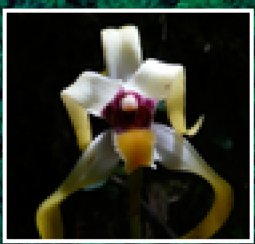
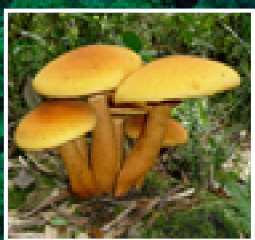
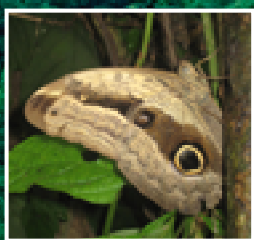
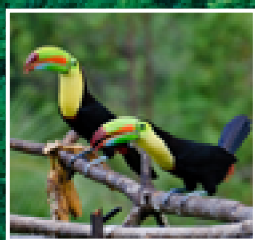
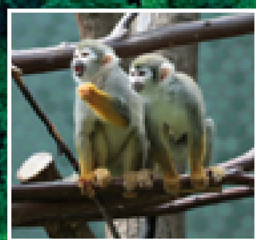
CLIMATE SERVICE CENTER

CSC Report 3

REDD+

Chances for biodiversity, potential risks and possible remedies

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REDD+
Chances for biodiversity, potential risks and possible remedies

Internship-Report by Linda Rohnstock

Host Organization:
Climate Service Center Germany (CSC)

Supervisor at CSC:
Dr. Michaela Schaller, Head of Management of natural resources department

Supervisor at University:
Dr. ir. Arnold J.H. van Vliet
Environmental System Analysis Group
Wageningen UR

Table of contents

Abbreviations

CBD	Convention on Biological Diversity
CDM	Clean Development Mechanism
COP	Conference of the Parties
DAF	Development adjustment factor
FAO	Food and Agriculture Organization of the United Nations
GHG	Greenhouse gases
HFLD	Countries with low deforestation rates but high forest cover
IPCC	Intergovernmental Panel of Climate Change
NGO	Non-Governmental Organization
REDD	Reducing emissions from deforestation and forest degradation
REDD+	Reducing emissions from deforestation and forest degradation, the conservation and enhancement of forest carbon stocks, and the sustainable management of forests
SMF	Sustainable management of forests
tCO_2e	Metric tons of carbon dioxide equivalent
UNFCCC	United Nations Framework Convention on Climate Change

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Introduction

Deforestation and forest degradation are estimated to account for approximately 17% of global greenhouse gas emissions (IPCC 2007) and thereby contribute substantially to global warming. To address this source of carbon emissions a mechanism was created, which has the intention to compensate developing countries for reducing their deforestation and forest degradation rates. REDD (Reducing emissions from deforestation and forest degradation) was first introduced by Papua New Guinea and Costa Rica into the climate change negotiations at the 11th conference of the parties (COP) to the United Nations Framework Convention on Climate Change (UNFCCC), held in Montreal, Canada in the year 2005 (UNFCCC COP11 2005).
In 2007 the derivative "REDD+" became part of the Bali Action Plan (UNFCCC COP 13 2007). This concept goes one step further and includes in addition to deforestation and forest degradation also the role of conservation and enhancement of carbon stocks as well as the sustainable management of forests.

REDD +

= Reducing Emissions from Deforestation and forest Degradation

\+

Conservation of forest carbon stocks
Enhancement of forest carbon stocks
Sustainable management of forests

REDD+ might be able to change the perverse perception that is driver of most forest conversion activities: "that forests are worth more 'dead' (or as agricultural lands) than alive" (SCBD 2011). Furthermore, besides its preliminary target of reducing greenhouse gas emissions, REDD+ is expected to have multiple environmental and social "co-benefits" (UNFCCC COP 13 2007), like conservation of ecosystem services, such as biodiversity, and support of indigenous people and local communities.

The biggest threat to biodiversity conservation under a REDD+ mechanism therefore might be the failure to implement REDD+ at all, because a successfully implemented reduction of deforestation and forest degradation can provide significant benefits for biodiversity conservation (SCBD 2010). It can, for instance, lead to a reduced fragmentation of forest habitats and thereby to the maintenance and enhancement of corridors. Furthermore, it will result in the protection of gene pools. This all increases the resilience and adaptation ability of forest systems to disturbances, like for instance the impacts of climate change. The biodiversity and ecosystem services in these areas are thereby protected, as well (SCBD 2009; SCBD and giz 2011). However, REDD+ projects bear still several risks for biodiversity and its conservation. At the 16th Conference of the Parties to the UNFCCC in Cancun, Mexico, in 2010, participants adopted decisions, known as Cancun Agreement. Therein, it was decided upon a list of safeguards in order to diminish potential negative implications of a REDD+ mechanism (see Box 1) (UNFCCC COP 16 2010). According to Huettner (2010), though, these safeguards will hardly lead to legally enforceable, measurable and monitored standards for the co-benefit aspects of REDD+. A transformation into uniform national rules is unlikely. If there will not be major efforts to amplify these safeguards, they will remain on paper and only reappear after evaluations of the first projects in the context of „what went wrong“ (Kühne 2011).

Box 1: Safeguards for activities under REDD+

(a) Actions complement or are consistent with the objectives of national forest programmes and relevant international conventions and agreements;

(b) Transparent and effective national forest governance structures, taking into account national legislation and sovereignty;

(c) Respect for the knowledge and rights of indigenous peoples and members of local communities, by taking into account relevant international obligations, national circumstances and laws, and noting that the United Nations General Assembly has adopted the United Nations Declaration on the Rights of Indigenous Peoples;

(d) The full and effective participation of relevant stakeholders, in particular indigenous peoples and local communities

(e) Actions are consistent with the conservation of natural forests and biological diversity, ensuring that they are not used for the conversion of natural forests, but are instead used to incentivize the protection and conservation of natural forests and their ecosystem services, and to enhance other social and environmental benefits;

(f) Actions to address the risks of reversals;

(g) Actions to reduce displacement of emissions.

The following report uses studies, organizational and conference papers, project documents and web pages to pick up the current discussions about impacts of a REDD+ mechanism on the potential environmental co-benefit biodiversity conservation. Chances as well as potential risks are presented together with suggested measures that could avoid negative implications of REDD+ on biodiversity.

Risk of leakage and failure to protect areas with high biodiversity value

One of the biggest concerns regarding REDD+ is the risk of leakage, meaning the displacement of deforestation to a non-REDD+ area. Leakage can occur nationally and internationally. Consequently, countries that do not participate in a REDD+ mechanism will have to face higher pressure on their forests, especially those with currently low deforestation rates like Suriname (Harvey et al. 2010a). Since REDD+ is designed for tropical forests, deforestation could also move to temperate or boreal zones (Miles and Kapos 2008).

Due to national or international leakages the intended mitigation effect of REDD+ could be eliminated, or worse, emissions could increase if deforestation moves to areas with greater carbon storages (Harvey et al. 2010a). Similar would be the implications for biodiversity, especially if deforestation is displaced to forests with a higher biodiversity value. To counteract negative implications for mitigation but also biodiversity conservation, mechanisms have to be created that prevent this national or international leakage (SCBD 2010). There are several suggestions to address this:

- Establish a monitoring and reporting system that allows for detecting leakage (SCBD 2010).
- Increase the scale from subnational to national level and promoting broad participation in REDD+ to reduce the risk of international leakage (SCBD and giz 2011).
- As long as country participation is not big enough to ensure that leakage is as far as possible avoided, REDD+ revenues could be discounted for the estimated leakages (Murray 2008).
- Address the overall drivers of deforestation, such as the demand for palm oil or beef. If they are not reduced, the incentives for continuation of the logging remains high (Kühne 2011).

Despite all efforts to prevent leakage, one has to be aware that a total avoidance is impossible, unless all forests and woodlands are protected under a REDD+ mechanism (Angelsen 2008).

Because there is a congruence of high carbon stocks and high biodiversity at the global scale one could expect that protecting the carbon will also lead to protection of the biodiversity (Strassburg et al. 2010). The big carbon stocks can mostly be found in tropical forests. At the same time tropical forests are among the most biodiverse terrestrial ecosystems on earth (UNEP-WCMC 2008) and they are the target of possible REDD+ efforts.

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Although there is on the global scale a big correspondence, on smaller scales, such as ecosystems, forests with high carbon and high potential income from REDD+ are not necessarily areas with high biodiversity value (Ebeling and Yasué 2008; Paoli et al. 2010). Therefore, there is a huge risk that deforestation or degradation shifts to areas with low carbon stock but high biodiversity value (either other forests or non-forest ecosystems) (Harvey et al. 2010a; Strassburg et al. 2010; SCBD and giz 2011).

In Indonesia, for example, forests on peat soils store more carbon than areas on mineral soils. However, biodiversity levels are higher in forests on mineral soils (Paoli et al. 2010). If leakages occur, co-benefits for biodiversity conservation will be eliminated and the threat to species and ecosystems can even increase.

Despite the preference for great carbon stocks, the areas that in the end will be protected under REDD+ are most likely those with the lowest foregone benefits from alternative land use (opportunity costs). Areas with high biodiversity values, however, might have high conversion rates and could therefore be too expensive too protect (Ebeling and Yasué 2008; Grainger et al. 2009). Deforestation might shift to these unprotected areas with incalculable consequences for the local biodiversity (Huettner 2010).

There are hopes that REDD+ will increase the total amount of protected areas. Areas that are not protected yet might be so under a REDD+ project.

Because of a general bias in the protected area networks towards places which would not face high pressures of conversion even if they would not be protected, other more threatened ones could benefit from REDD+. For instance tropical lowland forests in Indonesia are priority areas for biodiversity conservation but are still underrepresented in the protected area network compared to upland ecosystems (Joppa and Pfaff 2009; Paoli et al. 2010). Compensations payments for protecting theses areas could correct this bias. However, if adjacent forests to those under REDD+ are deforested or degraded, the habitat requirements for biodiversity might not be fulfilled and the positive effect of the mechanism might be low (Huettner 2010). REDD+ forests should not be "islands" within a deforested and/or degraded areas.

Because of the risk that the forests protected under a REDD+ mechanism are not necessarily biodiversity priority areas, it might be more efficient to focus conservation funds on non-forest ecosystems, low-carbon forests and REDD+ adjacent areas, rather than on forests covered by the new mechanism (Miles and Kapos 2008).

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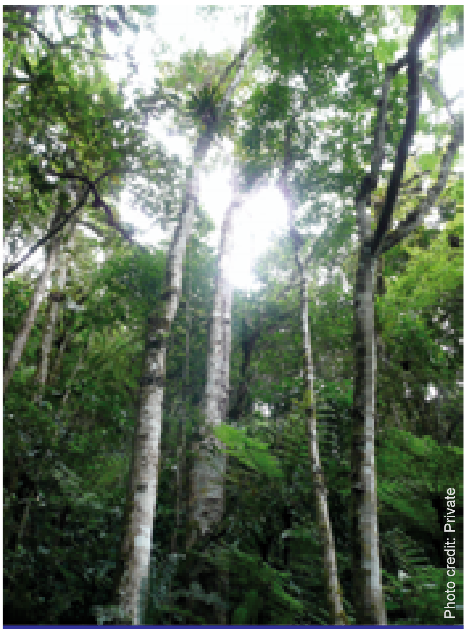
Definition of forest

The UNFCCC has adopted a forest definition for the Clean Development Mechanism (CDM) under the Kyoto Protocol (see EXCURS: Forests types and categories). However, many argue that this definition is not precise enough for a REDD+ mechanism. There is no distinction made between natural forests and plantations, although there are differences in the species composition, ecology, biodiversity value and safety as a carbon store. Furthermore, under the UNFCCC definition other non-forest systems, such as agro-forestry and biofuel crops, may fall into the category of forests (Sasaki and Putz 2009; Harvey et al. 2010a). Applying an inappropriate forest definition can therefore lead to several risks for biodiversity. It is one of the most important aspects of REDD+ that have to be decided upon, since it determines which areas will be eligible for REDD+.

If the current definition of the UNFCCC is not getting more precise and including safeguards, the result can be a conversion of primary forests or other biodiverse areas (e.g. wetlands, grasslands or peat) into timber or biofuel plantations or other monocultures with genetically modified or non-native species (Sasaki and Putz 2009; Harvey et al. 2010a; Pistorius et al. 2010; SCBD 2011).



Degradation could continue or even increase as areas where logging takes place still might correspond to the definition of forest, if for instance minimum crown cover is set too low (Sasaki and Putz 2009). It will be a challenge to monitor forest conversion because of an imprecise definition. Changes between different forest types and categories might thereby not be detected (SCBD 2011). If plantations have to be regarded as forest, financing might focus on them as REDD+ areas with the results that the pressure on natural forests increases (Harvey et al. 2010a).

The only way to avoid such implications is the adjustment of the current definition. It has to be more precise and there should be differentiations between the different forest types and categories (see EXCURS: Forests types and categories) (SCBD 2011). One suggestion is, for instance, that "forests" should have a minimum crown cover of 40% and a tree a minimum height of 5m (Sasaki and Putz 2009).

Avoiding the conversion of natural primary forests could be supported on the national scale by requiring the maintenance of a certain percentage of each of the countries natural forest types (Pistorius et al. 2010).

EXCURS: Forests types and categories

Definitions of forest

Forest definitions can be based on legal classifications (land use in countries: forest, agriculture, urban) or on the vegetation that forms the forest. Every country and even regions within countries have their own definition for “forest” but also of what is considered as “tree”. Fruit orchards, for instance, are in some countries considered as forests, in others not. Bamboo is sometimes defined as grass, sometimes as tree (Menzies 2007).

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The UNFCCC uses a forest definition which was adopted for activities under the Kyoto Protocol (UNFCCC COP 7 2002). The definition of the Food and Agriculture Organization of the United Nations (FAO) is used most in international processes (SCBD 2011). It is broader, as also the different forest categories are addressed (FAO 2010):

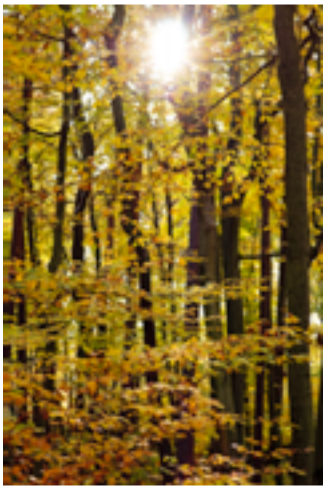
<u>UNFCCC</u>

Definition that is for activities under the Kyoto Protocol: “Forest is a minimum area of land of 0.05-1.0 hectares with tree crown cover (or equivalent stocking level) of more than 10-30 per cent with trees with the potential to reach a minimum height of 2-5 metres at maturity in situ. A forest may consist either of closed forest formations where trees of various storeys and undergrowth cover a high proportion of the ground or open forest. Young natural stands and all plantations which have yet to reach a crown density of 10-30 per cent or tree height of 2-5 metres are included under forest, as are areas normally forming part of the forest area which are temporarily unstocked as a result of human intervention such as harvesting or natural causes but which are expected to revert to forest”.
(UNFCCC COP 7 2002)

<u>FAO</u>

Forest is a “land spanning more than 0.5 hectares with trees higher than 5 meters and a canopy cover of more than 10 percent, or trees able to reach these thresholds in situ. It does not include land that is predominantly under agricultural or urban land use”
Other wooded land is defined as “land not classified as “Forest”, spanning more than 0.5 hectares; with trees higher than 5 meters and a canopy cover of 5–10 percent, or trees able to reach these thresholds in situ; or with a combined cover of shrubs, bushes and trees above 10 percent. It does not include land that is predominantly under agricultural or urban land use.
Other land is “all land that is not classified as ‘forest’ or ‘Other wooded land’”.
(FAO 2010)

Forest biomes and tropical forest types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After classifying land as “forest”, it can be further differentiated. Often this is done based on the climatic regions of the earth. The major forest biomes are:

- Tropical forests
- Temperate forests
- Boreal forests

Other biomes, mostly not included in forest definitions, are tropical savannas, temperate grasslands, deserts / semi deserts, tundra, wetlands and croplands. Despite not being classified as “forests”, they can store great amounts of carbon and therefore should be considered in climate negotiations (see Table 1).
Within the above mentioned forest biomes, differentiations in several types can be made based on criteria like species composition, productivity, etc.
Tropical forest as the prioritized target biome for REDD+ activities, can be separated further, for instance, via the seasonal rainfall distribution (Menzies 2007):

- Evergreen rainforest: no dry season
- Seasonal rainforest: short dry season
- Semi-evergreen forest: longer dry season
- Moist/dry deciduous forest: Monsoon season

Table 1: Estimate of global carbon stocks in the different biomes (SCBD 2009).

Biome	Global Carbon Stock (Gt C)
Tropical forests	428
Temperate forests	159
Boreal forests	559
Tropical savannas	330
Temperate grasslands	304
Deserts and semi deserts	199
Tundra	127
Wetlands	240
Croplands	131

However, there are several additional options to classify tropical forest types.

Forest categories

Forests can be classified also based on the way they are growing and the grade of disturbance by humans. Therefore, several different categories were established by organizations as well as countries. The names for the categories vary as well as the descriptions. The here used definitions are taken from different sources (e.g. FAO (2010), SCBD (2009), Denmark: from Menzies (2007)).

• Primary natural forest	Has spontaneously generated itself; consists of naturally immigrated tree species; has not been affected by human activities
• Modified natural forest	A natural forest which shows clear signs of human activities, such as logging
• Secondary forest	Has re-grown after intense disturbances (either natural like storms or unnatural like clearing)
▪ Naturally regenerated	Has re-grown without human activities
▪ Plantation	Trees are planted by humans; use of either native or non-native tree species

It is important to note that there are also forests that cannot be completely assigned to one of these categories.

Table 2: Estimates of carbon and biodiversity benefits of the different forest categories. Benefits can differ depending on several elements (e.g. location, age of the forest, carbon stock above or below ground etc.). Source: modified from SCBD (2009). In grey are one added category (naturally regenerated forest) and one additional benefit (permanence of carbon storage / resilience to disturbances). Level of added benefits is based on qualitative conclusions taken from several studies and meta-analyses (Sayer et al. 2004; Alberti et al. 2008; Williams et al. 2008; Thompson et al. 2009; Liao et al. 2010; SCBD 2011).

		Carbon stock	Carbon sequestration potential	Permanence of carbon storage / resilience to disturbances	Biodiversity
Primary forest		+++	+	+++ [4/6]	+++
Modified natural forest		++	++	++ [4]	++
Secondary forests	Naturally regenerated	++ [5]	++ [2/3]	++ [5]	++ [1]
	Plantation (native species)	+	+++	+(+) [4]	+(+)
	Plantation (exotic species)	+	+++	+ [4]	+

The different forest categories also provide different levels of carbon and biodiversity benefits. Forests can have similar sequestration and storage capacity but at the same time different biodiversity value (SCBD 2009). Several elements determine the current carbon stock, the carbon sequestration potential, the permanence of carbon storage and the biodiversity. Factors are for instance the location of the forest (e.g. tropic vs. temperate), the age and the species composition.
In Table 2 estimates about the carbon and biodiversity characteristics are indicated.

Old primary forests in the tropics are widely acknowledged to store more carbon than younger ones or plantations (Liao et al. 2010). The total carbon stock (plants and soil) is estimated to be on average 28% higher than in plantations (Liao et al. 2010). Despite the long persisting perception, they are not carbon neutral but still sequester it (Luyssaert et al. 2008). Biodiversity is highest in these undisturbed forests (SCBD and UNEP Issue Paper No. 5). Due to this richness in biodiversity, primary forests are more resilient than others and therefore can store the carbon over longer time periods (Thompson et al. 2009; SCBD 2010).


Photo credit: private

In contrast, modified natural forests are more prone to disturbances and climate change impacts due to the lower biodiversity (Thompson et al. 2009). Furthermore, they store less carbon because of logging activities and more young trees (SCBD 2009). However, sequestration potential might be higher than in primary forests as after having cut down trees, new ones can grow.

The carbon stock and sequestration potential in naturally regenerating secondary forests is likely to be similar to that of naturally modified forests. However, studies suggest that the accumulation of carbon in these forests takes rather place in live wood and less in soils (Alberti et al. 2008; Williams et al. 2008). Compared to plantations natural succession is said to be more effective on the long term, for carbon storage as well as biodiversity (Sayer et al. 2004; Liao et al. 2010).

There are still environmental benefits in plantations, although they strongly depend on the tree composition. Those with a diverse mixture of native species provide higher benefits than those of exotic monocultures (SCBD 2009). However, the reduced biodiversity results in a lower resilience and less adaptive capacities compared to primary, natural modified or naturally regenerated forests (Thompson et al. 2009). Nevertheless, plantations have the advantage of sequestering substantial amounts of carbon, when established on non-forest land (e.g. agricultural) (Liao et al. 2010). This, of course, depends on the species used and management applied. Furthermore, the time-averaged carbon stock is lower than in primary forests as the trees are usually harvested at young age (SCBD 2009).


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Reference level

Different reference levels against which emission reductions are being measured and rewarded are under discussion. These levels are supposed to indicate the additionality of reductions under REDD+ and those that would have happened anyway (Parker et al. 2009). Which approach is being used in the end will also determine, which countries might participate and which forests will be protected. This again is important for the aspect of biodiversity conservation in REDD+. Several options for reference levels have been suggested and are under discussion:

- Historical deforestation rates
- Modelled baselines (uses anticipations of economic development and then projects emissions)
- Adjusted historical baselines (uses additionally to the historical deforestation rate a development adjustment factor to include projected changes of drivers in the future)
- Negotiated reduction levels (each country negotiates its reference level with the UNFCCC)

Each approach has its own implications for the success of REDD+ and consequently also for the conservation of biodiversity.

Historical deforestation rates

This approach is favoured by many and has the advantage of being relatively simple in calculating emissions reductions (Parker et al. 2009) (see Figure 1). Countries with low deforestation rates but high forest cover (HFLD) and high biodiversity, however, might not participate because of too low economic incentives. Inappropriately, those with high deforestation rates would benefit (Harvey et al. 2010a).

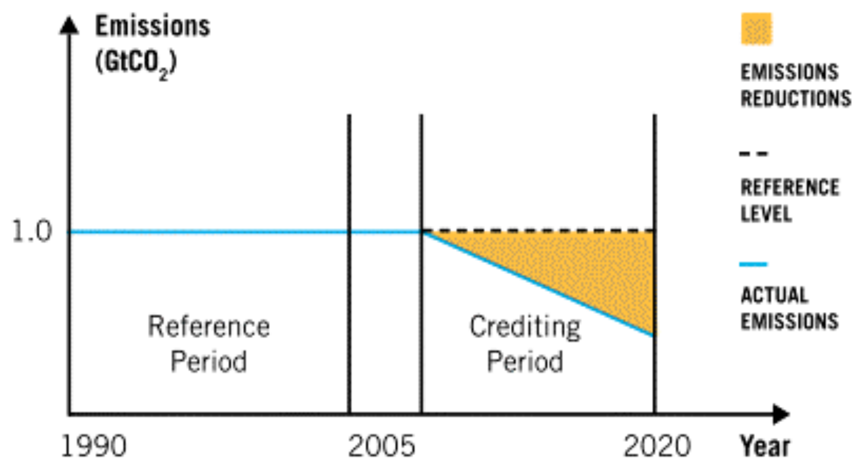

Figure 1: Emission reductions under a historical baseline approach with the reference period 1990-2005 and the crediting period until 2020 (Parker et al. 2009).

Da Fonseca et al. (2007) have designed a matrix which shows that developing countries can be divided into four categories. They indicate if participation is likely based on the potential for REDD credits (see Table 3). HFLD countries in Quadrant IV harbour 18% of the forest carbon on just 13% of the forest area but they might not have enough incentives under historical reference levels to maintain their low deforestation rate.
Besides the risk of a deforestation increase in HFLD countries, this approach requires the availability and high quality of past deforestation data. Countries that cannot provide those data might be excluded, as well. Moreover, historical rates ignore the changes in the deforestation level over time (Parker et al. 2009).

Table 3: Four categories of 80 tropical countries: Data from FAOs Global Forest Resources Assessment 2005 (FAO 2006), other information modified from da Fonseca et al. (2007). "Forest area" indicates the quadrant's share of the 80 countries' forest area, "Forest carbon" indicates the quadrant's share of the 80 countries' forest carbon stock, "Deforestation carbon" indicates the quadrant's share of the 80 countries' annual carbon emissions from deforestation. Those countries with high deforestation rates are likely to have high potential for RED credits under a historical baseline approach. In contrast, incentives for countries with low deforestation rates might be small. HFLD countries are in Quadrant IV.

	Low Forest Cover (<50%)	High Forest Cover (>50%)
High Deforestation Rate (>0.22%/yr)	*Quadrant I* e.g. Guatemala, Thailand, Madagascar High potential for REDD credits Number of countries: 44 Forest area: 28% Forest carbon (total): 22% Deforestation carbon (annual): 48%	*Quadrant III* e.g. Papua New Guinea, Brazil, Dem. Rep. of Congo, Bolivia High potential for REDD credits Number of countries: 10 Forest area: 39% Forest carbon (total): 48% Deforestation carbon (annual): 47%
Low Deforestation Rate (<0.22%/yr)	*Quadrant II* e.g. Dominican Republic, Angola, Vietnam, Mozambique Low potential for REDD credits Number of countries: 15 Forest area: 20% Forest carbon (total): 12% Deforestation carbon (annual): 1%	*Quadrant IV* e.g. Surinam, Gabon, Belize Low potential for REDD credits Number of countries: 11 Forest area: 13% Forest carbon (total): 18% Deforestation carbon (annual): 3%

Modelled baselines

The strength of using projected deforestation rates is the inclusion of a broader range of deforestation drivers than just historical behaviour. However, this approach requires adequate data on the key variables. It is rather complex and it might be difficult to negotiate it in a forum like the UNFCCC. Furthermore, it is unlikely that the total allowances based on projections will be equal to current rates. Thereby, the modelled baselines bare the risk of increases in deforestation rates, also called "hot-air" (Parker et al. 2009).

Adjusted historical baselines

The application of a development adjustment factor (DAF) to the historical baselines has the advantage of including future changes in the deforestation drivers. The adjusted historical baselines, however, might be higher than the just historical ones. Thereby, not only decreases but also increases in deforestation can be credited, resulting in net increases in greenhouse gas emissions (see Figure 2) (Parker et al. 2009).

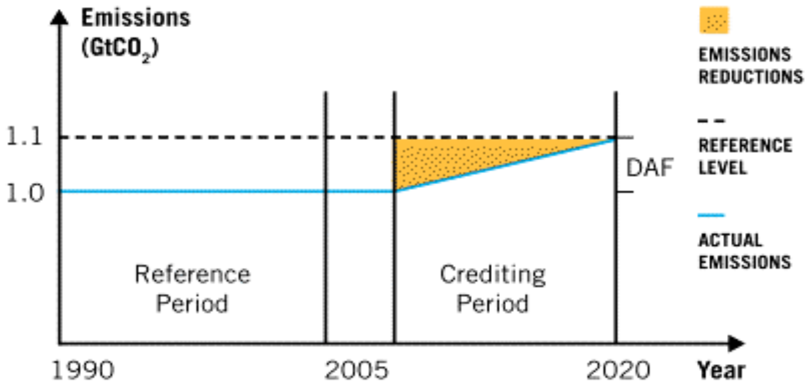

Figure 2: Emission reductions under a historical adjusted baseline approach with the reference period 1990-2005 and the crediting period until 2020 (Parker et al. 2009).

Negotiated reduction levels

The negotiated reference levels can be based on any of the before presented baseline options. The main advantage is that many countries might agree to this approach. However, reductions might be too low and there is the risk that they do not address the additionality aspect (TCG 2009).

On the 15th session of the COP to the UNFCCC (UNFCCC COP 15 2009) it was agreed that reference levels are to be based on "historical data, adjusted for national circumstances". If this approach is being used for REDD+, safeguards have to be created in order to avoid the hot-air effect described before. The mitigation effect would otherwise be limited.
For the conservation of biodiversity it is also of great importance, which approach will be used as it determines which countries will participate in the REDD+ mechanism.
There is the risk that countries with high biodiversity but low deforestation or forest conversion rate might not participate, if the potential revenues are too low. That is why there have to be enough incentives for those not participating countries with high forest cover and low deforestation rates (HFLD) to keep on maintaining and protecting their forest and avoiding leakage.
A proposed possibility is the use of a global deforestation baseline rate for those countries with low deforestation. The accounting for preserved carbon therefore has two different schemes in order to discriminate between countries with high and those with low deforestation rates (Mollicone et al. 2007). HFLD countries would receive "preventive credits" which they would loose if deforestation would increase. This approach decreases incentives for new forest conversions and may also reduce leakage to these HFLD countries (da Fonseca et al. 2007).

Not only is the level of reference under debate but also the scale of its application (subnational, national or global) (Parker et al. 2009). However, on this aspect there seem to be great consensus that reference levels should be applied on the national scale (Parker et al. 2009).

Of importance is also if net or gross deforestation rates are used. Net deforestation (net loss of forest area) is in the FAO Global Forest Assessments defined as the overall deforestation minus changes in forest area due to forest afforestation, landscape restoration and natural expansion of forests (FAO 2010).

If net instead of gross rates are considered, changes from one forest type to another are not discernable. Whereas this might not play a big role for the emissions reductions, it is crucial for biodiversity where deforestation takes place. For the local biodiversity it doesn't matter that somewhere else reforestation takes place (SCBD and giz 2011).


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Implications of the "plus-points"

Because of the "plus-points" (conservation of forest carbon stocks, carbon stock enhancement and sustainable management of forests) of REDD+, even more environmental benefits are possible (Harvey et al. 2010a). However, the definitions and the way of application of these additional activities can also result in problems for biodiversity conservation.

Conservation of forest carbon stocks

The addition "conservation of forest carbon stocks" can lead to the protection of areas which are currently not threatened and thereby keep the ecosystems intact. Furthermore, this provides additional funding for conservation activities (Harvey et al. 2010a). However, since the goal of this "plus-point" is the conservation of forest carbon stocks, there is a risk that the forests will be seen only as storage of carbon and not as whole ecosystems (Lang 2011).

Carbon stock enhancement of forests (reforestation and afforestation)

At first sight increasing the forest expanse via re- or afforestation seems to have several positive effects for climate change mitigation but also biodiversity conservation. However, the success of such measures strongly depends on the location and way they are implemented. Afforestation can change the whole ecosystem and if done in areas with high biodiversity, positive effects might be rare (SCBD and UNEP Issue Paper No. 5). Negative implications will also be the result, if re- and/or afforestation are done with fast growing and/or exotic monocultures, like in plantations.

However, if undertaken on degraded land or in ecosystems with mainly exotic species, reforestation measures with native species can provide several benefits for biodiversity and mitigation. If they are performed well with a mix of native species, it can result in a permanent, semi-natural forest (SCBD 2010; SCBD 2011), in which up to 80% of the original biodiversity can be regained within 50 years (Dent and Wright 2009). Afforestation and reforestation can also increase the connectivity through new corridors (SCBD and UNEP Issue Paper No. 5). Furthermore, it might reduce the pressure on natural primary forests by supplying timber and other forest products as alternative source (SCBD 2009). Prior to re- and afforestation activities, the location has to be selected cautiously and countries should further investigate the implications of possible invasive species before they are planted (SCBD 2010).

Despite the potential positive effect for biodiversity conservation, if conducted well, a recent study showed that afforestation activities might not lead to the highly expected mitigation effects. In contrast, it may even lead to a net climate-warming because of the higher absorption of incoming solar radiation (Arora and Montenegro 2011). These new findings bear the risk of reducing the incentives for further afforestation but also reforestation efforts and thereby the conservation effect for biodiversity.

Sustainable management of forests (SMF)

Forests under sustainable management can sequester more carbon and host more biodiversity than conventionally logged forests (Imai et al. 2009).

However, if SMF is done in intact primary forests, higher emissions and biodiversity loss can be the result (SCBD 2009).

In the context of REDD+ the inclusion of SMF as eligible mechanism for compensation payments can also lead to misuse of this concept. Logging and plantation industries might sell their activities as “sustainable management of forests” and “enhancement of carbon stock”.

In order to avoid potential negative implications of the plus-points they need to be defined precisely (Huettner 2010). Stringent concepts, well defined criteria and measurable indicators are needed (Pistorius et al. 2010).

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Managing procedures and permanent storage of carbon

Although a REDD+ mechanism can successfully be adopted, the long-term success cannot be guaranteed, if managing procedures fail to be effective.

If the forests are, for instance, not adequately monitored, logging and wildlife poaching might continue, as it is the case in many protected areas (Huettner 2010). Hence, effective monitoring mechanisms have to be established that do not fail to detect and thereupon avoid these activities.

Furthermore, the management should not only focus on the carbon, but also on other forest products, like fruits, wildlife or fungi, in order to enable the forest to continue providing these goods (SCBD 2011).

If not adequately organized, mayor proportions of the money might not reach the conservation initiatives on the ground but be spent for infrastructural and transaction costs.

Especially small-scale REDD+ projects could face this risk because they provide relatively low revenues from carbon credits (Huettner 2010). This can have severe consequences for the biodiversity aspect under REDD+ as in small areas there can be valuable ecosystems with endemic species. They might in the end not be protected because the area is just too small to be cost-competitive.

Changes in the project management or loss of its effectiveness can also jeopardize the permanent storage of carbon and thereby the protection of biodiversity (Angelsen 2008). Besides natural risks, which always threaten forests (e.g. forest fires, droughts), there is furthermore the risk that REDD+ areas will not be protected permanently. Due to, for instance, higher prices for forest products, biofuels or an increase in the demand for space (Huettner 2010), opportunity costs are likely to change over time (Angelsen 2008). Moreover, changes in the government that cause the reversal of any commitment can endanger the success of permanent carbon sequestration in tropical forest (Angelsen 2008).

Consequently, a first arising benefit for biodiversity could also vanish after time. The REDD+ mechanism has to provide enough incentives for the long-term protection. Additionally, instruments have to be installed that guarantee a successful management (Angelsen 2008). However, if efforts are only channelled to the storage capacity and not to the conservation of biodiversity, the aimed permanent storage is at risk as forests with reduced biodiversity can become instable and less resilient (SCBD 2011).

Financial aspect

Different options for the financing of REDD+ projects are currently discussed:

- Voluntary carbon market
- Market based
- Fund
- Hybrid

Each option has different implications for the conservation of biodiversity. They are presented in the following part.

Voluntary market

One option is funding via an existing voluntary carbon market, which is mainly supported by socially responsible individuals, corporations, and cities. They are already financing REDD+ like projects in forested developing countries (Phelps et al. 2011). However, this approach is regarded to be not sufficient enough to provide co-benefits, such as biodiversity conservation, on a global scale (SCBD and giz 2011).

Market based

The biggest advantage of a market based approach, such as linking the REDD+ funding to the international emission trading scheme (Loft 2009), is the assurance of demand. Annex I countries could be obliged to compensate part of their emissions by purchasing carbon certificates from REDD+ projects (Phelps et al. 2011). However, since REDD+ is often considered as a “bridge” strategy until new low carbon technologies are developed, the market might only be sustained as long as there is not a more economically efficient way of reducing emissions (Phelps et al. 2011). Moreover, REDD+ is a rather inexpensive way to avoid emissions compared to for instance industrial energy efficiency. That is why many fear an excess of certificates. This will result in a lower price and consequently less incentive to reduce emissions from fossil fuel use. It would be possible to counteract this development with an increase in the overall demand for emission certificates. This could be achieved via higher reduction commitments of the industrialized countries. Another option could be setting a cap of tradable REDD-certificates (Loft 2009).

Especially for the co-benefits such as biodiversity conservation, the marked-based approach bears a risk because no regulation takes place. The forests might be valued only for their carbon price, neglecting other ecosystem services. Buyers of carbon credits will purchase the cheapest ones, whether it comes from a biodiversity rich or poor forest (Grainger et al. 2009). Consequently, co-benefits cannot be guaranteed under a marked-based funding for REDD+.

Fund

Another option is that industrialized countries, the private sector and NGOs pay into a new international fund for REDD+. This money could then be used as compensation for countries that reduce emissions from deforestation verifiably (Loft 2009). This way of funding has already started. A readiness-fund was created from which first project preparations and pilot programmes in forested developing countries are financed (Phelps et al. 2011).

An advantage of the fund over the market-based approach is the possibility of more regulation and thereby a higher guarantee for environmental and social co-benefits.

Specific activities (at national, regional or local scale) and conditions could be prerequisite for multi-lateral and bi-lateral REDD+ funding. Payment could not only be linked to carbon storage but also to co-benefits (Paoli et al. 2010). A second financing mechanism with extra credits for activities that provide biodiversity co-benefits additional to the emission reductions could be developed (Bekessy and Wintle 2008). Another idea is to prioritize forests with higher biodiversity values among those with similar carbon stocks by incorporating a biodiversity premium into the REDD+ mechanism (Strassburg et al. 2009; Busch et al. 2011)

A big advantage of the fund would be that the emission reductions from deforestation and forest degradation would be additional to those from fossil fuel use (Loft 2009). This may lead to a weaker climate change what in the end is positive for the biodiversity as well. However, there are also drawbacks of this financing approach. REDD+ efforts would fully be dependent on the sponsor's willingness to pay. There is no guarantee for a voluntary long-term funding and this uncertainty aspect can hamper the readiness and implementation of projects (Loft 2009; Phelps et al. 2011). Conservation projects, though, require such a certain, long-term and stable funding in order to be successful. So the question here is, if the investment horizon corresponds to the lifespan of, for instance, protected areas or long living organisms. In order to overcome risks of non-permanent funding, the UNFCCC should create binding structures that help to ensure payments of Annex I countries for a REDD+ fund (Phelps et al. 2011).

Hybrid

Most proposals to the UNFCCC about REDD+ support a hybrid financing structure (Parker et al. 2009). This combines the advantages of the market-based and fund approaches while trying to avoid the drawbacks: A restricted connection to the international carbon market or creation of a new unit (e.g. a new forest-carbon certificate) for the assurance of financing and an additional fund-like allocation mechanism. Industrial countries would be obliged to offset part of their emissions by purchasing these, possibly new, certificates (Loft 2009).

For the aspect of biodiversity conservation this approach might likely be the most successful one.

Further recommendations for the national level to increase possible environmental co-benefits

There are several suggestions for the national level that can promote biodiversity co-benefits and that can help making REDD+ more successful.

- Countries should prepare national targets for ecosystem and species protection across the full range of native ecosystem types and biogeographic sub-regions. Already existing ones (e.g. under the Convention on Biological Diversity (CBD)) should be re-evaluated (Paoli et al. 2010; Pistorius et al. 2010).
- Gap analyses should be conducted to determine currently under-represented ecosystems in the protected area network that might be eligible for REDD+ or possible corridors. (Paoli et al. 2010; Pistorius et al. 2010). Thereby, REDD+ can gain from the available gap-analyses used for the national CBD targets (see Table 4) (SCBD and giz 2011)
- Further investigations have to be promoted to detect forests with both, high carbon and biodiversity value (SCBD 2010).
- REDD+ project should be subject to national biodiversity-including environmental impact assessments (Grainger et al. 2009).
- Creation of criteria and indicators for the monitoring of national biodiversity co-benefits (SCBD 2010) and impacts of REDD+ in order to evaluate and potentially readjust the mechanism. The monitoring and reporting could be coupled to existing monitoring schemes for other international agreements, such as the CBD (Pistorius et al. 2010; SCBD 2010). Due to an expanded monitoring system the actual extent and conditions of world's forests and its inhabitants can be better estimated and evaluated (Harvey et al. 2010a).

Table 4: Links between CBD National Protected Area System Gap Analysis and REDD+ (SCBD and giz 2011)

REDD+ activity	Potential contribution of CBD national protected area gap analysis
Reducing emissions from deforestation	Identify priority areas of high biodiversity value and high risk
Conservation of forest carbon stock	Identify priority sites of new forest protected areas
Sustainable forest management	Identify areas for SFM and efforts to reduce degradation
Enhancement of carbon stocks: Restoration Reforestation Afforestation	Identify priority areas which could also serve as biological corridors (e.g. between protected areas) and provide blueprint for landscape level planning

Blue carbon under REDD+: A new chance for biodiversity?

Deforestation, degradation and land use changes are not limited to inland forests. Coastal and marine ecosystems, such as mangroves, tidal salt marches, kelp forests, sea grass meadows and coral reefs are also target of these activities (Laffoley and Grimsditch 2009). Human induced causes for the losses are for example the need for timber, the development of aquacultures, an expansion of coastal infrastructures or eutrophication due to inland activities (Laffoley and Grimsditch 2009; Grimsditch 2011). Since coastal and marine ecosystems store great amounts of carbon and in the case of mangroves sequestration is found to be even more efficient than in tropical forests (Laffoley and Grimsditch 2009), they should be considered for REDD+ activities. During the Climate Talks in June 2011 in Bonn, several countries (amongst others Papua New Guinea) pointed out the need for research and systematic observations of the so called "blue carbon" in these systems. Many countries have one or more of the above mentioned systems and therefore a potential incentive to promote their inclusion in a REDD+ or similar mechanism. First of all, however, investigations are needed in order to reduce uncertainties about the sequestration and storage capacities of the different systems. Not all mangroves, for instance, accumulate carbon (Alongi 2011).

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Besides the mitigation service that plays the major role in defining REDD+ areas, marine and coastal ecosystems provide numerous environ-mental and socio-economic benefits (e.g. nursery for fishes, coastal protection, food, etc.) (Laffoley and Grimsditch 2009; Yee 2010). Hence, from the biodiversity aspect under REDD+, the inclusion of marine and coastal eco-systems would provide huge chances for the conservation of species and their habitats. The hosted valuable biodiversity as well as the sequestered carbon is at risk, if human made destruction continues. Furthermore, as alternative sources for products and space, pressure on these systems might increase, if they are not incorporated into REDD+ or otherwise protected.

Case studies:
REDD readiness, demonstration and pre-REDD projects

In the following part case studies are used to evaluate the general performance of REDD+ and the impact on biodiversity conservation. This is done based on already implemented sub-national projects from two countries. These countries are from different deforestation / forest cover categories, as presented in Table . Bolivia, as the first example, falls into the category of high forest cover and high deforestation rates and therefore has high potentials for REDD credits. Mozambique, in contrast, has a lower forest cover and also lower deforestation rate resulting in a lower potential for REDD credits.

The analysis of the different case studies was constrained by two main factors. Firstly, there is a lack of a clear definition about what is an actual REDD+ project. Several different names are circulating in the discussions. Pre-REDD, REDD readiness, and REDD demonstration activities are thereby the most common ones. The specific differentiations are not always clear. The term pre-REDD, for instance, is sometimes used for initiatives that started before COP 13, 2007 in Bali, sometimes for those that were launched afterwards. The other constraint of the analysis is based on the use of mainly secondary information (internet, brochures, and project documents), which describe the outcomes of the initiatives. Since these descriptions are often made by project partners, who have an interest in the success of the project, they might not always reflect the real state of the project on the ground.

Emergence of REDD activities and the role of co-benefits

Already before the call for action in relation to REDD+ activities on the COP 13, 2007 in Bali, several sub-national projects with forest carbon sequestration as an objective were launched. Caplow et al. (2011) reviewed the evaluation literature of pre-REDD+ projects (before COP 13). They found only five of which final reports of the outcomes and impacts were available. Many of the initiatives that were stated to be pre-REDD projects either never got started or were terminated prior to substantial implementation. Some of the projects are, however, important to analyse as they are already in later stages of implementation than the more recent REDD+ activities (initiated after COP 13, 2007 in Bali), or even have already finished. Thereby, they can provide first insights into the experiences about what can go wrong and where capacity is likely lacking.

Caplow et al. (2011) state that in the evaluation process non-carbon impacts were rarely measured. None of the assessment reports collected data about the impacts on biodiversity, water, or other ecosystem services. Biodiversity benefits were sometimes just taken for granted because of the assumption that greater forest extent preserves more biodiversity.

Since COP 13, 2007 in Bali, a wave of new emerging REDD+ activities has been launched. Many of them are still in the planning process. Harvey et al. (2010b) made an evaluation of 12 different pilot forest carbon initiatives, five of them being REDD+ initiatives at the sub-national level, the remaining were reforestation projects. Some have started before, some after COP 13, 2007 in Bali. Most of the analyzed projects were still in the design phase or had small pilot activities, while only one was already in the implementation stage. Nonetheless, these sub-national initiatives could give already good insights into opportunities and challenges of possible future REDD+ projects at the national scale, also in relation to the biodiversity aspect.

According to Harvey et al. (2010b) all forest carbon initiatives have been designed in a way that also social and environmental co-benefits could be achieved, besides the preliminary target of emission reductions. This approach was stimulated by the many partners that are interested in biodiversity conservation or livelihood improvements of local communities. That is also why most of the forest carbon initiatives evolved out of pre-existing conservation or development activities and therefore they are located in areas of high biodiversity.

While the expertise of the project partners lied mostly in the biodiversity conservation sector, capacity for the technical carbon tasks (e.g. carbon accounting, biomass measurements etc.), legal issues and stakeholder involvement was lacking (Harvey et al. 2010b). The success of these initiatives and follow-up REDD+ projects might be threatened, if no additional training is provided to fill the gaps of these missing expertises. As a result, also co-benefits could be at stake.

The anticipated environmental benefits of the 12 different projects analyzed by Harvey et al. (Harvey et al. 2010b) include support for ecosystem services, biodiversity hotspots and flagship-species. These as well as the social benefits played a major role in facilitating effective partnerships. Many of the partners stated to have a big interest in delivering high levels of co-benefits. Also the governments were specifically interested in that. They supported the projects because they could be integrated into their existing conservation policies. Similarly, effective fundraising was strongly supported by the inclusion of multiple benefits in the design plans, with biodiversity being the most attractive one. Donors and carbon investors were often also attracted by specific anticipated benefits. A water company, for instance, was particularly interested in the protection of the water resources (Harvey et al. 2010b).

Case Study I
Noel Kempff Mercado Climate Action Project (NKCAP) in Bolivia

Project description

The Noel Kempff Mercado Climate Action Project (NKCAP) in Bolivia is according to Caplow et al. (2011) one of the best known and said to be the first REDD+ project.

It was already established in 1996 by The Nature Conservancy (TNC), the Bolivian conservation organization Fundación Amigos de la Naturaleza (FAN) and the Bolivian Government (TNC 2009) and was developed under the UNFCCC Activities Implemented Jointly Pilot Phase. The project is planned to last for 30 years and falls into the category "forest preservation activity".

The main components of the initiative are (UNFCCC 2001; SGS 2005; TNC 2009):

- Expanding the existing Noel Kempff National Park by approximately 70% to the northeast, because this adjacent land was threatened by deforestation
- Cessation of legal and illegal logging activities by using the project funds to compensate three forest concessionaires for giving up their logging rights on government-owned forest lands
- Avoidance of deforestation leakage and long-term protection and regeneration of the Park and the expansion area
- Design of a sustainable development programme for the indigenous communities that live adjacent to the project area

Funding came from three energy companies: America Electric power Company (AEP), BP America and PacifiCorp. 51% of the future certified offsets were guaranteed to them and 49% to the Bolivian Government (TNC 2009). The Government presented beforehand how their revenues are planned to be allocated. 31% were supposed to be used for the protection of the park, 10% for a national system of protected areas and 59% for other purposes. These include biodiversity protection activities (inside and outside the park), improving the livelihood of the indigenous communities adjacent to the park, and supporting other GHG mitigation strategies in Bolivia. However, until 2009 the specific allocation of these 59% was not negotiated (TNC 2009).

Project implementation and performance

The Nature Conservancy (TNC), one of the NKCAP participants, describes the project as a "proof of concept" of forest carbon offset (Caplow et al. 2011): "NKCAP serves as an example of how well-designed REDD projects can result in real, scientifically measurable, and verified emissions reductions with important benefits for biodiversity and local communities" (TNC 2009). Over the years 1997-2005 371,650 tCO_2e emissions from an area of 763 ha have been avoided by reducing deforestation and 791,443 tCO_2e from an area of 468,474 ha because of avoided forest degradation. Consequently, the project is said to have generated a total carbon benefit of 1,034,107 tCO_2e over the 1997-2005 verification period (TNC 2009).

While the NKCAP is praised by The Nature Conservancy, it is strongly criticized by Greenpeace International as a "carbon scam" (Densham et al. 2009). Roman Czebiniak, a co-author of the assessment report, claimed that the results of this report show that sub-national carbon offset projects cannot result in reliable carbon emission reductions (Lang 2009).

Since the NKCAP was one of the first projects aiming to reduce emissions from deforestation, there were no real precedents from which the project could learn. New institutional, scientific and legal methods had to be created. It was, for instance, needed to develop the methodologies for calculating the baselines for the emission reductions of both,

deforestation and degradation. Thereby, the experiences gained show the importance of approaches that rely on field testing, satellite data and site-specific information in the calculations for the baselines rather than using surveys and proxy data from other countries/regions (TNC 2009).
Similarly, the validation and verification process had to face several obstacles because the NKCAP was one of the first carbon offset projects. The assessment was executed for 1997-2005 by the Société Générale de Surveillance (SGS), the world's largest auditor of carbon offset projects (Densham et al. 2009).
Since there were no specifications for carbon project design or validation at the start of the project in 1996, it was not possible to validate or verify NKCAP under a compliance regime. Therefore, in 2004-2005 the NKCAP underwent an ex-post validation and verification assessment for the voluntary market. Because there were no REDD voluntary or compliance standards, an own methodology was developed, based upon those described for the afforestation/reforestation projects of the Clean Development Mechanism under the Kyoto Protocol (TNC 2009).
Tested were particularly the project's additionality, baselines, potential leakage, monitoring plan, environmental and social impacts against the relevant UNFCCC and Kyoto Protocol requirements, host country criteria and the guiding principles of completeness, consistency, accuracy, transparency and scientific appropriateness (SGS 2005; TNC 2009).
According to The Nature Conservancy (2009) the additionality aspect was met: The project was not required by Bolivian law and the expansion of the park was not planned. Furthermore, the Government of Bolivia did not have the financial matters nor the political will to cease forest concessions and logging would have continued, if the project had not been created. Instead, Densham et al. (2009) from Greenpeace International argue that because of a new law in Bolivia from 1996, the additionality requirement was not met. This forestry law changed the economics of logging, leading to a 75% reduction in the area of land under concession. Consequently, emission reductions would have happened regardless of the NKCAP. Still, it might be likely that some logging would have continued also under the new forest law (Robertson and Wunder 2005). It can be argued therefore that the project still was relevant because even more deforestation reduction took place than only under the new forest law.


Photo credit: Private

No huge deforestation leakages were expected because of, amongst others, the installation of an indigenous ancestral territory for border communities ("Tierras Comunitarias de Origen" TCO), which includes also property rights (TNC 2009). The leakage estimate was set accordingly to 15%. However, this estimate might be far too low as Densham et al. (2009) claim, based on a report from 2002 of Winrock International. They state that the NKCAP leakage could be 42-60% high. Furthermore, leakage is only monitored and measured in a 15km buffer zone westerly to the NKCAP, ignoring the possible impacts on and leakage to other parts in the country.
Permanence of the carbon storage is said to be safeguarded by the legal financial and institutional means. The protected area is incorporated in a binding legal document. Furthermore, since 49% of the revenues are assigned to the Bolivian Government, it has a financial interest in the success and permanence of the project. The risk of fires is included via a 5% deduction from the estimated carbon benefits (TNC 2009). This might not be enough, also because other natural risks (e.g. pests, droughts etc.) are not included.

Permanence can simply not be guaranteed. If part of the forest will be destroyed and the investors already used the project to offset their own emissions, the resulting release of CO_2 into the atmosphere will be double (Densham et al. 2009).
The first assessments of SGS concluded that several improvements have to be made. Amongst others it was asked for the development of an action plan in order to meet the needs of the local communities. It was also detected that the hunting of fauna was not ceased (SGS 2005). Thereupon, the FAN conducted a socioeconomic impact assessment and established a development community action programme. The validation and verification process showed that the for the success needed national and local governmental capacities are often lacking (TNC 2009).
Nevertheless, in 2005 the NKCAP was validated and verified by the SGS. It was the first verified project by a third party auditor. However, future verifications are not guaranteed. Important points in the developed community plan are still not achieved (in 2009). Additionally, in 2009 the SGS was suspended by the UN because of its incapability of properly inspecting the projects it was accrediting (Densham et al. 2009).

Biodiversity benefits
The national park and the expansion area have, according to The Nature Conservancy (2009), one of the highest biodiversity in the neotropics. The project is therefore said to be designed in a way that also positive impacts on biodiversity and habitats in the project area are provided. It was assumed that especially rare and diverse species and ecosystems will benefit because of the expansion of the protected area from originally 889,446 ha to 1,523,446 ha under the NKCAP. It was furthermore expected that there will be a significant increase in the populations of aquatic and marsh fauna due to the protection of additional marshlands and lagoons in the expansion area. To detect changes in biodiversity and species composition, key species were monitored in the park (TNC 2009).
In the evaluation report of The Nature Conservancy (2009) it is stated that migration of fauna between the original park and the expansion area resulted in a significant dispersion of the flora. Furthermore, benefits for threatened species like the Brazilian
tapir and the jaguar are described, which are said to be based on the doubled habitat.
However, smaller land-uses are taking place in the expansion area because the grade of excess of local communities to the resources of the park is still ambiguous.
Consequently, hunting and fishing still occurs as the rules of the Park Management Plan are too unclear and open to interpretations (Asquith et al. 2002).
According to Robertson and Wunder (2005) it is just not possible to make definite conclusions about the impacts of the NKCAP on biodiversity and ecosystems. The reason is simply the lack of data about the migration of species and the effects of community activities.

Case Study II

Sofala Community Carbon Project (SCCP) (formerly N'Hambita Pilot Project) in Mozambique

Project description

The Sofala Community Carbon Project (SCCP), a follow up of the N'Hambita Pilot Project (2003-2008), is located in the buffer zone of the Gorongosa National Park in the Sofala province in Mozambique. In the research pilot period from 2003-2008 it was financed by the European Commission from its environment budget line (Marzoli and Del Lungo 2009). After this pilot implementation period, the activities in the project area continued and even expanded to an adjacent community. It is currently financed partly by the revenues of the carbon offsets and partly by Envirotrade UK (Marzoli and Del Lungo 2009).The goal is to be fully financed via carbon offset sales (Envirotrade 2009).
The project was developed by Envirotrade, which was also responsible for developing the market of carbon certificate buyers. Purchasers are mainly organisations or individuals from Europe and North America (UoE 2008a). Partner of Envirotrade was the University of Edinburgh's (UoE) School of GeoScience (Marzoli and Del Lungo 2009).

The main forest type in the project area is miombo woodland. Although the carbon stocks in woodland savannas are much lower than in rainforests, biomass and productivity are still considered to be significant in relation to the global climate system. Furthermore, these systems are disappearing and being degraded as well.
Woodland savannas can be biodiversity hotspots (UoE 2008a). The miombo ecosystem contains 8,500 species of plants of which 54% are endemic to that region (Campbell 1996) and about one thousand animal species, especially a distinctive avifauna. Many of the species are rare or endangered (Envirotrade 2009). The miombo ecosystem in the Gorongosa District is under threat because of increased demand for land for subsistence agriculture and commercial charcoal production (UoE 2008a). The usual way of expanding agricultural land in the region is via slash-and-burn (Marzoli and Del Lungo 2009). Furthermore, logging activities and wild fires are drivers of miombo degradation and deforestation (Envirotrade 2009).

The main objective of the project was to alleviate poverty using climate change related market based mechanisms. Therefore, sustainable land use and rural activities should be developed. It was aimed to reduce deforestation, conserve the forest and promote carbon sequestration via re- and afforestation activities. Communities or single households are paid, if they sign one or more contracts to adopt some of the proposed measures and reduce deforestation of the miombo woodland. They are expected to gain further from new emerging micro-enterprises, such as beekeeping.
It is assumed that the pressure on the Gorongosa National Park will decrease and biodiversity conservation is thereby an expected additional outcome (UoE 2008a). Several activities are developed to protect the miombo woodland species, such as the preservation of corridors, reduction of hunting, decrease of fragmentation, planting of indigenous trees, but also the protection of special areas with high biodiversity and biomass value like Riverine forest areas (Envirotrade 2009).
With the protection of the miombo woodlands and reforestation activities, the livelihoods of the communities can be sustained. This is especially important for the poorest, who are stated to be highly dependent on the ecosystem (Envirotrade 2009).

The main components of the SCCP project are (Kooistra and Wolf 2006; UoE 2008a; Envirotrade 2009; Marzoli and Del Lungo 2009)

- Promotion of sustainable land use to provide socio-economic and environmental benefits. The practices include:

- Reduce deforestation and adopt sustainable land management activities (e.g. restoration and reforestation of degraded areas, sustainable timber utilisation, and agroforestry, such as planting of fruit trees, N-fixing trees and setting up woodlots)
- Generate sustainable livelihoods via diversification of agriculture, soil improvement, employment generation and use and sale of forest products.
- Conserve biodiversity via restoring and protecting (e.g. through reduction of forest fires via forming a fire protection team) natural ecosystems and save species from extinction.
- Furthermore, reduce forest fires via forming a fire protection team.

• Research into the regional potential for carbon sequestration generated through these activities via biomass surveys, regional deforestation baselines, and carbon modelling.
• Capacity building to enable the verification of carbon offsets via carbon verification, trust fund administration, and land management planning support.

Project implementation and performance
The first evaluations address the pilot project and are mainly very positive about the structure itself and its outcomes. Kooistra and Wolf (2006), for instance, state that the project is of high relevance and quality, amongst others because of the provided benefits for rural communities and biodiversity conservation. All three project components are said to show encouraging first outcomes after the first years of implementation.
In contrast, delegates from the European Commission (consultants from the AGRECO Consortium) (Marzoli and Del Lungo 2009) found some positive but also negative aspects in their evaluation process. While, for instance, the agroforestry, socio-economic impacts and fire control is stated to have positively developed, the forest inventory and biomass estimates were not accomplished sufficiently. Consequently, the unsystematic inventory caused problems in the implementation of a satisfying forest management and the establishment of carbon baselines. Thereby assessments of potential carbon offsets were problematic. The annual deforestation rate, for instance, was estimated to be 2.4% of the forest extent. It was used for establishing the baseline for land cover changes. With this high rate the forest cover in the area would disappear within approximately 40 years (Marzoli and Del Lungo 2009). Marzoli and Del Lungo (2009) argue that the used simple assumption of a stable rate of land cover changes in the future is not likely to occur. For the calculation of the carbon offsets, which are currently based on an assumed decrease in the deforestation rate by 75%, they propose a more concrete calculation. However, since the end of the civil war in 1994, the area is subject to a high population increase. Thereby, the demand for land and forest products is rising as well. That is why a future high deforestation and degradation rate might be likely.

Within the sustainable land use part of the project, reforestation activities, for instance via agroforestry, and forest fire management were the main measures. According to Niles (2008) these were also the most successful components. One big advantage of the Sofala project over other forest carbon projects is supposed to be the diverse offer of agroforestry activities. The farmers are not prescribed to adopt one specific system but they can choose out of a menu and pick those practices that suit them the most. Among the proposed activities, boundary plantation was the most preferred option (UoE 2008b).


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The permanent storage of the carbon is still a main concern because of various project characteristics and general risks. The new planted trees, for instance, are still young and thereby prone to forest fires. The risks for fires, hence, remains (Kooistra and Wolf 2006) and a successful fire management is crucial.

The carbon payments for the farmers last only 7 years. After that it is expected that the new planted trees provide enough incentives (i.e. revenues from selling non timber forest products, higher productivities because of improved soil quality etc.) to continue with the protection of these trees for the coming years (UoE 2008b). If this is the case or if the incentives to start again with the slash-and-burn system are higher, remains to be seen.

Furthermore, an enduring peace in the area cannot be guaranteed as political instability is always possible. Changing political structures might threaten the success and permanence of the project (Niles 2008).

Another key issue is the charcoal industry in the Miombo woodlands, which increases the deforestation rates around the national park (Niles 2008) and thereby might influence the stability of the protected forest within the project. Approaches to a more sustainable and controlled charcoal production would enhance the overall project success (Kooistra and Wolf 2006).

Another characteristic of the area is the increase in number of households. Since the end of the civil war in 1994, former residents that had been replaced are returning. Thereby, the need for land for agriculture and the use of forest products has increased. This leads to leakage of carbon to the atmosphere which had been sequestered at another place due to the project activities beforehand. New or former inhabitants also have to be encouraged to sign project contracts in order to avoid these carbon leakages (UoE 2008b).

Finally, the permanent storage of carbon is jeopardized by future climate changes. Especially a decrease of the precipitation poses a risk to the project by increasing the chance of forest fires and reducing the overall growth rate (UoE 2008b). The area is also often subject to floods caused by high rainfall and excessive runoff (Envirotrade 2009).

Biodiversity and social benefits

According to Niles (2008), the project has clear biodiversity benefits. Several activities like the planting of new native trees and fruit trees or the prevention of forest fires help to maintain the high biodiversity levels in the project area.

Also Caplow et al. (2011), who investigated the evaluation process of different forest carbon projects, stated that in the N'Hambita pilot initiative more attention was given to co-benefits than, for instance, in the NKCAP.

However, in the final report of the UoE (UoE 2008b), Rohit Jindal from the Michigan State University assesses the environmental impact based only on the net-change in carbon sequestration. This approach might be too imprecise to detect changes in the complex ecosystems and its biodiversity. Also Brown et al. (2008) criticize the insufficient forest

inventory, including the detection of biodiversity loss and suggest a repetition of the whole inventory.
In the final evaluation report of the University of Edinburgh (2008b), partner of the project, it was stated that a thickening-up of the vegetation has been observed. It could, however, not be assured that this change was only due to the project or due to preceding conservation activities in the National Park.
The social targets of the project are said to be very well achieved. The locals were not only successfully integrated in the process but the whole area experienced huge development improvements. (Kooistra and Wolf 2006; Niles 2008) This has also led to an increase in the awareness of the local communities about the importance of forest resource protection (Marzoli and Del Lungo 2009).

In 2009 Envirotrade intended to validate the climate benefits of the Sofala Community Carbon Project according to the Climate, Community and Biodiversity (CCB) Standard of the Climate, Community and Biodiversity Alliance (CCBA).
The above mentioned deficits of the project seem to have been diminished as in 2010 this goal was achieved and the project was validated by Rainforest Alliance for the second edition of the CCBA standard at the Gold level in all three evaluation areas of climate, community and biodiversity. The Sofala Community Carbon Project is apparently the first one with “exceptional benefits” and the achievement of “CCBA triple Gold” status (Rainforest Alliance 2010). Therefore, it can act as a good practice example for all up-coming and already existing forest carbon projects.

Lessons learned from the case studies

The experiences from the N'Hambita pilot project show that during the first phase of the project problems that are expensive in both, time and money are likely to emerge. This initial phase may therefore even last a few years (UoE 2008b). That is also why the duration of projects related to avoided deforestation, degradation and carbon sequestration should be planned for a minimum period of 5 years for the development and implementation (Marzoli and Del Lungo 2009).

The outcomes of the N'Hambita pilot project suggest furthermore that regarding the economical revenues as well as the protection of the climate system, avoiding deforestation provides more benefits than afforestation activities such as agroforestry. These should be applied, however, as an important complementary part of the project (UoE 2008b). An offer of multiple activities that locals can adopt can result in substantial participation and support by the communities and inclusion in the whole project process as it is the case in the SCCP. Thereby, not only the climate and biodiversity aspects are likely to be more successful, but it can also help to alleviate poverty.

According to Caplow et al. (2011), who made a review of evaluation literature about forest carbon projects, measuring biodiversity outcomes still has to improve substantially in the evaluation processes of the activities. This would also provide the opportunity to incorporate local people to a greater extent into the project processes. They could support the monitoring and data collections on the ground.

While in the SCCP, as a follow-up of the N'Hambita pilot project, biodiversity conservation activities are a main part of the project design, environmental benefits are rather an assumed additional outcome in the planning of the NKCAP. The Sofala project could proof its ambitions about this aspect as it was just recently validated according to the CCBA standard at Gold level.

The analysis further made clear, that environmental co-benefits of forest carbon projects do not only help in sustaining the resilience of the forest and thereby the permanent storage of carbon, but they also play a significant role in starting the whole REDD+ project and achieve substantial support from partners, governments and carbon investors. Buyers are especially attracted, if the carbon sales are linked to other ecosystem services (UoE 2008b).

A key challenge of all already existing forest carbon projects on the sub-national level will be the integration into the potentially emerging, on national-level operating mechanisms for reducing emissions from deforestation and forest degradation (Niles 2008).

Conclusions and main messages

It is crucial to recognize that REDD+ alone cannot address the problem of biodiversity loss in tropical forests. The mechanism is preliminary designed for mitigation benefits. Therefore, cooperation with other international agreements, such as the CBD, should improve (Grainger et al. 2009) and the protected area networks have to be expanded (Busch et al. 2011).
Multiple gains could be achieved and many risks avoided by addressing the challenges for climate change mitigation and biodiversity conservation combined and not separately (Strassburg et al. 2010). However, changing the UNFCCC texts and explicitly direct REDD+ efforts to high-biodiversity forests might complicate and hamper the current discussions of REDD+ even more and in the end impede the whole mechanism of being implemented. Similarly, additional rules, requirements and restrictions could prevent countries to participate. This might in the end lead to even less conservation than under a REDD+ which is not directly linked to the co-benefits or which will not be implemented at all (Busch et al. 2011).
However, the permanent storage of carbon highly depends on the resilience of the forest itself. This again can only be guaranteed with a stable and well functioning ecosystem of which biodiversity is the basis (SCBD 2010). Therefore biodiversity should not only be seen as a nice co-benefit but as a crucial part to the success of REDD+ (Grainger et al. 2009). Therefore, the knowledge about the complex spatial and temporal relationships between carbon stock, biodiversity and ecosystem services has to improve and it should also be communicated to the REDD+ actors in the developing countries. This can assist countries in the decision-making process of where REDD+ should be prioritized (UN-REDD Programme 2009). The involvement of local communities and indigenous people in general will help to promote biodiversity conservation as they are the ones, who depend on a well functioning forest (SCBD and giz 2011). Capacity-building and improvements of forest governance is therefore crucial (SCBD 2010; SCBD and giz 2011), additionally to awareness-raising efforts about the linkages between climate change adaptation/mitigation and positive or negative effects on biodiversity (SCBD 2010). This aspect should generally get more focus in the discussions as Grainger et al. (2009) argue. They call for the inclusion of the impacts of mitigation options, such as REDD+, on ecosystems also in future IPCC reports.

The analyzed case studies reveal that there are still crucial lacks in the methodological capacity. The biomass estimates and forest inventories, for instance, were main problems in the project design and implementation. These aspects, however, are decisive for the establishment of reference levels or baselines. Further critical points are always the possible leakage and permanent storage of the carbon. Also the co-benefits should get more attention. The case studies show that this can attract investors and generate more support for the whole project.
Finally, the drivers of deforestation and degradation still have to be taken into account, such as the increase in demand for agricultural land as it is the case in the Sofala project. This conflict between the needs of the communities and the climate aspects of the projects has to be treated cautiously.
The whole REDD mechanism is still in the learning phase, in which the outcomes of pre-REDD or pilot REDD projects provide invaluable insights into potential challenges and possible solutions.


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Contact:
Climate Service Center
Chilehaus, Entrance B
Fischertwiete 1
20095 Hamburg
Germany

Phone +49(0)40-226 338-424
Fax +49(0)40-226 338-163

www.climate-service-center.de

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