goods and services they provide disappear. One reason for this substitution is that this specialization is in the short run more productive for firms than keeping the ecosystem intact while producing several ecosystem goods and services. To put it differently, the maximization of the private benefits derived from the production of *one* single ecosystem good (e.g. palm oil) does not necessarily imply the maximization of the *sum* of all social and private costs and benefits derived from the ecosystems impacted by the investment. Hence, the social costs associated with this specialization and the loss of related ecosystem services (storm protection, water supply, food security, etc), whether born by current or future generations, are seldom taken into account neither in market prices for (tradable) goods nor in cost-benefit analyses for private investments. Another reason for the preference for human interfered natural capital over pristine natural capital is that the markets for ecosystem services fail in quite a number of aspects: for many services markets simply don't exist or the services, such as the protection against natural hazards, are public by nature. Another reason is that private property rights often cannot be allocated as many ecosystem services aren't divisible nor transferrable. Finally, external effects spill over from other markets negatively affecting the level and quality of ecosystem services. As a consequence of these market failures, social costs are not reflected in market prices of ecosystem and leads to an inefficient allocation of ecosystem goods and services. If on the other hand

the social costs of the decline in ecosystems were incorporated into the market prices of other goods and services, these prices would be closer to their shadow price equivalents and ecosystems would be used more efficiently and sustainably.

Most contemporary research, policy making and action to protect the natural environment against further degradation has been initiated by governments, international agencies and non-governmental organizations, which amongst others resulted into stricter environmental legislation (e.g. against emissions), the introduction of a cap-and-trade system for carbon credits and the creation of protected areas. These measures either make the conversion of nature illegal or aim to correct market prices for social costs. However, if the private sector starts being more actively involved in the protection of ecosystems (whether as profit seekers, corporate social responsibility adherents or as the result of government intervention) significant amounts of private capital, knowledge and expertise will be released to support ecosystems. In the context of this thesis the question is if this can lead to investments with lower or no degradation of biodiversity, while the same level of development would be created. The most effective enticement for the business community is to show a business case can be made by investing in ecosystem supporting practices. Note however that investing in ecosystems is not a new phenomenon: organic agriculture is an old practice, and from the 1960s onwards public/private partnerships and NGO's started to actively promote organically produced c.q. fair trade coffee and bananas, amongst others, albeit at a very small scale.

How the protection of biodiversity and ecosystems can be supported by the private sector is our main focus in this thesis. In particular, we will present two types of markets for private investment opportunities in biodiverse ecosystems that create financial returns to investors by: (**A**) trading of **public ecosystem services** (e.g. carbon credits and biodiversity credits); if financial returns can be made out of standing forests by the trading of this type of services, (semi) pristine natural capital becomes a more attractive alternative for human interfered natural capital, so that the rate of substitution will be brought down and a market for certain ecosystem services is created and (**B**) **ecosystem goods under sustainable management** (e.g. certified agricultural products such as wood and food); this internalizes social costs arising out of the harvest of traditional goods. We will do this by examining several (agricultural) markets with high potential and by exploring the role of a crucial actor in the private sector, namely financial institutions and development banks in particular. Note that the underlying drivers for these sustainable private sector investments include consumers caring for sustainably produced products, producers interested in sustainably produced products, producers who see business opportunities in the ecosystem markets and stakeholders such as NGO's trying to influence consumption and production preferences.

We focus at the private sector as in most development countries *social* costs and benefits play no role when making investment decisions, partially because government institutions are weak and don't require social costs and benefits to be taken into account, and partially as such information is not available. At the level of investment decisions, there are two main drivers for investors (also called project developers or project sponsors) and its financiers (banks, institutional investors and insurance companies) to base their decisions on: (A) **risks** and (B) **financial returns**. Most of the biodiversity is located in developing countries, which investors consider a high business risk environment in terms of institutional, legal, political, environmental and social risks. In order to be persuaded to come to positive investment decisions, a high ex-ante internal rate of return expectations in the range of 15% to 30% is often required. The requirement to strive not only for financial returns but also environmental (biodiversity) and social returns, adds even more complexity to investment decisions. Most markets for sustainably produced ecosystems goods and services, are still small scale and in an early stage of development. Nonetheless, growth rates are high and therefore promising.

Why is the role of (development) banks relevant in this context? First of all, most abundant ecosystems under threat are located in developing countries in Asia, Africa and Latin America. Thus, markets for ecosystem goods and services will be closely affected by market practices and regulations in these developing countries, which, according to Western standards, are challenging in terms of (mal functioning) institutions, corruption and market failures. Thanks to their knowledge of local markets and international risk management standards, development banks play an important role in the financial sector of developing countries. Long term capital is still relatively scarce in developing

countries, because commercial banks are often not willing to make substantial and long term investments. Developing banks, set up to make long term capital available, can therefore often chose the markets and companies they want to support. This means they are also able to set higher than commonly practiced environmental and social conditions on their investments. We will describe the role of development banks and to what extent they are suited, through their investment policy, to help stop the continuing decline in the natural environment, biodiversity and ecosystems.

1.2. Research Questions

Given the current trade-off in many developing countries between (i) economic growth these countries aim to achieve and (ii) the decline in pristine natural capital this brings about, we aim to formulate answers to the following questions:

1. What are the market failures in markets for sustainable ecosystems goods and services?

2. Which private markets for (A) public ecosystems services and (B) ecosystem goods under sustainable management are most promising for the private sector to invest in to create a win-win situation for (i) the private sector in terms of sufficient financial return and (ii) the natural environment in terms of protecting biodiversity?

3. To what extent are financial institutions and, in particular, development banks suited to help halt the ongoing reduction in biodiversity in developing countries in their pursuit to spur economic growth?

4. Based on an a conceptual framework, two case studies will be presented, each a private sector enterprise, that aim to (i) create sufficient financial returns for the investors, (ii) increase the standard of living for the local community and (iii) create environmental support for the local ecosystems. The following questions will be answered:

    - Question 4A - for case study 1 - the Eco-Enterprises Fund I (an existing fund, US$ 6 million in size): what Internal Rate of Return is feasible when making sustainable investments in (start up) small and medium sized enterprises located in buffer zones of areas with high biodiversity value? The *methodology* used is an ex-post evaluation.

    - Question 4B - for case study 2 - what Internal Rate of Return is feasible for a REDD project in Tanah Papua (Indonesia)? The *methodology* used will be an ex-ante evaluation.

5. How can the Dutch government contribute to an enabling environment in developing countries to monetize and transfer public benefits into private cash flows while promoting more investments in biodiversity supporting ecosystems?

We approach the research questions by:

1. An analysis of the market failures in markets for sustainable ecosystems goods and services;
2. An analysis of markets for sustainable ecosystem goods and services that may offer attractive investment opportunities for the private sector and a description of the role (development) banks can play to stimulate investments in these markets;
3. A cash flow and risk analysis of two case studies, where development banks fulfill a pioneering financing role, aiming to counter the trade-off between private sector benefits and the conservation of biodiversity.
4. An analysis of the social and environmental effects of these two investments.

1.3. Lay out of this Thesis

In this thesis we will formulate answers to the five research questions as presented above. Chapter 2 formulates the background in which this thesis has been written and describes the global context of the ongoing decline in biodiversity. Chapter 3 explains the failures in the markets for biodiversity and ecosystem goods and services that contribute to a continuing decline in biodiversity. Chapter 4 describes two sets of markets that that reduce certain failures in the markets for ecosystem goods and services and support the conservation of biodiversity, while chapter 5 explains the supporting role developing banks can play to further develop these nascent markets. Chapter 6 analyzes two real case studies that aim to deliver financial profits and also show a good environmental and social performance. The thesis ends with certain conclusions and recommendations in chapter 7.

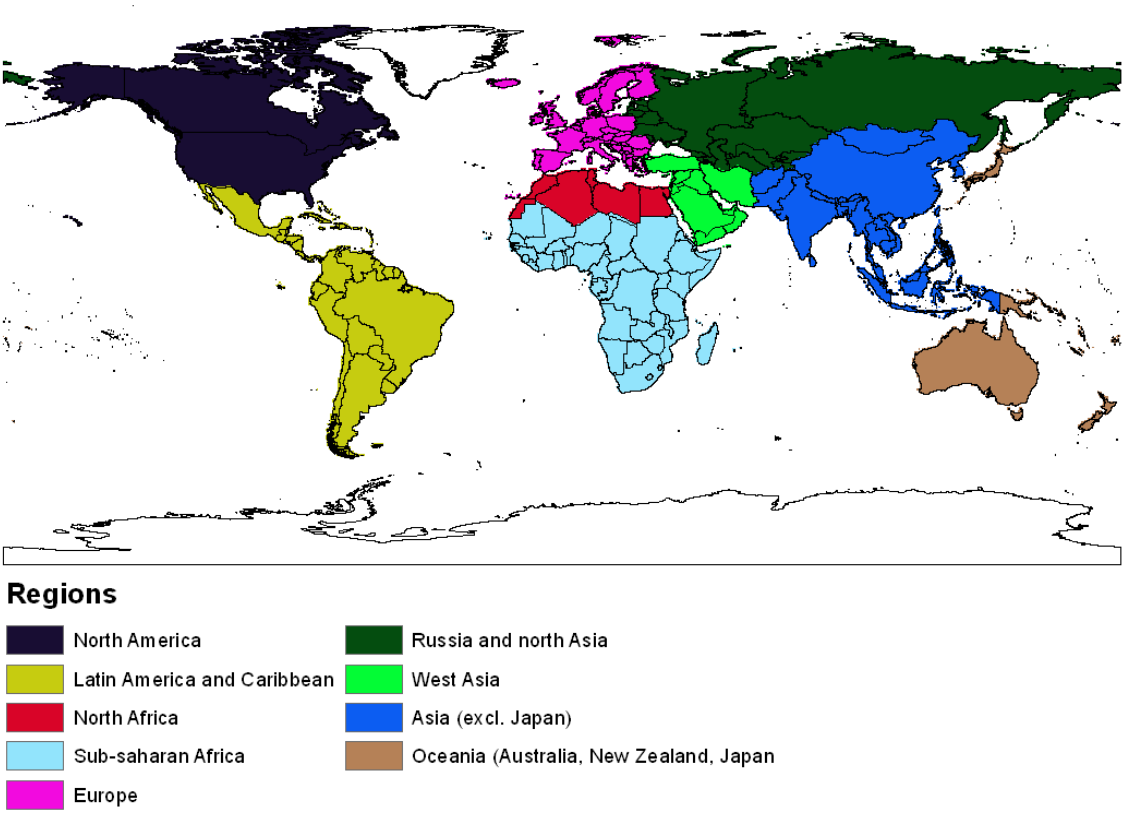
2. Cross Roads of Life on Earth

2.1. Introduction

As an introduction to and problem setting in which this thesis has been written, we will present an influential report that was published by the Netherlands Environmental Assessment Agency (NMP, Natuur- en Milieu Planbureau) in 2007. The report, commissioned by the secretariat of the Convention of Biological Diversity (CBD), is titled "Cross-Roads of Life on Earth, exploring means to meet the 2010 Biodiversity Target[1]".

The Convention of Biological Diversity was established in 1993 as an off spring from the 1992 Earth Summit in Rio de Janeiro and forms an international legally binding treaty in which its signatories commit to (a) conserve biological diversity or biodiversity, (b) use its components sustainably and (c) share the benefits arising from genetic resources fair and equitably. Given the rapid pace of global declining biodiversity, the members agreed on a '*significant reduction in the current loss of biological diversity by 2010'*.

The report describes, with respect to the nine globally defined regions (see picture 1 below), the current state of biodiversity, future developments and the impact certain policies will have on the level of global biodiversity in the period 2000-2050.



Picture 1: Nine biodiversity regions

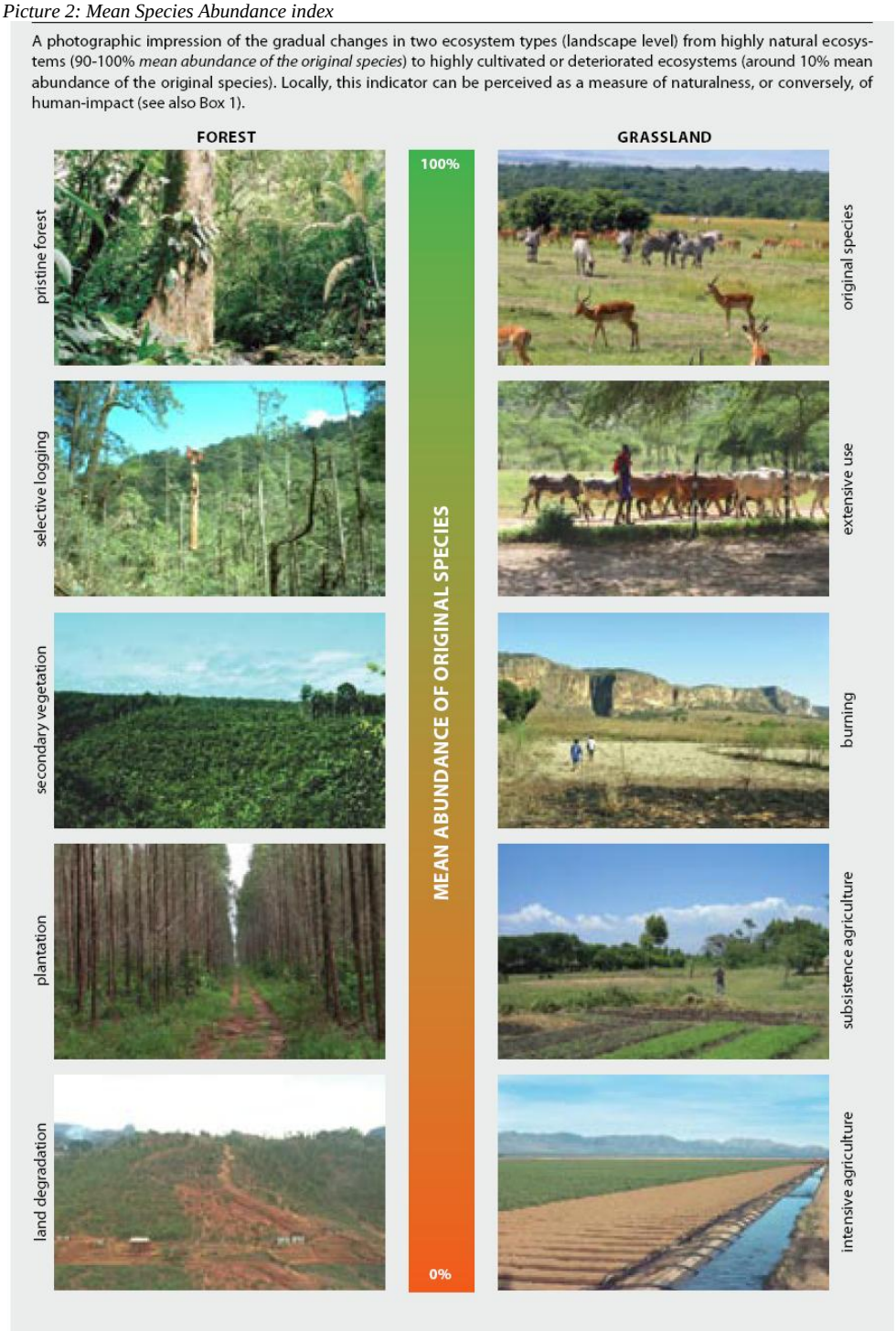
2.2. Mean Species Abundance

The indicator used in this report to measure biodiversity is the so-called *Mean Species Abundance of the Original Species (MSA)*, which is an indicator measuring the abundance (population size) of a

[1] CBD & MNP (2007)

number of selected key species (both fauna and flora) in a certain area or region. The MSA index tracks the degradation process of certain selected fauna and flora in comparison with its original or low impacted state. The indicator flows between 0% (complete degradation) and 100% (natural or low-impacted state). For example, if the MSA is 75%, this means that the average abundance of the original species in that specific region is 75% of the natural or low-impacted state. The picture below (CBD & MNP, 2007) gives a visual overview of the MSA index (from 0% to 100%) for grass land and forest.

Picture 2: Mean Species Abundance index



2.3. Baseline Scenario and Policy Options

In the report, the baseline scenario describes the evolution of the biodiversity target for 2010 in the period 2000 – 2050 under a business as usual model, including the following assumptions:

- Autonomous demographical developments: the global population will grow from 6.1 billion in 2000 to 9 billion in 2050;
- Social economic developments: the global average income will increase from $5,300 to $16,000 per capita, resulting into a fourfold increase in global GDP in the first half of the 21st century;
- Primary energy consumption increasing from 400 EJ to 900 EJ in 2050, with a continuous reliance on fossil resources (coal, oil and gas) and rising emissions of greenhouse gases, leading to a rising world temperature. After the implementation of the Kyoto Protocol for 2008-2012, no further measures are taken and implemented at the baseline;
- Following the larger global population and higher available income, there will be a sharp increase in agricultural output as (poor) people will take in more calories with a shift towards more animal products. Increased agricultural output will stem mainly from higher productivity of the agricultural sector. Although not included in the baseline scenario, more pessimistic scenarios predict conversion of natural to agricultural land, with an estimated conversion rate ranging between 8% and 23%. This implies that higher productivity in the agricultural sector is of key importance in the coming decades;
- Rising timber demand will be met by production from use of (semi) natural forests, including logging and deforestation;
- A stable protected area of 10% of global (non-water) surface.

The following six policy options, based upon discussions and studies from international bodies such as the WTO, CBD, IPCC, UNFCCC and FAO are used to determine the effects with respect to the baseline scenario (as measured by the MSA) development:

1. Liberalization of the global agricultural market, leading to a shift in production from the high productive markets in the USA and Europe to low productive but low-cost regions in the developing regions in Asia, Latin America and, albeit to a lesser extent, Africa;
2. Alleviation of extreme poverty and hunger in Sub-Saharan Africa by additional economic and technology support, in combination with the liberalization of the global agricultural markets;
3. Limiting climate change, through a stringent application of measures aiming to comply with the UNFCCC goal of a maximum temperature increase of 2 degrees Celsius. One of the means to do this is by conversion of both agricultural and natural areas into bio-energy producing areas (bio fuel production);
4. Sustainable meat production, to be attained through stringent requirements on animal welfare and nitrogen deposits. This will increase production costs and reduce meat consumption;
5. Increasing the area of plantation forestry that lead to more efficient wood production areas and less pressure on (semi-) natural forests;
6. Increase the size of protected areas from 10% to 20% of the earth's land surface.

Please note that only the effects of the individual policy measures have been determined, not a combination of one or more policy measures.

The following paragraphs will present the results of the baseline scenario and the six policy option, both on a global and on a regional level. Note that all in/decreases are measured in absolute levels compared to the baseline level, not in relative changes. The table below summarizes the changes in numbers.

Biodiversity Level Region	2000	2050	Baseline Loss	*Option 1* Trade Lib	*Option 2* Africa	*Option 3* Climate	*Option 4* Meat	*Option 5* Forestry	*Option 6* Protected Areas
North America	75%	65%	-9,2%	1,4%		-1,5%	0,7%	-0,3%	1,0%
Latin America	66%	59%	-6,2%	-5,4%		-1,6%	0,7%	0,0%	0,5%
Sub Saharan Africa	73%	61%	-11,7%	-3,7%	-5,7%	-1,7%	-0,2%	0,4%	0,8%
Europe	45%	33%	-11,4%	4,2%		-0,2%	0,6%	-0,6%	1,1%
Russia and North Asia	76%	71%	-5,1%	-0,1%		-2,0%	0,6%	-0,4%	1,2%
West Asia	76%	72%	-4,0%	-0,7%		0,2%	0,1%	0,0%	1,6%
South and East Asia	55%	46%	-9,0%	-0,3%		0,4%	0,3%	0,8%	1,3%
Oceania and Japan	78%	74%	-4,3%	-0,1%		-0,6%	0,1%	0,0%	2,9%
World	**70%**	**63%**	**-7,0%**	**-1,3%**	**-1,7%**	**-1,0%**	**0,3%**	**0,1%**	**1,1%**

Table 1: baseline biodiversity loss and the effects of 6 policy options (CBD & MNP, 2007)

2.4. Outcomes Baseline Scenario for the world as a whole

In the year 2000, the MSA-index has dropped 30% compared to the year 1700 as the result of natural land conversion to arable land, high population growth, human settlement, infrastructure, fragmentation and pollution. Under the baseline scenario, the level of biodiversity drops by a further 7% from 70% to 63% in the period 2000-2050. Most affected regions are drylands (grasslands and savannah), followed by tropical forests and tundra. Dominant factors for further loss are infrastructure (plus related settlement) and climate change.

The model assumes a significant improvement in efficiency in agricultural production, leading to a stable share in biodiversity loss. If this will not happen, the reduction in biodiversity will be another 1%-4%. A key factor in the mitigation of biodiversity loss will therefore be the enhancement of agricultural productivity.

2.4.1. Global effects of the policy options over the period 2000-2050

The main conclusion of the report is that, as a result of the ongoing pressure from increasing global population and global economic growth, the loss of biodiversity is very likely to continue at an unchanged pace, with or without the widely debated policy options. Therefore, the 2010 target of the Convention of Biodiversity, a significant reduction in the loss of biodiversity, is unlikely to be achieved.

The protection of natural areas (policy option 6) and sustainable meat production (policy option 4) have positive effects on the level of biodiversity, however, this is not enough to compensate the loss caused by the primary driving factors. However, the liberalization of agricultural markets (policy option 1) , poverty alleviation in Africa (policy option 2, also in combination with the liberalization of the agricultural markets) and limiting climate change (policy option 3) lead to significant losses of biodiversity.

Annex V describes regional effects in some more detail.

2.5. Conclusions

In the period 1700-2000, the level of biodiversity, as expressed by Mean Species Abundance, has dropped by 30%. The reasons for this development were natural land conversion to agriculture land, infrastructure investments, high population growth, human settlement and pollution.

It is unlikely that the Convention on Biological Diversity 2010 target, where member countries have agreed on a '*significant reduction in the current loss of biological diversity*' in 2010, will be achieved. More concretely, it is expected that in the period 2000-2050, global biodiversity will drop further from 70% to 63% of the original non or low impacted level. The main drivers behind this loss are an estimated global population growth of 50% and a quadrupling global economy, both leading to increased demand for food, fodder, energy, wood and infrastructure. More specifically, in the period 2000-2050, biodiversity will be particularly affected by the negative effects of climate change and infrastructure plus related settlement. Most affected regions are drylands (grasslands and savannah), followed by tropical forests and tundra. In the model it has been assumed that as a result of significant improvements in agricultural productivity, the global amount of arable land will not increase. If this productivity rise will not occur, biodiversity is likely to drop by another 1%-4%.

The effects on biodiversity of six, commonly agreed as feasible, policy options, stemming from reports and debates from large international forums and organizations, have been analyzed. It can be concluded

that a further drop of the biological diversity will result from a global liberalization of agricultural trade (-1.3%) and significant poverty reduction in Sub Saharan Africa (-1.7%). Further, climate change mitigation measures will lead to a further drop in biodiversity (-1%) as the production of bio-fuels, leading to an increased demand for agricultural areas, will outweigh positive results from a slower rise of world temperature. Most positive effects on biodiversity are to be expected from a doubling of the size of natural areas (1.1%) and sustainable meat production (0.3%).

Effects differ from region to region. In Africa, Latin America and Asia most losses, mainly in tropical savannah, grasslands and tropical forests, result from higher demand of agricultural products leading to drastic increases of arable land. This is only partially mitigated by smaller European and North American production amounts of agricultural products. Russia and North Asia mostly suffer from the effects of climate change, especially in the vast areas of boreal forests and tundra. Also North America will see its boreal and temperate biomes threatened by climate change and an increase of its agricultural land surface. European biodiversity suffers mainly from a conversion of natural to agricultural land.

Based on the report "Cross-Roads of Life on Earth, exploring means to meet the 2010 Biodiversity Target" as published by the Netherlands Environmental Assessment Agency it is clear that significant efforts need to be undertaken to commit to the COB 2010 target of a significant reduction in the loss of biodiversity. It is also widely agreed that without the involvement of the private sector, given the vast amount of people, knowledge, technology and capital available in that sector, it will be rather difficult to achieve the halt of further decline in biodiversity and ecosystems. This forms the background of this thesis as we will explore which markets are instrumental in preserving biodiversity and what role development banks can play.

3. Ecosystems & Biodiversity Loss: A market failure

3.1. Introduction

In this chapter, we will answer question 1 from chapter 1 (Introduction):

Research question 1:
"What are the market failures in markets for sustainable ecosystems goods and services?"

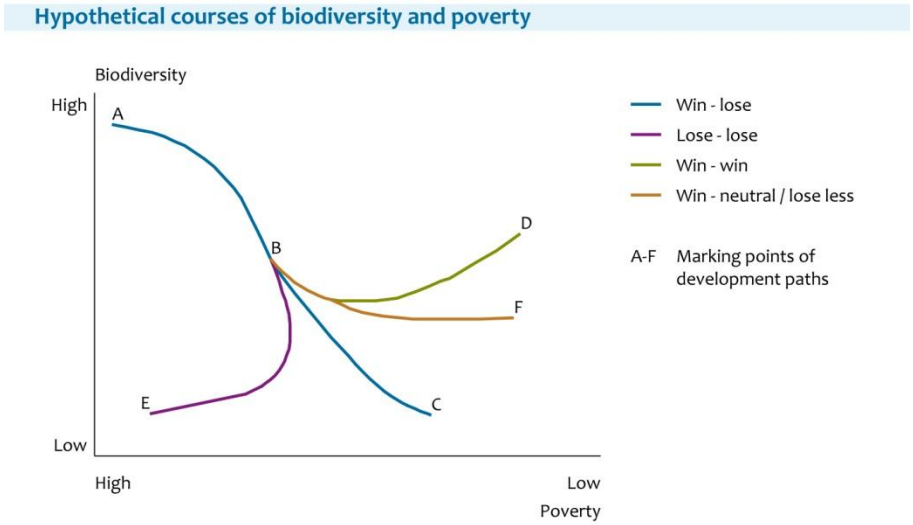
In order to understand the market failures in the markets for ecosystems goods and services, we will first explain in this chapter the trade off in developing countries between economic growth and the decline in pristine natural capital (section 3.2). Without significant pressure on the natural environment stemming from the preference for economic growth, there would most likely be no market failure in the markets for ecosystem goods. Section 3.3 continues with some relevant concepts in environmental and natural resource economics. Section 3.4 covers the ultimate purpose of this chapter, the analyses of the market failures in the markets for ecosystem goods and services. Sections 3.5 and 3.6 explain why substitution of the natural environment by physical capital is not the solution (section 3.5), especially if we deem sustainable, non-declining consumption and production important for future generations (section 3.6). However, before we go into the economics of the relevant market failures, we present the cause of all this, the trade-off between biodiversity and economic growth. If land, pristine natural capital and ecosystem services had not been scarce and were not affected by economic growth, the loss of it would be much less of a concern from an economic perspective. From an ecology perspective, it still could, as people from various disciplines object against the anthropocentric view towards the world, and point at the intrinsic value of plants and animals that would also have a right to exist on their own.

In economics, *natural capital* is an specification of the term "capital" referring to that part of capital generating ecosytem goods and services provided by the natural environment. We will assume that natural capital contains all goods and services provided by ecosystems. *Pristine natural capital* refers to natural capital generating all ecosystem goods and services in its non-impacted pristine state, while *human interfered natural capital* refers to the natural capital generating ecosystem goods and services after it has been affected by human inteference. If natural capital is mentioned without specifying whether it is pristine of human-interfered, it generally refers to the non-impacted state, while human interfered natural capital is then often included in *physical capital*, by definition created by man.

3.2. Trade-off: Biodiversity vs. Economic Growth

After some severe financial crises in the 1980s and 1990s, most developing countries in Latin America, Asia and Eastern Europe, and to a lesser extent the African continent, go through a period of abundant economic growth. Especially China and India, accounting for over a third of the world population, successfully manage to improve –in terms of GDP per capita – the lives of hundreds of millions of people. This growth however, as we learnt in chapter 2, goes at the cost of vast areas of natural vegetation, for a number of reasons. First, land is a scarce good and much in demand to expand urban centers to locate industries, businesses and build residential areas. Second, many developing countries are located in a temperate (sub) tropical zone with good circumstances to grow cattle and/or harvest other agricultural products such as timber, (palm) oils, fruits & vegetables and fuel crops, which are mostly exported to the more developed countries. The land needed for all these economic activities is obtained, supported by many governments that often provide significant tax cuts or subsidies, through the conversion of natural vegetation, such as tropical & subtropical forests and savannahs. This natural vegetation is valuable both in economic and biological terms, so that the conversion of natural areas leads to a decline in pristine natural capital, ecosystems and biodiversity.

The following diagram helps us to understand it conceptually (Tekelenburg, 2009). The diagram describes hypothetical courses between biodiversity and poverty (where GDP per capita can be used as a proxy for poverty):



Picture 1: hypothetical courses of biodiversity versus poverty (GDP per capital)

*Development path **A→C*** represents a win-lose relationship of biodiversity vs. poverty c.q. GDP per capita. Through gathering and hunting (local) people intervene in the original ecosystem, first by converting it into extensive agriculture and then into intensive agriculture. Often this intermediary step of extensive agriculture is skipped for example when large-scale palm oil plantations or cattle grazing fields are created on intact natural forests. Original species are replaced by more productive species, enlarging the production of goods and revenues streams. If population growth is less than growth in GDP in the area, GDP per capita will increase and poverty will reduce at the expense of biodiversity. After this period of development at the cost of biodiversity, society may choose, for example incentivized by government policy or the business community itself, abatement measures to restore biodiversity. This is depicted in d*evelopment path **B→D***, which is sometimes referred to as the green Kuznets curve: the production of goods increases and biodiversity is restored. Under the condition that the growth in the production of goods is higher than population growth, GDP per capita increases and poverty is reduced if profits are equally distributed.

However, society may not be willing or able to afford abatement measures. *Development path **B→E*** describes a lost biodiversity and reduction in GDP per capita relationship where the destruction of ecosystems brings about a collapse of productive capacity due to depletion of water and energy resources and soil degradation in combination with loss of key species. A loss of productive capacity goes hand in hand with a reduced production of goods. Unless the reduced production is compensated by a reduction in human population or alternative employment is created, GDP per capital falls and poverty increases.

*Development path **B→F*** is an intermediate path between ***B→C*** and ***B→D*** where GDP per capita increases at a lower cost of biodiversity than paths ***B→C*** and ***B→E***. Note that above pathways can also move in the opposite direction: starting from a degraded region in terms of biodiversity and poverty, more biodiversity combined with higher GDP per capita can be actively set in motion by support form outside in the form of (i) capital inflow, (ii) skills and technology or more passively by outward migration.

Biodiversity restoration or avoiding biodiversity loss supported by private capital inflow and combination with the import of skills and technology is what we will see in the case studies in chapter 6 of this thesis.

Although most natural areas belong to the government and very few are privately held, several groups suffer from the decline in supply of ecosystem goods and biodiversity. First, the rural poor are often much dependent on the products the natural environment provides to them. We will elaborate about this in the next section. Second, while nature conservation has opportunity costs at the local level, biodiversity is a global public good. Western governments and (local & international) NGO's, point at the destructive and irreversible effects of the degradation of nature that have also a global impact, for example the extinction of known and not yet known plant and animal species, loss of future pharmaceutical products and global climate change. These are all services that will be identified as 'ecosystem services' in section 3.3 from which the local, regional and even in certain instances, e.g. carbon storage and climate regulation, the global community as whole profit and the decline of which creates negative external effects. Although it is recognized that biodiversity is a global public good, there is a mismatch between the locations of diverse biological resources and the many beneficiaries of biodiversity conservation, which is most articulate in developed countries. However, it would be morally difficult to argue that already developed countries, which degraded their own natural environment in the past 200 years, are entitled to the pristine natural capital and ecosystem services created in the developing countries without a proper compensation mechanism for the opportunity costs. To the contrary, see for example Bulte (2006), it would be more logical for developed countries to compensate developing countries for missed income if they were to chose pristine natural capital over human interfered natural capital and economic growth in favor of the developed world.

Before we discuss market failures in the markets for biodiversity and other ecosystem services, we will first discuss that a conversion of pristine natural capital into human interfered natural capital does not necessarily lead to economic growth if a more inclusive definition of economic growth is used, nor to a reduction in poverty in developed countries, which is often the principal argument for the conversion[2].

3.2.1. Trade-off: Growth in GDP vs. Growth in Productive Base

In most economic literature, the *Gross Domestic Product (GDP)* indicator is used to measure economic growth. A country's GDP measures an economy's total output and equals the value of all final goods produced in a given year or equivalently, the sum of everyone's incomes (wages, salaries, profits, interests and government income). Dasgupta (2006), amongst others, argues that GDP is a flow rather than a stock indicator neglecting an important part of a country's capital: the decline or increase in pristine natural capital. Instead, he suggests using the productive base as an alternative measure for a country's wealth[3], which is the stock of all of a country's capital base (which is the sum of social capital ("people"), natural capital ("planet") and human capital, collectively the basis for "profit") and the quality of its institutions. A country's wealth decreases or increases to the extent that its productive base contracts or expands. GDP measures growth in income, but unjustly disregards changes in stock. A country's GDP may therefore grow while its productive base decreases (a reduction in one form of the capital base is not compensated by another form or by improvements in institutions); hence it loses parts of its wealth.

Dasgupta (2006) calculated the productive bases, corrected for population effects and using shadow prices, of a number of developing countries (Bangladesh, Nepal, India, China, Sub-Saharan Africa) and developed countries (UK, US) over the period 1970-2000. He concluded that for all developed countries but China the increase of wealth in terms of its productive base was considerably lower than in terms of

[2] We note that a detailed discussion on distributional effects of land degradation vs. economic growth falls outside the scope of this paper (see for example Clive et al., 2002 for distributional effects of the agri-business in Brazil).

3 Please note that wealth is a highly debated concept and contains all three elements of People, Planet and Profit. If all these three P's benefit from certain developments, the wealth of a society is said to increase. An in-depth discussion falls outside the intent of this thesis.

GDP per capita. This was due to net losses in the capital base (losses in natural capital exceeded gains in human made capital) and losses in the quality of institutions, especially in Africa. In China, the average economic growth in GDP per capita equaled growth in productive base per capita (7.8%). For the two developed nations (the US and the UK), the growth in GDP per capita and in productive base per capita were of the same order, however, incorporating other parameters such as the greenhouse gas effect might also lead to the conclusion that de productive base in developed countries has decreased during the last 30 years of the previous century.

This analysis gives us the insight that the conversion of (pristine) natural capital into human interfered capital may lead to more income, but reduces the overall wealth of a country. It is like a company showing an income statement with an impressive net profit, without the balance sheet. The net profit could have been created by selling of crucial assets, pre-empting future cash flows and future means of living. It is likely that this pre-emptive asset sale phenomenon has happened over the period 1970-2000 in many developing countries. On a more micro level, Solórzano at al. (1991) showed a similar result: they calculated that in 1989 in Costa Rica the depreciation of forests, fisheries and soil accounted for 10% of overall GDP and about one-third of total capital accumulation. Net changes in capital would have wiped out the positive economic growth, had it been included.

In conclusion, in developing countries, the trade-off between economic growth and natural capital is often settled in favor of economic growth. It creates income and rising GDP per capita and they probably had no choice but to sell natural assets to create short-term income. However, besides the negative externalities for other countries, it goes at the cost of long-term production capacity and therefore wealth of the developing countries. We will come back to this in section 3.6 below.

3.2.2. Trade-off - Distributional effects of the decrease in natural capital

Even if a developing country shows overall positive economic growth, the question rises whether also the poor profit from this economic progress. Dasgupta (1993) shows this is often not the case. Note that most economies in the developing world are biomass based subsistence economies where poor folk make a living out of products directly obtained from animals and plants. Most labor is conducted in close proximity of the natural environment where working hours are spread between (i) cultivation of crops, (ii) fodder collection and (iii) a combination of fuel collection, animal care and grazing. The neglect of the environmental base in GDP calculations provides a misleading picture of productivity in rural areas and a deterioration of the natural environment negatively affects the rural poor in a number of ways. Firstly, less nature means less fuel wood for cooking and fodder to feed animals. Secondly, a reduction in biomass implies more water evaporation. In the drielands of the Sahel for example, only 10% to 20% of yearly rainfall is used to grow crops, the sun evaporates a substantial part of the remainder. A reduction in the biomass enhances this effect even further, while making water a scarcer good. Besides evaporation, available water dwindles due to deforestation (lower ground water level) and land degradation (lower carrying capacity of water). A reduction in nature has also gender specific consequences. The collection of water, fodder and fuel wood is mainly a task for women and children. They already spend up to 5 hours per day for water collection alone. Less nature means even more hours spent on the collection of these basic needs.

In some countries, the poor own private assets in the form of land and animals, but very often depend on public goods such as open resource bases (the sea, a lake or a forest) and common property resource bases (a water well, cultivated land, mulch & draught animals, agricultural equipment etc), see section 3.3.3 for some elaboration of these two public goods. Especially in arid, mountainous and unirrigated zones (but less in humid zones and river valleys) non-trivial portions of income are derived from common property resource bases. During the 1980s in India for example (Dasgupta (1993)) this accounted for 15%-25% of family income. A decline in nature also leads to the degradation of certain common property resources specifically affecting the poor. Again in India, during the 1970s and 1980s, privatization of land, allocated

to rural non-poor and converted for cropping and grazing, lead to a 26%-63% decline in common property resources eroding family income of many poor. Common property resources were further affected by increased desertification.

The disappearance of common property resources did not lead to more inequality only in India. During the 1960s and 1970s in Brazil for example, vast areas of ecological zones were transformed into pastureland to increase the beef cattle production. This was stimulated by the government through tax incentives, the provision of infrastructure and by loans from international agencies like the World Bank. Although beef exports to North-American fast food chains increased exponentially, the protein intake by the rural poor declined.

These examples in India and Brazil illustrate that a preference of human-interfered natural capital over pristine natural capital may lead to higher GDP per capita in developing countries, but also cause, due to their dependence on the natural environment, a drop in family income of the poor and longer working hours.

Now that we better understand the background of the trade-off between growth and nature and its pitfalls, we will move on to the identification of certain market failures in the markets where 'nature' and 'nature-related' products are traded. Before we zoom in on the market failures in the provision of nature related goods and services, we present some necessary principles of welfare economics in section 3.3. taken from Perman et al. (2003).

3.3. Principles of Welfare Economics

3.3.1. Efficiency

Economics, or better, *welfare economics*, deals with efficient allocations of goods and services. We call an allocation (pareto) *efficient* if no person or firm, by a voluntary exchange of the products they use, can be made better off without making someone else worse off. An efficient allocation of resources (both at the level of production by firms and at the level of utilization by consumers) requires three types of efficiency. The first is efficiency in production, meaning that the inputs of capital, labor and natural resources are not used in a wasteful manner. The second efficiency requirement, efficiency in consumption, demands that trading between consumers continues until no further trade making one person better off without making someone else worse off. The third and final requirement is efficiency in product mix: firms produce those products from which consumers profit most.

We would like to point out that efficient allocations of resources are not unique nor necessarily socially equitable. This depends amongst others on the initial endowments of the goods that consumers had before they started trading: a trade between two persons where one person owns significantly more than the other will have a different outcome than a situation of more equal initial distribution. Further, an efficient allocation of resources does not necessarily imply that it is also desirable from an equity point of view. An efficient distribution of goods and services can make one person rich and the other poor. This may be undesirable from a social point of view, but it can reflect a pareto efficient allocation of resources. Hence, efficiency does not say much about equality of distribution.

3.3.2. Efficiency, free market principles and market failure

An efficient allocation of resources does not arise automatically in all markets, but it does so under certain conditions. In a market where all agents are maximizers (i.e. firms aim to maximize profits and consumers aim to maximize utility /consumption) and the market is 'free', trade will result into an efficient allocation of resources. By a 'free' market we mean that it functions according to the following principles:

1. Markets exist for all goods and services produced and consumed.
2. All markets are perfectly competitive: no agent has market force (i.e. no monopolistic power) and all agents act as price takers.
3. There is full and equal information available to everyone active in the market.
4. Private property rights are assigned to all resources and commodities.
5. No externalities exist: there are no positive or negative economic benefits, resulting from a transaction accruing to agents not involved in that transaction, without a compensation to or from the generators of the externality.
6. All goods and services are private, no public goods exist. Consequently, all goods and services are rival and excludable in their use.
7. All utility and production functions are well-behaved (i.e. convex);

Generally, no single market economy will fully meet the above criteria as they are strict and difficult to enforce. Any breach of the above 7 free market principles will in effect lead to a non-efficient allocation of resources. We will call such breach a market failure. In particular, the fifth condition of no externalities has been a subject of many discussions and research in environmental and natural resource economics. In this light, the next section discusses a few relevant concepts.

3.3.3. Market Failure in Natural Resource and Environmental Economics

In natural resource and environmental economics market failures are an important subject of research, mainly because many natural resources and environmental goods provided are public goods and do not or cannot have private property rights assigned to them. As a consequence, externalities, which we defined as a cost or benefit resulting from a transaction accruing to people not involved in that transaction, are widespread. Very often those who undergo negative externalities, do not receive compensation, so that the generator[4] of the externality faces marginal costs lower than socially desirable. Therefore, more of the good or service is produced than had been the case at the efficient level of production. Generally, the absence of private property rights, the nature of the goods (public instead of private) and the arise of externalities often lead to the overexploitation of certain environmental goods and services, especially if provided by open-resource or common-property resource bases.

Consider for example an open-access resource base such as an extra-territorial ocean. This type of ocean does not belong to a particular state, group of individuals or companies. Anyone has unlimited access to it and there is no incentive to save production capacity for the future, because (i) current production is preferred over future production and (ii) free riders would be stimulated to harvest the fish others would have saved for the purpose of future income. Therefore, many oceans are overfished. In other words, the non-excludable nature of marine oceans makes these goods provided by oceans public instead of private goods. As this is a requirement for efficient market allocations in free markets, the fishery market in public, open access resource bases fails.

Another example is the common-property resource base 'air'. A coal fired power plant located in the middle of a city, produces not only electricity, but also toxic gases such as sulfur dioxide, smogging the city and causing health problems to citizens. A negative external effect is inflicted upon the citizens, for which they are generally not compensated. From a social welfare point of view (which aims to take all costs and benefits into account on society as a whole), the marginal costs of the electricity producer are understated, resulting into an oversupply of electricity. One way the government could intervene is by allocating 'clean air rights' to the citizens: the polluter needs to pay the citizens a penalty for every unit of

[4] It is implied here that the generator of the externality is not entitled to create the negative effect and property rights should be assigned to the receiver of the property rights. However, the analysis also holds if the generator receives the rights to cause the external effect, in which case the receiver can compensate the generator for not doing so.

pollution (over a certain threshold). The efficient amount of electricity produced will be there where the marginal benefits of an additionally produced unit of electricity equals its marginal costs, including its pollution costs. If the government were not to intervene, an oversupply of toxic gases would be the result.

The latter example has been generalized in the **Coase theorem** that states that if (i) suitable property rights are assigned, (ii) there are no transaction costs[5] and (ii) all other conditions for free markets apply, then private bargaining between individuals can correct externalies and leads to an efficient allocation of resources. The Coase theorem does not say to whom property rights should be assigned. Whether they are assigned to the generator or receiver of the external effect, private bargaining will lead to an efficient outcome in both instances.

With the above principles welfare and environmental economics in mind, we will now analyse the market failures in nature related goods and services or ecosystem goods and services ("EGS"), as it is in fact ecosystems that provide these.

3.4. Failures in the Market for Ecosystem Goods and Services

Before we explain the basic concepts and categorization of the different ecosystem goods and services, we point out the purpose of this section is to shed light on the market failures in the markets for ecosystem goods and services. There are undoubtedly government failures that lead to the decline and overexploitation of ecosystems, however, that analysis falls out of the scope of this section.

3.4.1. Basic Concepts

The following definitions are based on the Millennium Ecosystem Assessment (2005).

Biodiversity is defined as *"the variability among living organisms from all sources including, inter alia, terrestrial, marine, and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems."*

Key words in this definition are variability and ecosystems. If an ecosystems hosts a diverse group of species it is called biodiverse.

Ecosystems

"An ecosystem is a dynamic complex of plant, animal and microorganism communities and the non living environment, all functioning as one unit."

Thus, ecosystems are biological units, consisting of different types of living organims, that as a whole function relatively independently of its surroundings. Ecosystems are important for humans and the economies they function in because of the ecosystem services (including goods) they provide.

5 Note that in certain negotiations transaction costs are fairly high. This effect weakens the general applicability of the Coase theorem and may prevent an efficient allocation of resources in certain instances.

Ecosystem Services

" Ecosystem services are the benefits people obtain from ecosystems. These include provisioning services, regulating services, cultural services and supporting services".

Note that ecosystem services also include the physical goods including fuels and food. As in economics 'goods' usually include 'services' we will use ecosystem services and ecosystem goods interchangeably, or generally refer to them as EGS.

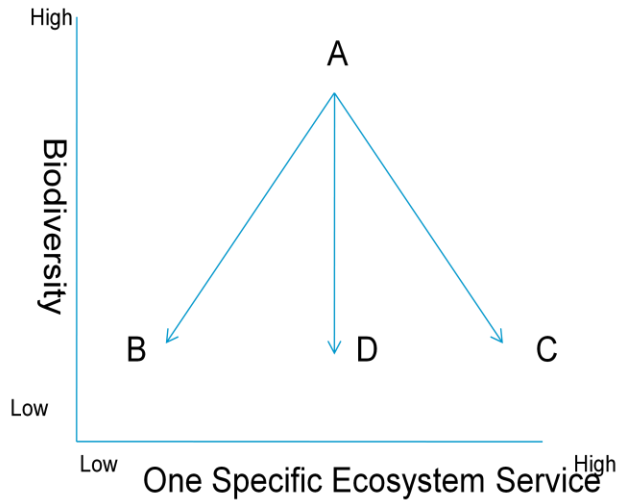
3.4.2. Classification of Ecosystem Goods and Services

Before we discuss the different types of services ecosystems provide to humans, we will give the relationship between biodiversity and ecosystem goods and services.

Relationship between Biodiversity and Ecosystem Goods and Services (EGS)

As we saw in chapter 2, the unprecedented growth in living standards and gross domestic product in developing countries across Asia, Latin America and Africa, has been accompanied by a significant loss of biodiversity. Natural vegetation is converted to create new, scarce land for agricultural, urban and industrial developments. This conversion brings about a loss in the biodiversity, and sometimes even the extinction, of living plants and animals in the converted area. The accommodation of a broad variety of species is an important precondition for nature, or more specifically ecosystems, to provide humans with several goods and services. Some of the plants and animals taken from ecosystems are used for consumption in the form of food, clothes, shelter and medicine. It is also a pool of genetic information from which we can learn about the history of the earth or which we can use for medical treatment. We will see below that ecosystems provide human beings with an array of different goods and services, thereby directly affecting their health and well-being.

Note that biodiversity is therefore not so much an ecosystem service in itself but an important pre-condition for the well functioning of ecosystems. Kok et al (2010) and the Millennium Ecosystem Assessment (2005) explain that, although the exact causal mechanics require further research, biodiversity is an important indicator for the capacity of most ecosystems to deliver EGS, endemic biodiversity is essential for the proper functioning of ecosystems, and the health and well being of human beings. This does not necessarily imply that more biodiversity automatically leads to more EGS, which we will illustrate in a conceptual manner by the following picture (vertically, the level of biodiversity and horizontally the level of one specific ecosystem service).



Picture 2: biodiversity versus ecosystem goods and services

Development path **A→C** versus **A→B**: consider a natural forest, containing amongst other species some palm trees, from which palm oil is extracted, and with abundant other forms of biodiversity. This forest is converted in its entirety into a mono-crop palm tree plantation to increase the production of the ecosystem good palm oil. Development path **A→C** describes the relationship between the level of biodiversity and the ecosystem service "palm oil". As the plantation only contains palm trees after conversion, C represents a situation of higher volumes of palm oil with a much lower corresponding level of biodiversity. Let the ecosystem service on the horizontal axis now represent the "pest regulation capacity". In situation A, the area will be able to sustain and absorb pests, diseases and overpopulation of certain species. Reducing biodiversity implies, through development path **A→B,** the lowering of the capacity to absorb and be protected against distorting species as their natural combatants disappear. So, turning a rain forest into a mono-plantation for palm trees, results into much higher yields for the ecosystem good (food and fuel) palm oil, but goes at the cost of the biodiversity and other ecosystem goods and services produced in the area (e.g. the protection against natural hazards). Hence, the maximization of *one* ecosystem good does not necessarily lead to the maximization of *all* produced (public) EGS. This is generally neglected when making investment decisions regarding the clearing of natural forests. Development path **A→D** represents a development where a reduction in biodiversity has no effect on a specific ecosystem service. Consider for example the ecosystem service carbon storage. A mono-plantation of one specific wood species may have equal carbon storage potential as a multi specie plantation, irrespective of the level of biodiversity it may bring about.

Although it generally cannot be said that an area with high biodiversity always leads to a higher value of ecosystem goods and services compared to an area with lower biodiversity, it is generally assumed that the sum of long-term social net benefits of ecosystem goods produced under sustainable management exceeds the sum of long-term social net benefits of ecosystem goods produced under non-sustainable management. However, despite efforts to value ecosystem goods and services, including those of international TEEB-initiative (the Economics of Ecosystems and Biodiversity, TEEB (2010)) drawing attention to the global economic benefits of biodiversity, so far it has not been possible to benchmark - in monetary terms - (a) the sum of ecosystem goods and services of an area of high biodiversity value and lower private gains against (b) the sum of ecosystem goods and services of an area of lower (degraded) biodiversity value and higher private gains. Therefore, we will make the following assumptions:

1. Loss of biodiversity goes at the cost of certain non-marketed (social) ecosystem goods and services;
2. For long the term sustainability (and survival) of our economic system, a certain level of these non-marketed (social) ecosystem goods and services is required;
3. A first indicator of the level of non-marketed (social) ecosystem goods and services is the level of biodiversity and amount of preserved natural habitat in the area. The more original biodiversity and natural habitat is maintained, the more non-marketed (social) economic goods and services will be preserved.

From this premise, we can say that the level of sustainable management is correlated with the level of biodiversity in the area under management, and therefore biodiversity a first proxy for the non-marketed ecosystem goods and services. From the point of view of the private sector, an investment opportunity with high private net benefits and a low level of biodiversity will, from a short term financial perspective, be preferred over an investment opportunity with lower private net benefits and a higher level of biodiversity as long as the biodiversity benefits cannot be monetized and, if they can be, the cash flow from biodiversity gains outweigh opportunity costs from lower private net benefits.

An example of how a drop in biodiversity can impact the ecosystem as a whole is the reduction of certain important mammals (such as the black panther). If the number of a certain predator drops, the amount of animals the predator eats increases more than what the ecosystem would allow in equilibrium. In turn, the animals eaten by the victims of the predator decrease in number, leading to fewer intake by animals that depend on them. Hence, a domino effect of decline can take place in an ecosystem due to the reduction of orignially one specie. The decline in different types of species, long before they are actually distinct, can already have a strong impact on the ecosystems they live in.

Classification of ecosystem services

Ecosystem goods and services can be classified into four categories: provisioning, regulating, cultural and supporting services. Only those goods and services are included that can be produced sustainably. It therefore excludes non-renewable fossil fuels (oil, gas and coal), metals (such as gold and silver) and minerals (e.g. diamond) as they cannot be reproduced by ecosystems in the foreseable future. Also wind and solar energy are exluded, because, although renewable, they cannot be attributed to a specific ecosystem.

The following classification is based on De Groot et al. (2002) and, for the most part, on the Millennium Ecosystem Assessment (2005).

a) Provisioning services

Provisioning services are the direct material products humans obtain from ecosystems in the form of *food* (plants, animals and microbes), *fibre* (including wood, cotton and silk), *fuel* (such as wood, dung and other renewable natural materials that can be used as source of energy), *genetic resources* (over 3,5 billion year old information is contained in genetic material and genes which humans use (i) to breed animals and plants with certain beneficial charateristics and (ii) for biotechnology), *biochemicals, natural medicines & pharmaceuticals* (many medicines, food additives and biocides are derived from ecosystems), *ornamental resources* (skins, shells, flowers and other plant & animal products are used as ornaments) and *fresh water* (people obtain fresh water from ecosytems to drink it, but also to wash themselves, clothes etc. and to generate energy).

An illustrative example of a provisioning service people obtain from biological diversity and ecosystems is given by Swanson (1995) with respect to the pharmaceutical industry. Swanson indicates that plant characteristics can be divided into primary and secondary metabolites. Primary characteristics of plants determine how efficiently they use inputs to grow. Modern agriculture makes use of those crops that have shown to have positive primary traits. Secondary characteristics of plants determine how well plants are capable of reproducing themselves or surviving in the ecosystems they live in. This is expressed by certain attractors, such as pleasant aroma's from flowers or sweet tastes like hunny, or repellents, that may arise in the form of strong aroma's and toxins. It is mainly these secondary characteristics of plants that humans have significantly profited from even before they understood the workings. For hundreds of years humans have eaten lemons to avoid scurvy. Now we know the effective secondary metabolite in fighting scurvy is the vitamin C contained in the lemons. Further, in the past people used to eat the bark of willow trees for pain relieve. Only recently it was discovered that the effective substance is salicylic acid, nowadays used in the drug aspirin.
In the past, most effective medicine was derived directly or indirectly from natural sources and even today a large proportion of contemporary medicine used throughout the world, including the rich nations, stems from natural resources. Much research in the pharmaceutical industry is devoted to explore the effects of secondary metabolites in plants. It is worth noting that even today the mechanisms behind many chemicals found in natural sources that have demonstrable positive effects on humans are not fully understood by scientists. For Swanson the reduction in pristine natural capital will go along with pharmaceutical opportunity costs and missed medicinal applications. First of all, there are many

substances used in certain cultures that are not yet generally known. Secondly, we have only begun to profit from the abundant range of possibilities the biosphere has to offer and the collective knowledge grasps only a small portion of what there is to know. Reducing ecosystems reduces the amount of future medicinal applications of substances that can be found in ecosystems around the world. This suggests the conservation of biodiversity is of great (future) value to humans. Swanson argues that the main problem is caused by the misallocation of property rights. Property rights are allocated to those who extract information from the ecosystems in the form of patents and the like attributed to pharmaceutical companies. There is nothing wrong with this, as it promotes expensive research. Swanson points out however that those countries who build up and sustain biodiversity are not rewarded for the reservoir of information that is kept in ecosystems they support. Therefore he suggests to not only reward intellectual property rights (such as patents) but also information property rights.

b) Regulating services

The regulation of ecosystem processes provide the following benefits to humans: *air quality regulation* (ecosystems affect the air quality in the atmosphere by adding and extracting chemicals to and from it), *climate regulation* (ecosystems influence both local and global climates; locally, as e.g. land cover impacts local temperature and precipitation; on a global level they play an important role in the emission and sequestration of greenhouse gases), *water regulation* (different land types have different water storage potentials: a wetland for example holds more water than when converted into cropland, which in turn holds more water than urban areas), *erosion regulation* (soil retention and prevention of land slides depend on the vegative cover), *water purification & waste treatment* (ecosystems purify water from organic wastes and detoxify soil), *disease regulation* (changes in ecosystems can increase or decrease numbers of (dengue & malaria circulating) mosquitos or spread c.q. control illnesses such as cholera), *pest regulation* (prevalence of life stock and crop pests is affected by changes in ecosystems), *pollination* (ecosystems determine the abundance and effectiveness of the pollination of plants and trees) and *natural hazard regulation* (certain types of ecosystems, such as mangroves and coral reefs, protect against damage caused by large hurricanes and waives).

c) Cultural services

Ecosystems also provide humans with non-material benefits. People enjoy beautiful views and solitude by being in the wilderness and like to spend leisure time at the sea shore for swimming or simply lying in the sun. Cultural services can be classified as follows: *cultural diversity* (diverse ecosystems are one of the reasons that cultures are different, for example groups of people are formed differently than others by the abundance of certain natural species), *knowledge systems* (ecosystems develop different knowledge systems for different cultures, for example, the science of biology is at a high level in Brazil given its richness in biodiversity), *educational values* (ecosystems provide the basis for knowledge and education in many societies), *inspiration* (ecosystems are a rich source of inspiration for arts, folkclore, architecture, advertisement and many other business sectors), *aesthetic values* (a great number of people enjoy the beauty of ecosystems given the existence of national parks and the development of residential areas with attractive views), *social relations* (differences in ecosystems influence social relations of its inhabitants: nomadic herders differ in their social relations from farmers), *sense of place* (humans enjoy a sense of place out of certain features in their environment), *cultural heritage values* (societies place value on historically important landscapes or culturally significant species) and *recreation & ecotourism* (many people spend their leisure time in certain natural or cultivated landscapes, if only at the seashore).

d) Supporting services

Supporting services differ from the previous thee classes in that they support all other ecosystem services, their effects on humans are mostly indirect and changes in supporting services usually take long to materialize. By contrast, changes in provisioning, regulating and cultural services have often shorter term (irreversible) effects on humans. We categorize supporting services as follows: *soil formation* (the rate of soil formation determines the quality of many provisioning services, and therefore human well-being),

photosynthesis (it is through photosynthesis that oxygen is produced, necessary for species to live), *nutrient cycling* (ecosystems continuously recycle about 20 important nutrients, including phosphorus and nitrogen, that are essential for life) and *water cycling* (water, indispensable for life, is recycled within and between ecosystems).

3.4.3. Market Failure in the provision of Ecosystem Services

A reduction in pristine natural capital implies a reduction in ecosystem goods and services, many of which are essential for human well-being. However, why not rely on the market to guide decisions on the natural source base? Why don't markets sufficiently protect biodiversity and ecosystem services? Several market failures prevent the well functioning of a market for ecosystem services and ignore social costs associated with markets in the close vicinity of ecosystems. We will discuss the most relevant market conditions for an efficient allocation of goods and services identified in section 3.3.2.

1. No direct markets exist for many ecosystem services

Humans need provisioning, regulating, cultural and supporting services in their daily lives, but many of them are not marketed. The big exceptions are the provisioning services *food, fiber* and *fuel*. The issue here is of course that, as explained in section 3.4.2, the production of these provisioning services, mostly produced through the creation of mono plantations, goes at the cost of other provisioning services as well as regulating, cultural and supporting services that are not traded nor marketed. Consider for example the regulating service 'erosion regulation'. Although there is an implicit demand for protection against landslides, there is no specific demand, as people are just used to the fact that it is there for them without having to pay a price for it. In case an area suffers from regular landslides, it may be easier and more effective to build a dam than to try to move or create an ecosystem. Ecosystems are far too complex to move from one place to the other or to set it up within a workable timeframe.

In addition, if markets were to be created, the costs of negotiation and monitoring can be high because of long geographical distances (upland deforestation vs. downstream erosion) or large temporal distances (e.g. carbon emissions will have effects mainly in the distant future).
However, a relatively successful attempt to create markets for ecosystems services is the carbon credit market in Europe and the biodiversity offset market in the USA. We describe them in more detail in chapter 4.

2. Many ecosystem services are public

Many ecosystem services are public services: they are non-rival and/or non-excludable by nature. Although most provisioning services (food, fiber, fuel and water) will be rival in use, certain ecosystems, including oceans, sees and forests are open to the public and therefore non-excludable.

Most supporting, cultural and regulating services are fully public. The regulation of climate, water, erosion, disease, pest and natural hazard are all non-rival nor excludable in their use: the use of one person does not prevent someone else to also benefit from it and no one can be barred from its use. Supporting services (soil formation, photosynthesis, nutrient and water cycling) are either used as inputs for other ecosystem services or produce the publicly available oxygen and water (although the latter can be scarce in some countries). Cultural services such as cultural diversity, inspiration and cultural heritage values are all public in use, however, aesthetic values and recreation & ecotourism can be turned into private goods. People generally pay a premium for a house with a nice view and protest if the view is disturbed. Also the market for ecotourism in wild and remote areas is booming (where transport cost to reach these location can be used as a proxy for the value tourists attribute to the ecosystem)

3. Absent or ill-specified private property rights

Currently, the majority of ecosystems on earth are not privately owned. They are either state owned (including forests, lakes and seas) or do not belong to a particular state (extra-territorial oceans) and are

therefore seen as public resource bases. Governments extend (temporary) permits to the private sector to generate private benefits from certain provisioning services, such as timber and resources for pharmaceutical use or cultural services such as ecotourism. Even if an ecosystem is privately held, it is difficult to market most of the regulating, cultural and supporting services, because who will buy the public goods?

A further complication is the enforcement of private property rights. In many developing countries, the legal system is weak, corruption prevalent and politics instable.

4. Negative Externalities from one ecosystem to the other and from Other Markets
The provision of all four categories of ecosystem services is distorted by the unsustainable production of certain provisioning services that are produced at mass scale (including hard wood, cattle, soybeans, palm oil and sugar cane) that need large areas of productive land. In addition, other markets, including the infrastructure and real estate markets, degrade ecosystems to produce their products and services. This leads to smaller amounts of goods and services provided at the local, regional and global level, affecting many people now and in the future.

At the local level, loss of natural habitat implies fewer provisioning (food, fuel, water) and regulating (erosion, natural hazard protection) services to the poor inhabitants of forests and farmers active at the border of the affected area (the so called "buffer zones"). Damage to natural areas on land or in water affects also inhabitants at the regional level in the form of erosion, water scarcity, higher impacts of natural hazards and loss of cultural services such as knowledge and inspiration. Some global effects of reduced natural habitats include global warming, reduction in supply of water (some areas become drier) and loss of genetic information.

Note that positive externalities arise from the preservation of ecosystems. However, the benefits, by neither private nor public agents, can be collected through markets, because they do not exist.

5. Incomplete information
Even if private agents wanted to account for negative externalities inflicted upon others, it would be very difficult to do so (e.g. in the form of compensation mechanisms) as there is a lack of information about the monetary values of services and goods provided by ecosystems and in particular in the changes of these values resulting from human impact.

The **conclusion** is that these five market failures prevent an efficient allocation of produced and consumed, ecosystem and non-ecosystem, goods and services. As argued above, many of the ecosystem goods are public goods with price zero. This leads to over-exploitation and the substitution of ecosystems for agricultural land and other forms of human made capital without, except for some transaction costs, any form of compensation to the owners and users of the services. Examples are plentiful: overfished lakes, rivers and oceans and the conversion of vast areas of tropical rainforests for palm oil, soybean and sugar cane plantations. Apart from some limited subsidies and taxes aiming to correct for social costs, the price of ecosystems goods is zero for the following two reasons:

(A) social benefits arising out of the preservation of ecosystems cannot be materialized through markets;
(B) social costs, mainly in the form of negative externalities, resulting from the over-exploitation and conversion of ecosystems, are not accounted for in the market price of marketable goods;

The following box shows six examples of projects where an attempt has been made to include some of the social costs of ecosystem degrading activities into the analysis of private sector benefits. It shows that the loss of non-marketed ecosystem goods often outweighs marketed private benefits of conversion. So, from

a social perspective, the preservation of ecosystems would generate more benefits to the public as a whole than the conversion of it.

*Recently attempts have been made to give a monetary **value** to **ecosystem services**. This is not an easy task, because many services are public and unmarketed. One scientist that made a substantial contribution to this subject is Robert Costanza from the University of Vermont (USA). In a 1998 study (Costanza (1998)), he estimated the agregated annual value of 17 provisioning, supporting, cultural and regulating ecosystem services per hectare across 16 biomes and then extrapolated this to the globe by multiplying it by each biome's area. In US$ figures (2000) the calculation amounted to a range of $18 trillion to $61 trillion ($10^{12}$), on average ~$38 trillion, which is of similar size of global Gross National Product. He calculated further that the annual degradation and conversion of ecosystems amounted to a loss of ecosystem services of ~$250 billion each year into the future.*

These figures received criticism from a number of economists mainly related to: (i) the number is inconsistent with micro economic demand curve theory: diminishing supply of non-substitutable services would escalate demand, so that simply summing up marginal values would underestimate total values; (ii) the $38 trillion was not a net benefit calculation, because the post-conversion value would be much more than zero.

In a study in 2002 (Balmford et al. (2002)) Balmford calculated, with the help of 19 other authors including Robert Costanza, ecosystem service values on a more micro level. In each of five projects, he calculated the net social benefits, which he dubbed the Total Economic Value (TEV), of two alternatives: (a) the net economic value of ecosystem services when not converting and (b) the net economic value after conversion. The projects and results were as follows:

Project 1: the net marginal benefits were calculated for two alternatives for a tropical forest in Malaysia. One study calculated a reduced impact logging variant with smaller private benefits but greater social and global benefits (including benefits from non-timber forest products, flood protection, carbon stocks and endangered species). The other study calculated the benefits from the high-intensity unsustainable logging variant. The TEV for the sustainable variant was 13% higher than the unsustainable one ($13,000 ha^{-1} cf. to $11,200 ha^{-1}).

Project 2: the second project compared a low-impact, sustainable logging variant in a tropical forest in Cameroon to two variants of more intense land-use changes: (1) small scale farming and (2) full conversion to palm oil and rubber plantations. The latter yielded negative private benefits once the effect of market distortions was removed. The TEV of sustainable forestry was 18% higher than for small scale farming ($2570 ha^{-1} cf to $2110 ha^{-1}), thanks to higher social benefits arising from NTFP's and flood prevention. Also higher global benefits from carbon storage and option & existence values attributed to a better outcome for sustainable forestry.

Project 3: in Malaysia an alternative for a mangrove forest to be turned into aquaculture was evaluated. Short term private benefits arising from aquaculture were higher than private benefits from the intact mangrove, but once social costs and benefits were factored in (in the form of sustainable collection of timber, charcoal, NTFP's, off shore fisheries and storm protection), the TEV of the intact mangrove was 70% higher than that of shrimp farming ($ 60,400 ha^{-1} cf to $16,700 ha^{-1}).

Project 4: the draining of a fresh water swamp in one of Canada's most productive agricultural areas yielded net private benefits (largely due to drainage subsidies) arising out of agricultural activities. The social benefits from retaining the wetlands (in the form of sustainable hunting, angling and trapping) exceeded the agriculture alternative by 60%: $8800 ha^{-1} cf to $3700 ha^{-1}.

Project 5: a study for a Philippine reef exploitation revealed that blast fishing (by dynamiting the reefs) had lower overall private benefits than sustainable fishing, despite intially higher private benefits. Adding social benefits from coastal protection and tourism made the TEV of the low-impact alternative 75% higher compared to the blast fishing alternative ($3300 ha^{-1} cf to $870 ha^{-1}).

Example 6: Economic Cost Benefit Analysis of a Conservation Case

A study in 2006 (Naidoo, 2006) in the Mbaracayu Biosphere Reserve (Eastern Paraguay) showed that under certain conditions, economic benefits from nature conservation exceed opportunity costs. These opportunity costs are defined as benefits generated from the alternative non-sustainable agricultural option, including smallholder agriculture, cattle ranging or soybean plantations. These activities have already cleared 38% of the reserve in the period 1973-2004.

The following economic benefits from leaving the threatened parts of the area intact, labeled as "Ecosystem Services", were identified and calculated: (i) bush meat harvest by indigenous people, campesinos and large landowners, (ii) sustainable (FSC-type) timber harvest of 3 trees per hectare during a 30 year harvest cycle, (iii) Bioprospecting of undiscovered pharmaceutical products or precursors, (iv) the existence value of the forests, meaning the willingness-to-pay (e.g. in the form of debt-for-nature swaps) of various groups, mainly in developed countries, to conserve natural biomes, even if they don't derive directly benefit from them and (v) carbon storage, leading to CO2 emission prevention and therefore income from a carbon trading mechanism. The existence value is also taken into account. Although the existence value is useful in economic utility terms, it does not lead to income for the local population in the reserve or the country as a whole if there is no income transfer from the people who derive the utility to the people who provide them.

The following underlying assumptions were made:

1. *Opportunity costs of conservation: US $ 60/ha.*
2. *Bush meat harvest: US $ 15.59/ha.*
3. *Timber harvest: US $ 27.260/ha (based on an average per tree value of $6.87).*
4. *Bioprospecting: US $ 2.2/ha.*
5. *Existence value: US $ 5/ha.*

Carbon storage, by far the highest level: US $ 378/ha (based on a conservative $2.50 per tonne CO2).

Please note that these values cannot simply be aggregated, as not every part in the reserve supports the same type of economic activity (for example not all areas are suitable for bush meat harvesting).

The cost-benefit calculations led to the following overall results: that part of the ecosystem services of which the local population would be directly benefiting (bush meat harvest, sustainable timber production and bioprospecting for pharmaceutical products) is only in limited areas of the reserve outweighing the benefits from the alternative opportunity, namely agricultural production. When in addition to these primary ecosystem services also existence value was added, 19% of the forests would pass the cost-benefit test in favor of nature conservation. When finally carbon storage was added as benefit, in 98% of the forests the economic benefits of conservation outweighed the opportunity costs of the agricultural alternative. Note that many other ecosystem services, including nutrient cycling, erosion control, water supply and regulation and climate regulation are not included in this research, as they are hard to quantify in economic terms.

These six examples present a development case for the preservation of the remaining habitat. The issue is however, that as long as (i) market failures continue to exist and the private sector remains exempt from the social, external costs of their ecosystem degrading activities, and (ii) benefits from the (preservation) of ecosystems cannot be materialized, pressure to convert habitat will remain.

This is not to say that conversion is or never has been economically beneficial. Prior to the 1800s, most of the global ecosystems remained broadly unaffected by human activities. When the free market system started to develop and global population started to grow exponentially, the switch from pristine natural capital to human interfered natural capital was mainly made to increase economies of scales. However, a decline in ecosystem services can only accommodate an increase in efficiency as long social benefits continue to exceed social costs and will stop once marginal benefits equal marginal costs. Once social losses (due to declining ecosystems) start to go beyond private gains, the turning piont is reached where more conversion leads to inefficiencies and diseconomies of scale.

The next section describes how the scetched failures in the market for ecosystem goods and services can be solved or internalized.

3.4.4. Internalization of Market Failures: shadow prices

Except for a few markets that started to develop a few years ago such as the carbon sequestration and biodiversity-offset markets, most markets for ecosystem services are still non-existent. Ecosystem goods and services are for large part public goods, with often a market price of zero, but with a non-zero social worth. The social worth of goods and services is expressed by its shadow price, being the increase in social well-being that could be enjoyed if one additional resource unit were made available without costs. Sometimes this definition of shadow price is extended by the *option* and *intrinsic* value of the ecosystem service. The option value reflects the value of the uncertainty in its future use and the irreversibility when lost. The intrinsic value reflects the worth of species as living creatures, i.e. the endangered blue whale is considered to be worth more than the revenues generated out of its flesh and oil. The zero market price of many ecosystem goods results into the overexploitation of ecosystems and forms a disincentive to preserve or create new ecosystems. The non-zero shadow prices reflect the social scarcity of ecosystem goods. Hence, an efficient allocation would result into less conversion and more preservation of ecosystems.

Products that are traded in markets with potentially negative external effects on ecosystems (unsustainably produced agro-industrial crops and related derivatives such as bio-fuels, (palm) oils, but also cattle, fossil fuels & minerals extraction, real estate & infrastructure development etc.) also have market prices that differ from their shadow price equivalents. The shadow price is distinct from their market price equivalent, because it reflects not only physical scarcity but also aims to incorporate all major external effects, or social costs, inflicted on other agents in society, now and in the future. If all social effects were to be priced into the market price, there would be no wedge between the shadow price and the market price. However, negative externalities resulting out of market distortions cause the difference between market and shadow prices.

There are several ways to internalize the market failures in the markets for ecosystems services. This can be achieved by (a) intervention by the government and (b) changes by and within the private sector. The government can intervene several ways. First, it can create legislation to protect ecosystems (e.g. in the form of natural parks), which, if enforceable, is a potentially effective way to safeguard the delivery of certain ecosystem services. Another form of legislation is the creation of markets for ecosystem services, which can be witnessed in the global market for carbon credits and the biodiversity off sets market in the United States (see chapter 4). Second, it can impose quotas, for example on fishing or timber logging. Third, if the government wanted to correct the market price of a product for its social costs, it could impose a Pigouvian tax on the product, equal to the marginal social costs arising out of the neglected

externalities. Note that Pigouvian taxes are considered more beneficial than quotas for several reasons. Resource rents of quotas are captured by harvesters and polluters while taxes are collected by the tax authority, which it can spend to the benefit of the public. Further, taxes provide incentives to explore resource saving technological improvements and they potentially remove market distortions if the government applies them to lower distortionary taxes such as income tax[6].

Nevertheless, not all government action leads to more efficiency. Governments are hampered by incomplete information about markets, producers, consumers and their consumption and production functions. External effects and social effects are not easy to determine, so that the chosen level of tariffs may over or understate social costs, again preventing an efficient allocation of resources. It is also well known that governments' ultimate goal is not always to stimulate efficiency but to obtain voter support. Note that a full analysis of government failures and corrective measures fall outside the scope of this thesis.

Besides government intervention, also the private sector can instigate corrective measures to account for social costs of declining ecosystems. There are two important driving forces. The first driver is pressure from stakeholders, such as clients, shareholders, governments, international agencies and non-governmental organizations. Hence, different production methods stem from changed consumption preferences now or in the future to which certain producers adapt themselves. A second driver, if only to guarantee the long term survival of their businesses, but also stemming from ethical business practices that certain producers find important, is the call for sustainably produced products by producers themselves. If producers become more accountable for the negative external effects they impose on current and future generations, the prevention of these will start to be incorporated in the market price of their products. Hence, under the assumption that agents are price takers, the equilibrium market price will go up (incorporation of social costs), and the shadow price will go down (fewer negative social effects) so that the gap between the market and shadow price diminishes.

We want to point out that these two drivers will most likely only work in the developed nations, where markets for sustainably products and ecosystems are a bit more advanced than in the developing world, where often the buying power of many is still too low to voluntarily accept to pay for indirect, social costs. Further, NGO's are not yet as influential as in many Western countries and governments are not to keen to place it on the agenda for political reasons. This is why it is interesting to assess the role of development banks in this context. To a certain extent development banks are monopolists in the provision of long-term capital and can formulate conditions and restrictions on their financing (to be further discussed in chapter 5).

Before we move on to describe markets with potential for private sector institutional change, we will first explain why the substitution of ecosystems for human-made systems is most likely not the answer to guarantee sustainable, non-declining production and consumption over time.

3.5. Substitution of Ecosystem Services

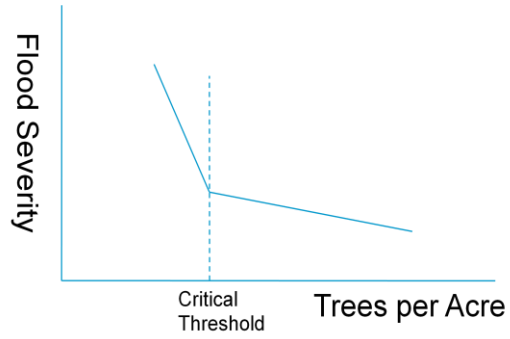
In the past 200 years, continuous substitution has significantly contributed to the extraordinary economic development in many parts of the world. This started already during the industrial revolution where capital-for-labor (e.g. in the agricultural sector mechanization helped to increase productivity) and capital-for-capital (e.g. the steam turbine replaced the piston in plants and ships) substitution increased efficiency. With this substitution in mind and the ongoing technological progress, some economists believe that in the long-term human-made goods and services, whether it is nylon that replaces cotton & wool or renewable energy that replaces oil & gas, will eventually replace all scarce non-renewable and ecosystem goods.

[6] Thus, Pigouvian taxes are assumed to lead to double dividends.

In this context, the following questions are key: are ecosystems essential in the provision of what we have called 'ecosystem goods and services' or can they be substituted by human made services? How much consumption, utility and efficiency will be lost if some ecosystems were to disappear for good?

Although a full answer to these questions is out of the scope of this theses, some qualitative remarks can be made. First, certain ecosystem services seem more unique and essential to humans than others. Many *provisioning* services, such as the production of food, fibre, (bio) fuels and water are currently also manufactured, mainly through agriculture, by humans without a complete dependence on ecosystems. Also, certain *regulating* services can and are already replaced by human made products. Think of dams replacing erosion regulation, waste water treatment plants in place of the water purification & waste treatment services and effective medicine & pesticides reducing the reliance on the disease & pest regulation function of ecosystems. We can also imagine substitution of certain *cultural services*. More and more people live in urban areas and depend less on cultural services in their daily lives. Certain people find inspiration in cities, spend their holidays in cosmopolitan cities and base their social relations on urban networks.

There is also another side of the coin. From a risk averse perspective, and many economists assume agents to behave in this manner, it is unwise to fully rely on technological substitution of pristine natural capital. Farber et al. (2002) explored the effects of the reduction in certain *regulating* services, for example the effect of a reduction in the amount of trees per acre on the flood severity due to erosion, see the picture below.



Picture 3: flood severity versus trees per hectare

After a critical threshold level is reached, a marginal reduction in the tree density leads to a dramatic increase in the the flood severity, an effect that can take place suddenly and irreversibly. It is risky to assume that technology will be able to replace this type of natural hazard regulation services ecosystems provide against affordable costs. This brings us to the second argument, which is an effiency argument. The following example makes clear that even if substitution is technically possible, it is less cost efficient:

Daguptha (2000) cites a well known example analysed by Chichilnisky and Heal who had done research on the Catskill Watershed ecosystem in New York State. A water purification plant was built to replace the natural water purification and filtration services the watershed provided in the past. They showed that the 8 billion USD capital costs for the plant alone were <u>net</u> (so, including the proceeds of the investment) 6 times higher than investing in the natural capital-base on top of the annual 300 million USD costs to run the plant. This is an illustrative example where the economic advantages of natural preservation exceed the costs of human made construction.

In conclusion, humans depend on ecosystem services for their daily survival. It would be a sign of irresponsible risk appetite of the current generation to expect future generations to replace vital ecosystem services with human made solutions on which many people will depend. Even if this were possible, it is unlikely that these substitutions will be generated at lower or equal costs and are able to guarantee non-declining consumption opportunities for future generations. This brings us to the following and final paragraph of this chapter.

3.6. Sustainability

Sustainable development refers to the fulfillment of human needs with the protection of the natural environment so that these needs can be met not only in the present, but also in the (indefinite) future. The linkage between environment and development was first made in 1980, when the International Union for the Conservation of Nature (IUCN) published the World Conservation Strategy and used the term "sustainable development." Later on, following publication of the 1987 report of the Brundtland Commission (formally, the World Commission on Environment and Development), it was coined as development that "meets the needs of the present without compromising the ability of future generations to meet their own needs."

In discussions about current generations inflicting negative externalities on future generations, sustainability becomes a relevant concept. If there were no concern for future generations, the scarcity of natural resources and declining ecosystems would be much less of a concern for economists and decision makers. However, economic agents do care to a certain extent about the well-being of next generations, or, if only, of their own descendants.

Economists use two similar definitions for sustainability (Perman et al (2003)):

a) A sustainable state is one in which consumption (utility) is non-declining (or at least constant) through time. Alternatively,
b) A sustainable state is one in which resources are managed so as to maintain production opportunities for the future (maintaining productive potential).”

The above-cited definition of the Brundtland Report is an example of the second form (i.e. current generation should not limit production possibilities of future generations).

One main stream economist thought, represented by amongst others Nobel laureate Solow, articulates that, in terms of natural resources, future generations are not interested in the stock of natural resources that is left for them to use, but the consumption opportunities they inherit. The only ethical commitment current consumers therefore have is to ensure they bequeath substitutes for depleted renewable resources that allow future generations the same consumption opportunities. Note that this vision neglects human dependence on ecosystems for other goods than natural resources, and regards ecosystems mainly as a source of the latter. The following section describes a necessary condition for non-declining consumption over time.

3.6.1. Weak vs. Strong Sustainability

To maintain consumption at a non-declining level, production cannot decline. A condition for non-declining production opportunities is the sufficient availability of the inputs of capital and labor. Assuming labor is available in unlimited supply, capital is the scarce input. Capital is the sum of:

a) Natural capital, i.e. the stock of all environmental goods and services including goods and systems flowing from ecosystems in its pristine state;

b) Physical capital, including all production capacity, infrastructure and human interfered natural capital;
c) Human capital, i.e. skills embodies in individuals;
d) Intellectual capital, i.e. the disembodied skills and knowledge available in society.

The sum of b, c and d is referred to as human made capital. Sustainability implies that for production not to decline, the level of all available capital needs to be non-declining over time. Thus, if declining natural capital due to declining stocks of non-renewable natural resources (oil, gas and minerals) and degraded ecosystems is compensated by an increase in human-made capital, consumption could be maintained over time. This leads us to the **Hartwick rule**.

The Hartwick rule formulates a *necessary* condition for sustainability. Given a set of preconditions, if all rents extracted from natural capital are not consumed but fully saved and invested in human made capital (i.e. the sum of human made capital and natural capital is held constant at all times), then non-declining consumption can be maintained over time. The Hartwick rule becomes a *sufficient* condition if all resources are depleted efficiently and if substitution possibilities between capital and natural resources are great enough.

The Hartwick rule carries with it relevance for the currently developing countries, many of which create economic growth by substantial amounts of exports. For example, Asian and Latin-American countries are strong producers of agricultural products such as soybeans, (palm) oil, cattle, timber, bio-ethanol etc. For this purpose natural capital (natural area) has been converted into human-made capital (plantations). If the productive base, i.e. natural capital + human capital, remains constant (all other things being equal), economic growth may be sustainable into the future. If the focus is on short-term exports, where natural resources are used for exports and the proceeds are used for daily consumption without investments in physical capital, economic growth will be unsustainable in the longer run. This is even more relevant for plantations that, due to intense harvesting, become worn out and unproductive after just a few years. In these cases natural capital has not been turned into physical capital efficiently, so sustainable economic growth cannot be guaranteed.

It is the Hartwick rule that divides the strong from the weak sustainability adherents. Weak sustainability adherents believe that in principle all natural capital can be replaced by human made capital and that possibly only a small minimum amount of natural capital is required that cannot be substituted. Strong sustainability adherents believe that these substitution possibilities are limited and a higher level of natural capital is needed to ensure constant consumption over time. Hence, weak sustainability requires that the sum of natural and human made capital is non-declining (and natural capital can approximate zero) to ensure sustainability, while strong sustainability demands that natural capital is non-declining.

Hence, if constant consumption is feasible (condition 1) and the extraction is efficient (condition 2), following the Hartwick rule, consumption is constant indefinitely. On the other hand, if constant consumption is feasible and the Hartwick rule is not followed (rents are used for consumption rather than investment), consumption will decline over time. The government can try to promote the compensation of a declining resource base by an increase in human made capital, for example by levying a tax on resource rents and investing the proceeds in human made capital, such as R&D. Whether the government is a weak or strong sustainability adherent has important policy implications, because this determines how far the government will allow natural capital to decline.

Historical experience (Dasgupta (2000)) tends to show that problems arising out of declining natural capital can be off set against increases human made capital, except for certain life saving and amenity functions of natural resources. This fits with the conclusion of the previous section, that risk averse agents

will tend to keep a minimum level of natural capital to avoid certain ecosystem goods and services to all abruptly and irreversible, especially if the well-being of billions of people depend on them.

3.7. Conclusion

In their pursuit of economic growth and reduction of poverty, many developing countries are faced with the trade-off between economic growth and decline in pristine natural capital. It is mainly a trade-off between private and social net benefits. Although the latter are expected to be higher than the former, preference is often given to short-term private benefits, because social benefits cannot be captured by the private sector and governments in many developing countries are often unwilling, incapable or too corrupt to capture them. In that sense, this trade-off forms a true 'prisoner's dilemma': long-term economic efficiency is achievable by incorporating the social costs of the decline of ecosystem services. Because this will entail short-term costs and hence loss in competitive power for firms or lower consumption for households, the neglect of these social costs will be the dominant strategy.

Governments in developing countries try to foster economic growth by promoting agricultural, industrial and urban developments, for which large quantities of scarcely available land are required. To make more land available, natural vegetation, often valuable both in economic and biological terms, is converted for human use. This results into the decline of pristine natural capital, biodiversity and ecosystems goods and services. Whether this conversion is effective for economic growth in the long term remains doubtful. Perhaps it contributes to growth in terms of GDP; however, when economic growth is measured in terms of growth in the productive base, some developing countries have suffered from an economic recession over long periods. Further, a country may grow as a whole, but it is not straightforward that the rural poor, profit from national growth to the same extent. In certain cases, the rural poor, who are almost entirely dependent on ecosystems for their daily survival, suffer significantly from a decline in the natural environment.

In answering the main research question of this chapter *"what are the market failures in markets for sustainable ecosystems goods and services?"* we first point out that ecosystem services consist of provisioning, regulating, cultural and supporting services. Several market failures arise on the 'markets' for ecosystems goods and services. *First*, for certain important ecosystem services no (well-functioning) markets exist. *Second*, many ecosystem goods and services have 'public good' features, so private property rights are difficult to establish. *Third*, negative externalities arise from the unsustainable production of certain ecosystem goods and other markets such as the infrastructure and real estate markets. *Fourth*, there is a lack of complete information. These market failures drive a wedge between market and shadow prices of ecosystem goods, which consequently leads to an inefficient allocation of goods and services, where goods produced at the cost of ecosystems are overproduced and ecosystem services are over-exploited.

Some economists argue that the over-exploitation of pristine natural capital is of no great economic concern, because human interfered natural capital will eventually replace all pristine natural capital at least equally benefiting human beings. However, this contradicts the risk-averse agent assumption. Many provisioning, regulating and supporting ecosystem services may only be replaced against very high costs or cannot be replaced because the workings are complex or even not yet fully understood. It also denies the option value of ecosystems and the goods and services they produce.

A necessary condition for sustainability, in terms of a non-declining consumption for future generations, is that the decline in pristine natural capital is fully compensated by an increase in human interfered natural capital and nothing is used for consumption. This would imply that all pristine natural capital could be replaced by human interfered natural capital and future generations could still profit from the same level of consumption. However, it is quite probable that a minimum level of pristine natural capital continues to be required to guarantee sustainable consumption. Trusting that human interfered natural

capital will eventually replace all pristine natural capital is a gamble on continuous progression of technology and transfers significant risks to future generations.

In the next chapter we will give an overview of the markets for (A) public ecosystems services and (B) ecosystem goods under sustainable management. The further development of these markets helps to (i) create markets and property rights for certain ecosystem services and (ii) include social costs related to the decline of pristine natural areas in the market price for certain commodities.

4. Markets for Ecosystems Goods and Services

4.1. Introduction

In the previous chapter, we analyzed the failures in the markets for ecosystem goods and services, which prevent the inclusion of social costs, associated with the decline in pristine natural capital and the public goods they produce, into private goods consumed by producers and consumers. However, certain markets for ecosystem goods and services have started to emerge recently leading to partial absorption of one or more market failures and the inclusion of certain social costs, caused by business activities, in the market prices of these goods. We will describe those markets in this chapter.

4.2. The markets for public and private ecosystem goods and services

While answering the second research question:

Research question 2:
Which private markets for (A) public ecosystems services and (B) ecosystem goods under sustainable management are most promising for the private sector to invest in to create a win-win situation for (i) the private sector in terms of sufficient financial return and (ii) the natural environment in terms of protecting biodiversity?

We identified the following two types of private investment opportunities related to the sustainable exploitation of biodiverse ecosystems creating financial returns to private investors:

A. The *trading* of **public ecosystem services**

This category refers to the trading of intangible mostly *regulating* ecosystem services currently under pressure. Therefore, certain Western governments took the initiative, either unilaterally (e.g. biodiversity mitigation laws in the US) or multilaterally (e.g. the Kyoto protocol) to impose restrictions on the further reduction of these regulating ecosystem services. This resulted into the following markets:

1. Biodiversity offsets in the Biodiversity Offsets Market – this market does not provide for the trading of a particular ecosystem service, but aims to protect the *foundation* of ecosystems: biodiversity (see section 3.4.2 for further reference). Biodiversity off setting originally took off in the 1980s and 1990s in the United States, but also recently certain round tables, including the Round Table for Sustainable Palm oil, started to stimulate biodiversity off setting of multi nationals that, under pressure by international NGO's, off set historical land clearing practices.
2. Carbon credits in the Carbon Sequestration Market – this market is set up to put a cap to the emission of greenhouse gases, protecting the climate regulation service provided by regional and global ecosystems. The Kyoto protocol, with its Clean Development Mechanism (CDM) and Joint Implementation program (JI), has given a boost to the carbon credits off sets markets. In addition, the voluntary market for carbon credits, allowing for the compensation of carbon emissions for those countries, companies and consumers that cannot be served through CDM and/or JI, contributes to the trading of carbon credits.
3. Wetland offsets in the Wetland Banking Market – the market to put a floor to the available wetlands in a given area, which was created in the US as the result the Clean Water Act in 1972.

B. The *production* of **ecosystem goods under sustainable management**

This category includes markets that produce tangible ecosystem goods on a sustainable basis. Principally, these markets refer to the capacity of ecosystems to sustainably produce *provisioning* ecosystem services such as food, fodder, fuel, fiber and fresh water, but also cultural services (e.g. eco-tourism). Sustainability, in the sense of sustainable management, is important in this context because, although the non-sustainable production sector of these goods would provide the same (and perhaps even higher levels of) provisioning and cultural services, according to the Hartwick rule we explained in section 3.6.2, this can potentially lead to the eventual decline of consumption possibilities of future generations. Based on the premise that many temporary consumers are unwilling to consume at the expense of future generations, this is undesirable from an economic welfare perspective.

Moreover, the sustainable production of agricultural goods such as food and fuel leaves a certain number of other ecosystem goods and services in tact that would have been significantly reduced by the non-sustainable option. In fact, it may be argued that in certain situations (for examples see section 3.4.3) that the sum of the *social* net benefits of the ecosystem goods and services produced under sustainable management exceed the sum of the *social* net benefits of the ecosystem goods and services produced under non-sustainable management. However, currently it seems that the (short term) *private* net benefits of the ecosystem goods and services produced under sustainable management are lower than the sum of the (short term) *private* net benefits of the ecosystem goods and services produced under non-sustainable management, as otherwise sustainable management would be the dominant market practice.

The current markets for the sustainable production of ecosystem goods we identified are the following:

1. Sustainable Forestry
2. Sustainable Agriculture
3. Sustainable Fisheries and Aquaculture
4. Non-timber forest products and Bio-prospecting
5. Ecotourism

These markets were spurred by a number of developments, including Western governments, seeking to procure sustainably produced goods and NGO's trying to influence consumer preferences and creating certification schemes for e.g. sustainably produced wood and food. In addition, certain environmental and social conscientious consumers, predominantly located in the USA and the EU, but also producers are seeking to buy sustainably produced goods, with or without pressure from stakeholders such as clients, shareholders, employees, suppliers and NGO's. These developments do not only create a market for sustainably produced ecosystem goods, in some markets they have also lead to a price premium paid for these (certified) consumer goods as buyers are willing to pay this premium if they are convinced that it has been produced without significant environmental and social detriment to the surroundings and future generations. This price premium leads to a lower gap between the *private* and *social* net benefits of the ecosystem goods and services produced under sustainable and non- sustainable management. Ideally, when a firm weighs its investment options, the investment decision to invest in a certain market or project, would ultimately be based upon a *social* cost benefit analysis of the investment option against its alternatives. However, with the absence of proper markets, it is difficult, if not impossible, to adequately measure the *social* net benefits of the production of ecosystem goods under sustainable management[7]. Further, in many developing countries the private sector is often not required to make such social cost benefit analyses.

[7] An in depth analysis of a measurement or calculation of social costs and benefits of ecosystem services falls outside the scope of this research.

The following sections will introduce the above markets in more detail, describing investment opportunities and, if applicable, effects on biodiversity. We do not intend do demonstrate that by investing in these markets short term financial gains from ecosystem goods under sustainable management outweigh the short term financial gains from the non-sustainable alternative. Instead, we will show that these markets have growth potential thanks to growing demand for sustainable produced products and that certain intangible ecosystem services are currently being brought to market. Final note: most data are sourced from Bishop et al. (2006), Rubino (2000, #1 and #2), unless otherwise indicated.

4.3 The markets for Public Ecosystem Services

4.3.1. Market 1: Biodiversity Offsets

Conservation banking, or equivalently, species or biodiversity banking, involves a government setting a limit to the harm that may be caused to certain species and then letting the market resolve the cost of compensating efforts above the limit. These compensating efforts are called biodiversity off sets. The market, through supply and demand, determines the financial value of biodiversity (off sets). Beside government intervention, there is also a voluntary market for biodiversity off sets, including those companies claiming to comply with corporate social responsibility practices.

Definition
The Business and Biodiversity Offsets Program (BBOP) defines biodiversity offsets as conservation actions designed to compensate for the (perceived) unavoidable impact on biodiversity in sectors such as infrastructure, mining, oil & gas and agriculture, to ensure "no net loss," and, preferably, a net gain of biodiversity.[8] No net loss is achieved by the restoration and/or creation of areas with the biodiversity that is reduced by the intended activity.

Biodiversity offsets are another alternative to existing methods mitigating biodiversity loss including avoidance (e.g. no investment or use of sustainable techniques), reduced loss, relocation to another site and reparation (e.g. after a project or investment is finished). The biodiversity off set market definition has three main characteristics: (i) the bank is protected and managed in perpetuity (or at least very long term), (ii) there is adequate funding in place to accomplish the conservation and (iii) the bank is a free market enterprise that is allowed to sell, purchase and trade the biodiversity credits.

Biodiversity offsets are an effective instrument to internalize certain social costs there were previously externalised. If biodiversity off sets apply, roads that damage wetlands cost more than roads that don't, local airports on endangered bird habitat cost more than airports without this impact and so on. This means that if the biodiversity off set market works well, less conversion and more conservation takes place than without this market. The converse is also true. If money can be made out of the conservation of habitat, businesses will arise to reap this financial opportunity.

Market Characteristics
The largest market for biodiversity offsets exists in the United States, which is a result of the Conservation of Endangered Species Habitat and the No Net Loss of Wetlands requirement. Since 1972, both public and private developers are required to compensate for the loss of wetlands or endangered species by financing the restoration or creation of comparable wetlands and other critical habitats. The compensation of the unavoidable loss of natural habitat can be outsourced to third parties and created a new market for mitigation services and the set up of compensation banks. For each hectare developers convert, they must buy credits from approved conservation banks to restore habitat that is similar to what has been (or, will be) destroyed. The biodiversity off set credits are the economic rewards that landowners

[8] http://www.forest-trends.org/biodiversityoffsetprogram/pilot.php

receive from those who reduce biodiversity for the conservation and protection (in perpetuity) of the habitat. Depending on demand from developers and restoration costs, prices are based on the buyers' willingness to pay, and are unlikely to exceed the costs of self-mitigation. In the past five years they ranged from US$1,200/ha to US$300,000/ha for exceptional conservation banks. For example, the going price for a fly habitat of the Delhi Sands Flower-Loving is about $100,000 an acre. Total market transaction is currently estimated to lie in the range of US$1 billion (Carroll et al., 2007). TEEB (2010) estimates the 2008 market for mandatory biodiversity offsets market at US$ 3,4 billion, which is to grow to US$ 10 billion in 2020. Voluntary biodiversity offsetting is estimated at only US$ 17 million but to grow to US$ 100 million by 2020.

Also in the European Union (recently) two directives have been accepted to regulate reduction in biodiversity and compensation: the Habitats Directive ((92/43/EEC) and the Environmental Liability Directive (2004/35/EC). The Habitats Directive applies to the development phase where no damage has occurred yet and required compensatory measures for biodiversity reducing activities. The Environmental Liability Directive applies to the phase after the damage has taken place and where the 'polluter pays' principle applies to regulate damage to animals, plants, natural habitats, water resources and damage affecting the land. These two directives have stimulated (Nyenrode, 2009) the environmental insurance market to minimize environmental risks through differentiated premiums and encourages the development of markets for biodiversity off sets and wetland and habitat banking.

The new market has, besides public agents, also attracted commercial operators. In 1993 there were 46 approved wetland banks (of which only 1 privately owned) active in 18 US states, by 2006 this increased to ca. 400 in over 40 states of which two-thirds were privately owned. Conservation banks for endangered species are also starting to spread: in 2006 there were ca. 70 banks (also two thirds privately owned) active in five states (Carroll et al., 2007).

Also in the developing world biodiversity offsetting initiatives are employed, e.g. in Uganda, Mexico and Brazil. In the latter case, industrial development projects are required to contribute 0.5% of their total capital costs to the National Protected Area System as compensation for environmental damage. However, there is no private sector involvement yet and transparency is limited. Interest from the private sector started to grow recently: companies such as ABN Amro, BNP Paribas, Goldman Sachs, IFC and Vereniging voor Duurzame Beleggers (VBDO) are looking into business opportunities of the biodiversity offsets sector.

The claimed benefits of biodiversity off sets are both biological and economic. Ecosystems can become stronger as smaller sized, scattered areas are traded for larger areas with better conservation prospects and better connected protected areas. This enhances efficiency: (i) efficiency of scales is obtained at large sites and (ii) location will be chosen where restoration of biodiversity can be achieved at the lowest costs. Further, conservation efforts can be integrated into regional planning and private investment proposals, so that loss of habitat is internalized into the cost of the project instead of externalized. Another positive effect of biodiversity offsets is that it may increase the local license to operate for environmentally sensitive projects. The overall impact on biodiversity is nonetheless ambiguous, due to (i) failure to implement the mitigation, (ii) insufficient management at the mitigation site, (iii) insufficient funding and (iv) absence of local support (licence to operate) resulting into unauthorized off-road-vehicle use and waste dumping.

4.3.2. Market 2: Carbon Sequestration

Definition
Bio carbon refers to the sequestration of carbon from greenhouse gases into several types of natural vegetation.

Market Characteristics
The main driver behind the market for greenhouse gases emissions is the Kyoto Protocol of the United Nations Framework Convention on Climate Change, so far ratified by 163 nations. Signatories of the Kyoto protocol agreed to reduce the level of greenhouse gas emissions in 2010 by 5% compared to their 1990 levels. The two most important markets are (A) the European Union Emissions Trading System (EU ETS), the European market for trading of carbon credits and (B) the global Clean Development Market (CDM) & Joint Implementation (JI). Both CDM and JI resulted from the Kyoto protocol and are project based programs that assign carbon credits to projects (for CDM in (developing) countries without an emission reduction target and for JI in (more developed) countries with such target) that reduce carbon emissions.

The carbon market is probably the most mature of the markets presented in this thesis. The total market turnover more than doubled in 2007 to the amount of US$64 billion (2006: US$31 billion). Most of the trade took place through the European EU ETS carbon credit system (US$ 50 billion), but also the sale of project related carbon credits through CDM and JI increased to US$ 14 billion. For the latter, the supply of CDM credits is largely dominated by China, while most of the demand comes from the UK and Japan (Capoor, 2008). Although most of the market works outside the scope of ecosystems, there are ways countries can employ to meet their individual carbon reduction targets through ecosystems. This includes the 'land use, land use change and forestry' method (LULUCF). The "F" forestry-variant includes several possibilities to sequester carbon into biomass, including (i) crops, (ii) grazing land and (iii) re-vegetation.

The LULUCF activities do not necessarily lead to conservation of biodiversity and ecosystems. For example, fast growing mono plantations of crops and trees successfully store carbon but don't promote biodiversity, especially if they were created out of conversion. The combination of both carbon sequestration and ecosystem conservation can be combined in reforestation of degraded land projects where a variety of native species are bred. A reported example is a project in Mozambique where 3,000 ha of 'slashed and burned' tropical rain forest pieces will be linked to each other, creating corridors of indigenous tree species. The 230 tonnes per ha of sequestrated carbon is offered to the voluntary carbon market to create revenues of almost EUR 11 million against current market prices (ca. EUR 16/ton)[9]. The bundling of carbon sequestration and biodiversity conservation remains a challenge as not all buyers of carbon credits are inclined to pay for the additional premium for the biodiversity services, although indirectly and not intentionally this is taking place.

At this stage, the Kyoto protocol and the Clean Development Mechanism & Joint Implementation program that followed suit, do not allow standing forests to be eligible for the emission of carbon credits. There are growing calls from developing countries arguing the increased income generated from (tropical) forests would offer a strong incentive for protection and would limit free riding by first world countries, who are calling for a halt of the further destruction of forests in developing countries, without making substantial compensatory payments to these countries. An important development in this respect is the so-called REDD scheme, an initiative developed in 2005 by a group of countries that dubbed themselves the 'Coalition of Rainforest Nations'. REDD stands for *Reducing Emissions from Deforestation and Forest Degradation*. The initiative, built on the back of growing awareness that ca. 20% of yearly greenhouse gas emissions stem from forest degradation, aims to create financial incentives for both public and private forest owners and users in developing countries to keep forests in tact, protect and preserve them and reforest degraded areas. In 2007 at the COP-13 conference in Bali, a road map for a regulatory framework was laid out with the intention to include REDD in the post-Kyoto negotiations and binding treaty. Although the COP-15 summit in December 2009 did not result in non-binding reduction targets and a deadline for a binding treaty, some progress was made in the further acceptance of

[9] Source: www.emit-markets.com

REDD by an explicit acknowledgement to act on reducing emissions from deforestation and forest degradation and by the establishment of a REDD-plus mechanism, where the idea is to expand the eligibility of LULUCF activities under the Clean Development Mechanism. The draft decision is still on the negotiation table and on the decision table for the COP-16 summit to be held in 2010 in Mexico. Despite its non-binding character to date, Norway, Japan, the United States, the United Kingdom, France and Australia pledged US$ 3.5 billion in short term financing to get REDD-plus off the ground. Currently, REDD carbon credits can be traded on the voluntary carbon off set market and as such form part of the voluntary forestry off sets, with 36% of all voluntary market transactions the largest sector in the voluntary market in 2006 (Nyenrode, 2009). Hence, even if negotiations are further delayed after COP-16, REDD continues to have potential for further growth through the voluntary markets, as market analysts indicate REDD credits have a price advantage over other carbon credits thanks to co-benefits in the form of biodiversity conservation and social benefits to local (indigenous) groups (there are example where 20% of carbon revenues are shared by local communities). Cast study 2 is fully dedicated to a REDD project in Indonesia.

4.3.3. Market 3: Wetland Offsets

Definition
A wetland mitigation bank is a wetland, stream or other aquatic resource area that has been restored, established, enhanced, or (in certain circumstances) preserved for the purpose of providing compensation for unavoidable impacts (Nyenrode, 2009).

Market Characteristics
Demand for wetland banking products was first established in the US in 1972 under the Clean Water Act of the US Army Corps of Engineers regulations. The act was put in place as a measure against America's disappearing rivers, lakes, swamps and other wetlands. After the act was established, it became illegal to fill, dredge, or damage a wetland without prior approval from the US government, specifically from the US Army Corps of Engineers. If the damage to a wetland cannot be avoided, it is determined whether it can be mitigated or minimized. However, damage done to the wetland needs to be compensated. Instead of creating new wetlands themselves, businesses (or individuals or public bodies) may acquire "wetland credits" from a public or private wetland bank that on its behalf creates and manages (large) areas wetlands with the same or similar characteristics as the wetland what was damaged. In case of a private mitigation bank, a third-party entrepreneur gains authorization to create or restore a relatively large area of wetlands. Afterwards, these 'banks of credits' can be sold to entrepreneurs to satisfy their mitigation obligation towards regulators. Wetland banking is now mostly a private sector undertaking: in 2006, 77% of 454 mitigation banks were privately held, the total market value was about US$ 3 billion and in 2007, 'right to develop' transactions exceeded US$ 750 million. Note that apart from the US, Puerto Rico established a similar market to sell the right to develop beach front property and New Zealand has a similar market for the right to exploit fisheries. In these countries, the concept of wetland banking has proved to be a viable business opportunity (Nyenrode, 2009).

A related area is Watershed Management[10]. According to the Centre for Watershed Protection[11], a watershed is an area of land where all the water that drains off goes into the stream, lake, or other water body and can cross country and state lines. Effective watershed management can protect a lake, river or stream by protecting the entire watershed that drains into it. A private market is generally still quite under developed, in most countries the supply of water is a public service. For example, in the Netherlands all citizens pay water payments to regional public water boards as a compensation for the management of

[10] Note that watershed management is sometimes undertaken only to produce the ecosystem good 'water'. In this situation, this market would fall in the category 'ecosystem goods under sustainable management' as described in the next paragraph.
[11] www.cwp.org/Resource_Library

watersheds and supply of clean water. The reasons that private sector initiatives are still limited are complexity of water issues, the high risk-low return profile and the presumption of high overhead and transaction costs in relation to the acquisition of legal title or use rights and capacity building to change unsustainable land-use practise. Nonetheless, payments for watershed management services have been established in Costa Rica and Colombia due to water scarcity and water-related conflicts. With ongoing climate change and decreasing drinking water supplies, this is expected to offer new private sector business opportunities, including financing incentives to compensate upstream land owners to maintain a certain land use to positively affect the quality and availability of water to downstream water users. Another example is Vittel in France, the largest bottler of natural mineral water. Vittel discovered that in certain instances watershed management is more efficient than current practises of moving on to the next water source when water quality degrades, or building (new) filtration plants. In a certain project, Vittel decided to pay holders of land (farmers and forest holders) adjacent to the water source, for improved agricultural practises and the reforestation of sensitive infiltration zones to reduce agricultural run-off of herbicides and other pollutants. According to the French National Agricultural Institute, a cost-benefit analysis of the area in question showed that the project was economically justifiable (Nyenrode, 2009). A note of caution: in large areas with many farmers this type of projects may be difficult to implement even with the help of governmental institutions.

4.4. The markets for the production of ecosystem goods under sustainable management

4.4.1. Market 1: Sustainable Forest Management

The International Tropical Timber Association[12] has defined sustainable forest management as follows:

Definition

Sustainable forest management entails timber harvest activities that do not damage or significantly reduce the capacity of forests to deliver products and services such as timber, water and biodiversity conservation. Sustainable forest management also aims to balance the needs of different forest users so that its benefits and costs are shared equitably.

Market Characteristics

Sustainable forestry managers map, plan and harvest selectively in order to reduce damage to flora and fauna that is not intended to be harvested. Not all trees, e.g. those below a certain age, are harvested in the area of operation to allow the forest to preserve its biological functions. Therefore, production volumes per ha are often smaller compared to conventional logging. However, the profitability of the activity is not necessarily lower, thanks to longer-term supply of wood and higher margins that consumers (mainly) in developed countries are willing to pay for sustainable wood.

The supply of timber in developing countries comes from both legal and illegal logging activities, but illegal logging largely prevails: some NGO's estimate illegal logging to be 80% of total logging in some developing countries. Most of the harvested wood is used locally as fuel in the form of charcoal. The United Nations Food and Agricultural Organization (FAO)[13] reported in 1994 that 56% of global wood production was used as fuel and charcoal of which 90% in the developing countries. This leads to deforestation and carbon-dioxide emissions (about 20% of yearly carbon-dioxide comes from the deforestation of forests)[14].

Owing to pressure from NGO's and consumer groups to limit the ongoing loss of large areas of tropical rain forests, a growing number of timber producers are applying sustainable forestry management

[12] Source: www.itto.jp.org
[13] http://www.fao.org/docrep/W4345E/w4345e05.htm
[14] 2006 Annual Report Precious Woods

techniques to produce 'green' or 'certified' timber. One of the best-known certification methods is the Forest Stewardship Council (FSC), which arose out of collaboration between environmental, industry, multilateral organizations and scientists. The area of FSC certified forestry has grown from 2.3 million ha in 1996, to 17.7 million ha in 2000 and 132 million ha as of March 2010, which is about 5% of the world's productive forests. Worldwide 977 FSC-certified companies are active in 82 countries. More than 80% of the FSC producers are located in Europe and North-America (Oct 2009): Europe (54 million ha; 46%), North-America (43 million ha; 37%), South-America (10 million ha; 8%), Africa (6 million ha; 5%) and Asia (3 million ha; 3%)[15]. Ca. 16% of supply comes from the developing world, which is relatively low compared to the vast resources in these countries. In total, although FSC certified forest supplies make up ca. 5% of the total market, it is growing by more than 25% per year. Demand comes mostly from buyer groups and consumers in markets in the developed countries (Western Europe, UK, Japan, Australia and to a lesser extent the US). For example, in 2007, 20% of construction timber in the Netherlands was FSC certified, while 25% of global industrial round wood volumes was certified in 2007 equaling 387 million cubic meters. In the UK, one of the most developed markets in terms of FSC certified wood, 78 FSC participants, led by the home supply firm B&Q, represent 25% of the total timber market. In a recent survey held by FSC, 49% of its participants indicated market leadership and competitive advantage to be the most important reason to seek certification, while 46% say that their clients are demanding FSC and 37% say it enhances their position as a responsible company. TEEB (2010) estimates the 2008 market for FSC certified forest products at US$ 5 billion, which is to grow to US$ 15 billion in 2020.

4.4.2. Market 2: Sustainable Agriculture

Definition
Sustainable agriculture is a form of agriculture with a low impact on the natural environment achieved through: (i) use of organic fertilizers, (ii) minimal or no use of chemical and pesticide inputs, (iii) crop rotation and (iv) recycling of waste materials.

Although this so called 'sustainable' or 'low-input' agriculture does not necessarily lead to the restoration of biodiversity of original natural habitat, it does result into more biodiversity compared to conventional agriculture as it encourages higher levels of soil fertility, soil fauna and bird & insect habitats. 'Certified organic' agriculture goes one step further and aims to enhance on-site and surrounding biodiversity, therefore leading to restoration or preservation of biodiversity.

[15] www.fsc.org statistics

Market Characteristics
The per hectare production of sustainable and organic agriculture tend to be lower than conventional agriculture while the labor costs usually higher. However, profit margins and returns on investment can still be attractive thanks to (i) avoided expensive chemicals, (ii) avoided, regularly occurring, contamination, (iii) higher niche market prices and (iv) the certification requirement in certain organic stores.

The size of the organic market is relatively small: currently less than 5% of the world trade volume is organically certified and certified coffee represents less than 2% of the world coffee market. However, growth rates are high. In the period 2002-2005, the global sales of organic food and drinks increased by 43% to a level of EUR 26 billion, of which the vast majority went to Europe, North-America and Japan. The International Federation of Organic Agricultural Movements (IFOAM) expects a growth of 21% in 2006 to reach a level of EUR 40 billion. TEEB (2010) estimates the certified agricultural products market to grow to US$ 210 billion in 2020. Especially in Europe, demand exceeds local supply, leading to large volumes of imports. According to the IFOAM 2007 year statistic, in 2006 there was in total 31 million ha. (+19%) of farmland under organic management, of which 39% is in Australia, 24% in Europe and 16% in Latin America. As for the emerging markets, Africa only has ca. 1 million ha. of organic farm land (almost solely used for exports) and the level of certification and inspection is low. Most promising countries in this field are Tunisia, Kenya, South-Africa and Egypt. In Asia, about 2.9 million hectares of organic area is managed by ca. 130,000 farms, mostly without market regulation or certification. Only India and Israel have attained equivalency status with the European Union regulation. Further, the sector is relatively well developed in Latin-America where in 2006 ca. 6 million ha. of farmland could be defined as organic, the majority of which is located in Uruguay, Mexico and Argentina. Organic production is also in Latin America mainly used for exports.

Large companies are increasingly involved in certified produce, including Chiquita and Kraft foods purchasing bananas and coffee certified by the Rainforest Alliance (with the ECO-OK label). In addition, McDonald's has recently vowed to only serve certified coffee in all of its stores. At the same time, there is growing concern about the proliferation of certification systems. There are currently 395 organizations worldwide offering certification services, of which only 40% have been approved by the European Union, all with different characteristics. This large amount is likely to cause confusion among consumers.

Although the positive effects of organic farming on the general environment is evident, there is no compelling evidence of the biodiversity conservation benefits. Measurement is currently restricted to the farm land with little attention to the surrounding areas and landscapes. Except for the Rainforest Alliance and Smithsonian Migratory Bird Centre, few certification systems have clear guidelines for the protection or rehabilitation of natural vegetation, rivers, water bodies, fauna etc. Particularly in Africa, the level of certification is very low. However, although not required for certification, the International Federation of Organic Agricultural Movements has set up biodiversity standards. There is definitely a great need for a system to measure the impact on biodiversity.

4.4.3. Market 3: Sustainable Fisheries and Aquaculture

Although a form of agriculture, we have decided to separately describe aquaculture as its principal input is water rather than land.

Definition
The sustainable fisheries market refers to the capturing of wild fish stock with a limited negative effect on the surrounding area, the stock and the survival of the species. Sustainable aquaculture refers to the cultivation of freshwater or marine aquatic species (including fish, shrimp, turtles, crocodiles and seaweed) in captivity (in ponds, cages or other structures) as an alternative to large-scale, often destructive fishing practices in seas and lakes.

According to the Marine Stewardship Council (MSC)[16], the world's largest certifier for wild life stock fisheries, sustainable fish practices are to (i) maintain and re-establish healthy populations of targeted species, (ii) maintain the integrity of ecosystems, (iii) take into account all relevant biological, technological, economic, social, environmental and commercial aspects and (iv) should comply with all international understandings and agreements.

Market Characteristics

Because of the year-on-year increase in demand for seafood products, aquatic ecosystems are under mounting decline. Some of the facts: in the last thirty years demand has doubled and is expected to grow by 1.5% per year in the coming 15 years; 75% of commercially important fish are currently over-fished or are at their biological limit; 52% of fish stocks are fully exploited and 24% are overexploited while only 3% are underexploited. 2.6 billion people depend on fish as their primary source of animal protein and 200 million worldwide earn all or part of their income from (related) fishing activities. The vast majority of commercial fishing made large-scale fishing possible but resulted into un-intentional by-catch and destruction of sea habitat as the result of (i) technological advances such as bottom trawling and (ii) the use of poisons and explosives. Fish currently most at risk are tuna, marlin and swordfish.

Aquaculture products can be distinguished into two different groups: (1) high values species such as shrimp and salmon, mainly produced for exports and (2) lowly-valued species such as carp and tilapia, mainly consumed locally. Aquaculture, with an average annual growth rate of 11% since 1984 still is the fastest growing food production sector in the world, compared to 0.8% for normal capture fisheries and 3.1% for farm meat. The vast majority of aquaculture produce takes place in the developing world: by weight, ca. 90% of total global aquaculture production came from Asia in 1998.

Fish produced in captivity has the potential to reduce the negative impact on ecosystems and stop the ongoing decline in fish stock. However, aquaculture as such does not necessarily lead to positive effects on biodiversity for several reasons. Aquaculture sometimes required the conversion of arable land or mangrove forests to shrimp ponds. In this respect Thailand, for example, lost 17% of its mangrove forests over the period 1987-1993. Other negative effects on ecosystems are disease and pollution problems, spread of alien species and lowered ground water. Finally, most carnivorous species depend on fishmeal, which puts an additional burden on fish harvesting: 10-15% of all fishmeal goes to aquaculture feeds and it takes about 2 kg of fishmeal to produce 1 kg of shrimp.

The Marine Stewardship Council initiative, the largest international certification organization in the field of sustainable fisheries (excluding aquaculture!), has managed to increase MSC certified fish to 3 million tonnes/day in 2006 (which is about 3% of total production per day, being 90 million tonnes/day). At final year end 2006, the amount of MSC-certified products grew to 332 in 25 countries (50% growth), while there was a growth of 76% in retail sales of MSC-labeled fish, with about 200 businesses trading sustainable seafood. This implies that as of 2006 42% of global wild salmon catch, 32% of global prime whitefish catch and 18% of spiny lobster catch are engaged in the MSC program[17].

There is growing interest by international supermarkets and suppliers to sell sustainable captured fish. Unilever, who assisted in setting up the MSC-initiative together with WWF, sells ca. 43%[18] of its fish with the MSC-label. In February 2006, the world's largest supermarket chain Wal-Mart, announced to source all of its fresh and frozen fish from MSC-certified fisheries within 3-5 years, starting with its 3,800 stores in North America. TEEB(2010) reported that in the period April 2008 - March 2009, the global market for eco-labeled fish grew by over 50% to a value of US$ 1,5 billion.

[16] http://www.msc.org/assets/docs/fishery_certification/MSCPrinciples&Criteria.doc
[17] 2006 Annual Report Marine Stewardship Council, available at www.msc.org.
[18] http://www.unilever.nl/onsbedrijf/nieuwsenmedia/persberichten/2005/UnileverintroduceertIglovissticksafkomstigvan2005630121950.asp

4.4.4. Market 4: Non-Timber Forest Products and Bioprospecting

Definition
Non-timber Forest Products (or, NTFPs) are products, other than timber, of biological origin derived from forests or wooded areas[19]. NTFPs include fruits, herbs, spices, honey, bamboo, rattan, edible nuts, cork, ornamental plants & flowers and plants & animal products used for medicinal or cosmetic purposes. The sustainable harvest of NTFPs aims to prevent damage to forests in its capacity to deliver products and services such as future NTFPs, timber, water and biodiversity conservation.

Market Characteristics[20]
Several million households in the world are reliant on NTFPs for subsistence and income. It is estimated that ca. 80% of people in the developing world depend on NTFPs for medicinal and nutritional reasons, backed up by a recent study of 54 case studies showing that forest-resources provide about 20% of average household income in poor rural areas of developing countries. In addition to the subsistence function, about 150 NTFPs are traded on the international commodity markets, with a total market value in the order of US$ 11 billion, most of which not harvested sustainably. The most important tropical suppliers are India, Indonesia, Thailand, Malaysia and Brazil. Another, more 'invisible' NTFP is bush meat ((often illegally) harvested meat from animals living in forest areas) including meat from apes and predators. Mostly in Central and West Africa, it is estimated that between $42 and $205 million worth of bush meat is illegally harvested each year. This has made bush meat an important source of income in these countries. However, there are growing concerns that this practice will lead to increased risk of extinction of a number of endangered animals.

The sustainable NTFP is not an easy market. It requests the same type of careful planning and restraints as sustainable forestry and depends largely on governments to support the enforcement of property rights. Other key success factors are market knowledge, market access & infrastructure, specialized marketing and financial capability.

One of the most prominent challenges for sustainable harvesting is the development of sustainable and verifiable harvesting guidelines (certification). The latter is important as some host trees have highly variable production levels (with variations of more than 1000%), which makes it more difficult to ensure sustainable harvests. The Forest Stewardship Council recently set up a certification framework for NTFPs, because sustainable harvesting of NTFPs has many similarities to the sustainable harvest of timber. Although a step forward, it seems most appropriate for large scale industrial NTFP operations due to the large costs involved, which is also similar to the sustainable timber market.

4.4.5. Market 5: Ecotourism

Definition
Ecotourism can be defined as linking travel (including leisure, adventure and educational activities) to undisturbed natural areas and to conservation of their natural resources. The International Ecotourism Society (TIES) defines ecotourism broadly as 'responsible travel to natural areas that conserves the environment and improves the well-being of local people'. As such, ecotourism intends to combine tourism with (i) the protection or restoration of areas with high biological value and (ii) improvement of the living standards of local people.

Market characteristics

[19] Derived from www.tropenbos.nl
[20] Data based on www.tropenbos.nl

Tourism is one of the largest business sectors in the world. World tourism generates approximately 11% of world GDP or ca. US 4 trillion a year. Eco & nature tourism is the fastest growing segment. Where the tourism industry as a whole grows by about 9% annually, ecotourism (incl. nature tourism) increased by 20-34% in 2005. Traditional types of tourism (including sun and beach holidays) are expected to mature as a market while eco, nature and cultural tourism are among the sectors expected to grow fastest in the next two decades.

While the demand is definitely there, supply is more the problem, especially in the field of certification. There are many uncertified eco-labels using tourism organizations, which are unreliable in terms of true sustainability and positive impact on the natural environment. However, there are attempts to harmonize them by the Sustainable Tourism Stewardship Council (STSC), following other successful certification programs such as FSC (Forestry Stewardship Council) and MSC (Marine Stewardship Council). The STSC initiative is supported by the Rainforest Alliance and TIES and is an accreditation body for sustainable tourism and ecotourism certification programs.

The challenge for most ecotourism companies is to combine profitability with a positive contribution to nature conservation. Currently most ecotourism companies are small (with the idea that small is beautiful in terms of negative impact to the environment) and few have yet teamed up with big tour operators. However, in this way relatively few tourists are reached and the impact on the tourism industry as a whole is limited. Further, small operators are difficult to finance and operate profitably. Considerable business opportunities lie in (i) one developer/operator with multiple sites to create economies of scale in marketing, supplies, finance etc., (ii) an exclusive rights approach where concessions of natural parks are granted to one or more developers who are allowed to undertake tourism activities in return for profit sharing and/or park management activities and (iii) small luxury operations.

There are several ways in which ecotourism promotes biodiversity conservation and ecosystems. First, entry fees of natural parks and other protected areas support the management of these areas. In South Africa, for example, some 60% of foreign tourists visit game reserves or natural parks, which allow the South African National Parks Board to finance up to 80% of its annual budget from entry fees. Secondly, indirect taxes such as airport taxes and cruise ship passenger fees are sometimes earmarked to support protected areas.

Now that we have presented some markets for ecosystem (related) goods and services, we will revisit the end of Chapter 3, where we described the principal cause of the decline in ecosystems and biodiversity: market failures.

4.5. Market Failures in Markets for Ecosystem Goods and Services

We concluded in section 3.4.3 of chapter 3, from a welfare economics perspective, the markets for ecosystem goods and services show certain market failures and thereby prevent an efficient allocation of resources. We will list them again here and explain to what extent the above described markets for ecosystems goods and services contribute to the reduction of certain market failures.

No direct markets exist for many ecosystem services

The creation of a market for public ecosystem services helps to reduce this market failure. In particular, the three markets we describe above, being the biodiversity offsets market, the carbon sequestration market and the wetland off sets market create markets for the following regulating ecosystem services: the climate regulation service, the water purification & waste treatment service and the natural hazard regulation. The eco-tourism market is a market for the cultural service education values, inspiration and aesthetic values.

Many ecosystem services are public
The creation of markets for public ecosystem services conduces to private entrepreneurship, to excludable & rival use of products and to the assignment of property rights. An entrepreneur employing an area to promote ecotourism, e.g. in a natural park, will somehow charge user fees (whether in the form of entrance fees or in the form of lodging and food charges) and people not willing to pay for these charges are excluded from the service. Further, an agent selling a carbon credit provides the buyer of the credit the right to emit a certain quantity of carbon dioxide. As the credit can be sold only once and to one party only, the use of the credit is rival and excludable, so no free riding should occur. In addition, an agent selling a biodiversity-offset credit provides the buyer of the credit the right to reduce somewhere a certain quantity of biodiversity. The use of the credit is, as it is attributed to one party only, again rival and excludable.

Absent, or ill-specified, private property rights
The creation of markets for public ecosystem services induces the assignment of private property rights to both those who produce and those who sell the service. This is a precondition without which most official markets simply do not function and requires the close involvement of local, regional and national governmental institutions such as the European carbon credit exchanges, UN registered carbon credit approval and registration agents, public and private biodiversity banks. Note that in many developing countries, legal title to land is often not well regulated and the rise in markets for ecosystem services helps solving this problem.

Negative Externalities from Other Markets
In Chapter 3 we argued that the non sustainable management of ecosystem goods, for example those markets that require the conversion of ecosystems to provide for more land, often exhibit negative external effects on the recipients of certain (public) ecosystem services, both on a global, regional and local scale. The markets that we identified in this chapter as ecosystem goods under sustainable management (sustainable forestry, sustainable agriculture, sustainable fisheries & aquaculture, eco tourism and NTFPs), use certified or otherwise sustainable production schemes that are designed to and aim to limit external effects on the (social) environment by excluding the (large scale) conversion of ecosystems, intensive use of pesticides, large resettlements of people, amongst others. If the certification program is well adhered to, negative external effects are less prevalent than in the production of goods under non-sustainable management.

Incomplete information
Even if entrepreneurs and governments in developing countries would like to take the social costs related to the reduction of certain ecosystem services into account in a social cost benefit analysis of investment opportunities, they are limited by the lack of information about the (monetary) value of ecosystem services. The trading of ecosystems services such as carbon and biodiversity offset credits, but also market information on the ecotourism and sustainable agri- and aquaculture provides information about opportunities and opportunity costs incurred as the result of investment decisions. The more information is available, whether in the form of market prices reflecting true social costs and benefits of (reductions in) ecosystem services, reduces this market failure and contributes to investments in ecosystem supporting markets.

4.6. Conclusion

In this chapter we provided answers to Research question 2:

Which private markets for (A) public ecosystems services and (B) ecosystem goods under sustainable management are most promising for the private sector to invest in to create a win-win situation for (i) the

private sector in terms of sufficient financial return and (ii) the natural environment in terms of protecting biodiversity?

We presented eight markets that support ecosystems and biodiversity. The first three markets refer to the trade of public ecosystem services: biodiversity off sets, carbon sequestration and wetland off sets. The other five markets are markets for ecosystem goods under sustainable management: sustainable forestry, agriculture, fisheries, NTFP's and eco-tourism. Furthermore, we concluded that the further development of these markets help to reduce certain markets failures and therefore establish a more efficient allocation of goods and services, better preserved ecosystems, smaller amounts of ecosystem destructive goods and, according to certain publications, billions of euro's and dollars worth of public goods.

Looking at the markets from a business perspective, there are both strengths and weaknesses. Probably the most important strength forms the growth capacity of the markets, despite the current infant stage of most of the markets. All markets show significantly higher growth rates than their traditional counterparts, especially sustainable forestry, fishery, agriculture and ecotourism. Further, the markets for ecosystem goods under sustainable management benefit from (up to 25%) higher profit margins thanks to a willingness to pay, mostly applicable to consumers in the developed world, for a premium on sustainably produced products. There are also significant risks in the ecosystems enhancing business sectors, which are usually (with the exception of aquaculture) more labour intensive and less suited for large scale production, tempering growth and profit expectations. Further, current producers often lack the financial, marketing and managerial knowledge necessary to effectively run a profitable business. Moreover, despite initiatives from the Forest Stewardship Council, the International Federation of Organic Agricultural Movements and the Sustainable Tourism Stewardship Council to provide common frameworks, there are still many different certification systems confusing both producers and consumers. Finally, most remaining ecosystems are located in developing countries in Latin America, Africa and Asia with weak institutions and insufficient attention to the protection of private property rights. Further, as long as social benefits of (public) ecosystem goods and services cannot be reaped by private agents, valuable ecosystems will continue to disappear as long as (i) opportunity costs outweigh the net benefits of ecosystem goods under sustainable management and (ii) governments in developing countries do not successfully protect them.

Due to the business risks involved, the described markets will appeal to (a) investors and entrepreneurs with a higher than average risk appetite (with a corresponding above average return expectation) and (b) frontrunners in the sustainable business practices. Not all financial institutions are yet ready to support and invest in the markets described in this chapter. This calls for the involvement of financial institutions that focus on and have experience in high risk markets in developing countries, including development banks. We will discuss the role of financial institutions and developing banks in more detail in the following chapter.

5. The Role for Financial Institutions in the Markets for Ecosystem Goods and Services

5.1. Introduction: Commercial Banks versus Development Banks

In this chapter, we turn our view to one of the more crucial actors in the development of these markets, namely financial institutions in general and development banks in particular, by answering the following research question:

Research question 3:
To what extent are financial institutions and, in particular, development banks suited to help halt the ongoing reduction in biodiversity in developing countries in their pursuit to spur economic growth?

In the previous chapter, we gave an overview of markets that either promote the direct trade of public ecosystem services or produce ecosystem goods sustainably. In this chapter, we will argue that development banks may play a front-runners role in the further development of these markets. In section 5.2, we explain what development banks are, their mission, scope of work and what kind of products and services they offer. We will also briefly introduce the most important development banks. In section 5.3, we will highlight an important distinction between commercial and development banks: the focus on sustainability and why this makes them suitable for the ecosystem goods market. Where commercial banks tend to maximize profits, development banks try to seek a balance between financial, social and environmental returns. Although social and environmental returns are not easily quantifiable, social and environmental risks and performance is managed by the IFC Performance Standards, which we will elaborate upon in section 5.3.

The general idea behind the concept of development bank is to fill the gap (or, to repair the market failure) that commercial banks leave in certain countries and sectors. Although it is rapidly changing, both international and local commercial banks were for long hesitant to provide long-term risk bearing finance in many developing countries. This leads amongst other to under investments in (large) infrastructural projects including power stations, ports, communications, airports and roads as these investments have in common that, due to its capital intensity, they need long repayment periods (often between 10 and 20 years). This is the reason why development banks, both on a national, regional and international level have been incorporated to invest in those sectors that were underserved by local and international commercial banks. Development banks primarily invest in local commercial banks (its long-term loans to local banks allows hem to also provide longer term loans to their clients), large-scale infrastructural projects and production companies.

5.2. Development Banks

Development Finance Institutions (DFI's), also referred to as Development Banks[21] are bilateral or multilateral finance institutions, usually with one (bilateral DFI) or more (multi-lateral DFI) governments as major shareholders. DFI's aim to promote sustainable private sector investment in developing countries as a way to reduce poverty and improve people's lives. As such, they are part of public policy of (often Western) governments to support the private sector development in developing countries and are distinct from national development banks that have more or less the same purpose, but which are active in the developing country only and are owned by the government of that particular developing country.

[21] The term 'Bank' is in the strict sense of the word incorrect, as many development finance institutions have no official banking license and are thus not supervised by a Central Bank.

5.2.1. Mission

Development banks are set up to promote and make investments in the private sector in developing countries and in this role try to resolve the market failure of absent local and international capital markets by providing long term loans and/or private equity, for which there exists a clear demand in developing countries. Finance is provided as much as possible on commercial terms to reflect the risk of the project they are financing, and as such creates necessary buffers for project losses, but also to reduce dependency of their clients on grant finance. Once companies in developing countries are self sufficient and no longer depend on assistance from national or international development banks (or even NGO's), they will more easily participate in global markets.

Development banks target those sectors that in their view are most vital to economic growth and contribute most to poverty reduction. Therefore, the majority of the loan portfolios of most development banks consist of financial sector clients, including local commercial banks, micro finance institutions, mortgage and leasing companies. Through the financial sector the development bank can reach certain groups that would be otherwise difficult to reach, for example individual customers who need finance to buy a house (mortgage finance), study & car loans or those who otherwise want to improve their living conditions. Other groups are small and medium sized enterprises that on its own are too small to directly borrow from a development bank. Through financial sector intermediaries, the development bank can reach individuals and companies it believes are vital to the economy and are underserved by the local commercial banks.

Besides the financial sector, development banks finance bigger sized corporate and infrastructural projects such as energy, telecoms, railroads, airports, harbors and (toll) roads often by means of project finance. Investments in social infrastructure such as health care, education and social housing also occur, however only to a limited extent since these sectors are often largely regulated and controlled by the public sector.

5.2.2. Scope of Work

Development banks differ from commercial banks. The prime focus area of development banks is the non-developed or developing countries in Africa, Asia, Latin America and Eastern Europe and Central Asia, where international commercial banks cannot or don't want to operate, or only on a limited basis, as the political and financial risks are perceived as too high. At the same time, the local commercial banking sector may be underdeveloped, provide only short finance (while large infrastructural projects require long tenors) or are selective in the sectors and type of clients they are willing to finance (e.g. only large clients). Further, development banks historically played an important role in *transitional* economies, i.e. economies that are in the process of changing from a centrally planned economy into a market economy. In such countries, a well functioning banking sector is often absent, which hampers economic development. Inefficiencies result from surplus cash (savings) not stored in banks and the impossibility to borrow funds for long-term investments.

If there is a banking sector at all, (local) banks tend to lend money on a short-term basis, e.g. up to one or two years only. Also in the more advanced developing countries, such as Brazil, Russia, India and China (these countries are called 'BRIC' nations, first defined by Goldman Sachs in 2003 as those countries that will have passed the industrialized nations by 2050 in terms of GDP size), development banks have an important role to play. In these countries, we see a relatively well developed banking sector (including subsidiaries of large international banks), however, the banks are still not keen on long term (subordinated) lending, let alone taking mezzanine (semi equity) or equity participations or providing (usually volatile) local currency denominated loans. Instead, they would provide short-term senior loans, and/or trade finance, denominated in US dollars or Euro's. International banks have recently increased their presence in developing countries all over the world, because of the economic boom in these markets.

However, the past has shown, for example during the crisis in 1998 in Russia or in 2001 in Argentina, commercial banks often quickly reduce their activities as soon as a country is hit by a (credit) crisis. In this instance, development banks replace the role of commercial banks during or right after crises. Alternatively, they provide high-risk finance in calmer times both local and international commercial banks are unwilling to extend.

Development banks differ from commercial banks in two aspects: in their *risk* appetite and in *sustainability* policy. Development banks will take higher risks through the type of finance they provide, but not by accepting bad quality or large loss making companies. Generally, development banks, in their complementary role, do not compete with commercial banks, because they offer different products. In addition, the role of development banks is in principle temporary. Once the commercial parties are willing to take over their role, development banks either leave of focus on other, underserved segments of the market or underserved regions. Finally, many development banks have separate divisions for private sector and public sector lending. The World Bank for example, lends to governments of developing countries, or finances (large infrastructural, health or educational) public projects directly. Its finance activities in the private sector are undertaken by the International Finance Corporation (IFC), which is part of the World Bank Group. Note that many bilateral development banks do not directly lend to governments or state-owned banks, as their role is to promote private sector development. A final note, the goal of development banks is not to get market share, but to finance companies that are inclined to follow international best practices in terms of sustainability or corporate governance, and seek strategic investments. Once the role of development banks is taken over by commercial banks, they leave.

5.2.3. Products and Services

Development banks replicate the absence of a well functioning banking market and provide products and services that commercial banks are not (yet) willing to provide. These include the following:

1. Long term (secured and unsecured) senior loans, with tenors up to 10 - 15 years. Many companies need long term finance to do their business, for example to invest in capital-intensive equipment for further expansion. These investments tend to have long pay back periods, which require long-term finance. In addition, large infrastructure and housing projects (with mortgages up to 20 years) are examples of investments that require long-term finance. This is type of long term finance is very often absent in developing countries.
2. Besides financing in Euro's or US dollars, some DFI's provide local currency loans.
3. Equity participations, where the DFI becomes a shareholder in a company by buying a (minority) share of the company, usually note more than 25%. As a shareholder, the bank has a more influential role in the company e.g. with strategic decisions (through Shareholders Meetings and Supervisory Board decisions), than it would have as a lender.
4. Guarantees: a development bank can enhance local banking sector development by guaranteeing (syndicated) loans or bonds, issued by local finance institutions, against a default.
5. Syndicated loans: development banks arrange large loans, in which, besides themselves, other commercial and developing banks participate. The involvement of development banks in arranging syndicated loans reduces the risk for participating commercial banks in several ways. Firstly, development banks often have a rigorous due diligence process, where a lot of time and resources are dedicated to determine the relevant risks of the company or bank that they will finance. Commercial banks derive comfort from this exercise. Secondly, development banks tend to take the higher risk portion of the loan (and as a result receive a higher interest rate margin) through: (i) keeping a large portion of the loan, (ii) a longer loan tenor than the one of the commercial parties or (iii) a subordinated[22] tranche. Thirdly, many development banks have

[22] Subordinated means here that interest payments and/or repayments of the notional will be subordinated to the senior lenders who receive funds *first* in case of bankruptcies.

separate agreements with local governments to allow them preferential treatment in crises. This makes nationalization and capital controls less likely for loans syndicated by development banks. This significantly reduces the political risk of these projects.

6. Bond issues: development banks can arrange finance for a financial institution or company by arranging a bond issue in the local capital market. In this way, the company benefits form the network of the development bank and its capacity to find interested parties to sell the bond to. The bond issue can be enhanced further by a (partial) guarantee of the development bank to the investors.
7. Technical assistance: development banks, because of their close links with governments as their shareholders, often have access to technical assistance funds. These funds can be provided to (future) clients to assist them in knowledge transfers and capacity building with respect to corporate governance, environmental and social performances, certification and management knowledge. Technical assistance is often given in the form of (partial) grants.

Please note that, except for the technical assistance, financing from development banks is usually provided on commercial terms with only limited subsidy elements. Moreover, development banks often have lower profit targets than commercial banks: on the back of their development mission, shareholders prefer the banks to invest in high risk projects instead of projects with the highest returns on investments. This means that given the high-risk appetite of development banks, regular profits and reserves are needed to fall back upon in case of crises and/or large non-performing loans. Given the high-risk profile of the portfolio, development banks tend to be vulnerable during times of crises. A buffer, or sound capital adequacy, is therefore paramount.

5.2.4. Multilateral and Bi-lateral Development Banks

In this section we will give a brief overview of some of the most active bi-lateral and multilateral development banks:

Bi-lateral development banks
Bi-lateral development banks are finance institutions controlled by a single state and focus on private sector development only. These include:

1. the Financierings-Maatschappij voor Ontwikkelingslanden (FMO, the Netherlands);
2. Deutsche Investitions- und Entwicklungsgesellschaft (DEG, Germany);
3. Commonwealth Development Corporation (CDC, United Kingdom);
4. Promotion et Participation pour la Coopération Economique (Proparco, France);
5. Others include the Nordic Investment Bank[23], Swedfund from Sweden, Norfund from Norway, Finnfund from Finland, BIO from Belgium and Cordiant, the development bank from Canada.

These banks have common grounds and many are active in all four continents of the emerging world (Africa, Latin America, Asia and Eastern-Europe & Central Asia). However, they also vary in dominancy in the different geographical areas and the types of companies they invest in. FMO and CDC have significant presence in Sub Saharan Africa, while DEG is prominent in Asia. Some of these institutions have historical roots in certain countries related to former colonies. Note that most bi-lateral development banks are not required to promote exports of the country of origin.

Multi-lateral Development Banks
Multi-lateral development bank are finance institutions set up by a group of governments to contribute to economic growth and poverty reduction by promoting (i) public infrastructural investments and (ii) private sector development in a specific geographical area.

[23] A development bank founded by five Nordic countries (Norway, Sweden, Finland, Denmark and Iceland).

Probably the most well known multi-lateral development institution is the World Bank. In 1956, thirty-one governments set up the International Finance Corporation (IFC), the private sector arm of the World Bank Group, now based in Washington D.C (USA). Currently the bank is owned by 179 member countries, of which the largest ownership stakes are held by the US (35%), UK (14%), China (7%), France (6%) and India (4%). Area of focus: Latin America, Asia, Africa and Eastern Europe and Central Asia

The European Bank for Reconstruction and Development (EBRD), headquartered in London (United Kingdom), was set up in 1991 by amongst others former President of France, Francois Mitterrand, to support eastern European countries with their transformation to market based economies. The bank is owned by 27 members, of which the largest shareholders are the USA (10%), the UK, Japan, France, Italy and Germany, each with a 9% stake. Area of focus: Eastern Europe and Central Asia.

The Asian Development Bank, headquartered in Manila (Philippines) was created in 1966 by 31 members to create growth in the Asian and Pacific region. Currently is has 67 member states and 65% of the voting power rests with regional countries (Japan 13%, China 5%, Australia 5%) and 35% with non-regional countries (USA 13%, 5% Canada and 4% Germany)

The Inter-American Development Bank was set up in 1959, has a regional focus in Latin America and the Caribbean and is currently owned by 46 member states. 30% of the voting power rests with the US, 11% by certain European countries & Israel, 5% by Japan, 4% by Canada and as much as 50% by countries in the investment area.

The African Development Bank targets both public and private sector investments on the African continent. The bank was founded in 1964 and currently has 77 member states. 60% of the voting power lies with African countries (the highest is 5% for South Africa), 6% with the US, 5% with Japan and 4% each for Germany, France & Canada.

The table below shows some details of the banks mentioned above including total investment portfolio, total capital (equity) and net income, all as of final year end 2009 (with the exception of IFC, which is per 30 June 2009). We note that 2009 has been a somewhat difficult year for many development banks and profits dropped due to provisions for bad performing loans. As of final year-end 2009, total outstanding commitments were in the order of €150 billion, however, as the IADB and the Asian Development Bank invest the majority of their portfolio in public projects, this amount is not representative for the funds invested in the private sector. We point out that all amounts for the bi-laterals and IFC are private sector investments only, while the amounts for the EBRD and the African Development Bank are for the most part private sector investments.

2009 (mln EUR)	Portfolio	Equity	Profits
Bi-lateral			
DEG	4,701	1,336	50-
CDC	1,647	1,751	242
FMO	4,598	1,327	60
Proparco	1,655	420	24
Multi-lateral			
EBRD	17,800	11,515	746-
IFC	28,083	13,123	123-
IADB	47,252	16,829	646
Asian DB	34,595	12,469	28-
African DB	4,019	2,461	35

Table 1: Financials certain development banks - Source: Te Velde (2007), Annual Reports IFC, FMO, CDC, EBRD, ADB, IADB, AfDB

Bi-lateral development banks, with an outstanding portfolio of around EUR 12 billion in 2006, represent 15% of global DFI investment in the developing world (2006, Te Velde et al.). The three largest bi-lateral development banks (FMO, DEG and CDC) are roughly equal in terms of portfolio size. However, CDC distinguishes itself significantly from the rest as a 'fund of funds' by providing finance to a selected number of private equity funds.

Bilateral DFi's are generally found to be more flexible, innovative, with specialized knowledge and less bureaucratic than multi-lateral finance institutions. On the other hand, multi-laterals, with an investment portfolio of around EUR 60 billion, account for 85% of global DFI investment as the result of their size and political influence and can therefore have larger scale impacts both in depth and breadth of their operations. This is also reflected in the project size: the average project size for multilaterals is about EUR 15 million compared to EUR 5 million for bi-laterals.

5.2.5. FMO - The Dutch Development Bank

History of FMO

In 1959, the Dutch government, together with twenty Dutch companies and banks, set up FMO's predecessor, the 'Nederlandse Overzeesche Financierings-maatschappij' (NOF), after President Soukarno of Indonesia had evicted all Dutch enterprises from the country. As a finance company, NOF's mission was to support Dutch companies to invest in alternative developing countries. In 1970, when it was decided the finance company's mission was no longer solely directed to support the Dutch business community, FMO was created to replace the NOF. FMO, the Netherlands Finance Company, or officially the Financierings-Maatschappij voor Ontwikkelingslanden N.V., was structured as a public private company with its shareholders being the Dutch government (51% of the shares), and a group consisting of Dutch banks (including ABN Amro, ING, Rabobank, Fortis and NIB Capital, together 42% of the shares) and employers and labour unions (Vakbond FNV and VNO-NCW, together 7%). Similar to other development banks, FMO invests in relatively poor, unstable, often corrupt and volatile countries in the developing regions, which makes it business vulnerable by nature and can only survive with sufficient reserves. Therefore FMO needs to be profitable in the long run.

In the 1980's FMO's loan portfolio quality worsened as the result of a number of bad performing loans amounting to increased losses. With the support of the Dutch government, who started to promote private sector development in developing countries, FMO was professionalized in terms of its staff, IT and control systems and internal processes. This, in contribution to well performing markets in almost all the developing regions in the world, lead to accumulated after tax profits of close to EUR 500 million over the period 2000-2009, which could be added to the reserves and reinvested after deductions of small amounts of dividend. These profits are in line with a long term profit target comparable to the return generated by Dutch state bonds[24]. Since 1999, FMO enjoys the highest credit rating possible, AAA by Standard and Poor's, mainly thanks to a government guarantee with respect to its outstanding debt.

Mission and role

FMO's mission is, by providing long term capital to companies and financial institutions in developing countries and emerging markets, to contribute to private sector development, economic growth and poverty reduction in these countries. As FMO has only one office, FMO has build partnerships with bi-lateral and multi-lateral development banks, as well as with commercial banks and private equity funds. Further, without a local presence, FMO always cooperate with local partners on the ground who have close relationships with the clients. Moreover, FMO's role is not to compete with regular commercial

[24] We note this relatively low return on equity is due to the large solvency of the bank (ca. 35% as of yearend 2009) which is needed as a buffer to absorb future losses from the high-risk investment portfolio.

banks, but to be *additional*, which means that FMO will provide long term finance in countries and sectors where commercial banks are hesitant to operate and/or FMO is providing finance on a longer term (up to 20 years) than what commercial banks can do. As of year end 2009, FMO's committed portfolio amounted to EUR 4.6 billion.

As we stated in the introduction, development banks distinguish themselves from commercial banks in the following respects: (i) countries and sectors they are active in, (ii) availability of long-term investments and (iii) balance between financial, social and environmental returns. Financial return is expressed by (realistic and modest) net profit targets, often expressed as a percentage of the available equity. However, social and environmental (or, sustainability) return targets are less obvious and therefore the ESG framework is introduced, which we will discuss in the following paragraph.

5.3. Sustainability- the ESG framework

There are several reasons why development banks emphasize the environmental, social and corporate governance aspects of their investments (together "ESG"):

(i) Mandate: development banks often have Western governments as shareholders who want to promote *sustainable* investments in developing countries, as they experienced the negative consequences of neglect in their own countries;
(ii) Risks: the lack of attention towards sound environmental, social and corporate governance policies in many developing countries pose significant financial risks for development banks. Past denial of ESG issues, intended to generate short term profits, has resulted into increased social and environmental related costs from environmental and other (legal) claims, social unrest from local populations and NGO's (boycotts, strikes etc.) leading to damaged reputations. There are cases where the social and environmental claims resulted into bankruptcy of the investment;
(iii) Reduced costs: if ESG is properly handled, a (local and international) social license to operate is more easily obtained. Taking care of the social and physical environment while creating a safe working environment with fair and equitable working conditions, can lead to more productivity, lower costs and higher profitability.

Corporate Governance

The corporate governance of a company describes the way a company is directed, administered and controlled and how the interests of the different stakeholders (shareholders, employees, customers etc) are maintained. Good corporate governance includes:

(i) Proper financial accounts, audited by a qualified external accountant;
(ii) Clear division of responsibilities between the management board of the company, the supervisory board (preferably including independent members and without (too many) executive members) and the shareholders;
(iii) Protection of the interests of minority shareholders.

A proper corporate governance policy increases trust from external financiers and other stakeholders and can result into availability of (more) external capital (both debt and equity) and lower borrowing costs as the risks are perceived to be lower. We note that corporate governance is distinct from social and environmental issues, however, as it is a non-financial item, for easy reference it is often merged all in one term: sustainability. A further analysis of this topic falls outside the scope of this thesis.

Social and Environmental Sustainability

The International Finance Corporation, the private sector arm of the World Bank Group, have set up a frame work, the so called Performance Standards ("PS")[25] to benchmark the environmental and social performance of an investment. Originally, these performance standards were designed for large

[25] Source: http://www.ifc.org/ifcext/enviro.nsf/AttachmentsByTitle/pol_PerformanceStandards2006_full/$FILE/IFC+Performance+Standards.pdf

infrastructural projects, however they have been extended to be applied to other types of investments as well. Many development banks around the world, but also increasingly commercial banks, have adopted these environmental and social financing criteria as lending requirements, with the result that these performance standards are now regarded as international best practices for large-scale (infrastructural) investments. Moreover, banks that have committed to abide by the Equator Principles, an agreement to adhere to social and environment safeguards of the World Bank group, in principle[26] also committed themselves to use the IFC Performance Standards for project financing. Project financing is distinct from other types of bank lending, including corporate lending, as it finances a single project rather than a company with different business activities. Project finance is generally considered higher risk than corporate or balance sheet financing. These projects may be located in remote areas of the world with high biodiversity value, for example in the mining and oil & gas industries. Investments financed by project finance therefore can and will often entail large social and environmental risks, so that the adoption of the Equator Principles (and thus the IFC Performance Standards) by 67 large international finance institutions is an important step towards the inclusion and mitigation of environmental and social risks. Annex 3 contains the finance institutions currently adhering to the Equator Principles.

The IFC Performance Standards are eight standards that need to be followed by project developers during the initial assessment of a project as well as during the implementation. Note that financial institutions verify compliance with these standards, but have no formal role as they are, apart from the financing, very often not involved project development. In addition, the verification and follow-up of the performance standards are often so complicated that specialized skills from a qualified (group of) consultant(s) are required for a successful implementation. After an initial assessment along the 8 performance standards, each investment is categorized into one of the following three risk classes:

1. Category A: Projects with potential significant adverse social or environmental impacts, which are diverse, irreversible or unprecedented. This is the category with potentially the most severe environmental and social risks. Mitigation requires a detailed assessment and project specific measures.
2. Category B: Projects with potential limited adverse social or environmental impacts that are few in number, generally site-specific, largely reversible and readily addressed through mitigation measure. This category entails moderate environmental and social risks for which solutions should be readily available.
3. Category C: Projects with minimal or no adverse social or environmental impacts.

In annex 4, we will discuss the eight performance standards[27] in more detail.

5.4. Development Banks and Markets for Ecosystem Goods and Services

In this section we argue that development banks are institutions that can play an important role in the financing of investments in the markets for ecosystem goods and services. Commercial banks usually consider the existing markets for ecosystem goods and services as too high risk, because (i) the existing markets for public ecosystem goods (carbon credits and biodiversity offsets) are new, untested and it is unsure if they continue to exist if there is no successor to the Kyoto treaty. (ii) the markets for ecosystem goods under sustainable management are driven by small sized companies, managed by (somewhat) idealistic entrepreneurs, selling in new and unknown markets (e.g. certified timber) and working in remote locations. If at all, commercial banks are sometimes willing to provide short term (e.g. up to one year) working capital facilities, for which they often require significant collateral (e.g. inventories worth 150% of the outstanding loan), as this is easy to execute in case of bankruptcy. This scarcity of finance

[26] In principle, because the project details are usually not disclosed to the general public.

[27] For a full description: http://www.ifc.org/ifcext/sustainability.nsf/Content/PerformanceStandards.

for projects in the markets for ecosystem goods and services provides an opportunity for development banks. They are well suited for this task for the following reasons:

Mission
The mission of development banks is to fight poverty in developing countries through private (and sometimes public) sector development. We argued in chapter 2 and 3 that certain poor countries are bio-mass based countries and that many of the poor depend on ecosystem goods and services for their daily survival. As poverty may increase for certain groups if certain vital ecosystem goods and services are no longer available, development banks may contribute to poverty reduction by stimulating the marketing of ecosystem services and goods.

Most shareholders of development banks, including governments in the EU, the USA and Japan put strong emphasis on the positive, or at least absence of negative, environmental and social impacts of their investments. This is illustrated by recent discussions in the World Bank and IFC to divert from fossil fuelled power projects and to focus on investments in renewable energy such as wind, hydro, geothermal and solar based power projects. To further combat climate change, development banks may increase their investments in biodiversity enhancing projects and companies. The high risk related to the markets for ecosystem services and the potential losses are compensated by increased social and environmental returns.

Track record
Over the past fifty years, development banks have gained significant experience in investing in unstable and corrupt markets, with no firm legal foundations. For example, they were the first institutions to assist the former communist countries in Eastern Europe, Central Asia and Soviet satellite states, but also other countries in Asia and South America to transform from centrally planned economies into market economies. Further, market failures based on legal, knowledge and financial gaps were and are solved with the support of development banks. In crisis situations, for example in Russia in 1998 and Argentina in 2001, the demand for financing from development banks rises, due to disappearing commercial funds. This has led to increased awareness within development banks how to deal with companies in crisis.

Further, through the focus on sustainable investments, development banks are experienced in addressing and mitigating environmental and social risks. With the growing demand for sustainable production of timber, (fish) meat, crops, bio-fuels & other forms of energy and tourism one the one hand, and the significant loss of biodiversity and ecosystems on the other, development banks can again contribute to helping remove market imperfections, this time in the markets for ecosystem goods and services, and show that the business case for biodiversity supporting businesses exists.

Changing risk perception of developing countries

In many emerging countries in Asia, Latin America and even Africa (especially in China, India, Indonesia, Brazil, Mexico and South Africa), over the past twenty years, there has been a significant rise in both (a) foreign direct investments from foreign banks, insurance companies and private equity c.q. hedge funds and (b) local investments. The most recent credit crisis in 2008/2009 has shown that it were European and US banks that experienced serious liquidity problems, while banks in the emerging world were not as badly affected and did not need to be assisted by their governments to the same extent. As a result of this, the role of development banks is changing, because capital is not as scarce anymore as it used to be in developing countries. This has the following three consequences: (a) the more mainstream finance continues to become available from commercial banks, the more development banks will be inclined to provide higher risk finance in the form of equity and subordinated mezzanine finance; (b) as local commercial banks in countries such as India, Brazil, China, Mexico, Russia and South Africa are becoming as advanced as financial institutions in OECD countries, development banks will start to focus more on the least developed countries in sub-Sahara and Asia; (c) the third consequence is that development banks will focus more on those sectors that still experience market failures. The market for ecosystem goods and services is one of those.

5.5. Conclusion

In this chapter, we answered the following research question:

To what extent are financial institutions and, in particular, development banks suited to help halt the ongoing reduction in biodiversity in developing countries in their pursuit to spur economic growth?

Development finance institutions, or development banks, are similar to commercial banks, but differ in terms of profit targets and risk appetite. Developments banks promote private (and sometimes public) sector development in developing countries and by mandate are less risk averse than commercial banks. Thanks to governments as shareholders, they are less profit driven than commercial banks, and can therefore also ask for non-financial returns resulting from their investments. Development banks are owned by either one single (bi-lateral) or multiple (multi-lateral) governments. The core business of (the private sector arm of) development banks consists of the issuance of long-term finance to (mostly) private enterprises in the form of debt, mezzanine, equity, bonds, guarantees and to, a limited extent, grant finance. The portfolios of most development banks are filled with investments in the local financial sector, infrastructural projects and industrial/manufacturing companies. The most prominent multi-lateral development banks are the International Finance Corporation (IFC), the European Bank for Reconstruction and Development (EBRD), the Asian Development Bank, the Inter-American Development Bank and the African Development Bank. The most active bi-lateral development banks are DEG from Germany, FMO from the Netherlands, CDC from the United Kingdom, Proparco from France and some Scandinavian development banks.

Through their ***mission***, development banks seek to find a balance between financial, environmental and social returns. Consequently, development banks have significant experience, also through the application of the eight IFC Performance Standards, to assess and mitigate social and environmental risks. Development banks by mandate are set up to take the first steps in emerging markets and sectors, such as the markets for ecosystem goods and services, to pave the ground for large scale investments from the commercial sector when the markets have reached the next level of development.

With their extensive ***track record*** in (a) transitional markets suffering from different types of financial, technological and legal market failures and (b) making sustainable investments through the use of the IFC (or similar) Performance Standards, development banks can play an important role in the development of the biodiversity enhancing markets. With a growing demand especially in the USA, Europe and Oceania for the sustainable production of agricultural products & bio-fuels and the increasing concern in both the

developed and developing world for the ongoing decline of biodiversity especially in developing countries, business opportunities lie in the biodiversity enhancing markets.

With the ***changing risk perception of developing countries***, there has been a significant rise in both foreign direct and local investments in many emerging markets. As a result of this, the role of development banks is changing, because capital is not as scarce anymore as it used to be in developing countries. This allows development banks to provide higher risk finance, to focus more on the poorest countries and on those sectors that still experience market failures, such as the market for ecosystem goods and services.

Another area of contribution would be to promote highly productive agricultural practices in established agricultural areas. With the increased demand for agricultural products, pressure to convert natural to arable land will continue to exist. However, the need for new land in expansion (relatively new) and frontier (new) areas will decline if productivity rises in existing agricultural areas. Development banks could stimulate foreign direct investments in agricultural production and/or the transfer of knowledge to these areas, so that there is not as much need for new arable land.

Investments in biodiversity enhancing projects should only be made if they are financially, environmentally and socially sustainable. To test this, we will evaluate three biodiversity enhancing investments to determine to what extent they meet the requirements in terms of sustainability and profitability.

6. The Contribution to Biodiversity of Two Case Studies

6.1. Introduction

In this chapter we will analyze two case studies and determine their financial, environmental and social performance. We argued in the previous chapter that certain development banks are well placed to invest in biodiversity and ecosystem supporting private sector projects, therefore the analysis made in this chapter will be from the *perspective* of a development bank. Consequently, projects, in which investments are made:

1) should be located in developing, non-OECD countries;
2) are held by private, non-public shareholders;
3) are set up to function on a commercial basis without dependency on grants;
4) the shareholders (or at least the management) have sector experience and sufficient means to make a substantial investment into the project while capable of supporting the projects in times of financial difficulties and
5) the investments made by the development bank are likely to be returned in full and will also provide an appropriate financial return.

Project selection and limitations: the case studies were selected out of a list of 23 opportunities that was presented during the congress 'Boosting investments in Biodiversity and Ecosystem Services' organized in November 2009 by the Nyenrode Business University, IUCN Netherlands, the Dutch Ministry of Housing, Spatial Planning and the Environment, ECNC and Eurosif. Being too dependent on grant funding, most opportunities did not meet criterion 3 above and were excluded from the scope.

The case studies analyzed in this chapter meet the five criteria and have the potential to generate financial, environmental (with a focus on biodiversity and ecosystems) and social returns. Regardless of its outcome, there may be investment opportunities available that were not presented during the conference that have better financial, environmental or social performance. We are aware, however, that several large financial institutions, including development banks, have expressed their willingness, under certain conditions, to invest in private sector projects that promote biodiversity. However, given the failures in the markets for biodiversity, as explained in chapter 4, but also because of its early stage of development, that are still few projects that meet the criteria 1 to 5 above.

Further, most companies that are active in the eco-conservancy niche, can be characterized as small or medium sized enterprises, which are too small to be individually financed by (development) banks. Instead, development banks may give dedicated credit lines to local banks or micro finance institutions that are able to lend to and monitor small loans. Another option is to invest in private equity funds that provide equity to small and medium sized enterprises active in the eco-conservancy niche. The case studies in this chapter are examples of the latter possibility.

In this chapter we will give an answer to the fourth research question:

Research Question 4:

Based on an a conceptual framework, two case studies will be presented, each a private sector enterprise, that aim to (i) create sufficient financial returns for the investors, (ii) increase the standard of living for the local community and (iii) create environmental support for the local ecosystems. The following questions will be answered:

Question 4A - for case study 1 - the Eco-Enterprises Fund I (an existing fund, US$ 6 million in size): what

Internal Rate of Return is feasible when making sustainable investments in (start up) small and medium sized enterprises located in buffer zones of areas with high biodiversity value? The methodology used is an ex-post evaluation.

Question 4B - for case study 2 - what Internal Rate of Return is feasible for a REDD project in Tanah Papua (Indonesia) ? The methodology used will be an ex-ante evaluation.

Case study 1 is an example of a fund active in the market segment of 'the production of ecosystem goods under sustainable management' while case study 2 is an example of an investment in the market segment 'trading of public ecosystem services', as defined in section 4.2 of chapter 4.

Before we analyze the case studies, we will present the conceptual framework used for the analysis.

6.2. Conceptual Framework

6.2.1. Financial performance: risk versus financial return

In private sector investments, investors such as financial institutions make an investment analysis prior to the investment to determine its attractiveness. This investment analysis leads to insight into the level of *risk* versus *financial return* as it is this ratio that determines if an investment will take place or not. If the risk expectations are considered high, then a high financial return is required. The reason behind this is rational: the higher the potential losses in a downside scenario, the greater the profits should be in an upside scenario. This also makes sense from a portfolio perspective. Most investors invest in a portfolio of different investments. If the risk of a group of projects is high, the likelihood of individual projects to fail is relatively high which must be compensated by sufficient returns to cover for losses of other investments.

Risk
Risks in projects are measured in terms of project *systematic* risks (referring to risks common to all investments in a particular economy) and project *specific* risks (which are the risks associated with the project investment under analysis) (Aalbers et al., 2009). Important project systematic risks are political, legal, regulatory and foreign exchange risks, while significant sources of project specific risks are market, management, shareholder and concentration risks. The Capital Asset Pricing Model (CAPM), which we will describe in some more detail below, attempts to capture these risks in the discount factor: the higher the project systematic and specific risks, the smaller the discount factor by which future cash flows are discounted. However, as many risks are difficult to quantify in practice and calibrate into the CAPM model, instead a *qualitative* risk analysis, including a risk categorization, is made in combination with an internal rate of return calculation. The outcome of the investment analysis is that, also based on historic experience, the risk level (qualitative), in combination with an expected financial (i.e. internal rate of) return, is deemed acceptable or not.

Financial Return
Just like in public sector investments, a commercial ex-ante cost-benefit analysis is made to determine the financial return of investment opportunities. A customary way of doing this, is the discounted cash flow method, which discounts all cash flows, negative and positive, that occur during the lifetime of a project (or during the period effected by the project) back to the time that the investment decision is taken. If the net present value (NPV) of the net cash flows is positive, the investment can be taken from a monetary, financial point of view. If it is negative, it should not. In a mathematical formula, this can be described as follows (Perman (2003)):

(1)

With the revenues in period *t*, the expenses in period *t* and the discount rate, which is often assumed constant in every period *t*. Only if *NPV* >= 0, the investment should be made. In cases where the cash flows are not certain, it would be more accurate to use the expected values of cash flows and therefore to replace by and by . In practice this is again a rather difficult concept as the probabilities associated with the uncertain cash flows can often not be measured. Instead, it is market practice to estimate the behavior of the net present values under several scenarios. This is called a sensitivity analysis.

An important parameter in this analysis is the *discount rate*. The larger the discount rate (for example in high interest rate environments) the more cash flows further away into the future are discounted and the more shorter term proceeds are required to make up for up front capital investments. Otherwise, the investment would not be worth the while and it could be more attractive to invest in interest rate investments such as corporate and government bonds or even a simple savings account. As explained by Aalbers et al. (2009) from the CPB Netherlands Bureau for Economic Policy, the standard practice to determine discount factors is the Capital Asset Pricing Model (CAPM) that yields a project specific required return or discount rate at which future cash flows generated by the investment should be discounted given the project's relative risk. In the CAPM model, the discount rate is the sum of the risk free rate *r* and the individual risk premium required by the project. Moreover, the individual risk premium is the product of (i) the project's beta (β, calculated by taking the covariance of the project's risk divided by the normalized market risk) and (ii) the market risk premium *m*. In mathematical terms:

(2)

where is the risk free rate, the project "beta" and *m* the market risk premium. For projects with a life time of up to 30 years, the risk free rate is often relatively easily observed by taking the appropriate government treasury bond as the risk free alternative. However, there are many challenging issues in determining the right values for market risk premium and beta in terms of time (in) variability, path (in) dependency and the optimal timing of the investment decision (option value). Consequently, for projects where the assumption of a constant beta is violated, it is not possible to *a priori* use the CAPM model to calculate the net present value of an investment as the discount rates are not known. For these reasons, many investors use the internal rate of return methodology to assess investment options.

The internal rate of return equates the formula (1) above to zero and calculates the corresponding internal rate of return (*IRR*):

(3)

Given the set of expected (but uncertain) revenues) and expenses ( ), the *IRR* informs the investor about the financial return he or she is likely to generate. If revenues exceed (fall short of) expectations, the financial return will be eventually higher (lower) than anticipated, and consequently if expenses are higher (lower) than expected, the resulting return will be lower (higher) than expected.

We point out that it is sometimes argued that NPV-based methodologies such as the CAPM model are to be preferred over an IRR calculation. The argument used is that formula (3) gives more than one solution for the IRR in cases of irregular cash flow patterns with alternating positive and negative cash flows. We

note that many private sector investments require upfront capital investments (e.g. for investments in capital intensive infrastructure projects or manufacturing facilities) during a short period of time, while generating cash flows during its economic life (varying from ca. 5 years up to 30 or even 40 years). Except for regular servicing and maintenance expenses, it is not always necessary to take large re-investments into account (leading to negative cash flows). In most cases the calculation period would be shortened to exclude these reinvestments as it cannot be guaranteed that the required financing will be available at this future point in time.

Another reason why investors prefer an IRR calculation over an NPV calculation is that the IRR gives a relative number (a percentage) while the NPV is an absolute number. In an investment analysis, the rate of return is compared to a lower risk or risk free alternative (such as AAA-rated government bonds). These benchmarks are not available for NPV's. We note that, as a rule of thumb, investors use the following hurdle rates to benchmark their investment opportunities with:

IRR benchmark	Risk free rate	Required private sector returns
OECD countries	2%-5%	8%-15%
Developing countries	5%-10%	15%-30%

In general terms, the poorer, less developed and more unstable the country, the higher the yields of the government bonds (risk free rate) are. For private sector projects, the more developed the sector or country in which the investment is made is, the lower the expected return. For example, a greenfield project in an underdeveloped market in a Least Developed Country would require an internal rate of return of at least 30%.

Hence, for the financial analysis of the case studies, we will present a qualitative risk analysis and a quantitative internal rate of return calculation. A floor of 15% IRR will be used to determine whether the investment is financially viable or not.

6.2.2. Environmental performance

In chapter 5 we explained that many development banks, and especially for large infrastructural projects, use the eight IFC Performance Standards or similar guidelines to assess environmental performance and compliance with international best practices. A full review of these standards requires a so called Environmental and Social Impact Assessment (ESIA), which requires a significant number of man-hours and studies and which is often outsourced to specialized consultancy firms. Therefore, a full analysis of the IFC Performance Standards for our case studies falls outside the scope of this research thesis. Instead, we will make a qualitative scan and report on a number of indicators that impact directly the level of (original) biodiversity in the area, as we explained in section 3.4.2 of chapter 3 that (i) biodiversity is a first proxy for the level of non-marketed ecosystem goods and services and (ii) certified production results into higher levels of biodiversity and therefore non-marketed ecosystem goods and services. This leads us to the following indicators to report on (if available and/or applicable): amount of direct and/or indirect hectares conserved, type of social and/or environmental certification and effect on mean species abundance, which we will elaborate a bit further on in the rest of this section.

A measure for biodiversity: Mean Species Abundance Indicator

In chapter 2 we identified the Mean Species Abundance (MSA) index, an often-used indicator measuring the biodiversity (the abundance, or population size, of a number of selected key fauna and flora species) in a certain area or region. The MSA index tracks the degradation process of the selected fauna and flora in comparison to its original or low impact state. Annex I describes the MSA for different vegetation

types. From this table it becomes clear that the impact on biodiversity largely depends on the type of economic activity undertaken.

Forest management
If original, undisturbed forest has an MSA of 100%, then the MSA of a timber plantation, an artificially planted forest with a limited number of species in close proximity of natural forests (often in the so called 'buffer zones'), is only about $1/5^{th}$ of the original level, i.e. ca. 20%. A slightly disturbed forest, where selective hunting and logging activities take place, followed by a long period of re-growth, may retrieve an MSA of up to 70%. This is different for a secondary forest that, cleared once, is subsequently recuperating: the MSA after re-growth may yield up to 50%.

Agriculture and Cattle Breeding
Agricultural activities can be undertaken in several ways and all differ in their impact on the available biodiversity. The type of agriculture with the smallest impact on biodiversity is agro-forestry. In agro-forestry agricultural production is mixed (intercropped) with (native) trees that are preserved for shade or wind shelter. In this type of agriculture, on which for example sustainable coffee production is often based, the MSA drops from 100% to 50%. In more intensely cultivated areas, the impact on biodiversity is more severe. The MSA of low input agriculture, such as subsistence and traditional farming, dominant in many rural areas of developing countries, drops to 30%. More intensive agriculture, such as specialized, high external-input agriculture, often using irrigation and/or drainage-based technologies, impacts biodiversity even more strongly: the MSA drops to a level of 10%. This is slightly above the MSA in fully built-up areas (in which more than 80% of the area is built upon): the MSA is 0.05% or less.

Cattle usually graze on grasslands and shrub-dominated vegetation types (including steppe, tundra and savannah). In the case where wildlife is replaced by grazing livestock on grasslands, the MSA drops from 100% to 70%. The level of biodiversity of man-made pasture suitable for livestock, after the conversion of forest and woodlands, drops to a level of often not more than 10%.

6.2.3. Social performance

Similar to what we described in the previous paragraph, the IFC Performance Standards (or similar guidelines) can give an indication of the social performance of an investment or compliance with international best practices. As a full assessment of the IFC Performance Standards for our case studies falls outside the scope of this research thesis, we will make a qualitative scan instead and report (if available and/or applicable) on a number of indicators that impact laborers working in, or adjacent to, the impacted area and surrounding communities affected by the project. Useful indicators in this context are amount of direct/indirect jobs generated, amount of other people indirectly benefited from the investment and benefits to communities and local NGO's.

6.3. Case Study I: Eco-enterprises Fund I

In this section we will make an ex-post project evaluation of a private equity fund that made investments in sustainable small and medium sized enterprises in the period 2000-2009 with the specific purpose of biodiversity protection.

6.3.1. Description of the Fund

The Eco-enterprises Fund I (Eco-E I) is a small private equity fund founded in 2000 by The Nature Conservancy and the Inter-American Development Bank's Multilateral Investment Fund (MIF). The Nature Conservancy (TNC) is a large US-based NGO set up to promote nature conservation in the USA and abroad. TNC, like many other American NGO's, funds itself almost entirely through private

donations. Eco-E I was set up to promote private sector investments in the biodiversity 'hot spots', or priority areas, of the Nature Conservancy to create alternatives to biodiversity diminishing economic activities whereby local communities would generate alternative means of income. As such, local communities would be more inclined to cooperate with TNC's conservation efforts if this was to provide (substantive) alternative means of income. The management team of Eco-E I, apart from their founders, approached other investors to invest in the fund. The following table presents the investors that provided capital (equity) to EcoE-I:

Investors	Amount
MIF	USD 2,6 million
The Nature Conservancy	USD 1,7 million
CAF	USD 0,5 million
Foundations	USD 0,45 million
Reinvestments	USD 1,1 million
Total	**USD 6,3 million**
Technical Assistance	USD 3,5 million

Table 1: Investors in Eco-Enterprises Fund I

With this capital, it is the aim of the fund to make investments in sustainable privately owned small and medium sized companies, with annual sales up to US$ 3 million when the first investment was made, that (i) were financially sound and could therefore provide a good financial return to the fund, (ii) contribute to nature and biodiversity preservation of the area in which they were located and (iii) contribute to social development in the region. All selected investee companies have been chosen by the fund because of their affinity with environmental protection and their in principal commitment to make a social contribution to employees and surrounding local communities. Note that certain investee companies were direct spin offs from local NGO's or had already existing working relations with them.

The fund analyzed 450 business proposals and made the decision to invest in 23 companies that were almost entirely active in the production of agricultural commodities under sustainable management: sustainable agriculture, sustainable forestry, sustainable aquaculture, sustainable apiculture, non-timber forest products and eco-tourism. This included (company name between brackets) the production of organic shrimp (Biocintinela), organic spices (Forestrade), FSC-certified furniture (Suma Pacha), pesticide-free biodynamic flowers (Organic Blooming), eco-lodges (Rainforest Expeditions), organic dried fruits (Terrafertil) and smoothies from the açaí palmberry (Sambazon). Investments were made in 11 different countries across Middle and South-America: Brazil, El Salvador, Bolivia, Costa Rica, Guatemala, Mexico, Panama, Ecuador, Peru, Paraguay and Belize.

In 2010, the fund is almost closed. Please note that the analysis is based on data obtained from the fund manager of Eco-Enterprises Fund I, mostly on paper and some by word.

6.3.2. Financial Performance

Table 2 below list all the 23 companies EcoE I invested in, the country in which the investee company was located, the sector it was active in, the sales it generated (for most companies only data for 2007 were available), the IRR it generated for the fund, the product(s) the fund provided and the amount EcoE I invested in the company.

	Company	Country	Sector	Sales (2007)	Product	Amount (US$)	IRR
	Profitable						
1	Agroalegre	Ecuador	Sust. Agriculture	0,1 mln	Loan/equity	125,000	19%/7%
2	Aqua Consult I'nal	Mexico	Sust. Aquaculture	0,2 mln	Loan	300,000	18%
3	Belize Lodge & Escursions	Belize	Eco-tourism	0,7 mln	Loan	300,000	15%
4	BioCentinela	Ecuador	Sust. Aquaculture	3,3 mln	Equity	250,000	8%
5	ForesTrade	Guatemala	Sust. Agri and NTFP	16 mln	Loan/equity	392,132	11%/NA
6	Interforest	Guatemala	Sust. Forestry	0,2 mln	Equity	500,000	11%
7	Loofah	Paraquay	Sust. Agriculture	0,2 mln	Loan	50,000	8%
8	NatuScience	Brazil	NTFP	0 mln	Loan	50,000	4%
9	Organic Blooming	Ecuador	Sust. Agriculture	0,1 mln	Loan	50,000	15%
10	Rainforest Expeditions	Peru	Eco-tourism	2,5 mln	Loan	150,000	9%
11	REPSA	Bolivia	Sust. Agriculture	0,5 mln	Loan	50,000	6%
12	Rolf Wittmer	Ecuador	Eco-tourism	5 mln	Loan	250,000	11%
13	Sambazon	Brazil	NTFP	12 mln	Loans	625,000	7%-10%
14	Suma Pacha	Bolivia	Sust. Forestry	8,2 mln	Loan	275,000	13%
15	Terrafertil	Ecuador	Sust. Agriculture	0,7 mln	Loan	235,000	19%
16	Veragua Rainforest	Costa Rica	Eco-tourism	0 mln	Loans	392,000	15%
	Loss making						
17	8th Sea	Brazil	Sust. Aquaculture	0,05 mln	Loan	500,000	-88%
18	Don Alvaro	El Salvador	Apiculture	0 mln	Loan	100,000	-34%
19	Jolyka	Bolivia	Sust. Forestry	0 mln	Loan	355,000	-50%
20	Los Nacientes	Costa Rica	Sust. Agriculture	0 mln	Loans	150,000	7%/-62%
21	Marimex	Mexico	Sust. Aquaculture	0,01 mln	Equity	100,000	-29%
22	Noram	Mexico	Sust. Forestry	0 mln	s.loan/Equity	200,000	-36%
23	Organic Commodity Project	Costa Rica, Panama	Sust. Agriculture	0mln	(sub) loan	530,000	-100%
	Other reinvestments					370,868	
	TOTAL					**6,300,000**	**0%**

Table 2: Financial Performance Eco-Enterprises Fund I

In total the Fund invested USD 6,3 million in loans (both in long term loans, working capital facilities and subordinated debt) and in 6 equity participations. Out of the 23 companies that were invested in, 7 companies experienced financial difficulties leading to a negative IRR's (varying in IRR between -29% and -100%) for the fund as the company was able to recoup only part or nothing of the initial investments. Ultimately (only) 3 companies went into bankruptcy (NatuScience, 8th Sea and Organic Commodity Project), the rest are to date all going concerns. 16 companies (and some interest income on cash) contributed positively to the IRR of the fund (ranging from 7% to 19% in IRR). We note that even the investee companies that contributed positively to the performance of the fund often faced operational and financial difficulties so that certain companies could not meet the originally agreed repayment and interest schedule and had to be restructured. Given the balance of gains and losses, the operational costs for the fund (including salaries, offices space, travel costs, legal and consultancy fees, which could be recovered partially out of the US$ 0,5 million technical assistance grant from IFC), the fund made an annual internal rate of return to its investors of 0% over a 10 year period (2000 - 2009), exclusive of operational costs. Including these costs, a negative internal rate of return of ca -4.7% would be the result.

Risk versus financial reward

There are three reasons why the Eco-enterprises Fund I should be classified as high risk: (A) The countries that were invested in in Middle- and Latin America, of which none are investment grade nor OECD-countries, can be considered high risk, both from a political, institutional and legal perspective.

Despite bureaucratic, political and legal improvements in countries such as Brazil, Costa Rica, Mexico, Peru and Panama, the region has historically been unstable and especially the systematic risks in El Salvador, Bolivia, Guatemala and Ecuador remain high. (B) As we explained in Chapter 4, the markets in which all companies are active are still, despite the growth potential, in their early phases of development, small in size and dependent on demand from OECD countries in the EU and the USA without much local demand. Finally, (C) all 23 investee companies are characterized as small to medium sized enterprises: with the exception of 5, all have sales below USD 2,5 million in 2007[28] and an average of 153 employees. Further, many companies were either recent spin offs from NGO's and still in the start up phase, dependent on support from NGO's or on technical assistance from the Fund. In financial terms, this type of business can be characterized as venture business for which high risk, high return venture capital is required. With reference to section 6.2.1., mainstream commercial investors would expect a return in the upper range of 20%-30%. Therefore, a return of 0% (or -4.7% taking operational costs into consideration) is far below the required level to attract commercial investors.

Nonetheless, we believe that the 0% (or, -4.7%) IRR is not a bad result given the circumstances. *First of all*, operational expenses draw heavily on a small fund like Eco-E I as the larger the fund, the easier it is to absorb operational costs and the smaller the effect on the IRR. *Secondly*, although rather difficult to compare due to the lack of comparable funds, the result may be characterized to be in line with other funds that raised funding in the same period. For the 1999 and 2000 "vintage year" in the U.S. venture capital industry, benchmark statistics compiled by Cambridge Associates, indicated that returns for focused funds are -4.5% and -2.2%, respectively[29]. *Thirdly*, investing in SME's is a challenging and time consuming task. There are examples of other funds managing investments in SME's that have not even returned the capital to their investors like Eco-E I did. *Fourthly*, providing financing to start up SME's, which is what this fund has done in 11 of its investments, would require a structure that would allow the fund to profit from upsides if their investee companies were to perform beyond expectations. However, from table 2 above we conclude that in most cases the fund provided loans with a fixed interest rate and provided equity to only 6 companies. In fact, from the successful companies, an average IRR of ca. 12% was obtained. This is not a true reflection of the risk Eco-E I was baring. Although the interest rates charged must have been difficult for certain investee companies to bear, it would have been recommendable to structure the financings in such a way that the fund would have profited from possible profit upsides that would now only be allocated to the shareholders. This could have been done by providing more equity type financings such as straight equity, but also mezzanine type financing including options. As said, given the risks, the overall result in terms of IRR would not have been acceptable for commercial investor, but certain development banks that want to promote this particular sector may be willing to (temporarily) accept lower returns on their investments.

In certain private equity funds governments participate with 'soft' funds (i.e. not requiring a return) and accept to take the first loss on non-performing investments, meaning that each investment that is written off is subtracted from the amount due to that particular government. This enhances the return prospects of and reduces the risk for the other, commercial investors. Had there been a first loss taking government involved in this fund taking the first loss of USD 1 million (USD 1,5 million), the gross return would have improved from -4.7% to 2% (4%). The improvement is relatively modest as the fund distributed the investments back to its investors only in year 9 and 10 of the fund's life. Since positive cash flows farther into the future are discounted more, this depresses the IRR.

6.3.3. Environmental Performance

In table 3 below we present the environmental performance of the fund by stating, of each investee

[28] Note that for certain firms no (exact) data were available and therefore we had to make estimates.
[29] www.cambridgeassociates.com

company, (1) the amount of hectares that the company directly preserved by ownership or leasehold over which the company had direct control, (2) the amount of hectares that the company indirectly helped to preserve (mostly by being part of a larger buffer zone of a protected area where other sustainable business activities took place) with limited control outside the project area and (3) the area that is protected in a broader context (often the natural reserve or protected area that the project was located in) with almost no direct control over the area outside the company premises.

	Company	Country	Sector	Conservation			Certification
	Profitable			**Direct (ha)**	**Indirect (ha)**	**Broader (ha)**	
1	Agroalegre	Ecuador	Sust. Agriculture	-	12	228,635	Yes
2	Aqua Consult I'nal	Mexico	Sust. Aquaculture	138	2,280	404,680	No
3	Belize Lodge & Escursions	Belize	Eco-tourism	11,230	-	1,500,000	No
4	BioCentinela	Ecuador	Sust. Aquaculture	88	738	1,200,000	Yes
5	ForesTrade	Guatemala	Sust. Agri and NTFP	-	83,948	2,355,642	Yes
6	Interforest	Guatemala	Sust. Forestry	3,327	7,366	236,300	Yes
7	Loofah	Paraquay	Sust. Agriculture	-	156	2,457	Yes
8	NatuScience	Brazil	NTFP	-	25	253,000	No
9	Organic Blooming	Ecuador	Sust. Agriculture	230	384	6,000	Yes
10	Rainforest Expeditions	Peru	Eco-tourism	970	12,000	274,690	No
11	REPSA	Bolivia	Sust. Agriculture	630	250,000	366,000	Yes
12	Rolf Wittmer	Ecuador	Eco-tourism	-	788,000	13,000,000	Yes
13	Sambazon	Brazil	NTFP	802,600	400,000	1,200,000	Yes
14	Suma Pacha	Bolivia	Sust. Forestry	30,000	250,000	1,000,000	Yes
15	Terrafertil	Ecuador	Sust. Agriculture	140	296	406,383	Yes
16	Veragua Rainforest	Costa Rica	Eco-tourism	1,300	1,380	199,063	No
	Loss making						
17	8th Sea	Brazil	Sust. Aquaculture	-	180	185,262	Yes
18	Don Alvaro	El Salvador	Apiculture	-	140	2,205	No
19	Jolyka	Bolivia	Sust. Forestry	-	462,347	1,000,000	Yes
20	Los Nacientes	Costa Rica	Sust. Agriculture	120	370	800	Yes
21	Marimex	Mexico	Sust. Aquaculture	-	228,802	2,546,790	No
22	Noram	Mexico	Sust. Forestry	10,000	125,000	6,000,000	Yes
23	Organic Commodity Project	Costa Rica, Panama	Sust. Agriculture	-	6,751	31,565	Yes
	TOTAL			**860,773**	**2,620,175**	**32,399,472**	

Table 3: Environmental Performance Eco-Enterprises Fund I

Effects on Biodiversity

All companies in table 3 were located in or close to the so called "Biodiversity Hotspots", which are areas classified by Conservation International (a US-based NGO similar to The Nature Conservancy) and/or WWF to be of high biodiversity value and are often partially protected by law; 7 companies were located in official World Heritage Sites and 15 in The Nature Conservancy's priority areas, implying that the areas where the investee companies operate can considered to be located in biodiversity sensitive areas. In the aggregate, the investee companies, though ownership or leasehold, directly conserved 860,773 hectares of land with high biodiversity value (which is an area as large as approximately 22% of The Netherlands) and indirectly contributed to the conservation of 2,620,175 hectares (ca. 66% of The Netherlands). The effects on biodiversity vary from investment to investment and are difficult to quantify as only for certain but not for all investments biodiversity baseline and follow up studies are available. We estimate that the mean species abundance indicator must have improved for almost all of the investments made in the sustainable agriculture, forestry and aquaculture sectors as (1) they were often located in areas that were abandoned by the former owners including degraded former plantations and

cattle pasture, (2) during the investment phase they were rehabilitated by reforestation efforts (for example for shade grown coffee and cocoa) and/or cleaned up (including the clean up of beaches and the restoration of mangrove forests in the case of Biocentinela), (3) pesticides were abandoned and (4) organic business practices were introduced. Note that in table 3, in the conservation column no distinction is made between rehabilitated production land and (pristine) land of high biodiversity value set aside for conservation purposes only.

For eco-tourism the picture may be mixed. In general, the effects of eco-tourism on biodiversity, in terms of mean species abundance, are controversial and may be considered negative if the tourist lodging and activities are taking place in a high biodiversity area. However, compared to a non-sustainable income and profit generating alternative, the effects on biodiversity may be favorable, which was the case in the Veragua Rainforest investment in Costa Rica, where the project owners turned a piece of land that was going to be converted for agricultural use into a research, exhibition and adventure centre so that a large part of the area could remain intact. In case of the two other eco-tourism made by Eco-E I, both were located in an area that already attracted many tourists of which one was located close to a well-used road, so that biodiversity effects, apart from providing an alternative to non-sustainable investments which must be considered positive, can generally expected to be slightly negative to neutral. A detailed assessment, however, would be necessary to come to thorough conclusion as the eco-tourism investees tended to set aside more land for conservation than its peers given the imperative of these companies to differentiate themselves and the importance of biodiversity to their assets.

Certification

Of all 23 companies, 16 (or 70%) were able to obtain one or more type of environmental and/or social certifications from organizations in the USA or the EU. These included Organic certifications, FSC, Fairtrade, ISO, Kosher and/or Eco-tourism certifications. Depending on the type of certification and its adherence, the effects on the social and environment surroundings are generally better than non-certified operations. Note that individual companies may adhere to up to 7 different certification schemes for different consumer groups throughout the world. Although certain schemes overlap each other, they often have a different emphasis, which results into increased administrational and implementation costs for the companies that as a start up already were facing many challenges.

6.3.4. Social Performance

In table 4 below we present the social performance of the fund by stating, of each investee company, the amount of direct employment, indirect employment, the amount of NGO's and local communities that the companies collaborated with and whether the company received training or any other kind of technical assistance from the fund (1= yes; 0 = no).

	Company	Country	Sector	Empl	Beneficiaries	NGO's	Communities	Training
	Profitable							
1	Agroalegre	Ecuador	Sust. Agriculture	23	175	1	2	1
2	Aqua Consult I'nal	Mexico	Sust. Aquaculture	22	110	-	6	-
3	Belize Lodge & Escursions	Belize	Eco-tourism	130	650	3	3	1
4	BioCentinela	Ecuador	Sust. Aquaculture	100	500	1	8	1
5	ForesTrade	Guatemala	Sust. Agri and NTFP	50	11,575	5	86	1
6	Interforest	Guatemala	Sust. Forestry	875	4,375	1	10	-
7	Loofah	Paraquay	Sust. Agriculture	329	23,645	2	5	1
8	NatuScience	Brazil	NTFP	9	695	6	7	-
9	Organic Blooming	Ecuador	Sust. Agriculture	16	145	2	5	1
10	Rainforest Expeditions	Peru	Eco-tourism	112	710	7	10	1
11	REPSA	Bolivia	Sust. Agriculture	4	4,020	1	9	1
12	Rolf Wittmer	Ecuador	Eco-tourism	160	5,800	3	4	1
13	Sambazon	Brazil	NTFP	205	12,850	4	59	1
14	Suma Pacha	Bolivia	Sust. Forestry	610	3,300	4	8	1
15	Terrafertil	Ecuador	Sust. Agriculture	150	800	1	2	1
16	Veragua Rainforest	Costa Rica	Eco-tourism	229	1,155	2	7	-
	Loss making							
17	8th Sea	Brazil	Sust. Aquaculture	220	1,600	-	16	1
18	Don Alvaro	El Salvador	Apiculture	26	980	2	3	1
19	Jolyka	Bolivia	Sust. Forestry	140	700	2	4	-
20	Los Nacientes	Costa Rica	Sust. Agriculture	15	200	1	3	1
21	Marimex	Mexico	Sust. Aquaculture	45	225	2	20	1
22	Noram	Mexico	Sust. Forestry	36	7,680	13	13	1
23	Organic Commodity Project	Costa Rica, Panama	Sust. Agriculture	7	16,830	3	3	1
	TOTAL			**3,513**	**98,720**	**66**	**293**	**18**

Table 4: Social Performance Eco-Enterprises Fund I

As part of the funds investment criteria, each investee company was required to work with an NGO in some capacity to strengthen the relationships with the local, often indigenous, communities and manage social risks related to the project. All in all, the fund has contributed to the creation of more than 3,500 in direct jobs and close to a 100,000 beneficiaries benefited indirectly from the project, where it is assumed as a generally accepted rule of thumb that every direct job and individual supplier (of raw materials) supports five other (unemployed) family members. Although we are unable to benchmark these results to similar funds, at FMO the following rule of thumb is used to classify the job generation capacity of the investment: if per invested million (US$) more than 10 jobs are generated as the result of the investment, the effect on job creation can be considered and rated as "very good". With a total invested amount of US$ 6,3 million, 3,500 created jobs is equivalent to about 500 jobs per invested million. However, EcoE I was not the only provider of finance. Nonetheless, if EcoE I provided more than 2% (10/500) of the required finance, which it did in all instances. In fact, Eco-E I invested on average about 20% of the financing needs of project companies, which could go up to 50% for start-up companies. Hence, it is likely that the hurdle of 10 job creations per invested million US$ is met and the effect on employment can therefore be characterized as "very good" in the context of other FMO investments.

Companies active in remote areas of the world, especially in the field of natural resource extraction, almost always come in touch, or collaborate, with local communities, NGO's and indigenous people, who are legally or illegally active on part of the land of the company. Current best international practices, as laid out by the IFC Performance Standards we presented in chapter 5, prescribe that affected communities are involved, informed and compensated for loss of shelter, work or other income. Investee companies of Eco-E I were selected on the basis of good existing relationships with local NGO’s and communities so

no compensatory measures were required. Somewhere during the course of its 10 years existence, the fund started to measure in monetary terms the exact amounts of cash flowing from the investee companies to local communities in the form of profit sharing, income and the purchase of raw materials and services. In total, measured economical benefits that flowed to communities and NGO's accrued to US$ 4,133,485. This is for a large part driven by a profit sharing arrangement eco-tourism company Rainforest Expeditions (Peru) had with a surrounding indigenous community (see text box below). However, due to the timing of start of the measurement, economic benefits of only 4 investments could be measured.

Community engagement
Table 4 above shows that all but 2 companies worked with in total 66 local NGO's and all companies had relationships with surrounding communities, 293 in total. Partnerships vary by formal purchase agreements whereby the company buys raw material from the rural community, but also informal arrangements with NGO's providing services (training, research or environmental and social monitoring) to local stakeholders who live close to the company's premises and whose support is needed. In the textbox below we will give three example of relationships investee companies maintained with local groups.

Sambazon, producer of smoothies, energy drinks, sorbets and juices based on the anti-oxidant rich berry "açaí", operates in the Amazon area of Brazil. Açaí is a staple food and source of energy to the local indigenous populations of North Brazil who are involved in the collection of the berries for their own consumption and livelihood. Through collaboration with 59 communities under the guidance of one local NGO, Sambazon engaged over 10,000 members of the local communities for the harvest of the açaí berry. The company managed to obtain both FSC certification for the collection of the açaí berry in the Amazon rainforests as well as fair trade certification for their relationships with and contributions to the local communities.

Also Suma Pacha, an FSC-certified garden furniture manufacturer in Bolivia, sources the majority of its raw materials from local indigenous communities in the rural regions of the country. In Bolivia there is no legal framework governing cooperatives and community led forest enterprises, so that the company is unable to enter into any long term purchase agreements with these groups. This adds risk and costs to the company. The fund paid for a lawyer from their technical assistance program to set up a template to formalize working relationships with local cooperatives and communities.

Rainforest expeditions, an eco-tourism company owning three eco-lodges in the Peruvian Amazon, has created a partnership with the indigenous community through the co-ownership of one of the three lodges. The agreement between Rainforest Expeditions and the community stipulates that 60% of net income of the shared lodge flows to the community. Through 2007, ca. US$ 660,000 has been paid and ca. US$ 1,7 million in additional accrued benefits flowed to the community.

Eco-E I experienced that maintaining good relationships with local communities and indigenous people asks significant time and attention from investee companies and may become a key risk (in the form of sabotage and/or law suits) to the project if not dealt with adequately. It requires communication, managing expectations, negotiation and seeking of common ground. It also involves discussions on how the communities want to be compensated for delivered goods and services. Certain groups prefer training, provision of medical services, a well for fresh water or the offering of educational opportunities. Others opt for immediate cash over a direct product or service. Further, it was recognized that it’s best to make the partnership official and set out the terms and conditions for all parties involved through use of formal agreements, whether it be letters of interest, memoranda of understanding or contracts. Finally, almost all investee companies and their surrounding communities benefited from institutional strengthening through technical assistance.

Technical Assistance

In the field of private equity investments, it is not uncommon for investors to provide support to investee companies in the field of accounting, marketing, reporting and/or the professionalization of internal processes. In addition to support to certain companies it ultimately decided not to invest in, the fund provided technical assistance (TA), in the form of grants, to 16 of the 23 investee companies to help achieve results in the triple bottom line: financial, environmental and social returns. In total US$ 3,5 million (of which US$ 1 million was provided by the IFC) was available for technical assistance. Although this is a large amount compared to the US$ 6,3 million investment budget, technical assistance generally requires significant efforts and budget. Out of the US$ 3,5 million, US$ 1,4 million was used to complete the fund's annual management fee[30], which was insufficient to cover all operational expenses. Most TA made available was in the US$ 3,000 – 10,000 range per investment and four companies received funds in the range of US$ 30,000 – 65,000. The following types of TA was provided: Environmental technical assistance: to achieve environmental (biodiversity) objectives, TA was made available in the form of (1) biodiversity impact assessments, (2) the development of environmental and social monitoring plans and (3) support to obtain environmental (organic) certification, training in organic and sustainable harvest techniques and biodiversity interpretation for eco-tourism companies. Social technical assistance: to achieve social specific objectives, TA was made available (1) often to obtain some type of social (fair trade) certification and training in sustainable harvest techniques to local communities and cooperatives supplying raw materials to the companies and (2) to strengthen relations and address social needs for example (i) a community outreach program to clean up a trashed area in the bay where Marimex' company operations were taking place, (ii) in the case of Sambazon to increase livelihood securities by expanding the income generation activities to honey production and (iii) a fresh water well for Biocentinela's employees. Business services technical assistance was provided to improve project principals' experience in financial management (including financial projections, systems and reporting), marketing assistance, introductions to other investors, assistance with writing a business plan (mostly for start up companies), cost accounting and pricing advice. Legal technical assistance was often required to those companies that did not have access to local lawyers to ensure proper documentation with regards to the fund's investment. The most important overall conclusion of the technical assistance provided to the 16+ investee companies, as indicated by entrepreneurs in a survey conducted by the fund, is that not all forms of TA are an essential factor in the short term success of companies, as small and growing businesses face many urgent operational challenges that need to be addressed first before social and environmental returns can be achieved. However, many companies really needed the business and legal technical assistance as their financial and operational performance depended on it. Moreover, in the medium to long term, attention to environmental and social needs are just as important to a company's commercial viability, in particular to avoid difficulties with local communities affected by the company and to obtain social and/or organic certification, because the cost and administrational burden this causes can be too much for young companies to bear.

6.3.5. Conclusion

To date there are very few private equity funds that (i) work on commercial basis and (ii) seek to make investments in (small and medium sized) enterprises that protect biodiversity and the natural habitat they operate in and at the same time provide an alternative income to surrounding communities that would be otherwise driven to be involved in less sustainable income generating activities. Eco-Enterprises Fund I, however, a US$ 6,3 million private equity fund active in 11 countries across Middle and South America is a fund with this triple bottom line. The fund had an investment horizon of 10 years (2000-2009) and is for a large part funded by a US based NGO (The Nature Conservancy) and a few regional development banks. The fund provided mostly fixed (high) interest loans to 23 investee companies, and made 6 equity investments. The investee companies can be characterized as small and medium sized enterprises often in an early (start up) phase of operations and mostly active in the sustainable production of agricultural

[30] Which is usually a fixed percentage of the investment budget.

commodities, forestry and eco-tourism. Overall, the gross return the fund generated to its investors was 0% and a net return of -4.7% if the operational costs were taken into account. This answers research question 4A (*"what Internal Rate of Return is feasible when making sustainable investments in (start up) small and medium sized enterprises located in buffer zones of areas with high biodiversity value?").*

Given the political, institutional and legal risks in Middle and South America, as well as the nascent stage of development of both the investee companies and the markets in which they operate, hard core commercial investors would have expected a return in the range of 20% to 30%. Nonetheless, we believe that a break even return of close to 0% is not a bad result given (i) the downward pressure operational costs bring about on the IRR of small funds, (ii) the time involved in managing investments in SME's and (iii) the financing the fund offered, which were mostly loans with fixed interest rates not allowing for an upside in case of profit wind falls. In environmental terms, the fund directly contributed to the protection of 860,773 hectares of land with high biodiversity value and indirectly to the conservation of 2,620,175 hectares. In social terms, by introducing sustainable, organic and often certified business practices, the fund contributed to the long term livelihood security of local community and indigenous groups. Further, the fund has contributed to the creation of more than 3,500 in direct jobs and close to a 100,000 in beneficiaries. The fund provided social, environmental, business services and legal technical assistance to its investee companies for free to assist them obtaining social and/or organic certification, increase financial management and marketing skills and improve relationships with local communities.

Some critical notes

Although it can be said that the fund with its investments in environmentally and socially responsible companies contributed to the conservation of large areas of native habitat with high biodiversity value, we are unsure if these areas would also have been protected without the involvement of EcoE I by obtaining finance elsewhere. It is generally true that in this segment, given the risks and low return, finance is very scarce and local banks are often unwilling to lend to these SME's given their risk profile. Nonetheless, in these particular instances we cannot know for sure if alternative financing could not have been obtained elsewhere if the Fund had not invested.

Moreover, we have been unable to verify how local communities were satisfied with the relationships with the investee companies, if they were adequately compensated for rendered goods and services and if alternative, non-sustainable business alternatives would have been preferred over working with the investee companies financed by Eco-E I.

Despite the seemingly large numbers of protected area, we are unable to benchmark this result to other biodiversity funds. Although we are unaware of other similar funds and the fund seems to be rather unique in terms of running a commercial fund with an emphasis on environmental and social sustainability, we are yet unable to qualify these results. To measure overall positive or negative effects on biodiversity of the fund's investments (for example by measuring mean species abundance), base line and follow up studies would have been required for all investee companies

No matter how mindful of the social and environmental surroundings the business activities are being conducted, there is always some loss of biodiversity and therefore loss of biodiversity value. It can therefore be argued that instead of financing these business activities and making it possible for them to be commercially active, it would have been better to leave the areas fully in tact by disallowing all business activity. Note, however, that in many areas of high biodiversity value, often local communities and indigenous people are living that need a livelihood. Even in the most remote areas there is pressure on land conversion for subsistence agricultural production, hunting, cattle grazing and wood collection. With growing populations and the continuing search for scarce land, it can be argued that it is more effective to introduce sustainable and certified business practices rather than full protection, even in the proximity and buffer zones of Biodiversity Hotspots to provide an alternative to non-sustainable business practices as

the need for a livelihood continues to exist. Further, even if the areas around Biodiversity Hotspots were to be turned into protected natural reserves, it remains difficult in large and remote areas of the developing world to avoid illegal business practices including logging, food collection and poaching.

6.4. Case Study 2: Reduced Emissions from Deforestation and Degradation of forests

In this section we will make an ex-ante project evaluation of a potential investment in a REDD project, based on data provided by forestry management company New Forests. We chose a REDD investment as a second case because this type of investment is currently widely debated as being an opportunity both for the reduction of greenhouse gases as well as a means to protect biodiversity. In the context of chapter 4, it is one of the few examples of a tradable public ecosystem service.

6.4.1. Description of the investment

New Forests, with headquarters in Australia and offices in New Zealand, Malaysia, Indonesia and the US, is a small forestry management company managing sustainable forestry and eco-product private equity funds. Mainly in their capacity as fund manager, they manage timber plantations and natural forests in Australia, New Zealand, Hawaii, the Solomon Islands, Indonesia and Malaysia. New Forests' staff is involved in the development of legal frameworks and markets for REDD carbon credits. The Asia team manages a 200,000 ha REDD project in Indonesia and is developing further projects.

REDD is a carbon emission reduction methodology for the Reduced Emissions from Deforestation and Degradation (REDD) of forests. Over the past years, REDD increasingly received attention out of the awareness that approximately 18%[31] of global greenhouse gas emissions can be attributed to deforestation and forest degradation. If forests under threat of conversion are left intact, and even restored in those areas already converted, significant amounts of carbon are prevented from being released, or are even captured. If consequently carbon credits can be issued out of the reduced emissions from the conservation of threatened forests, parties buying the carbon credits are paying for the continued sequestration of carbon by forests. In fact, they are paying for the regulating ecosystem service 'climate regulation' we introduced in section 2.4.2.

To date REDD carbon credits are not accepted under any of the compliance markets for carbon credits, including the clean development mechanism, and are traded under voluntary schemes only. The Voluntary Carbon Standard (VCS) is the leading standard for the certification of REDD carbon credits. Based on information from New Forests, we note that the amount of REDD carbon credits that were traded over the past years is small: 1.4 million tonnes of carbon dioxide equivalent units (MtCO2 -e) and 0.72 million MtCO2 -e in 2008. The average prices for REDD credits were US$ 6.3 per tCO_2 -e in 2008 and US$ 4.0 per tCO_2 -e in 2009, so that in the model in this chapter an average carbon sales price of US$ 5.0 per tCO_2 -e is used. This is lower than carbon prices in the compliance markets, for example the EUA (EU emission Allowance) trades at about €14 per tCO_2 -e in July 2010. Where a REDD project has significant biodiversity protection and social benefits, and most will, it can be certified under the Climate, Community and Biodiversity Standards (CCB Standards) issued by the Climate, Community & Biodiversity Alliance (CCBA). Such certification is likely to add value to the carbon credits produced from the REDD project.

The utility of REDD projects to produce carbon credits at a low cost has been recognized by developed nations with high levels of GHG emissions. State and national trading schemes in the US and a national trading scheme in Australia have signaled that REDD credits produced overseas are likely to be allowed to be traded.

[31] http://www.redd-oar.org/

Although there are not many REDD projects that are currently generating carbon credits (reportedly there are not more than a handful worldwide), several efforts are undertaken in Latin-America, Africa and Asia to have REDD projects officially validated and verified under VCS. Indonesia, with its vast forest resources combined with the continuing threat of forest conversion mainly by Indonesian and Malaysian palm oil producers, offers opportunities for REDD.

Figure 1: Tanah Papua (Indonesia)

West Papua and Papua provinces in Indonesia (see figure 1 above), collectively termed here Tanah Papua, are of particular interest to REDD developers for the following reasons: (1) the high percentage of forest cover (ca. 85% of Tanah Papua is still forested); (2) the largest remaining lowlands forest in Indonesia, suitable for land conversion, lie in Tanah Papua; (3) Tanah Papua is in the frontier zone of the Indonesian palm oil industry as it still has large areas of land available; (4) Tanah Papua has rich biodiversity in the forests and the surrounding ecosystems with a high dependency of local communities on these ecosystems for livelihoods. There is potential for biodiversity and social benefits beyond carbon sequestration which may translate to higher prices for the carbon credits; (5) reportedly, there is local government and community support for commercial activities that leave the forests intact. Finally, (6) Indonesia is said to have a somewhat better developed legal system to support REDD type of investments than other developing countries.

We analyzed a generic example of a REDD project in Tanah Papua provided by New Forests, which is in the range of and based on future and existing REDD projects developed by New Forests. The assumed gross area is 100,000 hectares (i.e. a zone of more than 30 km by 30 km), currently zoned for clearance for agricultural use, most likely for the production of palm oil. The gross estimated area suitable for palm oil estate development is 70,000 hectares (a percentage of 70% is based on satellite pictures) to exclude areas not suitable for oil palm production, such as swamps, mangrove forests and mountainous areas. The area is further 20% discounted to comply with Indonesian law that demands certain buffer zones for conservation purposes and to avoid erosion, for example around rivers and steep mountains. This leads to a net area of 56,000 hectares that would be fully converted into palm oil plantation, which forms the basis for the project baseline carbon reduction calculations. We will explain the carbon reduction methodology in the following section.

6.4.2. Carbon sequestration alternatives: the base line land conversion versus REDD

As mentioned in the previous section, the area in which the REDD project lies is currently zoned for land conversion (clearance) which is estimated to take place from 2013 onwards. Until that time the forest is left standing, as a result of which no carbon credits are produced. Hence, the project developers (in this case, New Forests) have allowed 2,5 years for the full development of the REDD project (which allows for 6 months delays as in fact it is indicated they need only two years to complete the project development phase). Any expenses incurred during this period are born by the interested investor(s), for example a development bank, which will ultimately be the main beneficiary of the sales of carbon credits during the operational phase of the project. Note that New Forests receives a management fee during the development phase and a share of the carbon sales once the project generates credits. Regulations on baseline assumptions, predominantly the assumptions related to the pace and the start of forest clearance in the baseline scenario are still being debated within the various proposed GHG trading schemes. Such regulations may change the approach to the baseline modeling from that used in this example.

Figure 2 below depicts the cumulative carbon sequestration c.q. release of carbon credits resulting from the baseline (land conversion) option versus the REDD project (conservation option) and presents three carbon curves related to the area: (1) the red dotted line represents the base line: the cumulative net amount of carbon that is released or captured by the business as usual scenario (i.e. conversion into palm oil plantations); (2) the green curve represents the cumulative net amount of carbon that is estimated to be sequestered by the REDD project and (3) the brown line (mostly) represents the difference between the brown and dotted red curves and reflects the cumulative difference in carbon storage with respect to the two alternatives. In the picture, the vertical axis depicts carbon sequestration as positive (in $MtCO_2$ -e), hence the release of carbon is negative (negative sequestration).

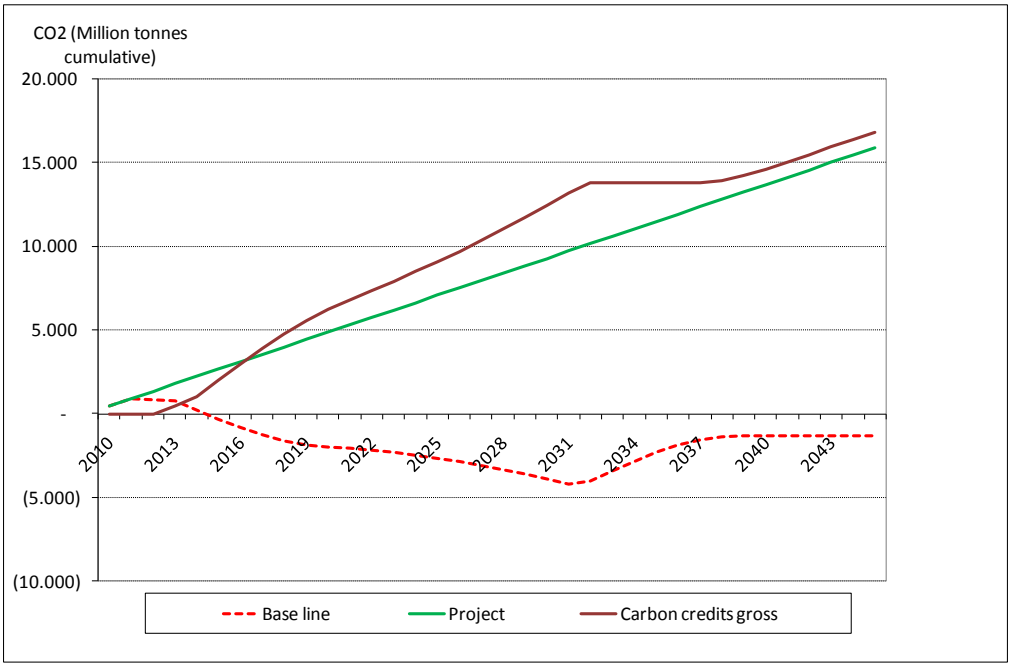


Figure 2: Cumulative carbon sequestration

As for the red dotted base line curve, a distinction can be made between two periods. In the period 2013-2032, the conversion of natural forests leads to the release of large quantities of carbon and the cumulative carbon balance continues to decline, where it is assumed that each year 5% of the forest will be cleared over a period of 20 years. However, from 2032 onwards the slope of the curve becomes

positive at the tipping point where the palm oil trees in the plantations start to sequester more carbon than what is being released by the conversion of the remaining forested areas.

The green curve, representing the cumulative net amount of carbon that is estimated to be sequestered by the REDD project, has a continuous and constant fixed slope, because the REDD project is undertaken on an area in which, like in many forests, selective logging has taken place over the years. It is assumed that 85% of the area to be converted to palm oil plantations has been subject to selective logging, which has left the forest canopy reasonably intact and allows for forest re-growth on these areas. It is assumed that in a period of 50 years, the logged areas can grow back to a more or less original state, which leads to a net sequestration of carbon and a positively sloping green curve.

Comparing the base line (conversion scenario) to the REDD project (conservation scenario), we see from the brown curve that during the first twenty years of operation (2013-2032) the difference of the cumulative carbon sequestration (release) between the base line scenario and the REDD project increases from year to year. We point out that once a net sequestration of carbon has been sold through the release of carbon credits, it is assumed to keep that amount of carbon stored for a period of 20 years. This implies that only the yearly (marginal) carbon sequestration can be sold through the release of carbon credits and not any cumulative amount if that was already sold in any previous year. Hence, as long as the brown curve increases, carbon credits can continue to be sold. We note that during the period 2033-2036 the brown curve is flat, which relates to the fact that the baseline scenario sequesters more carbon than the REDD project due to the fact that, post conversion, the plantation grows at its peak in that period. As this would mean that the project developers would have to *buy* (instead of sell) carbon credits in the years 2033-2035, it sells fewer credits in the year 2032 than it would be entitled to in order to avoid having to buy them back in later years. Figure 3 below shows in red the net annual carbon credits that may be sold from year to year during the period 2013-2032, which coincides with the 20 year period of forest clearance.

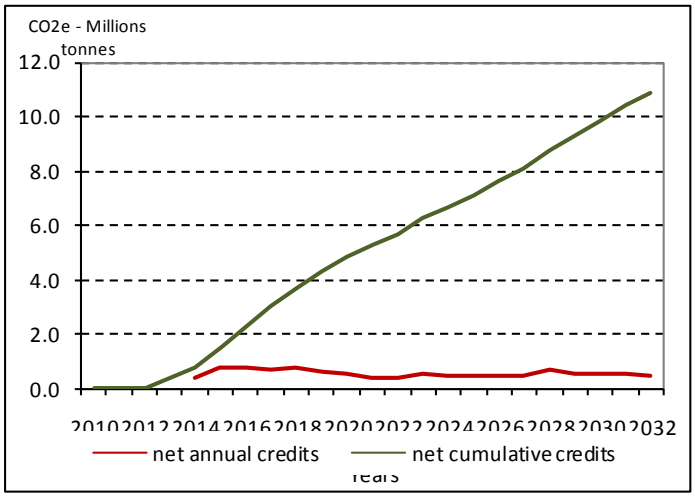


Figure 3: Net annual vs. cumulative credits

The next paragraph explains the cash flows related to the sale of carbon credits.

6.4.3. Financial Performance

Table 5 below lists the credit sales (in US$) that are being generated to the project stakeholders through the sale of carbon credits.

	01-07-10	01-01-11	01-01-12	01-01-13	01-01-14	01-01-15	01-01-16	01-01-17	01-01-18	01-01-19	01-01-20	01-01-21
Gross Credit sales	-	-	-	2.136.357	2.230.211	4.162.318	4.242.255	3.987.043	4.130.487	3.302.085	2.872.339	2.398.960
Revenues to Community	-	-	-	427.271	446.042	832.464	848.451	797.409	826.097	660.417	574.468	479.792
Revenue to Governments	-	-	-	427.271	446.042	832.464	848.451	797.409	826.097	660.417	574.468	479.792
Less NF share of carbon	-	-	-	213.636	223.021	416.232	424.226	398.704	413.049	330.208	287.234	239.896
Gross Revenues	-	-	-	1.068.178	1.115.106	2.081.159	2.121.128	1.993.521	2.065.244	1.651.042	1.436.170	1.199.480
Operational Costs	(145.000)	(1.436.444)	(966.389)	(572.343)	(574.033)	(633.811)	(635.249)	(605.656)	(608.238)	(618.326)	(610.591)	(627.070)
Net Cashflow	(145.000)	(1.436.444)	(966.389)	495.835	541.073	1.447.348	1.485.878	1.387.866	1.457.006	1.032.716	825.579	572.410
IRR to investor	**28,3%**											

Table 5: Revenues from REDD project

The first line presents the gross sales, while the three lines below that depict: (i) revenues to the local community (20% of gross sales, based on current Indonesian regulation[32]), (ii) revenues to the Indonesian governments (20% of gross sales, based on current Indonesian regulation[33]) and (iii) revenues to the investment manager New Forests (10% of gross sales). All operational costs are born by the investor, and the line ' Net Cash flow' represents the cash flow generated by the investor net of operational costs. Figure 4 below shows the cash flows in histogram format, where we see that in the first 6 six years of operation high cash flows are generated thanks to the release of carbon from deforestation under the base line scenario where the forest would be cleared while the plantation is still capturing relatively little carbon. From 2018 onwards, however, cash flows drop mainly due to the (quite significant) sequestration of carbon in the palm oil plantation which partially offsets the carbon storage in the REDD project. From 2022 onwards, cash flows pick up again once the plantation is fully grown and in its steady state while the REDD project continues to sequester carbon from forest re-growth. The spikes in 2023 and 2028 are explained by the release carbon credits from the buffer account: VCS certification requires that 15% of annual carbon credits produced each year go into a buffer account to mitigate against the risk of forest clearance on the conservation area. Every 5 years, 15% of the credits in the buffer account may be released.

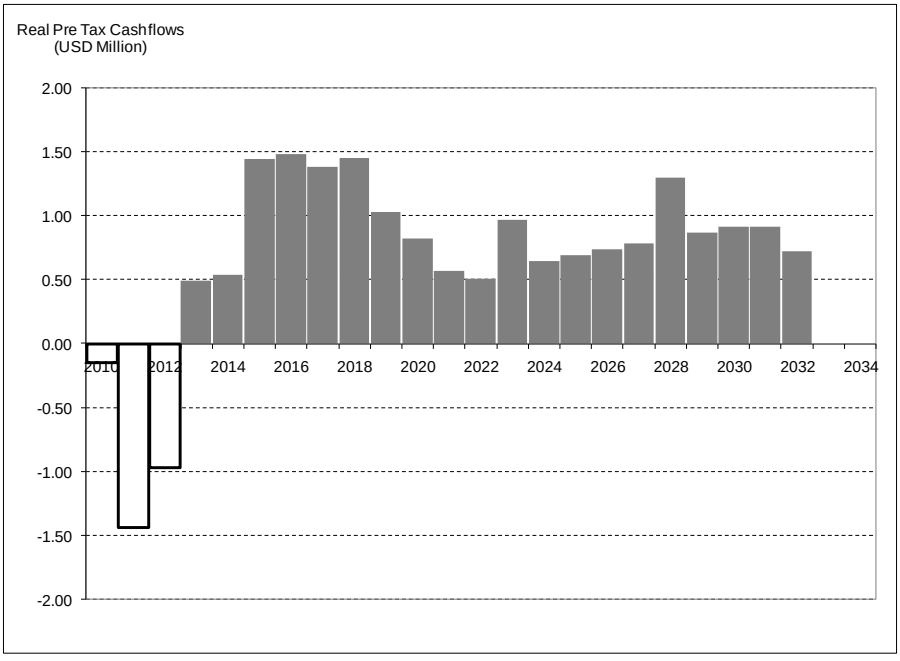


Figure 4: Annual cash flows REDD project

[32] This is currently under debate.
[33] This is currently under debate.

We derive that for this REDD project with a gross area of ca. 100,000 hectares to be converted into palm oil plantations, a total investment of ca. US$ 2,5 million is required during the development period of the project during which no revenues are being generated. Although the project development phase would take about 2 years, the project will not generate carbon credits until 2,5 years after project inception (scheduled for July 2010) as conversion in the base line scenario was scheduled for beginning of 2013. During this period, the following steps are taken to eventually come to accreditation and validation of VCS certified carbon credits: (1) administrative issues including the set up of a limited liability company in Tanah Papua and applications for licenses; (2) Free and Prior Informed Consent (FPIC) procedures with local communities; (3) biodiversity value mapping according to the FSC based High Conservation Value Forest (HCVF) standards; (4) setting up a community trust; (5) develop a detailed carbon methodology and a forest carbon inventory; (6) boundary demarcation; (7) the preparation of a management plan; (8) VCS approvals process including a validation and verification audit and (9) the CCBA validation audit. With the CCBA validation it is hoped that in the voluntary market a higher carbon price will be received for the carbon credits compared to a project without a biodiversity enhancement.

In this analysis, although the project continues to generate carbon credits, we assume that the investor wishes to exit after 12 years which is considered the maximum period for many investors, including development banks, given the risk profile of the transaction (see section 6.4.6.). Based on a cumulative investment amount of US$ 2,5 million in the period 2010-2012 and positive net revenues during the period 2013 - 2021 (ca. US$ 9 million, cumulative and non-discounted), the investor is expected to earn an IRR of ca. 28% on his investment. This is in the upper range of the 15%-30% bandwidth mentioned in section 6.2.1. The reason why such a high IRR can be achieved is that relatively small up front investments are needed to set up a REDD project with limited yearly recurring operational costs to compensate forest dwellers to leave a forest under threat of conversion standing. We note that the project IRR is highly sensitive to carbon price fluctuations: the IRR jumps to 36% with a price increase from US$ 5 per tCO_2 -e to US$ 6, while the IRR drops to 8% if the price falls to US$ 3. These price changes represent reasonable down and upward scenario's based on historical data[34]. Hence, even in a downward scenario, the investor is expected to earn a positive IRR.

After year 2021 the management of the REDD project will be transferred to the community trust who will continue to manage the REDD project for the remainder of the 20 year period up to 2032 (and possibly beyond). Operational expenses will be covered by the sale of new carbon credits produced (related to forest re-growth) and the release of the carbon buffers until the project ends.

6.4.4. Environmental Performance

The REDD project scores well on environmental aspects and is considered to outperform the palm oil plantation option in several ways other than significant carbon sequestration. Instead of converting 56,000 hectares of natural forest into mono-culture palm oil plantations, of which the mean species abundance indicator is estimated to be around 10% (see annex I), the REDD project aims to protect the area. This area is generally considered to be of high biodiversity value, because the low forest area in Tanah Papua is well known for its large amount of endemic species. Further, we mentioned in section 6.4.2. that although the forest canopy is still intact, it is estimated that about 85% of the area has been subject to selective logging. These areas are expected to re-grow to its original state in a period of 50 years, which not only stores carbon but may also attract other species both in flora and fauna. We expect that the mean species abundance indicator of the re-grown area is > 90% (see annex I) after 50 years. On the other hand, the base line alternative is likely to have damaging effects on the environment. Not only in terms of a net cumulative carbon release of close to 2 million CO_2 -equivalents (see figure 2) and reduced biodiversity,

[34] www.carbonpostive.net

but also due to increased sediment and fertilizer run-off in adjacent rivers. This causes well known damage to down stream coral reefs and coastal fisheries that are predominant in that region. Further, roads constructed to build the plantations open the area up to illegal hunting and logging. A final point, the requirement to establish riparian and steepland reserves is often neglected by palm oil developers.

6.4.5. Social Performance

In REDD projects, local communities are generally involved during the project implementation process. During and after the Free and Prior Informed Consent period, the communities are informed what the REDD project entails and what rights and obligations flow from an agreement with the investor and manager. Mapping of each community's land is undertaken, which is a big social benefit as the indigenous people's land tenure rights are strengthened through this process. If an agreement is signed, the community is obliged to keep the demarcated forest intact. In return, the local communities are permitted to continue with their lives and subsistence livelihood practices they are accustomed to including hunting, the small scale harvesting of timber logs and small scale slash and burn agriculture. Further, a community trust fund, governed by representatives of the communities and local NGO's, apart from a US$ 0,2 million start up donation during the development phase, receives 20% of gross carbon sales during the first 12 years and 100% of the carbon credits (net of the government's share) until the end of the 20 year term (and beyond if the project continues). Cumulatively, this amounts to ca. US$ 5,8 million (undiscounted) over the period 2013-2021. It can be assumed that about 5,000 community members live on the affected area, so that the community trust can spend about US$ 130 per community member per year during the 2013-2021 period. Although we are unable to benchmark this amount to other comparable (REDD) projects, this is a significant amount for people who made a subsistence livelihood prior to the REDD investment. Compared to the conversion into palm oil plantations, it is likely the local communities will be better off under the REDD project. Although it is expected that the palm oil producers will provide some sort of compensation to local communities for loss of livelihood and/or shelter depending on the form of (physical or economic) resettlement needed, such compensation is very unlikely to be equivalent to the value of the cash contribution and the perpetual provision of food, medicines, fuel, building materials and land on which to live that retention of the community's forest ensures. It can neither be guaranteed that local communities will be employed by the palm oil plantations, as generally migrant workers from other parts of Indonesia are used. Other negative social effects resulting from this migration include prostitution and the introduction of HIV/Aids and other transmittable, non-endemic diseases. Finally, workers are likely to engage in poaching activities in the nearby forests either for recreational purposes or for consumption.

6.4.6. Conclusion

In this section we presented the second case study: a REDD project located in Tanah Papua, Indonesia. The area consists of 100,000 hectares that is currently zoned for conversion into a 56,000 hectare palm oil estate. The project scores well in **financial** terms. Over the period 2013-2021, it is expected that this project may, as an alternative to the palm oil investment, generate carbon credits for the sequestration of over 6 million ton CO_2 -equivalents. In the period 2010-2012, ca. US$ 2,5 million is needed in up front investments to obtain VCS certification. Given revenues worth of US$ 9 million (cumulative and non-discounted) in the period 2013-2021, the investor is expected to make a real IRR of 28% where a carbon credit price of US$ 5 per ton CO_2 is assumed. This answers *research question 4B (" what Internal Rate of Return is feasible for a REDD project in Tanah Papua (Indonesia)?").*

The REDD project scores well on **environmental** aspects and is expected to outperform the palm oil plantation option in several ways. The project not only contributes positively to the changing climate by storing large quantities of carbon, it also has beneficial effects on biodiversity as it prepares for a climate, community & biodiversity alliance (CCBA) certification by protecting 57,000 of selectively logged rain

forest. After a 50 year reforestation period the area is expected to mimic a natural, untouched rainforest of high biodiversity value. The palm oil plantation alternative is likely to have damaging effects on the environment, not only in terms of a net 2 million CO_2-equivalent carbon release and severely (>90% in terms of mean species abundance) reduced biodiversity, but also due to increased sediment and fertilizer run offs in adjacent rivers. This causes well known damage to down stream coral reefs and coastal fisheries that are predominant in the region. From a **social** perspective, the REDD project is likely to be beneficial to local communities as a community trust will be set up collecting 20% of gross revenues from the sale of carbon credits during the lifetime of the project. Cumulatively this amounts to ca. US$ 5,8 million (undiscounted) over the period 2013-2021. The community trust also receives payments (in total US$ 0,2 million) in the years before credits are sold, in addition to administrational support. Further, a big social benefit is that the indigenous people's land tenure rights are strengthened through the mapping process and the local communities are permitted to continue with their lives and subsistence livelihood they are accustomed to including hunting, the small scale harvesting of timber logs and small scale slash and burn agriculture.

In the remainder of this section, we present a few critical notes, which are in our view the main reasons (i) to justify a higher than expected IRR and (ii) why to date there are only few REDD projects actively generating carbon credits.

Some critical notes:
There are several reasons why we consider a REDD project in Tanah Papua of high risk. From an environmental protection point of view, land allocated to REDD developers may lead to logging and palm oil activities elsewhere on the island ("leakage").

From a financial perspective, there are several issues we would like to point at. The carbon credits that will be generated are VCS certified, which so far is not yet part of any compliance scheme such as the CDM mechanism. This implies that credits can only be sold in the voluntary markets to customers that voluntarily off set their carbon emissions. This market is relatively small and has a low carbon sales price. Another effect of the voluntary market is that long term sales contracts are not yet customary, implying that the investor and project manager bear both volume and price risk.

REDD developments in Indonesia are surrounded by a set of uncertainties, one of which is the carbon calculation methodology, relying on a number of assumptions including the currently more or less agreed values for carbon content (both in the palm oil plantation and in the natural forest), but more importantly on the forest conversion rate (in the model a 5% conversion rate was assumed over a period of 20 years), contemplated by the various emission trading schemes, as well as the assumed land conversion date (in the model set at January 2013). These assumed values greatly impact the project base line and therefore the amount of credits that can be issued in the voluntary market. Changes in the (baseline) carbon calculation methodology may have a large influence on future cash flows and IRR's for REDD projects.

Other risks are the underdeveloped legal framework for REDD, also in Indonesia. Government decisions are sometimes unpredictable, for example the recent announcement from the Indonesian government to declare a moratorium on future conversion of land with high biodiversity value in certain parts of Indonesia. Although there is no guarantee that this moratorium will be effectuated beyond a two year term, it does increase the uncertainty around investments in REDD projects, which may no longer be viable if the moratorium on land conversion were to be continued. The risk with the moratorium is that it not only makes REDD unviable, but it also does not bring in enough cash to counteract the very strong economic incentive for forests to be cleared.

7. Conclusions and Recommendations

In this chapter we will present the conclusions that we draw from and the research questions that we answered in the previous six chapters. Further, we will present recommendations for further research and policy development.

7.1. Conclusions

In this section we give a brief conclusion of the previous six chapters by answering the four research questions.

7.1.1. The state of Biodiversity

In the period 1700-2000, the level of global biodiversity, an indicator measuring the abundance (population size) of a number of selected key species in a certain area or region, which can be expressed by Mean Species Abundance, has dropped by 30%. The main reasons for this development were natural land conversion to agriculture land, infrastructure investments, high population growth, human settlement and pollution.

Given the current economic and demographic developments, it is unlikely that the Convention on Biological Diversity 2010 target, where member countries have agreed on a '*significant reduction in the current loss of biological diversity*' in 2010, will be achieved. More concretely, it is expected that in the period 2000-2050, global biodiversity will drop further from 70% to 63% of the original non or low impacted level. The main drivers behind this loss are an estimated global population growth of 50% and a quadrupling global economy, both leading to increased demand for food, fodder, energy, wood and infrastructure. More specifically, in the period 2000-2050, biodiversity will be particularly affected by the negative effects of climate change and infrastructure plus related settlement. Most affected regions are drylands (grasslands and savannah), followed by tropical forests and tundra.

The effects on biodiversity of six, commonly agreed as feasible, policy options, stemming from reports and debates from large international forums and organizations, have been analyzed. It can be concluded that a further drop of the biological diversity will result from a global liberalization of agricultural trade (-1.3%) and significant poverty reduction in Sub Saharan Africa (-1.7%). Further, climate change mitigation measures will lead to a further drop in biodiversity (-1%) as the production of bio-fuels, leading to an increased demand for agricultural areas, will outweigh positive results from a slower rise of world temperature. Most positive effects on biodiversity are to be expected from a doubling of the size of natural areas (1.1%) and sustainable meat production (0.3%).

Effects differ from region to region. In Africa, Latin America and Asia most losses, mainly in tropical savannah, grasslands and tropical forests, result from higher demand of agricultural products leading to drastic increases of arable land. This is only partially mitigated by smaller European and North American production amounts of agricultural products. Russia and North Asia mostly suffer from the effects of climate change, especially in the vast areas of boreal forests and tundra. Also North America will see its boreal and temperate biomes threatened by climate change and an increase of its agricultural land surface. European biodiversity suffers mainly from a conversion of natural land to agricultural land.

Based on the report "Cross-Roads of Life on Earth, exploring means to meet the 2010 Biodiversity Target" as published by the Netherlands Environmental Assessment Agency it is clear that significant efforts need to be undertaken to commit to the COB 2010 target of a significant reduction in the loss of biodiversity. It is also widely agreed that without the involvement of the private sector, given the vast amount of people, knowledge, technology and capital available in that sector, it will be rather difficult to

achieve the halt of further decline in biodiversity and ecosystems. This forms the background of this thesis as we will explore which markets are instrumental in preserving biodiversity and what role development banks can play.

7.1.2. Failures in the markets for Ecosystems and Biodiversity

In their pursuit of economic growth and reduction of poverty, many developing countries are faced with the trade-off between economic growth and decline in pristine natural capital. It is mainly a trade-off between private and social net benefits. Although the latter are expected to be higher than the former, preference is often given to short-term private benefits, because social benefits cannot be captured by the private sector and governments in many developing countries are often unwilling, incapable or too corrupt to capture them. In that sense, this trade-off forms a true 'prisoner's dilemma': long-term economic efficiency is achievable by incorporating the social costs of the decline of ecosystem services. Due to the fact that this will entail short term costs and hence loss in competitive power for firms or lower consumption for households, the neglect of these social costs will be the dominant strategy.

Governments in developing countries try to foster economic growth by promoting agricultural, industrial and urban developments, for which large quantities of scarcely available land are required. To make more land available, natural vegetation, often valuable both in economic and biological terms, is converted for human use. This results into the decline of pristine natural capital, biodiversity and ecosystems goods and services. Whether this conversion is effective for economic growth in the long term remains doubtful. Perhaps it contributes to growth in terms of GDP; however, when economic growth is measured in terms of growth in the productive base, some developing countries have suffered from an economic recession over long periods of time. Further, a country may grow as a whole, but it is not straightforward that the rural poor, profit from national growth to the same extent. In certain cases, the rural poor, who are almost entirely dependent on ecosystems for their daily survival, suffer significantly from a decline in the natural environment.

In answering research question 1 *"what are the market failures in markets for sustainable ecosystems goods and services?"* we first pointed out that ecosystem services consist of provisioning, regulating, cultural and supporting services. Several market failures arise on the 'markets' for ecosystems goods and services. *First*, for certain important ecosystem services no (well-functioning) markets exist. *Second*, many ecosystem goods and services have 'public good' features, so private property rights are difficult to establish. *Third*, negative externalities arise from the unsustainable production of certain ecosystem goods and other markets such as the infrastructure and real estate markets. *Fourth*, there is a lack of complete information. These market failures drive a wedge between market and shadow prices of ecosystem goods, which consequently leads to an inefficient allocation of goods and services, where goods produced at the cost of ecosystems are overproduced and ecosystem services are over-exploited.

Some economists argue that the over-exploitation of pristine natural capital is of no great economic concern, because human interfered natural capital will eventually replace all pristine natural capital at least equally benefiting human beings. However, this contradicts the risk-averse agent assumption. Many provisioning, regulating and supporting ecosystem services may only be replaced against very high costs or cannot be replaced because the workings are complex or even not yet fully understood. It also denies the option value of ecosystems and the goods and services they produce.

A necessary condition for sustainability, in terms of a non-declining consumption for future generations, is that the decline in pristine natural capital is fully compensated by an increase in human interfered natural capital and nothing is used for consumption. This would imply that all pristine natural capital could be replaced by human interfered natural capital and future generations could still profit from the same level of consumption. However, it is quite probable that a minimum level of pristine natural capital

continues to be required to guarantee sustainable consumption. Trusting that human interfered natural capital will eventually replace all pristine natural capital is a gamble on continuous progression of technology and transfers significant risks to future generations.

7.1.3. Markets for Ecosystem Goods and Services

In evaluating research question 2,

"Which private markets for (A) public ecosystems services and (B) ecosystem goods under sustainable management are most promising for the private sector to invest in to create a win-win situation for (i) the private sector in terms of sufficient financial return and (ii) the natural environment in terms of protecting biodiversity?"

we presented eight markets that support ecosystems and biodiversity. The first three markets refer to the **trade of public ecosystem services**: biodiversity off sets, carbon sequestration and wetland off sets. The other five markets are **markets for ecosystem goods under sustainable management**: sustainable forestry, agriculture, fisheries, NTFP's and eco-tourism. Furthermore, we concluded that the further development of these markets help to reduce certain markets failures and therefore establish a more efficient allocation of goods and services, better preserved ecosystems, smaller amounts of ecosystem destructive goods and, according to certain publications, billions of euro's and dollars worth of public goods.

Looking at the markets from a business perspective, there are both strengths and weaknesses. Probably the most important strength forms the growth capacity of the markets, despite the current infant stage of most of the markets. All markets show significantly higher growth rates than their traditional counterparts, especially sustainable forestry, fishery, agriculture and ecotourism. Further, the markets for ecosystem goods under sustainable management benefit from (up to 25%) higher profit margins thanks to a willingness to pay, mostly applicable to consumers in the developed world, for a premium on sustainably produced products. There are also significant risks in the ecosystems enhancing business sectors, which are usually (with the exception of aquaculture) more labour intensive and less suited for large scale production, tempering growth and profit expectations. Further, current producers often lack the financial, marketing and managerial knowledge necessary to effectively run a profitable business. Moreover, despite initiatives from the Forest Stewardship Council, the International Federation of Organic Agricultural Movements and the Sustainable Tourism Stewardship Council to provide common frameworks, there are still many different certification systems confusing both producers and consumers. Finally, most remaining ecosystems are located in developing countries in Latin America, Africa and Asia with weak institutions and insufficient attention to the protection of private property rights. Further, as long as social benefits of (public) ecosystem goods and services cannot be reaped by private agents, valuable ecosystems will continue to disappear as long as (i) opportunity costs outweigh the net benefits of ecosystem goods under sustainable management and (ii) governments in developing countries do not successfully protect them.

Due to the business risks involved, the described markets will appeal to (a) investors and entrepreneurs with a higher than average risk appetite (with a corresponding above average return expectation) and (b) frontrunners in the sustainable business practices. Not all financial institutions are yet ready to support and invest in the markets described in this chapter. This calls for the involvement of financial institutions that focus on and have experience in high risk markets in developing countries, including development banks.

7.1.4. The role of Financial Institutions

In evaluating research question 3,

"To what extent are financial institutions and, in particular, development banks suited to help halt the ongoing reduction in biodiversity in developing countries in their pursuit to spur economic growth?",

we argued that development finance institutions, or development banks, are similar to commercial banks, but differ in terms of profit targets and risk appetite. Developments banks promote private (and sometimes public) sector development in developing countries and by mandate are less risk averse than commercial banks. Thanks to governments as shareholders, they are less profit driven than commercial banks, and can therefore also ask for non-financial returns resulting from their investments. Development banks are either owned by one single (bi-lateral) or multiple (multi-lateral) governments. The core business of (the private sector arm of) development banks consists of the issuance of long-term finance to (mostly) private enterprises in the form of debt, mezzanine, equity, bonds, guarantees and to, a limited extent, grant finance. The portfolios of most development banks are filled with investments in the local financial sector, infrastructural projects and industrial/manufacturing companies. The most prominent multi-lateral development banks are the International Finance Corporation (IFC), the European Bank for Reconstruction and Development (EBRD), the Asian Development Bank, the Inter-American Development Bank and the African Development Bank. The most active bi-lateral development banks are DEG from Germany, FMO from the Netherlands, CDC from the United Kingdom, Proparco from France and some Scandinavian development banks.

Through their *mission*, development banks seek to find a balance between financial, environmental and social returns. Consequently, development banks have significant experience, also through the application of the eight IFC Performance Standards, to assess and mitigate social and environmental risks. Development banks by mandate are set up to take the first steps in emerging markets and sectors, such as the markets for ecosystem goods and services, to pave the ground for large scale investments from the commercial sector when the markets have reached the next level of development.

With their *track record* in (a) transitional markets suffering from different types of financial, technological and legal market failures and (b) making sustainable investments through the use of the IFC (or similar) Performance Standards, development banks can play an important role in the development of the biodiversity enhancing markets. With a growing demand especially in the USA, Europe and Oceania for the sustainable production of agricultural products & bio-fuels and the increasing concern in both the developed and developing world for the ongoing decline of biodiversity especially in developing countries, business opportunities lie in the biodiversity enhancing markets.

With the *changing risk perception of developing countries*, there has been a significant rise in both foreign direct and local investments in many emerging markets. As a result of this, the role of development banks is changing, because capital is not as scarce anymore as it used to be in developing countries. This allows development banks to provide higher risk finance, to focus more on the poorest countries and on those sectors that still experience market failures, such as the market for ecosystem goods and services.

7.1.5. Financing Biodiversity: two case studies

To answer research question 4 we analyzed two case studies: an *ex-post* evaluation of the Eco-Enterprises Fund I in South-America and an *ex-ante* evaluation of a REDD project in Tanah Papua, Indonesia.

Question 4A - for case study 1 - the Eco-Enterprises Fund I (an existing fund, US$ 6 million in size): what Internal Rate of Return is feasible when making sustainable investments in (start up) small and medium sized enterprises located in buffer zones of areas with high biodiversity value?

To date there are very few private equity funds that (i) work on commercial basis and (ii) seek to make investments in (small and medium sized) enterprises that protect biodiversity and the natural habitat they operate in and at the same time provide an alternative income to surrounding communities that would be otherwise driven to be involved in less sustainable income generating activities. Eco-Enterprises Fund I, however, a US$ 6,3 million private equity fund active in 11 countries across Middle and South America is a fund with this triple bottom line. The fund had an investment horizon of 10 years (2000-2009) and is for a large part funded by a US based NGO (The Nature Conservancy) and a few regional development banks. The fund provided mostly fixed (high) interest loans to 23 investee companies, and made 6 equity investments. The investee companies can be characterized as small and medium sized enterprises often in an early (start up) phase of operations and mostly active in the sustainable production of agricultural commodities, forestry and eco-tourism. Overall, the gross return the fund generated to its investors was 0% and a net return of -4.7% if the operational costs were taken into account. This answers research question 4A (*"what Internal Rate of Return is feasible when making sustainable investments in (start up) small and medium sized enterprises located in buffer zones of areas with high biodiversity value?").*

Given the political, institutional and legal risks in Middle and South America, as well as the nascent stage of development of both the investee companies and the markets in which they operate, hard core commercial investors would have expected a return in the range of 20% to 30%. Nonetheless, we believe that a break even return of close to 0% is not a bad result given (i) the downward pressure operational costs bring about on the IRR of small funds, (ii) the time involved in managing investments in SME's and (iii) the financing the fund offered, which were mostly loans with fixed interest rates not allowing for an upside in case of profit wind falls. In environmental terms, the fund directly contributed to the protection of 860,773 hectares of land with high biodiversity value and indirectly to the conservation of 2,620,175 hectares. In social terms, by introducing sustainable, organic and often certified business practices, the fund contributed to the long term livelihood security of local community and indigenous groups. Further, the fund has contributed to the creation of more than 3,500 in direct jobs and close to a 100,000 in beneficiaries. The fund provided social, environmental, business services and legal technical assistance to its investee companies for free to assist them obtaining social and/or organic certification, increase financial management and marketing skills and improve relationships with local communities.

Some critical notes

Although it can be said that the fund with its investments in environmentally and socially responsible companies contributed to the conservation of large areas of native habitat with high biodiversity value, we are unsure if these areas would also have been protected without the involvement of EcoE I by obtaining finance elsewhere. It is generally true that in this segment, given the risks and low return, finance is very scarce and local banks are often unwilling to lend to these SME's given their risk profile. Nonetheless, in these particular instances we cannot know for sure if alternative financing could not have been obtained elsewhere if the Fund had not invested.

Moreover, we have been unable to verify how local communities were satisfied with the relationships with the investee companies, if they were adequately compensated for rendered goods and services and if alternative, non-sustainable business alternatives would have been preferred over working with the investee companies financed by Eco-E I.

Despite the seemingly large numbers of protected area, we are unable to benchmark this result to other

biodiversity funds. Although we are unaware of other similar funds and the fund seems to be rather unique in terms of running a commercial fund with an emphasis on environmental and social sustainability, we are yet unable to qualify these results. To measure overall positive or negative effects on biodiversity of the fund's investments (for example by measuring mean species abundance), base line and follow up studies would have been required for all investee companies

No matter how mindful of the social and environmental surroundings the business activities are being conducted, there is always some loss of biodiversity and therefore loss of biodiversity value. It can therefore be argued that instead of financing these business activities and making it possible for them to be commercially active, it would have been better to leave the areas fully in tact by disallowing all business activity. Note, however, that in many areas of high biodiversity value, often local communities and indigenous people are living that need a livelihood. Even in the most remote areas there is pressure on land conversion for subsistence agricultural production, hunting, cattle grazing and wood collection. With growing populations and the continuing search for scarce land, it can be argued that it is more effective to introduce sustainable and certified business practices rather than full protection, even in the proximity and buffer zones of Biodiversity Hotspots to provide an alternative to non-sustainable business practices as the need for a livelihood continues to exist. Further, even if the areas around Biodiversity Hotspots were to be turned into protected natural reserves, it remains difficult in large and remote areas of the developing world to avoid illegal business practices including logging, food collection and poaching.

Question 4B - for case study 2 - what Internal Rate of Return is feasible for a REDD project in Tanah Papua (Indonesia) ?

The second case study we analyzed concerned a REDD project located in Tanah Papua, Indonesia. The area consists of 100,000 hectares that is currently zoned for conversion into a 56,000 hectare palm oil estate. The project scores well in **financial** terms. Over the period 2013-2021, it is expected that this project may, as an alternative to the palm oil investment, generate carbon credits for the sequestration of over 6 million ton CO_2 -equivalents. In the period 2010-2012, ca. US$ 2,5 million is needed in up front investments to obtain VCS certification. Given revenues worth of US$ 9 million (cumulative and non-discounted) in the period 2013-2021, the investor is expected to make a real IRR of 28% where a carbon credit price of US$ 5 per ton CO_2 is assumed. This answers *research question 4B (" what Internal Rate of Return is feasible for a REDD project in Tanah Papua (Indonesia)?").*

The REDD project scores well on **environmental** aspects and is expected to outperform the palm oil plantation option in several ways. The project not only contributes positively to the changing climate by storing large quantities of carbon, it also has beneficial effects on biodiversity as it prepares for a climate, community & biodiversity alliance (CCBA) certification by protecting 57,000 of selectively logged rain forest. After a 50 year reforestation period the area is expected to mimic a natural, untouched rainforest of high biodiversity value. The palm oil plantation alternative is likely to have damaging effects on the environment, not only in terms of a net 2 million CO_2-equivalent carbon release and severely (>90%) reduced biodiversity, but also due to increased sediment and fertilizer run offs in adjacent rivers. This causes well known damage to down stream coral reefs and coastal fisheries that are predominant in the region. From a **social** perspective, the REDD project is likely to be beneficial to local communities as a community trust will be set up collecting 20% of gross revenues from the sale of carbon credits during the lifetime of the project. Cumulatively this amounts to ca. US$ 5,8 million (undiscounted) over the period 2013-2021. The community trust also receives payments (in total US$ 0,2 million) in the years before credits are sold, in addition to administrational support. Further, a big social benefit is that the indigenous people's land tenure rights are strengthened through the mapping process and the local communities are permitted to continue with their lives and subsistence livelihood they are accustomed to including hunting, the small scale harvesting of timber logs and small scale slash and burn agriculture.

In the remainder of this section, we present a few critical notes, which are in our view the main reasons (i) to justify a higher than expected IRR and (ii) why to date there are only few REDD projects actively generating carbon credits.

Some critical notes:
There are several reasons why we consider a REDD project in Tanah Papua of high risk. From an environmental protection point of view, land allocated to REDD developers may lead to logging and palm oil activities elsewhere on the island ("leakage").

From a financial perspective, there are several issues we would like to point at. The carbon credits that will be generated are VCS certified, which so far is not yet part of any compliance scheme such as the CDM mechanism. This implies that credits can only be sold in the voluntary markets to customers that voluntarily off set their carbon emissions. This market is relatively small and has a low carbon sales price. Another effect of the voluntary market is that long term sales contracts are not yet customary, meaning that the investor and project manager bear both volume and price risk.

REDD developments in Indonesia are surrounded by a set of uncertainties, one of which is the carbon calculation methodology, relying on a number of assumptions including the currently more or less agreed values for carbon content (both in the palm oil plantation and in the natural forest), but more importantly on the forest conversion rate (in the model a 5% conversion rate was assumed over a period of 20 years), contemplated by the various emission trading schemes, as well as the assumed land conversion date (in the model set at January 2013). These assumed values greatly impact the project base line and therefore the amount of credits that can be issued in the voluntary market. Changes in the (baseline) carbon calculation methodology may have a large influence on future cash flows for REDD projects.

Other risks are the underdeveloped legal framework for REDD, also in Indonesia. Government decisions are sometimes unpredictable, for example the recent announcement from the Indonesian government to declare a moratorium on future conversion of land with high biodiversity value in certain parts of Indonesia. Although there is no guarantee that this moratorium will be effectuated beyond a two year term, it does increase the uncertainty around investments in REDD projects, which may no longer be viable if the moratorium on land conversion were to be continued. The risk with the moratorium is that it not only makes REDD unviable, but it also does not bring in enough cash to counteract the very strong economic incentive for forests to be cleared.

7.2. Recommendations

In this section we provide recommendations for policy development and recommendations for further research.

7.2.1. Recommendations for policy development

In this section we will answer research question 5:

How can the Dutch government contribute to an enabling environment in developing countries to monetize and transfer public benefits into private cash flows while promoting more investments in biodiversity supporting ecosystems?

We see the following opportunities for the Dutch government:

Contribution 1: Setting up a Biodiversity Fund

The Dutch ministry of Development Cooperation (DGIS) invests about €4 billion per year in developing countries to improve human rights, contribute to solving (armed) conflicts and reduce poverty. Policy implementations may follow a public route (government-to-government, government-to-multilateral institutions, governments-to-NGO's) but are also made by involvement of the private sector for example through subsidies and technical assistance. As such, DGIS made contributions in developing countries to private sector health care, access to energy, reducing climate change and improvements in infrastructure. Development banks, including the World Bank and the EBRD, have regularly received funds from DGIS to implement specific renewable energy and climate change policy objectives in developing countries.

Further, over the past 5 to 10 years, DGIS asked FMO, the Dutch development bank, to manage four investment funds on their behalf: (1) the Infrastructure Development Fund, a revolving €270 million fund for infrastructure investments mainly in the least developed countries in Africa, (2) the Access to Energy Fund, a revolving €70 million fund to provide poor people in developing countries with access to (clean) energy, (3) the Massif Fund, a revolving €300 million fund, to provide capital to financial intermediaries, mainly micro finance institutions, in developing countries to improve access to finance for (very) small and medium sized enterprises in those countries and (4) the Capacity Development Fund, a €50 million fund that provides grants, mainly to existing clients of FMO, to build capacity by transferring knowledge and skills. In its capacity as fund manager and based on a set of criteria agreed with DGIS, FMO searches investment opportunities to make investments in the form of debt and equity which may occasionally be complemented by grants. After the investment is made, the project is monitored for a period of up to 15 years to ensure timely repayments and check compliance with other contractual obligations including environmental and social covenants.

In the same light, a biodiversity fund can be set up with the goal of protecting biodiversity and ecosystems by (1) making scarce financing available (and decrease that specific market failure) to small and medium sized enterprises that are active in the markets for ecosystem goods and services, which is predominantly in sustainable agriculture, aquaculture, eco-tourism and sustainable forestry, but also in the less tangible provision of ecosystem services such as carbon sequestration; (2) providing alternative income opportunities to local communities and indigenous groups, as an alternative to large scale unsustainable slash-and-burn and other non-sustainable business practices prevalent in many developing countries. The fund can be constructed in several ways. One way is similar to the funds described above. DGIS, or any other ministry, would be the sole financier of the fund and FMO, or any other development bank, acts as fund manager by selecting, based on a set of pre-agreed criteria, and monitoring investments. Another way would be to catalyze funds both from development banks and the commercial sector that may include pension funds and financial institutions seeking socially and environmentally responsible investments. We have seen that at this stage making investments in funds such as Eco-E I, may result into financial returns that don't justify the risks that investors face. We see two ways to reduce risks, increase financial return expectations and therefore commercial appetite to participate in a biodiversity fund. The first would be to have the financial contribution by the Dutch government to absorb the first losses of the fund. Suppose that the Dutch government provides US$ 2 million of a US$ 10 million[35] biodiversity fund, this amount can be used to absorb all losses c.q. investment write offs to an amount of up to US$ 2 million. Another way would be to allocate any returns, if any, to the private investors in the fund only while the government would only receive back its original investment without any return. In the same example, the maximum amount the government will receive back after the investment period is US$ 2 million, leading to a 0% return. All excess cash flows are allocated to the other investors. This will improve their financial return compared to the situation the government would share in any excess cash flows.

[35] It is proposed to start with a small fund at first to test the absorption capacity of the fund. The exact amount can be linked to the conservation objective of the Dutch government.

In the case study of Eco-Enterprises Fund I, in total and over a period of ten year ca. 861,000 hectares of natural habitat with high biodiversity value was helped to be conserved during the investment period, which is an equivalent of 100,000 to 150,000 hectares of natural habitat per invested million. If similar investments as the Eco-Enterprises Fund I can be found, a US$ 10 million biodiversity fund can contribute to the conservation of 1,0 to 1,5 million hectares of habitat with high biodiversity value. We need to make two caveats. Firstly, Eco-E I was not the only financier and on average it invested ca. 20% of the financing needs per individual investment, so it can be argued that each investment contributed to the conservation of 20,000 to 30,000 hectares and, similarly, a US$ 10 million biodiversity fund can help to conserve 200,000 to 300,000 hectares of habitat with high biodiversity value. Secondly, the conservation areas with high biodiversity value cannot be guaranteed to be managed sustainably after the investment period ends. In fact, regular biodiversity studies, including a base line study at the start of the investment, are needed to assess more precise effects on the level of biodiversity. This latter recommendation requires time, funding and efforts, for which technical assistance is helpful.

Contribution 2: providing technical assistance

As indicated in the previous section as well as in section 6.3.4, technical assistance is considered supportive for the medium and long term viability of small and medium sized enterprises active in the eco-conservancy niche, as attention to environmental and social risks are important particularly to avoid difficulties with local communities affected by the company and to obtain social and/or organic certification to access foreign organic and fair trade (super) markets. Without technical assistance in the form of (partial) grants, the cost and administrational efforts can be too much for young companies to bear. The following types of technical assistance, in line with what Eco-E I offered, are therefore suggested to be made available by the Dutch government:

(1) Environmental technical assistance in the form of biodiversity impact assessments, the development of environmental and social monitoring plans and support to obtain environmental (organic) certification, training in organic and sustainable harvest techniques and biodiversity interpretation;

(2) Social technical assistance to obtain social (fair trade) certification and training in sustainable harvest techniques to local communities and cooperatives supplying raw materials to companies, but also to address certain social needs such as access to healthcare, education and potable water.

(3) Business services technical assistance to build capacity in financial management, cost accounting, marketing and, for start ups, assistance with writing a business plan.

(4) Legal technical assistance can be offered to those companies who have no have access to local lawyers for proper legal documentation.

The Dutch government can make grant type technical assistance available separately through a technical assistance fund but also in combination with a biodiversity fund as suggested in Contribution 1. The advantage of combining funding (so that it becomes less dependent on grants from NGO's and other donors) with technical assistance is that it helps small and medium sized enterprises to obtain the scarce capital which is needed to set up and expand the business, while the technical assistance transfers knowledge and skills companies don't yet have access to.

Contribution 3: harmonizing certification schemes

Currently, there are perhaps hundreds of different environmental and social certification schemes mainly originating from the USA, the EU, Australia and Japan that are being labeled as organic, fair trade, kosher

or otherwise in some way socially or environmentally friendly. In order to access different markets, many producers of organic and fair trade products are therefore often faced with having to comply with several different compliance systems. Although these systems have certain overlaps, they may also differ slightly in several areas and as each certification scheme requires annual fees, monitoring reports and verification visits, this adds costs and administrational burden to companies. This may be cumbersome especially for small and medium sized enterprises that are already faced with numerous challenges in their early days of existence.

The Dutch government could make financing available and/or political support to harmonize different certification schemes into a clear subset of aligned organic and fair trade certification systems.

Others
Other areas of contribution would be to promote more productive agricultural practices in established agricultural areas in developing countries. With the increased demand for agricultural products, pressure to convert natural to arable land will continue to exist. However, the need for new land in expansion (relatively new) and frontier (new) areas will decline if productivity rises in existing agricultural areas. Development banks could stimulate foreign direct investments in agricultural production and/or the transfer of knowledge to these areas, so that there is not as much need for new arable land.

The Dutch government could also stimulate demand for ecosystem goods and products by requiring that all local, regional and central governments buy only sustainable (certified) products with an agricultural component, including FSC certified paper and wood, and organic and fair trade food. We understand that certain developments are currently being considered.

7.2.2. Recommendations for further research

The topic of this thesis, financing biodiversity through private sector investments, is relatively new. Therefore, there are several recommendations we may suggest for further research. First of all, we were only able to give a brief analysis of the markets for ecosystem goods and services in chapter 4. A more in depth analysis including a SWOT[36] and risk analysis in addition to any price premiums received on sustainable, certified agro-commodities will be beneficial for investors to assess business opportunities and make profitable investments.

Further, we have presented only two case studies. The more case studies are analyzed and made available that have the potential to generate profits to investors while at the same time conserving biodiversity as well as involving local communities, the better investors will be able to test the biodiversity business case and bench mark proposals.

Finally, it would be worthwhile to have a set of bench marks to test case studies against. Although financial parameters are already available (including the internal rate of return), accessible and standardized environmental (biodiversity) and social parameters would be useful to benchmark environmental and social performance across the range of available case studies.

[36] Strengths, Weaknesses, Opportunities and Threats.

Annex I: The MSA - Index for different vegetation types

Main GLC 2000 class (GLC 2000 class[a])	Sub-category	Description	MSA_{LU}
Snow and ice (20)	Primary vegetation	Areas permanently covered with snow or ice considered as undisturbed areas	1.0
Bare areas (19)	Primary vegetation	Areas permanently without vegetation (e.g. deserts, high alpine areas)	1.0
Forest (1, 2, 3, 4, 5, 6, 7, 8, 9, 10)	Primary vegetation (forest)	Minimal disturbance, where flora and fauna species abundance are near pristine	1.0
	Slightly disturbed or managed forest	Forests with extractive use and associated disturbance like hunting and selective logging, where timber extraction is followed by a long period of regrowth with naturally occurring tree species	0.7
	Secondary forest	Areas originally covered with forest or woodlands where vegetation has been removed, forest regrowing or areas with a different cover and no longer in use	0.5
	Forest plantation	Planted forest, often with exotic species	0.2
Shrubs and grassland (11, 12, 13, 14, 15)	Primary vegetation (grass or shrubland)	Grassland or shrub-dominated vegetation (e.g. steppe, tundra or savanna)	1.0
	Livestock grazing	Grasslands where wildlife is replaced by grazing livestock	0.7
	Man-made pasture	Forests and woodlands that have been converted to grasslands for livestock grazing	0.1
Mosaic: cropland /forest (17)	Agroforestry	Agricultural production intercropped with (native) trees; trees kept for shade or as wind shelter	0.5
Cultivated and managed areas (16, 18)	Low input agriculture	Subsistence and traditional farming; extensive farming and low external-input agriculture	0.3
	Intensive agriculture	High external-input agriculture, conventional agriculture, mostly with a degree of regional specialization, irrigation-based and drainage-based agriculture	0.1
Artificial surfaces (21)	Built-up areas	Areas more than 80% built-up	0.05

[a] 1, Broadleaved evergreen forest; 2, Closed broadleaved deciduous forest; 3, Open broadleaved deciduous forest; 4, Evergreen needle-leaf forest; 5, Deciduous needle-leaf forest; 6, Mixed forest; 7, Swamp forest; 8, Mangrove and other saline swamps; 9, Mosaic: forest/other natural vegetation; 10, Burnt forest; 11, Evergreen shrub; 12, Deciduous shrub; 13, Grassland; 14, Sparse shrub and grassland; 15, Flooded grassland and shrub; 16, Cultivated and managed areas; 17, Mosaic: cropland/forest; 18, Mosaic: cropland/other natural vegetation; 19, Bare areas; 20, Snow and ice; 21, Artificial surfaces.

Annex II: Literature sources

1. Annual Report 2004, 2005 and 2006 Precious Woods, Zug, Switzerland;
2. Angus Maddison, *The World Economy: A Millennium Perspective*, OECD Development Centre Studies, 2001, Paris (France);
3. CBD & MNP (2007) Cross-roads of life on earth. Exploring means to meet the 2010 Biodiversity Target. Solution-oriented scenarios for Global Biodiversity Outlook 2. Report nr. CBD Technical Series no. 31 / MNP report nr. 555050001, Secretariat of the Convention on Biological Diversity (sCBD) and Netherlands Environmental Assessment Agency (MNP), Montreal & Bilthoven.
4. Clive W. J. Granger, Lykke E. Andersen, Eustaquio J. Reis, Diana Weinhold, Sven Wunder, *the Dynamics of Deforestation and Economic Growth in the Brazilian Amazon*, 2002, Cambridge University Press (United Kingdom), ISBN: 0521 81197;
5. Kerry Ten Kate, Josh Bishop, Ricardo Bayon, *Biodiversity Offsets: Views, experience and the business case*, IUCN The World Conservation Union, ISBN 2-8317-0854-0, November 2006, Cambridge (United Kingdom);
6. Joshua Bishop, Sachin Kapila, Frank Hicks, Paul Mitchell, *Building Biodiversity Business: Report of a Scoping Study*, October 2006, Working Paper for IUCN The World Conservation Union and Shell International, London (United Kingdom);
7. Joshua Bishop et al., *the Economics of Ecosystems and Biodiversity (Report for Business)*, TEEB executive summary 2010.
8. Michael C. Rubino, *Biodiversity and Business in Latin America*, Discussion Paper Environmental Projects Unit International Finance Corporation/World Bank, 2000 (#1), Washington DC (United States);
9. David Vaughan, *Tourism and Biodiversity: A Convergence of Interests*, International Affairs 76/2, p. 283-297, 2000;
10. Michael C. Rubino, *Biodiversity Finance*, International Affairs 76/2, p. 223-240, 2000 (#2);
11. Jeffrey A. McNeely, W. Paul Weatherly, *Innovative Funding to Support Biodiversity Conservation*, International Journal of Social Economics, Vol 23 No 4/5/6, 1996;
12. Michael Jenkins, Sara J. Scherr, *Markets for Biodiversity Services: Potential Roles and Challenges*, Environment vol. 46 p.32-43, 2004.
13. Timothy M. Swanson, *The Theory and Practice of Transferring Development Rights: the Institutions for Contracting for Biodiversity*, Working Paper for Conference on Financing Biodiversity Conservation Harare (Zimbabwe), Cambridge University & CSERGE, 1995;
14. Marió Jorge Cardoso de Mendonça, Adolfo Sachsida, Paulo Loureiro, *A Study on the Valuing of Biodiversity: the Case of Three Endangered Species in Brazil*, Ecological Economics, vol. 46 p.9-18, 2003;
15. J.A. Gobbi, *Is Biodiversity-Friendly Coffee Financially Viable? An Analysis of Five Different Coffee Production Systems in Western El Salvador*, Ecological Economics, Vol. 2 p.267-281, 2000;
16. PriceWaterhouseCoopers, World Wildlife Fund Germany, *Sustainable Investments for Conservation: The Business Case for Biodiversity*, Working Paper Presented on Seminar in February 2007, Brussels (Belgium);
17. The World Commission on Environment and Development: Our Common Future, ("Brundtland Report"), Oxford (United Kingdom), 1987.
18. Partha Dasgupta, *An Inquiry into Well-Being and Destitution*, 1993, Oxford University Press, Oxford (United Kingdom).
19. Partha Dasgupta and Karl-Göran Mäler, *Poverty, institutions and the Environmental-Resource Base*, 1994, World Bank Environment Paper 9.
20. Partha Dasgupta, *Valuing Biodiversity*, 2000 (revised), University of Cambridge and Beijer International Institute of Ecological Economics Stockholm, published in Encyclopedia of Biodiversity.

21. Partha Dasgupta, *Nature and the Economy*, 2006, University of Cambridge, lecture at the annual conference of the British Ecological Society.
22. The Role of Bilateral Development Finance Institutions in the Development Finance Architecture, *Dr. D.W. te Velde et al*. 21 November 2007, Overseas Development Institute (UK).
23. 2006 Comparative Analysis of European Development Finance Institutions (EDFI) Members, 2006, Brussels (Belgium).
24. Robin Naidoo & Taylor H. Ricketts, *Mapping the Economic Costs and Benefits of Conservation*, PLoS Biology, November 2006, Volume 4, Issue 11, p. 2153-2164.
25. Will. R. Turner et al., *Global Conservation of Biodiversity and Ecosystem Services*, BioScience, November 2007, Volume 57, No. 10.
26. *Ecosystems and Human Well-Being, a Synthesis*, a Report of the Millennium Ecosystem Assessment, 2005, World Resources Institute, Washington D.C., USA.
27. Integrated Modelling of Global Environmental Change. An overview of IMAGE 2.4, Netherlands Environmental Assessment Agency (MNP), Bilthoven (the Netherlands), 2006.
28. Marcel Kok et al, *Prospects for Mainstreaming Ecosystem Goods and Services in International Policies*, a publication of the Netherlands Environmental Assessment Agency & International Institute for Sustainable Development, January 2010.
29. A. Tekelenburg at al., *How do Biodiversity and Poverty Relate? An explorative study, Netherlands Environmental Assessment Agency*, October 2009, Bilthoven (The Netherlands).
30. Roger Perman et al, *Natural Resource and Environmental Economics*, Third Edition 2003 Pearson Educated Limited, ISBN-13: 978-0-273-65559-6, Harlow (United Kingdom).
31. Nyenrode Business Universiteit, *Conference Paper "Boosting Investments in Biodiversity and Ecosystem Services",* Amsterdam (The Netherlands), November 2009.
32. P. Akong Minang, D. Murphy, *REDD After Copenhagen: The Way Forward*, Working Paper written by the International Institute for Sustainable Development and ASB Partnership for the Tropical Forest Margins, February 2010.
33. Rob Aalbers et al., *CPB Memorandum: The valuation of risky projects*, CPB Netherlands Bureau for Economic Policy Analysis, Bilthoven (The Netherlands), April 2009.
34. Rudolf S. de Groot et al., *A typology for the classification, description and valuation of ecosystem functions, goods and services*, Ecological Economics 41 (2002) 393-408.
35. Robert Costanza et al., *The Value of Ecosystem Services: putting the issue in perspective*, Ecological Economics 25 (1998) 67-72.
36. Robert Costanza, *The Ecological, economical, and social importance of the Oceans*, Ecological Economics 31 (1999) 199-213.
37. Stephen C. Farber et al., *Economic and ecological concepts for valuing ecosystem services*, Ecological Economics 41 (2002) 375-392.
38. Jan Joost Kessler et al., *Biodiversity and Socio-economic impacts of selected agro-commodity production systems*, The Journal of Environment & Development (2007); 16; 131.
39. Andrew Balmford et al., *Economic Reasons for Conserving Wild Nature*, August 2002, volume 297, Science.

Websites

The following websites were consulted:

- Wikipedia: www.wikipedia.nl & www.wikipedia.com
- Verde Ventures: www.verdeventures.com
- Root Capital: www.rootcapital.com
- Ecologic Finance: www.ecologicfinance.org
- Precious Woods: www.preciouswoods.com

- Conservation International: www.conservation.org
- The International Tropical Timber Association: www.itto.or.jp
- Food and Agricultural Organisation: www.fao.org
- Marine Stewardship Council: www. msc.org
- Tropenbos International: www.tropenbos.nl
- International Monetary Fund: www.imf.org
- International Finance Corporation: www.ifc.org
- European Bank for Reconstruction and Development: www.ebrd.org
- European Investment Bank: www.eib.org
- Financierings-maatschappij voor Ontwikkelingslanden: www.fmo.nl
- Deutsche Investitions- und Entwicklungsgesellschaft: www.deginvest.de
- Asian Development Bank: www.adb.org
- African Development Bank: www.afdb.org
- Inter-American Development Bank: www.iadb.org
- Centre for Watershed Protection: www.cwp.org
- Carbon Positive: www.carbonpositive.net

Annex III: Banks adhering to the Equator Principles

1. Absa Bank Limited
2. Access Bank
3. ANZ
4. Arab African International Bank
5. ASN Bank NV
6. Banco Bradesco
7. Banco de la República Oriental del Uruguay
8. Banco do Brasil
9. Banco Galicia
10. Banco Santander
11. Bancolombia S.A.
12. BankMuscat
13. Bank of America
14. Bank of Tokyo-Mitsubishi UFJ
15. Barclays plc
16. BBVA
17. BES Group
18. BMCE Bank
19. BMO Financial Group
20. BNP Paribas
21. Caixa Econômica Federal
22. Caja Navarra
23. Crédit Agricole Corporate and Investment Bank
24. CIBC
25. CIFI
26. Citigroup Inc.
27. CORPBANCA
28. Credit Suisse Group
29. Dexia Group
30. DnB Nor
31. EFIC
32. EKF
33. Export Development Canada
34. FirstRand Bank Ltd
35. FMO
36. Fortis Bank Nederland
37. Fortis Bank NV/SA
38. HSBC Group
39. Industrial Bank Co., Ltd
40. ING Group
41. Intesa Sanpaolo
42. Itau Unibanco S/A
43. JPMorgan Chase
44. KBC
45. KfW IPEX-Bank
46. la Caixa
47. Lloyds Banking Group Plc
48. Manulife
49. Mizuho Corporate Bank

50. Millennium bcp
51. National Australia Bank
52. Nordea
53. Nedbank Group
54. Rabobank Group
55. RBC
56. Scotiabank
57. SEB
58. Societe Generale
59. Standard Bank Group
60. Standard Chartered Bank
61. SMBC
62. TD Bank Financial Group
63. The Royal Bank of Scotland
64. UniCredit Bank AG
65. Wells Fargo & Company
66. WestLB AG
67. Westpac Banking Corporation

Annex IV: The IFC Performance Standards

PS 1: Social and Environmental Assessment and Management Systems

The first performance standards is a mostly generic. It requires and prescribes the assessment of environmental and social risks, a description of impacts and opportunities and, thirdly, the management of environmental and social performance during the life time of the project by means of an Environmental and Social Management System ("ESMS"). Once, following the assessment, the significant social and environmental risk and impacts are identified, an action plan ("Environmental and Social Action Plan", or "ESAP") details the required action needed to avoid, mitigate, minimize or compensate environmental and social effects. Performance Standard 1 underlines the importance of interaction between the project developer on the one hand and workers and the local community on the other. More explicitly, PS 1 requires that "community engagement will be free of external manipulation, interference, or coercion, and intimidation, and conducted on the basis of timely, relevant, understandable and accessible information". A grievance mechanism needs to be in place during the implementation of a project to allow the local community to report about aspects of the implementation or agreement they disagree with.

PS 2: Labor and Working Conditions

Performance standard 2 aims to balance economic growth through employment and income generation with the protection for basic rights of workers. The purpose of it is an effective worker-management relationship, including the fair treatment of workers and safe and healthy working conditions, improving the (longer term) efficiency and productivity of the operations. An effective worker-management relationship includes the fair treatment, non-discrimination and equal opportunities of workers (including compliance with national labor and employment laws) with an explicit exclusion of child and forced labor. Further, workers are provided with written information, as laid out in the company's Human Resources Policy, regarding their rights including wages & benefits, hours of work, overtime arrangements and compensation, and leave for illness, maternity, vacation or holiday, all of which need to comply at least with national law. If the company plans to fire a significant amount of people, a retrenchment plan needs to be set up based upon the principle of non-discrimination and consultation with employees.

PS 3: Pollution Prevention and Abatement

The object of the third performance standard is to minimize detrimental effects on human health and the environment that is caused by increased levels of pollution to air, water and land resulting from increased industrial activity and urbanization. It also promotes the reduction of greenhouse gas emissions. The client is to avoid the release of pollutants, greenhouse gases, waste and hazardous materials and if this is not possible, they need to be controlled and minimized. For this purpose, PS 3 promotes the use of internationally disseminated technologies and practices as far as they are technically and economically feasible in the context of the project and a detailed set of guidelines contain maximum emissions of the major pollutants. If the project requires the use of pesticides, an integrated pest (and/or vector) management must be implemented. By choosing pesticides that are low in human toxicity, unacceptable levels of pest damage are avoided. Extremely hazardous and highly hazardous materials, as specified by the World Health Organization Recommended Classification of Pesticides by Hazard Classes, are explicitly excluded.

PS 4: Community Health, Safety and Security

Project activities often bring benefits to local communities, including employment, opportunities for economic development and (health and education) services. However, negative effects on communities arise from accidents, structural failures and the release of hazardous materials. Communities may be further negatively affected by impacts on natural resources they depend upon, exposure to diseases (including HIV/Aids) and the use of (sometimes violent) security personnel. PS 4, although recognizing

that community health, safety and security lies traditionally with project authorities, addresses the client's responsibility to avoid or minimize risks that arise from project activities.

PS 5: Land Acquisition and Involuntary Resettlement

Project-related land acquisition sometimes leads to involuntary resettlement of dwellers involving physical displacement (loss of shelter) or economic displacement (loss of assets, means of livelihood or income sources). Resettlement is considered involuntary if individual people or communities are not entitled to refuse the land acquisition that leads to the displacement, arising in situations where (a) land can be lawfully expropriated from the dwellers or (b) failed negotiations may be followed by legal expropriation. Project developers and financiers have experienced that involuntary resettlements, even if they are legal and supported by local and national governments, may lead to severe social unrest, hardship, impoverishment for affected people and environmental damage. Further experience demonstrates that the project developer's involvement in the resettlement, while taking the interest of the resettled people or activities into account, may lead to timely and efficient implementation of the project as well as improved or sustained livelihoods of the communities involved. In this light, Performance Standard 5 seeks to (i) avoid or minimize involuntary resettlement by exploring alternative project designs, (ii) offer compensation for loss of assets to those who are negatively affected and restore or improve the livelihoods and standards of living of the displaced, (iii) improve living conditions of displaced people by offering them adequate housing with security of tenor and (iv) disclose appropriate information to, consult and involve those affected.

PS 6: Biodiversity Conservation and Sustainable Natural Resource Management

As many projects financed by way of project finance are located in remote, often heavily forested, areas of the world, the natural environment is directly affected by the project activities. Performance Standard 6 requires the protection and conservation of biodiversity in all its forms (genetic, species and ecosystem diversity) and is based on the Convention on Biological Diversity that emphasizes the social, economic, cultural and scientific importance of ecosystems, habitats, species, communities, genes and genomes. Therefore, this performance standard promotes the sustainable management and use of natural resources by integrating conservation needs and development priorities. In practice this means that (i) in modified habitat, conversion is minimized and opportunities are looked for to promote biodiversity, (ii) in natural habitat, conversion or degradation of habitat is only allowed when there are no alternatives, overall benefits outweigh the costs (including those of the environment and biodiversity) and conversion and degradation is mitigated, (iii) in critical habitat no activities can take place unless there are no measurable adverse impacts to support the established population of species and no reduction of endangered species will take place and (iv) in legally protected areas, the law needs to be followed and the conservation aims of the protected area needs to be promoted.

PS 7: Indigenous Peoples

Indigenous People, characterized as social groups with identities distinct from dominant groups in national societies, are often vulnerable groups and easily marginalized. Because of their economic, legal and social status, indigenous people often have a limited capacity to defend their interests and therefore often receive small benefits from project developments. Performance Standard 7 promotes the full respect for the dignity, cultures and resource-based livelihoods of indigenous people and calls for the preservation of cultural, knowledge and practices of these groups. It prescribes to avoid, or otherwise mitigate and compensate, adverse impacts of projects on communities. This enforces the need to maintain ongoing relationships with the communities throughout the lifetime of the project by establishing good faith negotiations and informed participation of indigenous people when projects are located on traditional or customary lands under use by these groups.

PS 8: Cultural Heritage

Following the Convention Concerning the Protection of the World Cultural and Natural Heritage, this performance standard is formulated to project irreplaceable cultural heritage. It also promotes the sharing of economic benefits arising from the use of cultural heritage. Cultural heritage includes tangible property and sites with archaeological, paleontological, historical, cultural, artistic and religious values (including, e.g., sacred groves). Intangible forms of culture (traditional lifestyles, cultural knowledge, practices of communities etc.) are also included. Cultural heritage is not to be disturbed or removed from its site unless it is demonstrated that (i) there are no feasible alternatives to removal, (ii) overall benefits of the project outweigh the cultural heritage loss from coming the removal and (iii) removal of cultural heritage is conducted by the best available technique. Critical cultural heritage, which refers to internationally recognized cultural heritage used within living memory for long-standing cultural purposes and legally protected cultural heritage areas, is not to be damaged, altered or removed unless, on top of the above requirements, unless good faith negotiations with the affected communities have resulted into a successful outcome. Legally protected cultural heritage requires the following *additional* measures: (i) project complies with local regulations and management plans, (ii) consult key stakeholders (including area sponsors, managers and local communities) and (iii) promote and enhance the conservation aims of the protected area by additional programs.

In conclusion, the eight IFC performance standards are considered international best practices, now used by a number of large commercial and development banks in project finance, to mitigate social and environmental risks, reduce costs and avoid reputational damage. Note that many development banks either explicitly endorse the IFC Performance Standards, or use their own benchmarks (including the EBRD and the IADB), which are almost identical or inspired by them.

Annex V: Regional Effects Cross Roads of Life on Earth

Regional effects for Sub-Saharan Africa

In the baseline, biodiversity drops from 73% in 2000 to 61% in 2050, mainly driven by an increase in agricultural area (in fact, this is the only region where this happens) at the cost of tropical grasslands and savannah and tropical forests (deforestation). Main drivers are population increase and absence of substantial improvements in agricultural productivity.

Both trade liberalization (-3.7%) and poverty reduction (-5.7%) have significant negative effects on biodiversity, as a result of larger agricultural productive areas. Tropical forests, grasslands and savannah will be mostly affected by conversion into arable land. If trade barriers were to be removed, the area profits significantly from a shift in production from the developed countries to Africa and Latin America (the latter even more). The level of GDP will be 5% above the baseline value in 2030. In the case of poverty reduction (option 2), poverty is removed in all dimensions of the Millennium Development Goals context, leading to a 25% increase in GDP per capita above the baseline level in 2030. Biodiversity will lose -5.7% as a result of higher demand for agricultural production (partly offset by higher productivity) and improved infrastructure. Limiting the effects of climate change (option 3) leads to a biodiversity decrease of -1.7% because the region becomes an important producer of bio-fuels at the expense of tropical grasslands and savannah. A surplus in emission rights may lead to the sale of these rights so that income levels might increase by 1%. The protected area scenario (option 6) leads to a biodiversity increase of 0.8%.

Regional effects for South-East Asia

In the baseline, biodiversity drops from 55% in 2000 to 46% in 2050 in this large region that has already experienced high losses in the past, due to population pressures and economic activity. Therefore, the future reduction is expected to be relatively moderate. Although there is not much room for additional agricultural expansion[37] (mainly in India and China, it might be different in other locations), reduction in biodiversity levels is expected due to strong economic growth, leading to higher levels of infrastructural investments and human settlements. Further, Asia will show the highest demand for wood in all regions, explaining a large share of forestry in the biodiversity decline. Also climate change has a negative effect on South and East Asia where a wide variety of natural biomes will be affected including grasslands and forest biomes, tundra and boreal forest.

With respect to the six policy options, the region will benefit most from the forestry option (+0.8%), where large areas of plantations will produce significant quantities of wood. This reduces the pressure on natural woods and original levels of biodiversity can return in degraded natural areas. Biodiversity both wins and loses in the climate mitigation option. Positive effects arise from better climate conditions, but this is counteracted by the bio-fuel production that will arise (which is partially taking place on available agricultural land that could otherwise gradually restore). Total effect climate mitigation option is +0.4%.

Trade liberalization has also a negative impact in this region (mainly in China) as agricultural production, though there is not much room for physical expansion, will rise on the basis of higher productivity. This leaves less land available for nature restoration in abandoned agricultural areas. Total effect trade liberalization option is -0.4%. Finally, the doubling of the protected area size will lead to 1.3% higher biodiversity in this part of the world.

Regional effects for West Asia

In baseline of the West Asian region, biodiversity will drop from 76% in 2000 to 72% in 2050. This relatively small decline of biodiversity is explained by the large desert biome, which cannot easily be

[37] In fact the area of arable land will be decreasing thanks to productivity increases mainly in China.

developed for human use. Nonetheless, most of the drop in biodiversity stems from the negative effects of climate change. Droughts, desertification and temperature increase will negatively affect arable land and natural biomes. Further, strong economic development will lead to infrastructural developments and settlements, with negative effects on the level of biodiversity.

In terms of effects of the six policy options, trade liberalizations negatively affect biodiversity by -0.7% as temperate grassland and species rich Mediterranean shrub and woodland will be turned into arable land. The climate change mitigation option will, unsurprisingly as this is the main driver in the baseline scenario, have a positive impact (0.2%). This is partially mitigated by more bio-fuel production (Turkey) at the expense of grassland, steppe and Mediterranean biomes. Increasing the area of protected areas lead to an increase of 1.6% in biological diversity.

Regional effects for Latin America & the Caribbean
In baseline of the Latin American and Caribbean region, the regional biodiversity will drop from 66% in 2000 to 59% in 2050. Until 2000, the majority of the loss was created by land conversion for agricultural production and forestry (habitat loss). The additional 7% loss will be driven by fragmentation, negative effects of climate change and infrastructural development. The effects of agriculture development are more or less neutral in the area. Increased population and economic development will drive up the demand for food and fodder, combined with a maintained strong position in the world food market. However, productivity is expected to rise, so that a certain portion of abandoned agricultural land can (slowly) revert to tropical dry forest.

Effects of the policy options: the trade liberalization option has by far the most impact in the Latin American region, where biodiversity will drop by an additional -5.4%. Agricultural production will be boosted, at the expense of European and North American production, as cheap, productive land is widely available and production costs are relatively low. In this scenario, higher productivity will not counterbalance the need for more arable land to produce food crops, grass and fodder, which is expected to reach to a level 40% above the baseline. Affected habitats will be tropical and dry forests, grassland and savannah areas. In the climate mitigation option, the negative effects resulting from the higher levels of bio-fuel production (in fact, the area will become one of the largest producers of bio-fuels on the globe) will in the short run outweigh positive effects from a more stable climate. Total effect: -1.6%. Sustainable meat production, an important activity in the region, will lead to a 0.7% gain in biodiversity levels. The protected forestry option leads to a 0.5% gain in biodiversity.

Regional effects for Russia and North Asia
In the baseline, biodiversity drops from 76% in 2000 to 71% in 2050 in Russia and North Asia. Biodiversity deterioration is relatively modest in the region thanks to a decreasing population. This results into a surplus of arable land which, after it has been taken out of production, will gradually return to its original state (boreal and temperate forests, steppe and grasslands).The most important factor contributing to further biodiversity loss is the climate change effect, which has a negative impact on the vast areas of boreal forest and tundra. Another important factor is infrastructural development caused by economic development.

In terms of the effects of the six policy option, the option with the most impact on biodiversity is the climate change mitigation option. The arable land that will become available will be used for bio-fuel production and not lead to restoration (resulting from the base case scenario). As this effect is bigger than the positive effects from the climate mitigation the combined effect on biodiversity is estimated to be a 2% drop. The trade liberalization option leads to a -0.4% drop as the result of a small increase in arable land at the cost of forest, grassland and steppe. A positive effect of 1.2% can be expected from the increase of the protected natural areas.

Regional effects for North America
In the baseline, business as usual scenario, biodiversity drops from 75% in 2000 to 65% in 2050 in North America. The main driver is the negative climate change effect on boreal and temperate biomes. Further, the region is expected to maintain a strong position in the global agricultural market and as the productivity is already at a high level no further major gains are to be expected. The rising global demand for agricultural products will lead to an increase in arable land at the expense of temperate grass land and steppe.

For the policy options, the lifting of trade barriers has a distinct positive effect on biodiversity in North America (1.4%), which is the result of a shift in production to other regions such as Latin America, Asia and Sub Saharan Africa. The climate mitigation option leads to a further loss in biodiversity (-1.5%) as the area's production of bio-fuels increases at the expense of temperate grasslands and tundra.
Both an increase in the size of protected areas and the sustainable meat option have positive effects on biodiversity (1% resp. 0.7%). The latter is the result of lower demand for more expensive meat and less nitrogen deposits in the environment.

Regional effects for Europe
After centuries of land conversion, densely populated regions and large infrastructure investments, Europe shows the lowest level of biodiversity in the world (45% in 2000). This is expected to decrease further to 33% in 2050 in the baseline scenario. This extreme drop is expected as the result of further economic developments. Although it can be argued that this further deterioration is politically unlikely, losses in biodiversity elsewhere in the world are likely to be more significant. The main drivers for the biodiversity losses are climate change, infrastructural developments, and, assuming Europe maintains its dominant position in the agricultural markets under the current protective policies, forestry and agriculture activities.

With a 4.2% jump, European biodiversity profits most from the lifting of the trade barriers (policy option 1). This is the result of the shift of agricultural production to Latin America, Sub Saharan Africa and Asia. European agricultural production is expected to decline by 24% in 2050, leading to a (slow) restoration of original biomes on former arable land. The climate mitigation scenario has an almost neutral effect as there is only little room for additional bio-fuel production in Europe. On the other hand, there is the positive effect of a more stable climate. Total result: -0.2%. The sustainable forestry option (option 5) will lead to the conversion of natural forests as the productivity in Europe is not very high compared to natural forests. The effect as an estimated drop of -0.6% in biodiversity.