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Pitfalls and opportunities for mutually addressing climate change and biodiversity conservation

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The idea for this study evolved over the course of a scientific project targeting the development of approaches for selecting, financing and implementing a global network of protected areas under the CBD. This project was conducted by the *Institute of Forest and Environmental Policy* at the University of Freiburg and was accompanied by a group of experts with scientific, political and NGO backgrounds. Towards the end of the project, *Greenpeace International,* a member of this project advisory group, asked the IFP to work on a short subsequent study to address further questions that have evolved.

The purpose of this study is to contribute to the discussion regarding the integration of biodiversity conservation aspects into the cross-cutting issue of reducing emissions from deforestation and forest degradation in developing countries (REDD). At the forefront of discussions taking place at COP9 of the CBD, it became obvious that a new large-scale REDD financing mechanism, such as that currently being negotiated under the UNFCCC, could provide tremendous chances for synergies between different environmental objectives and development goals. At the same time, the focus on one ecosystem service, namely carbon sequestration, bears considerable risks for perverse incentives regarding these objectives.

Deforestation is continuing at an alarming rate and creating tremendous environmental costs. Thus, there is an urgent need for international regimes under extreme time pressure to act and provide solutions to the interlinked environmental problems; this need for action leaves little time for detailed assessments. However, in order to make the most of the resources being directed into a new mechanism and not counteract other objectives, it is necessary to take all relevant objectives into account and provide solutions to the identified pitfalls.

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Executive Summary

Forests provide a variety of different ecosystem services (ES) which are in peril as a result of continuing deforestation and forest degradation. Due to the increasing awareness of politicians and society regarding the necessity of responding to global climate change, there is a high valuation of the function of forests to store significant amounts carbon and other greenhouse gases (GHG). Currently, approximately 20% of all anthropogenic GHG emissions (mainly carbon dioxide) are released as a result of deforestation and forest degradation, speeding up human-induced climate changes. At the same time, other vital ES provided by forest ecosystems are rapidly decreasing, e.g. the current rate of biodiversity loss is 100 to 1000 times faster than the natural rate and is expected to continue to increase due to changing climatic conditions. This creates a self-accelerating loop because genetic, species and habitat diversity are the main assets for adapting to climate change.

In order to cope with the problem of emissions resulting from forest depletion, the Parties to the United Nations Framework Convention on Climate Change (UNFCCC) are currently negotiating on a mechanism labelled ‘Reducing Emissions from Deforestation and Forest Degradation’ in developing countries (REDD). The idea of REDD is to provide positive, performance-based incentives to support developing countries in reducing their national deforestation rates. There are different views and proposals on a variety of still unresolved questions and aspects related to the REDD mechanism, e.g. regarding the scope, international and national distribution of funds and technical issues.

Most proposals focus on carbon as the target variable of REDD while potential positive effects on other environmental and development objectives are considered as ‘co-benefits’. The common belief is that any reduction of deforestation is generally also beneficial for biodiversity. However, focusing on the optimization of one ES (carbon storage) in multifunctional ecosystems bears considerable direct and indirect risks, particularly regarding the conservation of biodiversity. This study analyzes the risks resulting from REDD as it is presently discussed and elaborates on the requirements and options for addressing them in order to avoid risks and perverse incentives, and to optimize the synergies to the objective of conserving forest biodiversity.

In light of the time pressure until COP 15 in December 2009, it appears to be necessary to focus on the immediate risks for biodiversity evolving from REDD. In this context, probably the most urgent need from the conservation perspective is to develop a suitable and sound set of definitions applying to the scope of eligible REDD activities. The scope should widen in phases with regard to a broad availability of monitoring capacities. The Marrakech forest definition of the UNFCCC cannot be applied to REDD because it would allow for massive degradation resulting in significant biodiversity and carbon losses. Furthermore, it would also allow for the afforestation and reforestation of deforested areas with industrial monoculture plantations, serving mainly economically motivated production purposes and providing few ecological and other values. Therefore, REDD compensation payments should only refer to gross deforestation rates. In this context, it is proposed to distinguish between two types of forests subject to REDD – intact forests and all other modified natural forests (managed / degraded). Monoculture plantations should be excluded and reported as a separate land-use category under ‘other land uses’. Such a simple differentiation is a pragmatic approach and takes the rudimentary capacities which are currently available in developing countries for monitoring and reporting into account.

During a subsequent second phase, it is recommended to widen the scope to REDD+ and to allow countries that have successfully built the necessary capacities and implemented sound national REDD strategies to account for the ecological restoration of their degraded forests. Accordingly, the ‘+’ should only refer to the restoration of native forest ecosystems according to the ecosystem approach (ESA) of the Convention on Biological Diversity (CBD). Restored secondary forests offer a higher carbon sequestration potential and benefits to biodiversity as well as other ES. Additionally, they

contribute substantially more to climate change adaptation than monoculture forest plantations because they have a greater abundance of biodiversity as well as increased ecosystem resilience.

Since the quality of monitoring, reporting and verification (MRV) is a question of costs and available capacities, carbon stocks should be underestimated in order to offset errors and uncertainties. The application of conservative area-based monitoring and accounting of deforestation and forest degradation ensures the environmental integrity of REDD as long as pragmatic compromises have to be made regarding the uncertainties resulting from MRV. Carbon-stock based reporting remains an option for the future, e.g. for the proposed REDD+ phase, provided that the challenges regarding the MRV of all pools, including soils and all GHG can be resolved at an appropriate uncertainty level.

Another major risk inherent to REDD, especially regarding biodiversity, is international leakage, i.e., the displacement of deforestation or emissions. A precondition to reducing this risk is having a mechanism that facilitates participation by a range of countries and provides incentives to, countries with both, high and low deforestation rates. Most proposals thus far rely on measuring national performances against national reference rates, which are based on historic deforestation rates. This would leave little incentive for countries with large amounts of remaining forest cover to participate and would inadequately reward those who are already farther along in transitioning their forests. From the conservation perspective, it appears absolutely necessary:

- to develop clear guidelines for the determination of national reference rates,
- to include likely future deforestation rates, and
- to provide additional performance-based incentives for countries that succeed in significantly reducing their gross deforestation, respectively keep it at a very low level.

A possible solution builds on the market-linked TDERM approach developed by Greenpeace. It provides a sound approach for the generation of funds in Annex I countries as well as the necessary institutional structures. Concerning the international distribution of funds, it is proposed that the country performance (based on the individual reference level) should be compared to a tropical target baseline (TTB). The TTB is derived from the average gross deforestation rate of 62 tropical countries between 1990 and 2005 and decreases every 5 years by 25%. The comparison of individual performances in each commitment period to the TTB results in a SOFT-factor which reflects the country's 'state of forest transition' (SOFT). This factor influences the payments a country may get for its emission reductions: if a country succeeds in reducing or keeping domestic deforestation below the TTB it receives a performance-based premium on its compensation payments. In this manner REDD would provide strong incentives for countries with low levels of deforestation to participate in REDD and remain at such levels. Countries with a national performance exceeding the global average would receive a full compensation in the first period, but the SOFT-factor would gradually be reduced in successive periods. Since the TTB rapidly decreases, developing countries are also provided with an incentive to improve their MRV in order to be eligible for the described REDD+ activities.

Establishing new forest protected areas (FPA) and subsequently improving their effectiveness is cost efficient and offers multiple benefits for REDD activities. In order to promote these options and optimally use the arising synergies for mitigating emissions, it is proposed to use REDD funding to pay extra area-based premiums for establishing new FPA in high-priority areas and, as a further option, pay a lower premium for keeping areas free of degradation through ecologically responsible forest management, as outlined by the ESA. This recognizes the likelihood that not all countries will be able to successfully follow the ambitious pace of the TTB and, accordingly, allows these countries to also profit from the mechanism. The amount of any type of premium should be based on the average direct and indirect costs. Of course, strong environmental and social standards are a prerequisite for such additional payments, as well as sound MRV requirements. The same holds true for other activities in a future phase of REDD that target the ecological forest restoration of degraded forest areas.

Structure

1 Introduction

Direct and indirect anthropogenic activities often lead to significant, rapid and irreversible changes in ecosystems. According to the MILLENNIUM ECOSYSTEM ASSESSMENT (2005b), more than 60% of all ecosystems are already highly damaged, putting the various ecosystem services (ES) they provide at jeopardy. This especially concerns forest ecosystems, covering approximately 30% of the total global land area (FAO 2006). During the past 8000 years, about 46% of the original forest cover has disappeared, most of which was cleared during the last century (BRYANT *et al.* 1997). While a large share of the remaining total forest area in the northern hemisphere has been transformed into secondary forests, there has been a strong increase in developing countries in the number of industrial plantations on formerly primary forest areas. Today, there are only approximately 1.3 billion ha of primary forest left, accounting for 36.4% of the combined forest area from the reporting countries (FAO 2006).

Forest ecosystems directly contribute to the livelihoods of 90% of the more than 1.2 billion people living in extreme poverty and indirectly provide the basis for agriculture and subsequently the food supplies of nearly half the population in the developing world (SEGALL 2006; WORLDBANK 2004). They provide vital regulatory and other services at both the local and global levels, e.g. the prevention of soil erosion and the provision of biodiversity habitats[1] and hydrological functions, as well as a plethora of non-timber forest products like food and medication (Millennium Ecosystem Assessment 2005b). These ES are likely become even more important due to demographic developments, the increasing impacts of climate change and persistent problems to support the basic needs of the entire world population; more than one billion people already have insufficient access to clean water (UNEP/CBD/AHTEG/BD-CC-2/2/2).

Currently, the most widely discussed forest ES is the storage of carbon. Forests play an important role in the global carbon cycle and also in the efforts to mitigate climate change: Globally, forests ecosystems store approximately 638 GtC in biomass, soils and dead organic matter (FAO 2006)[2]. Estimations about the amount of emissions resulting from deforestation range from 17.3 to 25% of the total anthropogenic GHG emissions, with 20% being a commonly accepted dimension (IPCC 2007b; STERN 2007). Currently, forest destruction is particularly a problem in tropical countries, and to a lesser extent also in boreal and temperate regions. Between 1990 and 2005, tropical forests were converted to other land uses at an average rate of approximately 5% per decade, resulting in a loss of about 13 million ha of forest per year and an additional non-quantified area of degraded forests (FAO 2006; 2009). The total global net change of forest area is estimated to 7.3 million ha per year due to afforestation, reforestation and revegetation activities. What appears to be a partly compensation for the annual loss of forest cover (FAO 2006), disguises the fact that the conversion of primary forest land into monoculture plantations entails significant negative impacts on biodiversity, the carbon balance and other ES.

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[1] Forests harbor between 50 and 90% of all terrestrial species (REID & MILLER 1989).

[2] They account for 77% of all carbon fixed in terrestrial vegetation and forest soils contain roughly 39% of all carbon stored by all soils (IPCC 2007c).

As a result of global forest destruction and associated land use changes, the current rate of species extinction in all of the world's ecosystems is presently 100 to 1000 times the natural rate (MILLENNIUM ECOSYSTEM ASSESSMENT 2005b). This trend may speed up significantly; if the average global temperature increase by more than 2°C, twenty to thirty percent of all species will face an increased risk of extinction (IPCC 2007a). Furthermore, forest depletion reduces the livelihood options of many of the approximately 350 million forest and 60 million indigenous people who directly depend on forest ecosystems and causes the loss of cultural values and traditional knowledge (BORRINI-FEYERABEND *et al.* 2004; ELIASCH 2008; OVIEDO *et al.* 2000).

The processes depleting and destabilizing forest resources are driven by a number of regionally varying agents, drivers and underlying causes (FAO 2009; GEIST & LAMBIN 2001), but the majority of these causes can be attributed directly or indirectly to human activities, e.g. land-use changes and unsustainable resource extraction (CHOMITZ 2007; MILLENNIUM ECOSYSTEM ASSESSMENT 2005b). GEIST & LAMBIN (2001) identified proximate causes such as infrastructure extension, agricultural expansion and wood extraction that are intricately linked to demographic, economic, technological, policy and cultural factors. These factors often interact and are exacerbated through poor forest governance, characterized by illegal logging, corruption and land speculation (SEGALL 2006). An example is the allocation of forestry concessions to political allies and foreign corporations that seldom operate in a sustainable manner (GREENPEACE 2007).

According to the forest transition theory, deforestation follows a broad universal pattern which is independent from the national circumstances (Figure 1). First, relatively undisturbed forests that were formerly without infrastructure and market access are developed. This and other triggers initialize and then further accelerate deforestation processes (ANGELSEN 2007; GEIST & LAMBIN 2001); thus, a forest frontier is established. At a certain level, the stabilization of forest cover takes place, e.g. due to the absence of forest ES and a realization of the connected social and economic costs, leading to forest and agricultural mosaics. The last stage is characterized by reforestation with secondary forests and plantations. Deviations from this pattern may occur due to national or local circumstances (ANGELSEN 2007).

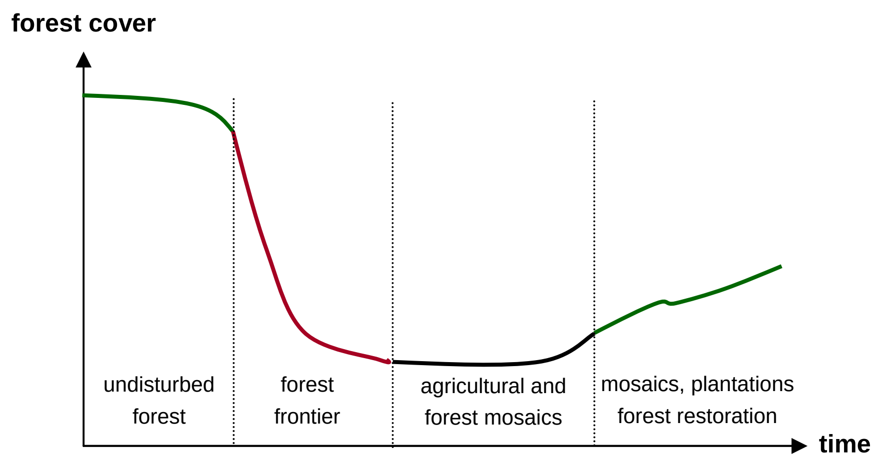

Fig. 1: Forest transition curve (adapted from (ANGELSEN 2007))

The forest transition theory describes how anthropogenic activities result in a deforestation pattern. Additionally, depending on their sensitivity and vulnerability, forest ecosystems are also increasingly being affected by changing environmental conditions induced by climate change, e.g. increasing biotic and abiotic calamities (KAPOS *et al.* 2007). Well-functioning forest ecosystems and genetic diversity are the main assets in the efforts to cope with climate change, particularly regarding adaption. Compared to today's focus on mitigation, adaption is likely to play an increasing role in the near future – especially due to the intricate link between the mitigation of GHG emissions from the biosphere and diverse and resilient ecosystems (IUFRO 2009; UNEP/CBD/AHTEG/BD-CC-2/2/2).

Economic aspects related to tropical deforestation

Why are forests being exploited and transformed, despite the knowledge about the many services and values they provide? From an economic perspective, natural resources, as with forest biodiversity and the atmosphere, have been treated thus far as 'public goods'. This is based on the (false) underlying assumption that they are available in infinite amounts and can therefore be 'consumed' at no charge. It leads to the depletion of natural resources that are vital for the well-being of mankind. Many unsustainable activities would not occur if the responsible actors had to internalize the external costs resulting from such activities (PIGOU 1932). Instead, tremendous economic losses caused by the unsustainable use of ecosystems are transferred to society as a whole and to future generations (ELIASCH 2008; SUKHDEV 2008). DALES (1968) realized four decades ago that "if economic growth […] is to continue, and yet pollution is to be checked, the cost of disposing wastes must rise." Despite efforts at different levels to correct such market failures, e.g. though the introduction of regional and national payment schemes for ecosystem services (PES), most economic activities still do not take the costs arising from the depletion and overuse of natural goods and services into account (STERN 2007; UNEP 2004).

A precondition of and a main hurdle for correcting the market failures leading to the loss of ES is an internalization of the arising costs, requiring a valuation of nature and its ES (SUKHDEV 2008). However, although the significance and economic value of the vital ES provided by forests become increasingly evident through the costs arising from their absence, e.g. after flood events, it remains a challenge to attribute a reasonable price to ES. The results of such valuation exercises highly depend on the approach used and tend to vary greatly, as shown in the following. Consequently, such approaches and their results have provoked a long discussion between experts and politicians on whether they adequately meet the goal of determining the value of the biosphere. A calculation based on an extensive literature review estimates that the value for the entire global biosphere ranges from US$ 16 to 54 trillion per year (COSTANZA 2000; COSTANZA *et al.* 1997). However, as acknowledged by the corresponding authors themselves, there are several flaws, e.g. many categories of services are left out, prices used are distorted and willingness-to-pay may differ greatly (PAGIOLA *et al.* 2004; WORLD BANK *et al.* 2004).

Some estimations regarding economic losses from forest destruction put the value of this resource into perspective. The WORLD BANK (2004) estimates that the mismanagement of forest resources has cost governments revenues exceeding the World Bank's lending to these countries, and that illegal logging results in additional annual losses of at least US$ 10 to 15 billion. KRISHNASWAMY & HANSON (1999) estimate the value of the direct yearly loss of forest capital, excluding the costs arising from impaired ES, as being US$ 45 billion per year. ELIASCH (2008) cites a study by BRAAT & TEN BRINK (2008) that estimated annual damage costs arising from the loss of ES to € 1.35 to 3.1 trillion.

Another perspective is the calculation of costs for maintaining ES. KINDERMANN *et al.* (2008) modelled the costs for halving tropical deforestation by 2030 amounting to US$ 17.2 to 28 billion per year. In comparison, TRINES (2007) calculated the minimum annual costs of a 66% reduction in emissions resulting from deforestation and forestry between now and 2030 at US$ 25 billion a year. Together, the figures show that the value by far exceeds the costs for maintaining ES and, consequently, that such activities can be considered as well-invested money.

Reducing Emissions from Deforestation and Degradation in Developing Countries (REDD) under the UNFCCC

Recognizing the failure of past efforts to curb deforestation in developing countries, substantial efforts have been made towards tackling the resulting sources of GHG emissions by way of a future agreement about an international climate regime (DUTSCHKE & PISTORIUS 2008). Since 2005, the Parties to the United Nations Framework Convention on Climate Change (UNFCCC) have been negotiating an international mechanism aiming at effectively 'Reducing Emissions from Deforestation and Degradation in Developing Countries' (REDD). The general idea of REDD is to provide performance-based incentives to developing countries that successfully reduce their national deforestation rates. The beneficiary countries should develop and implement national REDD strategies, taking into account their specific national circumstances. Such a national approach respects the national sovereignty – the main hurdle in all international policy processes – and the large variability of drivers and underlying causes of deforestation (GEIST & LAMBIN 2001; KREMEN *et al.* 2000). Measures could be to, e.g. improve forest and land use governance[3], install fire monitoring systems or establish new forest protected areas (FPA) while securing the effectiveness of those already existing. National accounting also aims at reducing leakage[4], a phenomenon tending to occur at the project level.

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[3] The term 'governance' describes the pursuit of collective interests, as characterized by the articulation of a common set of priorities, a creation of coherence between individual goals, the steering society to attain the goals and actors which 'deliver' governance to society; the European Commission has five principles for defining good governance: openness, participation, accountability, effectiveness and coherence (Pierre & Peters 2005).

[4] Leakage refers to the situation in which a carbon storage activity on one piece of land inadvertently, directly or indirectly triggers an activity which, either in part or in its entirety, counteracts the carbon effects of the initial activity (IPCC 2001). In the context of REDD, international leakage is referred to as a 'displacement of emissions'.

Although the intention was to keep the mechanism simple, many unresolved questions and highly relevant aspects arose in the context of the political process. These aspects can be grouped into four building blocks which are to a large degree interdependent (DUTSCHKE & PISTORIUS 2008; PARKER *et al.* 2008):

- the scope of REDD,
- the international distribution of funds,
- aspects related to the financing mechanism, and
- technical issues.

There is some consensus among the Parties to the UNFCCC that REDD should focus on the storage of carbon as its target variable in order to avoid further complications in this process. Most of the Parties are aware that biodiversity may be affected through such a mechanism and thus refer to it as a 'co-benefit'[5]. FRY (2008) supports this view by arguing that a failure to reduce emissions will lead to suffering forests and other ecosystems; therefore a focus on carbon storage should be the primary concern. Some of the Parties have acknowledged the need to take biodiversity concerns into account[6], but few of the Parties identified the need to assess potential perverse incentives. [7] No Party has made a concrete proposal so far, suggesting how an optimization of benefits for the mutual achieving of objectives could be achieved. In this context, it is important to mention that many of the same Parties are also members of the CBD, which does not share this view. A possible explanation is, on one hand, the limited amount of cooperation that has taken place between multilateral regimes on cross-cutting issues like forests and, on the other hand, the fragmentation of competences within the Member States.

Many ideas and proposals were raised in the discussion by scientific institutions and NGOs. Even in these proposals, biodiversity was rarely considered because of the inherent complexities associated with measuring and valuing and also due to the consensus to primarily focus on the mitigation of emissions. However, in the same spirit as this paper was developed, some proposals aim to ensure and optimally utilise the co-benefits for different objectives. For example, the Greenpeace proposal 'Tropical Deforestation Emission Reduction Mechanism' (TDERM)[8] explicitly attempts to address both the objectives of mitigating emissions and enhancing biodiversity (GREENPEACE 2008). Accordingly, biodiversity conservation should be a guiding principle for any REDD mechanism by prioritizing key biodiversity areas, e.g. intact forest landscapes and other natural forests with high conservation values (HCV). Therefore, strong environmental and social principles and criteria that are consistent with those of the Convention on Biological Diversity (CBD) should be developed.

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[5] It is important to note that 'conservation' in these submissions, views and proposals does not always refer to conserving biodiversity; e.g. India has presented its proposal labeled "compensated conservation", in which 'conservation' refers to preserving forest cover and carbon stocks.

[6] E.g. EU, Japan and Australia.

[7] For a comprehensive overview on documents assembling the official proposals and views by Parties: http://unfccc.int/methods_science/redd/items/4615.php

[8] TDERM was first introduced by HARE & MACEY (2007) and further developed by STOCKWELL *et al.* (2008)

As a large-scale financial transfer mechanism, REDD offers an opportunity to mutually tackle different yet interrelated environmental problems that are associated with the cross-cutting issues of deforestation and forest degradation. At the same time, several risks arise that need to be addressed in order to avoid perverse incentives and the inefficient use of resources, especially in light of the tight schedule and limited time left until COP15.

Objectives, research questions and structure of this study

The main objectives of this study are to analyze the risks associated with these REDD issues for both climate protection and biodiversity conservation, as well as to derive options to support the achievement of the named objectives by utilising the plethora of existing approaches.

The main questions to be answered by using the existing knowledge on this topic are:

1. What economic impacts relating to biodiversity loss and climate change are caused by tropical deforestation?
2. Where do carbon mitigation and biodiversity conservation synergies occur? Where do these objectives clash?
3. How can perverse consequences for biodiversity (e.g. forest destruction caused by the translocation of deforestation hotspots because of emission cuts) be avoided?
4. How do different definitions influence the risks for biodiversity?
5. How can a REDD mechanism pursue the objectives of mitigating emissions from deforestation and forest degradation while also safeguarding biodiversity? In this context, what should the role of forest protected areas be?
6. What are examples of pragmatic indicators that could be used for the verification of emission reductions coming from deforestation and forest degradation as well as biodiversity conservation? How could a fair distribution of evolving funds across tropical forest countries be facilitated?

Chapter 1 gives a comprehensive overview of the state of global forests, some economic figures and estimations regarding the values they provide and the costs resulting from their loss (question 1). Additionally, this chapter outlines the present state of the REDD process under the UNFCCC. Chapter 2 assesses the potential synergies connected with the objective of enhancing biodiversity conservation and identifies the direct and indirect risks of REDD, focusing only on carbon (questions 2, 3, 4 and 5). Chapter 3 defines the general preconditions for making use of the synergies, including: the identification of high value forests on different levels, the generation of (additional) funding for high-biodiversity projects and multilevel governance of REDD (questions 2 and 5). Chapter 4 provides options and concrete proposals on how the direct and indirect risks of REDD could be addressed, addressing questions 3 to 6.

2 Setting the stage for an environmentally integer REDD mechanism

Despite the promising potential of combining the objectives of carbon storage and conservation and maximizing the benefits of REDD for both, it is often argued that due to several different reasons, the focus should be on carbon. It is a complex task to establish preferences for protecting and maintaining forests in and outside of FPA with regard to their biodiversity. There is a plethora of different approaches that focus on various aspects, such as threats, vulnerability or representativeness (BROOKS *et al.* 2006; SCHMITT *et al.* 2007). In addition, it is difficult if not impossible to calculate and attribute an appropriate price to biodiversity (cf. Section 1). Scientific exercises dedicated to setting preferences by valuing biodiversity were only able to show that the values, and correspondingly the costs acquainted to its loss, are tremendous. This is aggravated both by the fact that many species have not yet been discovered and due to the still poorly understood role of individual species in the complex ecosystems to which they are intricately linked (MONTOYA *et al.* 2006). Halting the present loss of biodiversity is not just about saving species; instead, it is more important to ensure that the habitats in which they have indispensable functions can continue to function and provide different kinds of vital ES (UNEP/CBD/AHTEG/BD-CC-2/2/2).

Carbon storage in natural forests can be considered as a common currency for the delivery of further ES, e.g. biodiversity conservation, hydrological services or scenic beauty (WUNDER 2005). However, forests are multi-functional and focusing on one forest function bears the risk of optimizing this function at the cost of other important ES, e.g. if plantations replace natural forests. Additionally, carbon stocks and flows are very dynamic, meaning that their fluxes can only be monitored at a rough level with large implicit uncertainties. Monitoring remains a challenge even in developed countries with low forest cover, well-established infrastructure and inventories (MOLLICONE *et al.* 2007; UBA 2006). At a certain point, the monitoring costs related to further reducing uncertainties exceeds a level which could be considered as reasonable.

Climate change increases the dynamics of both biodiversity loss and carbon fluxes. Due to the velocity of the observed changes, the chance of survival for many species will depend on their ability to migrate. These chances are being significantly reduced by the increasing fragmentation of ecosystems (MONTOYA *et al.* 2006). Forest ecosystem responses to climate change are complex and uncertain; they are increasingly threatened by a variety of climate change driven biotic and abiotic calamities which directly destroy habitats and reduce carbon reservoirs (IPCC 2007c). Fire events beyond natural fire regimes are especially responsible for quickly releasing large amounts of CO_2 into the atmosphere (NASA 2004). These events are furthered by unusual droughts and changes in precipitation patterns, e.g. caused by the El-Niño-phenomenon, and are also often aggravated by human activities which contribute to the susceptibility to fire by providing ignition sources, by forest fragmentation, and by thinning the forest through logging – especially at forest edges (NEPSTAD *et al.* 2008).

In conclusion, the focus on carbon may be operational, but it bears many direct and indirect risks for biodiversity (cf. Section 2.2). Biodiversity must be taken into account because ecosystem and species variety play a crucial role in terms of adaptation (CBD 2006; IUFRO 2009; MILLENNIUM ECOSYSTEM ASSESSMENT 2005a, b). Unintentional losses of genetic diversity due to leaving risks unaddressed are irreversible and these losses reduce the options available for responding to climate change.

2.1 Synergies between conserving biodiversity and carbon storage

The term 'co-benefits' implies that benefits and synergies may arise through REDD, but their generation is only considered as a sub-ordinate goal. In order to ensure that both objectives can be achieved two important questions have to be answered:

- Which activities are most beneficial for both objectives?
- Which forests should be concentrated on for optimizing such activities?

As a precondition to answer these questions a common understanding on the term 'biodiversity', which can refer to the species level, to habitats and to genetic resources, would be helpful. Reducing deforestation and forest degradation is generally beneficial for biodiversity. However, the prioritization of biodiversity in curbing forest destruction will determine whether a lot or relatively little biodiversity will be lost. Integrating conservation into these efforts implies that certain forests and forest types need immediate attention with respect to the significance of their climate and habitat functions, e.g. forested peatlands (URYU *et al.* 2008). Defining the criteria for such priorities does not imply that conserving biodiversity in forests outside of these areas is negligible, but instead indicates where activities should be started, e.g. by establishing new forest protected areas (FPA) or improving their effectiveness (UNEP/CBD/AHTEG/BD-CC-2/2/3).

While many other activities have direct or indirect impacts on biodiversity, in-situ conservation in FPA is a predestined activity to generate synergies (UNEP/CBD/AHTEG/BD-CC-2/2/3). FPA equally target several environmental objectives onsite, help to maintain the environmental stability of surrounding regions and contribute to the Millennium Development Goals by supporting rural development and employment (MILLENNIUM ECOSYSTEM ASSESSMENT 2005a). They are a cornerstone regarding the conservation of terrestrial biodiversity and essential for achieving the objectives of the Convention on Biological Diversity (CBD)[9] and the 2010 biodiversity target[10] agreed in 2002 (SCBD 2007).

Depending on regional circumstances, improving the effectiveness of existing FPA and establishing new FPA often represent cost-effective options for reducing deforestation (ANDAM *et al.* 2008) and contribute to both, the mitigation of and the adaption to climate change (SCBD 2008): Although FPA are primarily designated for conservation, they also protect the prevailing carbon stocks. Globally, terrestrial PA cover more than 12% of the land's surface and store approximately 15% of the biosphere's carbon stock, accounting to

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[9] The objectives of the CBD are *the conservation of biological diversity, the sustainable use of its components and the fair and equitable sharing of the benefits arising out of the utilization of genetic resources* (CBD 1993).

[10] To achieve a significant reduction by 2010 of the current rate of biodiversity loss at the global, regional and national level as a contribution to poverty alleviation and to the benefit of all life on Earth.

more than 312 GtC (CAMPBELL *et al.* 2008). Nevertheless, many studies have shown that existing FPA are insufficient in terms of ensuring a representative and adequate protection for all biomes and species. In order to meet the global and local biodiversity conservation objectives, FPA need to be further increased in number and size, and be better connected (SCHMITT *et al.* 2009).

In addition, many FPA have to be considered as 'paper parks'. Although the rates of deforestation in FPA between 2000 and 2005 were much lower than in unprotected humid tropical forests, they considerable amounts of forest were still lost and stored GHG emitted due to inadequate management effectiveness and sustainable financial endowment: more than 1.7 million ha were cleared within protected areas in the humid tropics and thus contributed approximately 990 million t of CO_2 equivalents to global GHG emissions (CAMPBELL *et al.* 2008). Thus, the carbon stocks of FPA should not be taken for granted within REDD deliberations, e.g. in the context of the additionality criterion.

To conclude, well-endowed and carefully implemented FPA are a very important tool for the successful implementation of national deforestation mitigation strategies. If local circumstances and pressures are adequately taken into account, FPA may result in significant local and regional deforestation reductions while also conserving biodiversity. It is important to mention that FPA do not exclude the right to use; depending on the assigned IUCN category, low impact resource use may be allowed to a certain extent for the benefit of the local people, especially in buffer zones.

Although FPA contain much of the global forest biodiversity, the majority is contained outside of areas designated for conservation. Therefore, conservation should not be restricted to FPA. Other activities valuable for biodiversity and carbon storage as well as other ES, refer to the restoration of degraded forest ecosystems to structured close-to nature secondary forests with site-adapted native pioneer and climax tree species. Furthermore, increasing the connectivity of habitats and the protection of environmental gradients can be considered multi-beneficial in this context. Guidance on these activities is provided by the ad-hoc technical expert group of the CBD on biodiversity and climate change (UNEP/CBD/AHTEG/BD-CC-2/2/3).

2.2 Identification of inherent direct and indirect risks for biodiversity

The final design of REDD, including its financial mechanism, will affect the area and location of encompassed forests and thus also the scope of biodiversity conservation, livelihoods, and watershed protection (MILES & KAPOS 2008). As there exist no experiences with such a large-scale mechanism there are specific and general risks for biodiversity (DUTSCHKE & PISTORIUS 2008).

Direct risks associated with the design of REDD

- A REDD mechanism solely focusing on carbon as the target variable is likely to prioritize forest areas storing large amounts of carbon and to insufficiently consider other important forest values and services. Some sites may be less valuable from a carbon perspective but have a high priority for other ES. REDD could support a shift of land-use pressure for the production of crops, cattle and biofuels to highly diverse ecosystems with lower carbon stocks (KAPOS *et al.* 2007). Forest and non-forest ecosystems that store less carbon may become the most threatened, e.g. savannas or non-forested wetlands (UNEP/CBD/AHTEG/BD-CC-2/2/2).
- International leakage / displacement may occur if only few countries participate, e.g. due to high monitoring and reporting requirements (FRY 2008) or if the compensation for protecting forests are insufficient and it appears to be more profitable for countries (in the short-term) to sacrifice further forests for other land uses (PARKER *et al.* 2008). This risk holds particularly true for countries with high forest cover and biodiversity and currently low rates of deforestation. Another risk is that these countries increase their deforestation rate in anticipation of a future compensation mechanism, which would also lead to an accelerated loss of habitats and species. These risks are to a large degree dependent on the regulations concerning the definition of national deforestation reference rates (IIASA 2009).
- Severe risks for perverse incentives are inherent in underlying definitions (KAPOS *et al.* 2007), e.g. if the presently valid broad Marrakech forest definition is applied without adaption to the specific needs of REDD (UNFCCC 2001).[11] Reforestation with monoculture plantations[12] would still count as 'forest' and thus be eligible for REDD payments because the reported land use category would not change. From the biodiversity-perspective there is a clear need to distinguish between disturbed and undisturbed forests in the forest definition used for REDD, and to exclude plantations.

Using the Marrakech forest definition without including forest degradation would allow to severely degrade forests without crossing the threshold to 'non-forest' due to the very low required minimum stocking level of 10 to 30% – with tremendous impacts on both, the carbon stored and biodiversity (DUTSCHKE & PISTORIUS 2008; SKUTSCH 2008). However, with the Bali decision regarding its inclusion (UNFCCC 2008), there is now a need to agree on a definition of forest degradation and resolve the challenge of monitoring with the given capacities, available methods and data.

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[11] "Forest" is defined as a minimum area of land of 0.05-1.0 ha 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 meters at maturity in situ. A forest may consist either of closed forest formations where trees of various stories 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 meters 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.

[12] Even oil palms also count as trees under this definition.

Indirect risks associated with the design of REDD

While the primary objective of this paper is to analyze the direct risks to biodiversity under REDD, there are also considerable indirect risks which relate to different objectives and which therefore have to be adequately addressed. General risks mainly refer to the indirect political risks evolving from the different tactical and strategic interests surfacing in political negotiations. Allowing for too much compromise in trying to reaching an agreement furthers the creation of 'hot air' and the risk of setting 'perverse incentives'[13] for biodiversity.

Governance-related risks can also be considered as indirect risks; such risks mainly concern the implementation of national REDD strategies and the accompanying policies and instruments. Particular risks are:

- The majority of generated REDD funding remains at a government level and does not "reach the ground". Insufficient compensation (on the basis of the local opportunity costs that arise for the land owner / user) may perpetuate deforestation or increase illegal logging and forest degradation.
- Illegal and uncontrolled logging is responsible for a significant portion of deforestation and especially forest degradation (FAO 2009). Furthermore, illegal settlements in some forested regions are an issue of concern. In this context, a set of governance issues holds risks for the successful implementation of REDD, e.g. regarding land use planning or uncertain tenure and land use rights (ALSTON *et al.* 2001; SAUNDERS *et al.* 2008).

[13] The CBD describes perverse incentives *"as a policy or practice that encourages, either directly or indirectly, resource uses leading to the degradation of biological diversity*" (UNEP/CBD/COP/5/15).

3 General requirements for integrating biodiversity into REDD

3.1 Identification of forests with high conservation values

As pointed out in Chapter 2, there are still many difficulties regarding the setting of preferences for REDD areas which highly value both conservation and carbon storage. However, this should not lead to inaction and further delays in implementing relevant measures because there are already instruments to identify forest areas in need of immediate protection (PISTORIUS *et al.* 2008; UNEP-WCMC 2008). Forests with high conservation values can be identified at the global, national and local levels by using available instruments and concepts (several of which are briefly introduced below). Such guidance and information for actors is important for donor and implementing countries alike in terms of making implementation decisions.

Identification at the global level

During the last decades, conservation scientists and NGO have developed different approaches for identifying areas of global importance to biodiversity conservation. They can be described as either proactive[14], reactive[15] or as focusing on representativeness[16] (BROOKS *et al.* 2006; SCHMITT *et al.* 2007). Each approach measures the distribution of particular components of biodiversity, and many incorporate measures of threat (UNEP-WCMC 2008). The CBD tries to combine these approaches and provide guidance in its programmes of work on protected areas and forest biodiversity through three general criteria (UNEP/CBD/COP/6/22; UNEP/CBD/COP/7/15): vulnerability, irreplaceability and representativeness. Both vulnerability and irreplaceability are defined in terms of species (threatened and endemic) and habitat (threatened and vulnerable forest ecosystems, areas of particular importance). Attention is given to large intact areas or relatively unfragmented areas, e.g. the remaining intact forest landscapes (POTAPOV *et al.* 2008), as well as to areas that are highly threatened. The representativeness criterion also remains very general: areas should be biologically, geographically and ecologically representative.

Regarding only the representativeness of biodiversity, a global ecological forest classification and FPA gap analysis have been carried out by the World Conservation Monitoring Centre (UNEP-WCMC), the World Resources Institute (WRI) and the Institute of Forest and Environmental Policy (IFP) at the University of Freiburg (SCHMITT *et al.* 2009). One approach that examines both high carbon and high biodiversity forest areas is the atlas provided by the UNEP-WCMC (IIASA 2009; UNEP-WCMC 2008). Although the resolution is large and general proxy data had to be used, it can be considered as a guide for locating regions of special importance. The 'carbon / biodiversity atlas' uses the International Hotspots approach,

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[14] Focus on large and undisturbed ecosystems with a comparably low vulnerability.

[15] Focus on areas with high vulnerability and irreplaceability which are under immediate threat.

[16] Focus on areas with a high degree of irreplaceability; vulnerability is not considered because the main objective is to conserve a representative share of the global biodiversity.

the ‘WWF Global 200 ecoregions’, ‘Endemic Bird Areas’ by Birdlife International, the WWF/IUCN ‘Centers of Plant Diversity’ and the Amphibian Diversity Areas (UNEP-WCMC 2008). In the regional maps of the atlas, areas are considered as harboring ‘high biodiversity’ if they are identified by at least four of these global prioritization schemes. The authors note that although this represents a certain consensus regarding the significance of these areas, other areas like wilderness areas or intact forest landscapes, for example, are also important to biodiversity (UNEP-WCMC 2008), supporting the idea that further assessments should be carried out at lower levels. This approach acknowledges that forest ecosystems with similar significance in terms of carbon storage may have different biodiversity values, indicated by the atlas. However, in order to exclude the risk that important forest areas for conservation are not included, there is a need to also admit other instruments into the identification, e.g. those presented in the following section.

Identification at the national level

The general global indication of focal areas for conservation can be supplemented by the national gap analyses that are carried out in the context of the Programme of Work on PA of the CBD and which are financially supported by the Global Environment Facility (GEF). Presently, gap analyses are elaborated with relevant stakeholders in more than 40 countries, many of which are included as pilot countries for REDD capacity building activities supported by the FCPF (SCBD 2008). The aim is to identify so-called high priority sites (HiPs) by analyzing multiple GIS data layers in order to expand or improve existing PA systems and networks (SCBD 2008). The HiPs combine high conservation value and livelihood demands of the affected population, but these assessments may leave out the consideration of outstanding values at the site level. In order to compensate this shortcoming resulting from high resolution in national or global top-down approaches, the approach of high conservation value forests (HCVF) could be used as a bottom-up approach for the site level.

Identification at the local level

A high conservation value forest (HCVF) is defined by the Forest Stewardship Council (FSC) as a forest of outstanding and critical importance due to its inherent high environmental, socio-economic, biodiversity or landscape values (WWF 2007). The HCV approach provides a framework for the identification, management and monitoring of areas with outstanding biological, social and cultural significance, including representative PA networks consisting of core and buffer zones. Therefore HVC areas are not exclusively designated for conservation purposes. The HCV framework could be used for the local identification of sites for REDD activities and the assessment of co-benefits, thus serving as a basis for prioritizing funds and supporting projects in these areas. In addition it could be considered as a proof of quality because the sites have to be managed both, sustainably and according to the precautionary principle. The concept lists six HCV (WWF 2007):

1. Forest areas containing globally, regionally or nationally significant concentrations of biodiversity values (e.g. endemism, endangered species, refugia).

2. Forest areas containing globally, regionally or nationally significant large landscape level forests, contained within, or containing the management unit, where viable populations of most if not all naturally occurring species exist in natural patterns of distribution and abundance.
3. Forest areas that are in or that contain rare, threatened or endangered ecosystems.
4. Forest areas that provide basic services of nature in critical situations (e.g. watershed protection, erosion control).
5. Forest areas fundamental to meeting the basic needs of local communities (e.g. subsistence, health).
6. Forest areas critical to local communities' traditional cultural identities (identified in cooperation with such local communities).

3.2 Multilevel governance of REDD

Recognizing the sovereign authority over their forest resources, national governments will be the key players regarding the implementation of effective long-term REDD policies that will address the prevailing drivers and underlying causes of deforestation and forest degradation. They will be responsible for establishing the necessary domestic REDD frameworks (Figure 2), including definitions of property rights, market rules, benefit sharing, risk management, regulatory oversight and national carbon accounting systems (PEDRONI *et al.* 2009; PESKETT & HARKIN 2007). At the same time, many REDD activities will take place at the project level (ANGELSEN *et al.* 2009; MILES & KAPOS 2008).

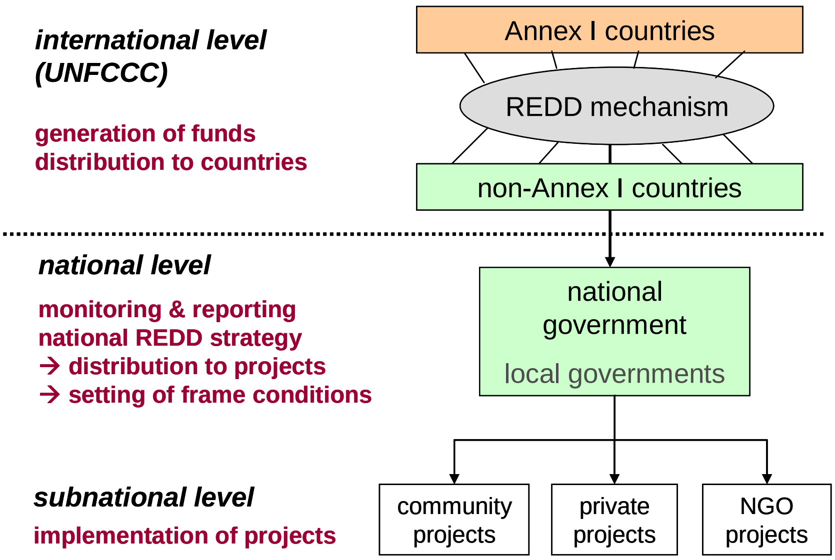

Fig. 2: Different governance levels of REDD

Fair, effective and efficient allocation of generated funds among the domestic stakeholders will be crucial for a successful implementation of both, the national REDD strategies and project activities (MILES & KAPOS 2008). This requires effective structures for good governance and capacities for implementation, e.g. effective law enforcement, judicial structures to resolve land-tenure and other disputes and effective measures against corruption (EBELING & YASUÉ 2009). Whether or not actors beyond the government level can get engaged will most likely depend on the country's efforts to install sound and effective domestic incentive systems, e.g. PES schemes such as that of Costa Rica. National PES can address the opportunity costs arising for local stakeholders and thereby help to avoid deforestation or forest degradation. These costs vary greatly over time and in different local contexts (CHOMITZ 2007), e.g. due to prices fluctuations for agricultural commodities, changes of domestic land use policies and pressures. Accordingly, compensation payments have to be assessed on the national level. They should be adjusted regularly and should meet the opportunity costs to ensure broad participation.

Furthermore, an internationally agreed verification standard and procedure will be needed which provides a seal of quality to projects implemented at the site level. Existing standards, e.g. the Climate, Community & Biodiversity Standards (CCBS) [17] or the Plan Vivo Standard could serve as models (EBELING & FEHSE 2009). These standards have evolved to avoid malpractice in different forest projects subject to voluntary carbon markets. The CCBS appears to be particularly suitable for REDD due to its focuses on the socio-economic and environmental benefits from forest and other land-based projects and its aim to provide evidence for their delivery through the respective projects. The standard provides flexible regulations and guidance for the development of a comprehensive project design by addressing:

- socio-economic criteria: Identification of affected communities, impacts, participation, knowledge dissemination, local employment, conflict management and best management practices. There should be no harmful impact on communities, or at least measures for reducing such impacts have to be taken.
- ecological criteria: Prevailing biodiversity, threats to species and ecosystems, identification of HCV areas and values and no use of invasive species or genetically modified organisms (GMO).

The CCBS provides several tools and questionnaires for assessing and monitoring socio-economic and environmental impacts. Project developers are obliged to conduct a comprehensive monitoring plan which is subject to verification in audits taking place every 5 years. For REDD projects, it currently represents the currently most applicable voluntary certification standard.

[17] The CCBS was developed by the Climate, Community & Biodiversity Alliance (CCBA), a cooperation consisting of NGO, scientific institutes and business corporations

4 Addressing the risks by putting the elements together

The design of a comprehensive REDD mechanism that promotes synergies between carbon storage and biodiversity conservation requires a differentiated multi-level approach that is characterized by learning, flexibility, conservativeness and practicability. Carbon may be used as a vehicle to deliver and promote all forest functions and ES that are in jeopardy; however, due to the plethora of risks resulting from such a focus on one ES in multifunctional ecosystems (cf. Chapter 2) it appears to be necessary to develop alternatives to a solely carbon-based REDD from a different perspective – the conservation perspective[18]. In this context, two questions arise:

- How can negative consequences for biodiversity be avoided with a REDD mechanism?
- How should REDD be designed to optimize the benefits for carbon and biodiversity?

This chapter tries to contribute to the answer of these relevant questions. After more than three years of discussing REDD, numerous contributions, proposals and submissions enriched the discussion. Most of them focus on specific elements of REDD, and are characterized by different strengths and weaknesses. PARKER *et al.* (2008) structured the most prominent proposals by their contributions to the scope, the financial mechanism, technical issues and the distribution of funds. Suitable elements of these approaches should be merged in a 'mix and match' approach by "taking the most desirable […] to create an effective, efficient, and equitable REDD proposal which maximizes the potential benefits and minimizes the perverse outcomes (PARKER *et al.* 2008)."

4.1 The scope of REDD

The discussion originally focused on deforestation, but it soon became obvious that forest degradation, often leading to deforestation, needs to also be included. This scope currently represents the largest potential for reducing carbon emissions and loss of biodiversity. However, further demands evolved in the meantime regarding eligible REDD activities, i.e. to include afforestation and reforestation. While plantations may reduce the pressure on remaining undisturbed forests, they seldom depend on economic incentives due to their strict focus on profit-oriented biomass production. They primarily serve economic purposes and contribute little to the ecological and social dimensions of sustainability. As compared to structured secondary forests with native pioneer and climax tree species, industrial plantations store less carbon, harbor few species and are less resilient to natural disturbances and biotic pests (IUCN *et al.* 2004; UNEP/CBD/AHTEG/BD-CC-2/2/3; WILKIE *et al.* 2003). Supporting the afforestation and reforestation of monoculture plantations through REDD would impair the environmental integrity of the mechanism, and it would also reduce funding for the conservation of undisturbed forests (EBELING & FEHSE 2009).

[18] Due to time constraints, this paper focuses on the need to link carbon and biodiversity objectives. However, any REDD mechanism has also to pay heed to other objectives and principles – especially the rights of local and indigenous peoples.

On the other hand, the forest exploitation has taken place at unprecedented rates over the last 50 years and has resulted in large degraded land and forest areas, providing a large potential for ecological forest restoration. However, it is important to pay heed to the environmental integrity of such activities, e.g. by applying the ecosystem approach (ESA) on such degraded areas. In contrast to plantations, ecological forest restoration and establishing new and well structured forests with native tree species improves land conditions, and provides livelihood options and different kinds of ecosystem services; benefits for biodiversity include new wildlife corridors and the restoration of viable forest habitat sizes (EBELING & FEHSE 2009). Therefore, sustainable forest restoration could be included in the second phase of REDD.

Figure 3 shows how a phased approach could look like. The Preparation Phase marks the Kyoto period which has to be used to shape the framework, build capacities and start with demonstration activities. *Phase I* lasts for 10 years, respectively the following two commitment periods (CP). During this period, the scope is restricted to REDD; monitoring and reporting may be based on simple Tier 1 approaches[19], using conservative estimations and discounts to ensure environmental integrity. In the following decade, *Phase II*, the scope is widened to REDD+ for those countries who have successfully established monitoring systems and are able to report according to Tier 2 requirements as defined by the IPCC good practice guidance for LULUCF (IPCC 2003). In order to not counteract biodiversity objectives, REDD+ funding for afforestation and reforestation should be limited to forest restoration with native tree species and the target should be to establish site-adapted, structured, close-to-nature secondary forests. Therefore, plantations should be regarded as a separate land use category with a clear definition. In order to provide additional incentives for improving the quality of monitoring, the discounts could eventually be reduced.

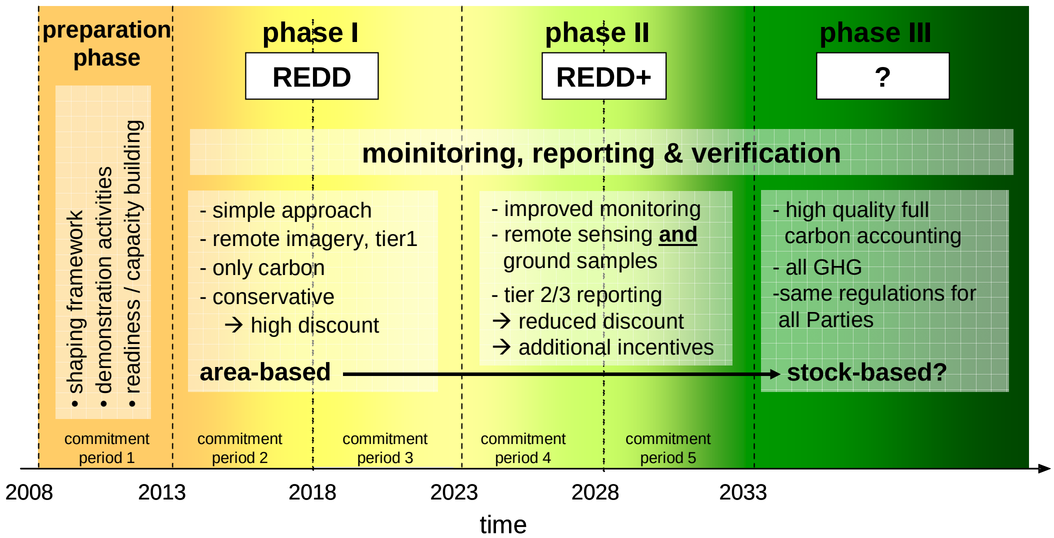

Fig.3: Long term strategy for widening the scope of REDD according to available MRV

[19] *Tier 1* employs basics methods and default emission factors. The activity data used are spatially coarse, such as nationally or globally available estimates of deforestation rates or global land cover maps. *Tier 2* is more accurate because it applies national emission factors and activity data. At *Tier 3*, higher order methods are used including models and inventory measurement systems tailored to address national circumstances, repeated over time, and driven by high-resolution activity data and disaggregated at sub-national to fine grid scales (IPCC 2003).

In order to not restrict REDD to halting forest loss, a long-term strategy for the land-use sector. In *Phase III* the target of a comprehensive system should be pursued that covers all GHG pools and land uses, including forest enhancement and restoration and other land uses as well. Such comprehensive accounting approaches are important for the completeness of national reporting of anthropogenic emissions and removals. However, it remains a challenge even for many developed nations to install sound and contestable reporting schemes. If time should prove that it remains impossible for some countries to install monitoring systems which deliver consistent data at an acceptable quality, they could remain at a previous stage. Advanced countries, however, should be allowed to account for and report on carbon stock changes following the guidance and methodologies provided by the IPCC. Since this stage is still in the remote future, it will be necessary to evaluate and reconsider the performance, the needs and the design of the transfer mechanism.

4.2 International distribution

Not surprisingly, the national interests regarding the scope determine the amount of compensation from REDD and often match the relative state of the country in the forest transition curve, a theory based on empirical observations regarding the correlation of deforestation and economic development (Figure 1). The idea of REDD is to flatten this curve for countries during the deforestation stage without impairing their right for economic development, and, at the same time, to reduce emissions and loss of biodiversity. This implies that countries with high forest cover in an early stage of this curve should receive sufficient funding to avoid the classic deforestation path. Solely focusing on historic deforestation rates implies that they would receive little benefit from REDD, while countries advanced in this curve with historically high rates would profit much more. For biodiversity (and also for carbon storage), this would create two major risks: it could lead to deforestation in anticipation of a future compensation mechanism or to the international displacement of deforestation, because land use changes would remain a more financially attractive option for many countries in the early stage.

Since using historic reference rates would predominantly benefit those countries that have transformed large shares of their forests into other land uses, it is necessary to find a way to prevent countries with yet remaining high forest cover and low to medium deforestation following this path on the forest transition curve. Fair and equitable international distribution is an important precondition for reducing the risk of international displacement of deforestation. Consequently, national reference rates should be developed in a globally consistent manner with guidance from the IPCC, taking into account future land-use perspectives in order to reduce the problem of geographic and sector leakage (IIASA 2009).

The following proposal takes these concerns into account by proposing a common target baseline for tropical countries. This ‘tropical target baseline’ (TTB) is based on the average gross deforestation rate of 62 tropical countries and amounts to 0.6% for the period between 1990 and 2005 (cf. Annex 2). It aims to present a road map for halting deforestation and forest degradation in these countries within the next 15 years (Figure 4). It is important to note that the proposal strives to set high incentives for reaching this extremely ambitious objective even earlier than 2023.

The TTB serves as the basis for individual country performance evaluations and influences the amount of compensation payments a country can receive. It is gradually reduced by 25% every 5 years, starting in the Kyoto commitment period in which many demonstration activities are initiated.

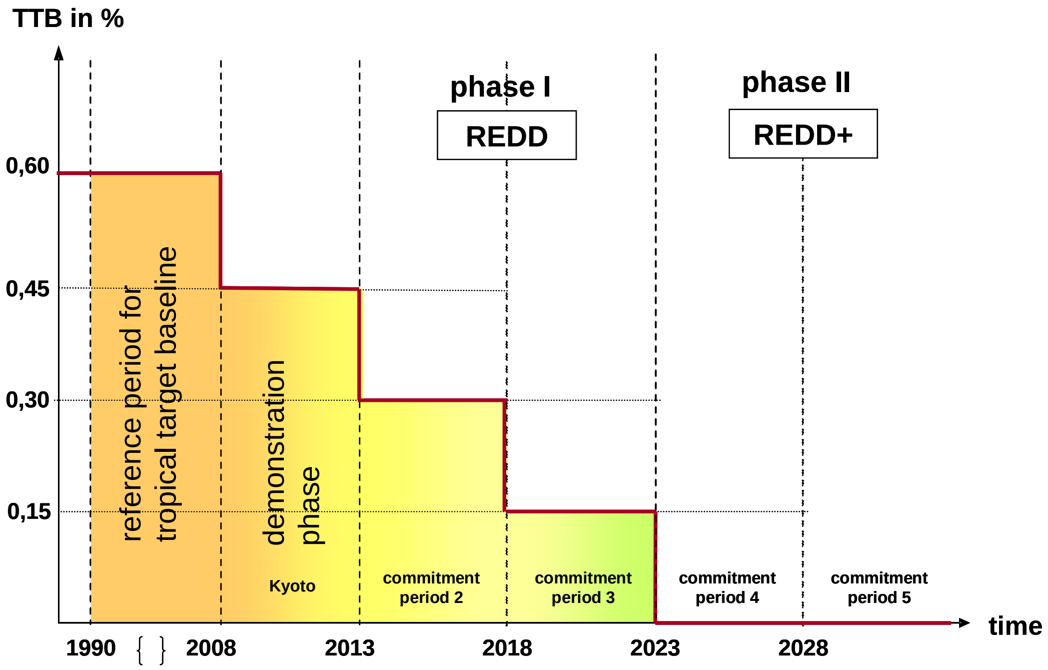

Fig. 4: A gradually decreasing tropical target baseline (TTB) for comparing individual country performance

State of forest transition – the 'SOFT'-factor

On the basis of individual country reference rates taking historic and likely future deforestation into account, performances are measured at the end of each commitment period. Then the individual country performance is then compared to the TTB to determine the SOFT-factor ('state of forest transition'), influencing the compensation each country will receive.

The SOFT-factor is an additional incentive tool to make measurable progress more attractive over time. This tool would be applied by the proposed REDD fund at the end of each commitment period; the more a country succeeds in staying below this line, the higher the amount of payments would be, potentially doubling if the country's gross deforestation would be reduced to zero (SOFT-factor 200%). In the second CP (from 2013 until 2018) which marks the beginning of the REDD Phase, countries above the global average would still receive the full amount of incentives (SOFT-factor 100%) for their achieved reductions (Figure 5). However, the fix share of this factor for countries which have a worse national performance than the TTB, would gradually be reduced in every subsequent period, for instance by 25%. Accordingly, in the third CP (2018 - 2023) the fix SOFT-factor amounts to 75%, while the performance-based SOFT factor can still amount to 200% (Figure 6).

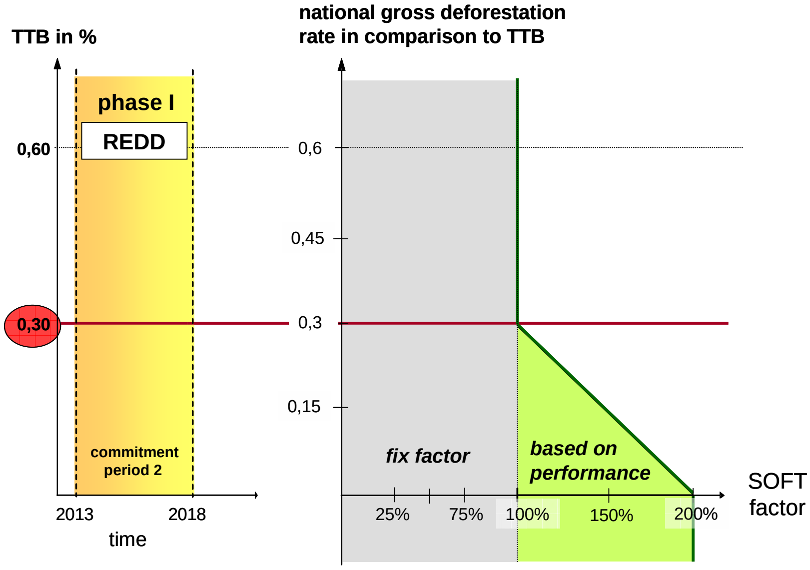

Fig. 5: The first period of the REDD phase I from 2013 to 2018, with an average TTB and a SOFT-factor ranging between 100% and 200% in the first period until 2018

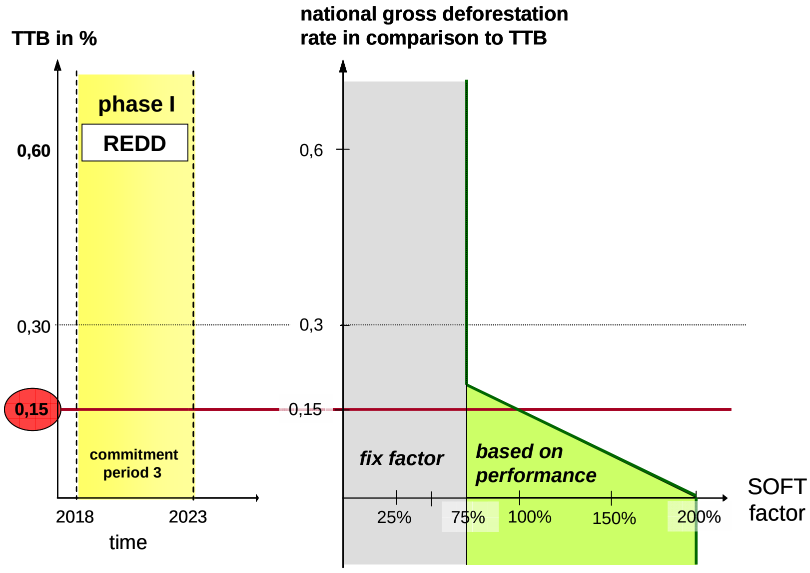

Fig. 6: The second period of the REDD phase I from 2018 to 2023, A decreasing TTB and a SOFT-factor range between 75% and 200%

The REDD+ Phase would begin in the fourth CP (2023 - 2028) and would allow countries to include ecological forest restoration, an activity with multiple benefits, especially with regard to biodiversity conservation and adaptation to climate change. A necessary precondition is that countries intending to use this option are capable of reporting stock-changes instead of area-based changes, i.e., they must have installed a working national monitoring system and be able to fulfill Tier 2 and Tier 3 reporting requirements as defined by the (IPCC 2003). Due to the sinking TTB, the SOFT-factor requires countries to make constant progress in order to receive the full amount of payments. Countries above the TTB would receive proportionally less compensation: in the fourth CP, the fixed share of the SOFT-factor is reduced to 50% (Figure 7), respectively to 25% in the fifth CP from 2028 until 2033 (Figure 8).

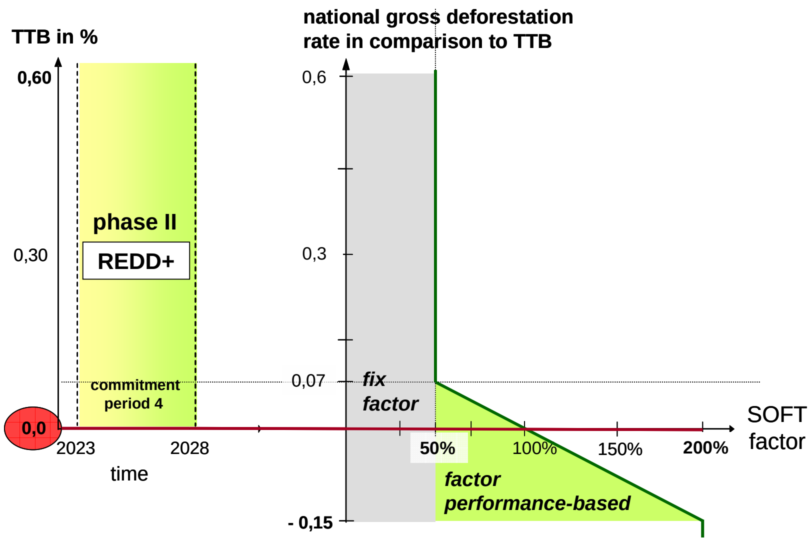

Fig.7: The first period of the REDD+ phase II from 2023 to 2028, with a TTB at zero deforestation and a SOFT-factor ranging from 50% to 200%

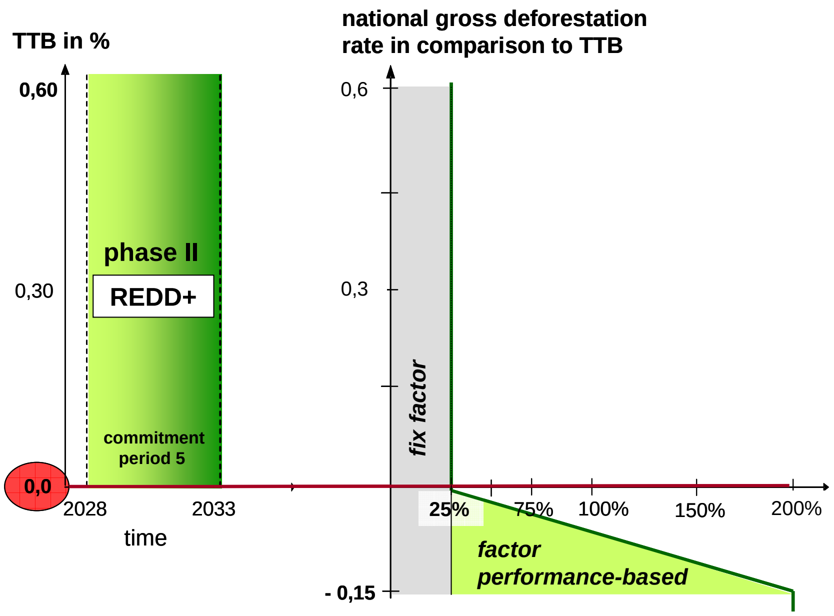

Fig.8: The second period of the REDD+ phase II from 2028 to 2033, with a SOFT-factor range from 25% to 200%

Of course, not all countries will succeed in following this ambitious path to zero deforestation and subsequent forest restoration as lined out by the TTB and the decreasing fix SOFT factor. In order to not loose these countries, the following chapter proposes a second type of direct area-based payments for establishing new FPA.

4.3 Distribution through the REDD finance mechanism

Numerous proposals have been made about how to raise the necessary funds for REDD in order to achieve meaningful emission reductions. Regarding the many uncertainties, the number of advocates of market-linked and fund-based mechanisms seems to be growing because these mechanisms are better suited to influence the type of activities that are funded and to ensure co-benefits by targeting specific drivers and underlying causes of deforestation (PEDRONI *et al.* 2009). In the longer run, however, there are also arguments to integrate deforestation activities into carbon markets (STERN 2007), provided the technical hurdles of monitoring and reporting can be solved.

This study supports a market-linked approach such as the TDERM introduced by Greenpeace because it ensures reliable and calculable funding and excludes market risks, e.g. an unexpected generation of pure market-based reduction certificates which could have severe consequences on the market price for CO_2 and lead to disincentives concerning emission reductions in other sectors (industry, traffic and households). In the TDERM, Annex I parties agree on buying a fixed minimum amount of their assigned amount units (AAU) instead of fulfilling a part of their commitments with REDD credits (GREENPEACE 2008). Thus, they have an additional incentive to commit to more ambitious reduction targets – the less AAUs a country needs, the less TDERUs have to be purchased.

In order to ensure that REDD activities also directly promote and foster the conservation of biodiversity, it is proposed to pay an extra area-based premium to governments for such activities in addition to the general compensation payments based on the TTB and the individual SOFT-factor. In the proposed REDD Phase, this would refer to establishing well-planed new and effective FPA in high priority areas as part of the national REDD strategies. Furthermore, a lower premium could be paid for areas that are kept free of degradation through ecologically responsible forest management as outlined by the ESA. The amount of any type of premium for FPA should be based on the average direct and indirect costs. An indication of the arising costs can be derived from estimations by (JAMES *et al.* 2001) and (BALMFORD *et al.* 2003). The selection of suitable areas should be based on the tools lined out in Chapter 3 to ensure that high-priority areas are targeted. If countries proceed to use stock-based accounting in the REDD+ phase where ecological restoration of degraded land and forest ecosystems would become an eligible activity, the premium could be paid on the respective stock changes. Of course, strong environmental and social standards are a prerequisite for additional payments, along with sound monitoring and verifiable reporting.

The long-term success of REDD for carbon and biodiversity will also depend on the distribution of funding within beneficiary countries, i.e., that funds reach the ground and local stakeholder benefit appropriately. In contrast to PEDRONI *et al.* (2009) who proposed a ‘nested approach’ for sub-national activities, the author believes that with the exception of general guidelines and principles, the definition of sub-national incentive mechanisms should not be decided at the international level. The responsibility of ensuring progress and the transfer of international REDD funding should remain at the government level[20] because it seems unrealistic that developing countries will be able to adhere for the underachievement of other, sub-national actors. Countries should be encouraged and supported to implement national PES schemes in order to facilitate local stakeholder participation and to attract additional financing sources for high value biodiversity activities. This goes along with the

[20] Fore example by installing Designated National Authorities (DNA) as proposed by (STOCKWELL *et al.* 2008), which are the national focal points for REDD activities and responsible for developing national REDD strategies in which conservation has to be addressed and impacts of REDD activities on biodiversity are assessed.

'complementary financing' approach, aiming to connect different financing options over time (Boucher *et al.* 2008). National PES could also facilitate the link between REDD and other objectives, such as poverty alleviation (Peskett & Harkin 2007).

4.4 Technical issues

There are still many technical challenges that have to be overcome in order to implement a successful REDD mechanism. A large part of the complexity associated with reliably monitoring GHG fluxes in the biosphere will not be resolved in the near future. This subchapter addresses only those aspects that are of the utmost importance for ensuring the environmental integrity of the mechanism.

Any future REDD mechanism should fulfill the following general UNFCCC principles for estimating and reporting emissions and removals of GHG:

- transparency as a basis for verification,
- consistency by using the same methodologies and consistent data,
- comparability by using the methodologies and tools provided by IPCC,
- completeness, regarding the agreed land use categories, gases and pools, and
- accuracy, in the sense that uncertainties are reduced in so far as is practical.

Definition of national reference levels

National reference levels should be determined by an independent international technical body working as a global clearing house for data to be used in the definition of national reference rates (IIASA 2009). Since inconsistent and inflated baselines create a significant risk of hot air, harmonized and standardized rules and procedures regarding the definition of national reference rates are a precondition for the generation of measurable, reportable and verifiable achievements to be compensated through REDD. Sound reference levels based on historic and likely development rates can help to avoid international leakage, and to ensure transparency and equity. As proposed by Stockwell *et al.* (2008) data and information could be assembled by designated national authorities according to negotiated standards.

Conservativeness

Given the tremendous difficulties in meeting these demands along with the lack of data and high uncertainties, Grassi *et al.* (2008) and Mollicone *et al.* (2007) support using conservative approaches, e.g. by applying discounts as a practicable and credible approach to addressing incomplete or inaccurate data and in order to minimize the risk of overestimation. Conservativeness has several advantages:

- robustness, comparability and environmental integrity ensure general credibility,
- incentives for qualitative reporting and improvement of monitoring, and
- flexibility regarding the accuracy of reporting facilitates broad participation.

Definitions

As described in Chapter 2, the present valid Marrakech Forest Definition does not suit the objectives of reducing deforestation, forest degradation and biodiversity loss. For forest degradation there is currently no agreed upon definition under the UNFCCC. Since remote sensing techniques will at least initially play a key role in monitoring, there is a need for a pragmatic approach regarding the differentiation of intact forests and forests subject to forest degradation and management. A helpful approach that distinguishes between 'intact' and 'non-intact' forests was presented by ACHARD *et al.* (2005) and builds on the 'intact forest landscape' approach, stating that an intact forest area should meet six criteria (POTAPOV *et al.* 2008):

- be located within the forest zone,
- have a minimum size which is larger than 50 000 ha, with a smallest width of 10 km,
- contain a contiguous mosaic of natural ecosystems,
- not be fragmented by infrastructure,
- not show no signs of significant human transformation, and
- be subject to natural fire regimes.

For any forest type (e.g. humid, dry), the carbon stock of the non-intact forests will be considered (for instance) as 50% of the intact forests (ACHARD *et al.* 2005). Thus, there is a reasonable distinction between the worlds remaining intact forests and those that have been subject to management or degradation. Literature and the IPCC provide default values for the average carbon pools in different forest types. Forest conversions are defined as changes from intact forests to other land uses (deforestation), non-intact forests to other land uses (deforestation) and intact forests to non-intact forests (forest degradation) (ACHARD *et al.* 2005).

From the biodiversity-perspective, there is a further need to define plantations. Afforestation and reforestation with plantations should be reported as a separate land use category and be referred to as a type of 'other land use'. Thus, the establishment of plantations on forest land which is *"temporarily unstocked as a result of human intervention such as harvesting or natural causes but which are expected to revert to forest"* can be avoided. The case is different for ecological forest restoration, which also needs a practicable and integer definition, e.g. that of UNEP-WCMC[21]: "*to re-establish the presumed structure, productivity and species diversity of the forest originally present at a site. (In time, the ecological processes and functions of the restored forest will closely match those of the original forest)".* Furthermore, the definition of 'forest management' should draw upon the concept of the ESA (MALTBY 2003; UNEP/CBD/AHTEG/BD-CC-2/2/3).

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[21] http://www.cifor.cgiar.org/rehab/_ref/glossary/restoration.htm

5 Conclusion / Outlook

Most initiatives to curb deforestation during the last decades have not resulted in significant changes. The loss of forests is still takes place at alarming rate and is impairing vital ES at the global and local levels. Without strong political will, international cooperation and new policy instruments, the decline of forest resources and their ES is expected to continue for the next 30 to 50 years (CHOMITZ 2007). The REDD process under the UNFCCC created momentum for curbing forest depletion while simultaneously addressing other environmental objectives. The urgency to succeed is underlined by many factors; for example regarding climate change, further large-scale forest losses and the acquainted sudden release of emissions may push the inert reacting climate beyond a tipping point, instigating a reaction in which climate (and living) conditions alter much faster, and significantly fewer options remain for adaptation (NEPSTAD *et al.* 2008). Currently, the international climate regime and its policies regarding forest ecosystems focus on the mitigation of emissions which represents a chance for mankind to 'buy time'; however, maintaining functioning forest ecosystems and their biological diversity is essential for adaption which will play an increasingly important role in the near future (GULLISON *et al.* 2007; IUFRO 2009; UNEP/CBD/AHTEG/BD-CC-2/2/2).

In light of the need to act and considering the outstanding cost-benefit-ratio as compared to technical emission reductions, there is a general consensus among the scientific community and within the international climate regime that the large source of emissions resulting from deforestation and forest degradation has to be reduced soon. However, since forests are worth more than the sum of their parts, it is not an option to focus on one target variable (carbon) and leave other forest functions and ES unconsidered, despite good reasons for practicable approaches and a quickly operable mechanism.

Concerning the financing mechanism, many risks and challenges arise from starting with a pure market-based system, e.g. unpredictable supply and demand of credits, and tremendous difficulties in accurately measuring and monitoring carbon stocks and fluxes. Since REDD will make performance-based payments, any mechanism will require robust estimates for both, the areas deforested and the changes of carbon stocks within those areas. To be fully and appropriately assessed, national monitoring capabilities have to be installed which will take considerable time; comprehensive monitoring and reporting even and still represents a challenge for industrialized countries (MOLLICONE *et al.* 2007). Therefore, it is necessary to combine pragmatism, e.g. through increasingly ambitious monitoring requirements and the inclusion of additional land use activities, and the principle of conservativeness in order to secure the environmental integrity of REDD. In this sense, a learning-by-doing strategy which is translated into a phased approach appears to be the most appropriate way with regard to the many unresolved questions and the existing capacities.

One of the main risks of REDD for biodiversity relates to the definitions presently applied under the Kyoto Protocol for forests and forest-related activities. Since REDD is a financial transfer mechanism with the intention to stimulate positive changes in developing countries, it requires a set of clear definitions which ensures that funds result in efficient and measurable progress without corrupting other environmental objectives, especially the conservation of biodiversity. Therefore, it is essential to agree on a forest definition which distinguishes between intact and non-intact natural forests (managed and/or degraded). Plantations should be excluded completely and be reported in a separate land use category, because setting incentives to transform high biodiversity forests into plantations can be considered as perverse, also regarding carbon storage.

The scope of REDD should widen once working and reliable monitoring and reporting systems are in place. However, from the biodiversity perspective, it is essential to ensure that REDD will not be based on an undifferentiated reporting of net deforestation rates. A widened scope of a REDD+ mechanism should include 'forest restoration' to close-to-nature secondary forests as a contribution to both, mitigation and adaption. Thus, the '+' should refer to ecologically sound activities which explicitly promote the multi-functionality of forests. In contrast to commercial plantations, restored forest ecosystems provide multiple benefits besides carbon storage and support the maintenance of different ES. Emerging structured stands with a diversity of adapted native tree species will likely be better able to adapt than monoculture systems to the challenges related to rapidly changing conditions. In order to include restoration, a well-elaborated definition and a 'good practice guidance' for such activities are needed.

Another major risk for biodiversity is a displacement of deforestation from one country to another, also referred to as international leakage. In order to reduce the risk, REDD must foster a broad participation from developing countries, implying the need to prioritize the flows of funding among and within countries (MILES & KAPOS 2008). This also concerns equity and (traditional) use rights issues of local forest and indigenous people. REDD should provide positive incentives to the wide range of tropical developing countries with differing stages of deforestation and national circumstances. Countries which are advanced in the forest transition curve would profit significantly more than those countries which still possess large forest areas and are at the verge of increasing their deforestation rates. In order to avoid this, national reference rates should be developed by an independent technical body and take into account historical and development of deforestation, as well as the individual country's 'state of forest transition' (SOFT). The proposed SOFT-factor is a transparent instrument that awards long-term progress by successively reducing the TTB and increasing the requirements for receiving compensation payments.

In conclusion, the success of the mechanism depends on its environmental integrity which should be the primary guidance for its design. Effectively reducing deforestation should be considered as an investment and not as a simple transfer of funds, because all of mankind will profit from the future ES provided by forests. If REDD will not lead to measurable and visible progress, the ability and willingness of industrial countries to compensate the renunciation of deforestation for development may cease quickly in a time marked by economic crisis. To further postpone a solution to the problem of increasingly depleted vital ES may be fatal for this and coming generations; the loss of these services is irreversible and the values destroyed are tremendous.

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Annex 1: abbreviations

AAU	assigned amount units
AR	afforestation / reforestation
CBD	Convention of Biological Diversity
CDM	clean development mechanism
CO_2	carbon dioxide
COP	Conference of the Parties
CP	commitment period
ES	ecosystem services
ESA	ecosystem approach
FAO	Food and Agriculture Organization
FONAFIFO	Fondo National de Financiamento Forestal (de Costa Rica)
FPA	Forest Protected Area
FSC	Forest Stewardship Council
GEF	Global Environment Facility
GHG	greenhouse gases
GMO	genetically modified organisms
GtC	Giga tone carbon (one billion tones)
ha	hectare
HCVF	high conservation value forest
HCVs	high conservation values
HiPs	High Priority Areas
IPCC	Intergovernmental Panel on Climate Change
IUCN	International Union for the Conservation of Nature
MRV	monitoring, reporting and verification
NGO	non-governmental organization
PA	protected area
PES	payment for ecosystem services
REDD	reducing emissions from deforestation and forest degradation
RMU	Removal Unit
SOFT	state of forest transition
t	one ton
TDERM	tropical deforestation emission reduction mechanism
TDERU	tropical deforestation emission reduction unit
TTB	tropical target baseline
UNFCCC	United Nations Framework Convention on Climate Change

Annex 2: deforestation data from 62 tropical countries

Country	Total forest cover			Total forest cover change				Primary forest cover				
	total area 2005 (1000 ha)	total forest area (1000 ha)	forest area 1990-2005	Annual change 1990-2005 (1000 ha)	Total change 1990-2000 %	Annual Change 1990-2000 %	Annual Change 2000-2005 %	Area 2005 (1000 ha)	Area 2005 %	Annual Change 1990-2005 (1000 ha)	Total change 1990-2005 %	Annual Change 1990-2000 %
Angola	124.670	59.104	47,4%	-125	-3,1	-0,2	-0,2	0,0	0,0	n/a	n/a	-0,1
Belize	2.296	1.653	72,0%	n/a	n/a	n/a	n/a	612,0	26,7%	n/a	0,0	-2,9
Benin	11.262	2.351	20,9%	-65	-29,2	-2,0	-2,4	-	n/a	n/a	n/a	n/a
Bolivia	109.858	58.740	53,5%	-270	-6,5	-0,4	-0,5	29,4	0,0%	-135,2	-6,5	-0,6
Brazil	851.488	477.698	56,1%	-2.822	-8,1	-0,5	-0,6	415,9	0,0%	-2974,9	-9,7	-0,1
Brunei	577	278	48,2%	-2	-11,2	-0,8	-0,7	278,0	48,2%	-2,3	-11,2	-4,1
Burkina Faso	27.400	6.794	24,8%	-24	-5,0	-0,3	-0,4	0,0	0,0%	n/a	n/a	-0,6
Burundi	2.783	152	5,5%	-9	-47,4	-3,2	-4,7	0,0	0,0%	n/a	n/a	n/a
Cambodia	18.104	10.447	57,7%	-167	-19,3	-1,1	-1,9	322,0	1,8%	-29,6	-58,0	-2,1
Cameroon	47.544	21.245	44,7%	-220	-13,4	-0,9	-1,0	-	n/a	n/a	n/a	n/a
Central African Republic	62.298	22.755	36,5%	-30	-1,9	-0,1	-0,1	-	n/a	n/a	n/a	n/a
Chad	128.400	11.921	9,3%	-79	-9,1	-0,6	-0,6	190,0	0,1%	-1,3	-9,1	n/a
Colombia	113.891	60.728	53,3%	-47	-1,2	-0,1	-0,1	53,1	0,0%	-52,8	-1,5	-0,2
Congo	34.200	22.471	65,7%	-17	-1,1	-0,1	-0,1	7,5	0,0%	-5,6	-1,1	-5,3
Costa Rica	5.110	2.391	46,8%	-12	-6,7	-0,7	0,1	180,0	0,0	n/a	-29,4	n/a
Côte d'Ivoire	32.246	10.405	32,3%	12	1,8	0,1	0,2	625,0	1,9%	n/a	0,0	n/a
D.R. Congo	234.486	133.610	57,0%	-461	-4,9	-0,4	-0,2	-	n/a	n/a	n/a	n/a
Dominica	75	46	61,3%	0	-8,0	-0,6	-0,4	27,0	36,0%	n/a	-3,6	n/a
Dominican Republic	4.873	1.376	28,2%	n/a	n/a	n/a	n/a	-	n/a	n/a	n/a	n/a
Ecuador	28.356	10.853	38,3%	-198	-21,5	-1,4	-1,7	4,8	0,0%	n/a	0,0	n/a
El Salvador	2.104	298	14,2%	-5	-20,5	-1,4	-1,6	6,0	0,3%	n/a	0,0	n/a
Equatorial Guinea	2.805	1.632	58,2%	-15	-12,3	-0,8	-0,9	-	n/a	n/a	n/a	n/a
Fiji	1.827	1.000	54,7%	1	2,1	0,2	0,0	894,0	48,9%	n/a	-0,1	n/a
French Guiana	9.000	8.063	89,6%	-2	-0,3	0,0	0,0	7,7	0,0	-13,9	-2,6	-0,1
Gabon	26.767	21.775	81,4%	-10	-0,7	-0,1	-0,1	-	n/a	n/a	n/a	n/a
Gambia	1.130	471	41,7%	2	6,6	0,4	0,4	-	n/a	n/a	n/a	n/a
Ghana	23.854	5.517	23,1%	-129	-25,9	-1,8	-1,9	353,0	1,5%	n/a	0,0	n/a
Guatemala	10.889	3.938	36,2%	-54	-17,1	-1,1	-1,3	2,0	0,0%	-26,8	-17,0	-1,3
Guinea	24.586	6.724	27,3%	-46	-9,2	-0,7	-0,5	63,0	0,0	n/a	0,0	n/a
Guinea-Bissau	3.612	2.072	57,4%	-10	-6,5	-0,4	-0,5	940,0	26,0%	n/a	0,0	n/a
Guyana	21.497	15.104	70,3%	n/a	n/a	n/a	n/a	9,3	0,0	n/a	n/a	n/a
Honduras	11.209	4.648	41,5%	-182	-37,1	-2,7	-2,9	1,5	0,0%	n/a	0,0	n/a
India	328.726	67.701	20,6%	251	5,9	0,6	0,0	-	n/a	n/a	n/a	n/a
Indonesia	190.457	88.495	46,5%	-1.871	-24,1	-1,6	-1,9	48,7	0,0%	-1447,8	-30,8	-2,3
Kenya	58.037	3.522	6,1%	-12	-5,0	-0,3	-0,3	704,0	1,2%	-2,5	-5,1	-2,3
Laos	23.680	16.142	68,2%	-78	-6,8	-0,5	-0,5	1,5	0,0%	n/a	0,0	n/a
Liberia	11.137	3.154	28,3%	-60	-22,3	-1,5	-1,7	129,0	1,2%	n/a	0,0	n/a
Madagascar	58.704	12.838	21,9%	-57	-6,2	-0,5	-0,3	10,3	0,0	-10,4	-1,5	-0,1
Malawi	11.848	3.402	28,7%	-33	-12,7	-0,8	-0,9	1,1	0,0	-39,7	-34,5	n/a
Malaysia	32.975	20.890	63,4%	-99	-6,6	-0,4	-0,7	3,8	0,0%	n/a	0,0	n/a
Mexico	195.820	64.238	32,8%	-319	-6,9	-0,5	-0,4	32,9	0,0%	n/a	-15,3	0,0
Myanmar	67.658	32.222	47,6%	-466	-17,8	-1,2	-1,4	-	n/a	n/a	n/a	n/a
Nicaragua	13.000	5.189	39,9%	-90	-20,6	-1,5	-1,3	1,8	0,0	n/a	0,0	-1,0
Nigeria	92.377	11.089	12,0%	-410	-35,7	-2,4	-3,1	326,0	0,4%	-82,0	-79,0	-0,6
Panama	7.552	4.294	56,9%	-5	-1,9	-0,2	-0,1	3,0	0,0	-45,5	-18,4	-0,9
Papua New Guinea	46.284	29.437	63,6%	-139	-6,6	-0,4	-0,5	25,2	0,1%	-266,6	-13,7	-0,4
Peru	128.522	68.742	53,5%	-94	-2,0	-0,1	-0,1	61,1	0,0%	-123,0	-2,9	-0,4
Philippines	30.000	7.162	23,9%	-227	-32,3	-2,5	-2,0	829,0	2,8%	n/a	0,0	n/a
Rwanda	2.634	480	18,2%	11	50,9	0,8	7,9	0,0	0,0%	n/a	n/a	n/a
Senegal	19.672	8.673	44,1%	-45	-7,2	-0,5	-0,5	1,6	0,0%	-10,7	-9,2	-0,8
Sierra Leone	7.174	2.754	38,4%	-19	-9,5	-0,6	-0,7	-	n/a	n/a	n/a	n/a
Solomon Islands	2.890	2.172	75,2%	-40	-21,5	-1,4	-1,7	-	n/a	n/a	n/a	n/a
Sri Lanka	6.561	1.933	29,5%	-28	-17,7	-1,1	-1,4	167,0	0,0	-6,0	-35,0	-5,1
Suriname	16.327	14.776	90,5%	n/a	n/a	n/a	n/a	14,2	0,1%	n/a	0,0	n/a
Tanzania	94.509	35.257	37,3%	-412	-14,9	-1,0	-1,1	-	n/a	n/a	n/a	n/a
Thailand	51.312	14.520	28,3%	-96	-9,1	-0,7	-0,4	6,5	0,0%	n/a	0,0	n/a
Togo	5.679	386	6,8%	-20	-43,6	-2,9	-4,1	0,0	0,0	n/a	n/a	n/a
Uganda	24.104	3.627	15,0%	-86	-26,3	-1,8	-2,1	-	n/a	n/a	n/a	n/a
Venezuela	91.205	47.713	52,3%	-288	-8,3	-0,6	-0,6	-	n/a	n/a	n/a	
Viet Nam	33.169	12.931	39,0%	238	38,1	2,5	2,1	85,0	0,3%	-19,9	-77,9	-1,1
Zambia	75.261	42.452	56,4%	-445	-13,6	-0,9	-1,0	-	n/a	n/a	n/a	n/a
Zimbabwe	39.075	17.540	44,9%	-313	-21,1	-1,4	-1,6	-	n/a	n/a	n/a	n/a
Total	**3.745.546**	**1.629.991**	**43,5%**	**-10.240**	**-8,3**	**-0,57**	**-0,62**					

source: http://rainforests.mongabay.com/deforestation_alpha.html, building on FAO data (FAO 2006)