Tropical deforestation and climate change

Towards an international mitigation strategy

Dissertation by

Johannes Ebeling

for the degree of
Master of Science in Environmental Change and Management
University of Oxford

August 2006

Comments, criticism, and suggestions are highly welcome!

Please contact me at
johannes.ebeling@ecosecurities.com
office +44 (0)1865 26 4010
mobile +44 (0) 770 799 2110

Photos: © Greenpeace/Daniel Beltra

ABSTRACT

This dissertation evaluates recent proposals to include tropical deforestation into international climate change mitigation strategies. Deforestation is responsible for up to 25 percent of global greenhouse gas emissions. The research aim here is to evaluate implications of a range of policy options for the environmental *effectiveness* of a prospective agreement, as well as for its political and economic *attractiveness* for different countries and stakeholders. A literature review, 48 key stakeholder interviews, analyses of submissions to the United Nations Framework Convention on Climate Change (UNFCCC), modelling approaches and statistical analyses were carried out to answer these questions. On this basis the study identifies potential deal breakers and explores possible solutions to existing "real" and perceived obstacles. Findings suggest that, given sufficient political will, an effective agreement between current UNFCCC Parties is feasible and that existing concerns can be addressed in pragmatic ways. Among the different policy alternatives, creating a new carbon trading mechanism under a post-2012 Kyoto regime is likely to deliver greatest economic and environmental benefits. Measuring emission reductions against national-level baselines based on historical base periods would increase the environmental integrity of resulting carbon credits. The study also finds that potential monetary benefits are distributed very unevenly between potential host countries, and that this may partly explain current negotiation positions. Complementary approaches, not based on emission trading, may have to be developed to foster broader support for an agreement. Finally, setting more ambitious emission reduction targets for industrialised countries would overcome concerns about "flooding" of carbon markets, and would make the most of a unique opportunity to tackle both climate change and deforestation.

ACKNOWLEDGEMENTS

Where to begin? First of all, many many thanks to my numerous interview partners, who found time in their busy schedule to endure a myriad of questions and to patiently lay out the complexities of carbon markets, satellite imagery, and global politics. In fact, their insights and those of all my unfortunate friends and family members whose tea-breaks turned into climate change debates generated so many ideas that it was genuinely impossible to squeeze them into the meagre number of words available for an MSc thesis!

I was very lucky to have Diana Liverman (ECI) and Robert Tippmann (EcoSecurities) as supervisors for this thesis, as well as Till Neeff and Jan Fehse who were willing to join this endeavour. I very much enjoyed working with all of you, and having pints of beer and tea, as well as relaxing dog-walks together!

Thank you to all the fantastic classmates – turned into friends – I have had throughout the year! I am also very grateful to John for putting together an amazing programme and to all the ECI staff who made this time so memorable for us (especially to Maria, Debs and Lisa who almost became the big sisters I never had – hmm, how cheesy does that sound….). I am equally indebted to all the EcoSecurities staff and fellow interns for all their support and a for great summer! Oh, and thanks again to John for allowing this acknowledgement rambling to remain unhampered by word count regulations (not that it really made a difference in this case…).

In addition, I am very thankful to those friends who (hopefully) remained my friends despite having to provide editing services with ridiculously short notice, and who had some valuable (and some not so valuable, albeit entertaining) ideas during the crucial last days, most of all Praveen Gopalan, Jennifer Henman, Helen MacMullen, Mai Yasue, and Martin Ebeling. On this note, also many thanks to Praveen, Przemek, and Matias for sharing our new home (the MSc room) during many long nights in the final two weeks! And a special thank you again to Mai, the Queen (or rather: Empress) of SPSS, among many other things.

Finally, thanks to Google Earth, for feeding me with awe-inspiring images of my study subject, although this did not exactly help the speed of writing. And – yes indeed, to the English weather, despite its reputation, for being actually quite agreeable and surprisingly sunny during the whole summer – or is it climate change?

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF ACRONYMS

AD	Avoided Deforestation
AOSIS	Alliance of Small Island States
A/R	Afforestation and Reforestation
BAU	Business as Usual
CBD	Convention on Biological Diversity
CCX	Chicago Climate Exchange
CDM	Clean Development Mechanism
CERs	Certified Emission Reductions
CI	Conservation International
CO_2	Carbon Dioxide
CO_2e	Carbon Dioxide Equivalent
CR	Compensated Reductions
CRN	Coalition for Rainforest Nations
ER	Emission Reduction
DR Congo	Democratic Republic of Congo
EU	European Union
EU ETS	EU Emissions Trading Scheme
FAO	Food and Agriculture Organisation of the United Nations
FSC	Forest Stewardship Council
G77	Group of 77
GDP	Gross Domestic Product
GEF	Global Environmental Facility
GHG	Greenhouse Gas
Ha	Hectare
HFC	Hydro-fluorocarbon
IGO	Inter-Governmental Organisation
IMF	International Monetary Fund
IPCC	Intergovernmental Panel on Climate Change
KP	Kyoto Protocol
LEBA	London Energy Brokers' Association
LUC	Land-Use Conversion
LULUCF	Land Use, Land-Use Change and Forestry
MDGs	Millennium Development Goals
NGO	Non-Governmental Organisation
ODA	Official Development Assistance
PNG	Papua New Guinea
SBSTA	Subsidiary Body for Scientific and Technological Advice of the UNFCCC
UN	United Nations
UNCCD	United Nations Convention to Combat Desertification
UNDP	United Nations Development Programme
UNFCCC	United Nations Framework Convention on Climate Change
VERs	Verified Emission Reductions
WBI	World Bank Institute
WWF	World Wide Fund for Nature

1. INTRODUCTION

1.1. Deforestation and climate change

Tropical forests play a central role in the planetary climate system, as well as in human-induced climate change. Deforestation in the tropics has turned them into one of the largest sources of current emissions of carbon dioxide (CO_2) – the most important greenhouse gas (GHG).[1] In fact, the destruction of tropical forests is second only to the combustion of fossil fuels in contributing to global warming (IPCC, 2001, IPCC, 2000). Deforestation accounts for up to 20 percent of global CO_2 emissions and for up to 25 percent of all global GHG emissions[2]. Almost all of this is attributable to forest conversion in the tropics (FAO, 2006, Houghton, 2005). Historically, approximately 270 Gt C have been emitted from the burning of fossil fuels and the production of cement, whereas 136 Gt C stem from land-use change (LUC), mainly through forest conversion (IPCC, 2000). During the 1990s, annual emissions from LUC were 1.6 ± 0.8 Gt C, almost entirely due to the loss of approximately 13 million ha of tropical forests per year (FAO, 2006, IPCC, 2001). Deforestation is also the largest source of emissions in the developing world (Houghton, 2005). When official GHG emission inventories are adjusted to include emissions from LUC, the figures for countries like Brazil may increase 2.5-fold (60 percent of Brazilian emissions stem from deforestation) (UNFCCC, 2005d).

The current legal framework under the United Nations Framework Convention on Climate Change (UNFCCC) and its Kyoto Protocol (KP) do not contain any mechanism to reward efforts aimed at preventing deforestation in developing countries. Instead, the possibilities to gain carbon credits from forestry activities under the Clean Development Mechanism (CDM) are limited to projects involving forest plantations (UNFCCC, 2001). Meanwhile, environmentalists have never ceased to point out that the scale of tropical deforestation's contribution to climate change corresponds to the potential of avoided deforestation (AD) to be part of the solution (e.g. Laurance et al., 2001, Totten et al., 2003).

The political debate gained new momentum in late 2005 when a proposal submitted to the UNFCCC by Papua New Guinea and Costa Rica on behalf of the recently formed "Coalition for Rainforest Nations" called for the inclusion of AD into future climate regimes. The proposal suggests creating a mechanism of compensation for countries which reduce their deforestation rates and thus their GHG emissions. It differs from previous approaches in that it recommends measuring deforestation prevention on a national level against a historical baseline, rather than focusing on individual forest conservation projects (UNFCCC, 2005c).

---

[1] See list of acronyms.

[2] The 25 percent figure includes estimated emissions of other GHGs which are associated with deforestation, namely CH_4, N_2O and CO (see Houghton, 2005).

The initiative comes at a critical time as the future of the current climate regime is being discussed. Participating countries are negotiating a new round of emission reduction targets and are evaluating additional mitigation options. Thus, the proposal has to be seen in the context of negotiations beyond the KP's first commitment period, which ends in 2012, where possibilities to modify the current political framework exist and a regime for rewarding AD is a policy option. The idea assumes an even greater importance in light of the broadening debate about a more significant participation by developing countries in future climate regimes. Some developing countries are already among the major emitters of GHGs today, and projections see China and others as surpassing the current top emitters before long (Sugiyama and Liu, 2004). If current trends persist, emissions from present-day developing countries will more than triple by 2050, accounting for over two thirds of vastly increased emissions by then (CNRS/LEPII-EPE et al., 2003) (see Figure 1). The previous exclusion of emission targets for developing countries contributed to the decision by the United States – responsible for over 20 percent of global fossil-fuel based emissions (UNFCCC, 2005d) – to opt out of the Kyoto Protocol and the limited geographical focus of the agreement continues to cause resistance also in other developed countries. Conversely, including developing countries into global mitigation efforts through a mechanism for avoided deforestation might entice other industrialised countries to join a post-2012 climate regime – while at the same time creating a major new and potentially cheap option for abating emissions. Suddenly, tropical deforestation and forestry more generally thus find themselves at the centre of a heated international climate policy debate.

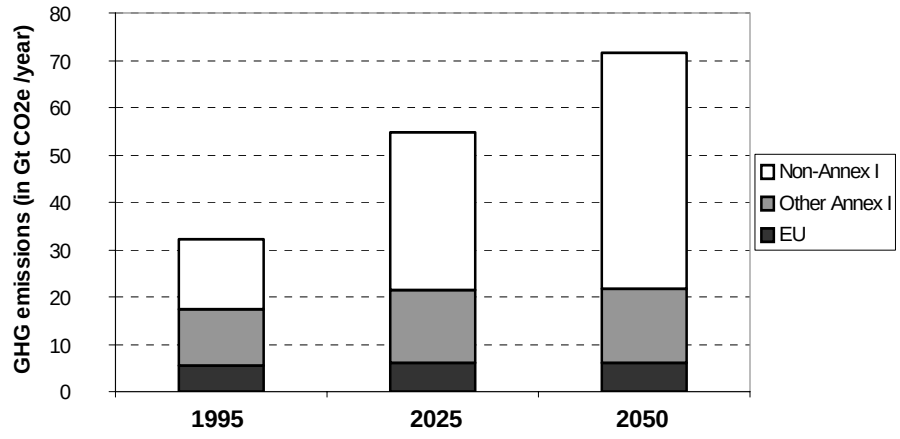

Figure 1 – Projected greenhouse gas emissions in different world regions

Source: Author's elaboration with data from (CNRS/LEPII-EPE et al., 2003) (CPI baseline scenario)

Initial responses to the AD proposal have largely been favourable. Apart from the aforementioned reasons this can be ascribed mainly to the increased sense of urgency that surrounds the climate change discussion. Since the KP was first signed in 1997, it has become clear that anthropogenic climate change is real and that its effects are already discernible today. Research and observations from all around the world, from melting polar ice-caps to an increased frequency of heat waves and floods (see Schellnhuber et al., 2006), have started to convince the remaining sceptics that climate change is more than "a theory" and that GHG emissions from human activities are the root cause. Preventing *dangerous* climate change, the

ultimate objective of the UNFCCC, has now become a policy priority for many countries. Several organisations and governments have adopted the stabilisation of atmospheric GHG concentrations and global warming (at no more than 2 °C above pre-industrial levels) as pragmatic mid-term goals (EC, 2005, ISSC, 2005). It is increasingly clear that current mitigation efforts are grossly inadequate and that new and additional approaches have to be implemented fast if we want to prevent the worst effects of global warming.

In addition, there has now been nearly ten years of experience with the flexible Kyoto mechanisms (see following section), especially the CDM, and many of the initial technical problems have been overcome. A number of carbon accounting methodologies for CDM "afforestation and reforestation" (A/R) projects have now been approved by the UNFCCC. There has also been significant technological and scientific progress which has established the forest-climate link much more strongly and has made monitoring from satellites, measurement of carbon stocks etc. more reliable and less costly (DeFries et al., 2005, Houghton, 2005).

Finally, avoided deforestation is not only strongly linked to climate change but also to other pressing global problems, perhaps most importantly the loss of global biodiversity. Tropical forests are home to more than half of the estimated global biodiversity (possibly 60 to 90 percent of the world's terrestrial species) and forest conversion and degradation are major contributors to its rapid decline (UNEP, 2001). Protecting tropical forests makes sense for a variety of very good reasons and time is running out. This has aligned an unusually broad base of supporters behind the proposal which is at the centre of this thesis.

1.2. Avoided deforestation and forestry under Kyoto

The UNFCCC was signed at the "Rio Earth Summit" in 1992, along with the Convention on Biological Diversity (CBD) and the Convention to Combat Desertification (UNCCD). The Kyoto Protocol to the climate framework convention established a binding target for GHG reductions of five percent below 1990 levels for industrialised countries, which are listed in the "Annex 1" of the UNFCCC. This target, to be met in the Protocol's first commitment period from 2008 to 2012, follows the principle of *common but differentiated responsibilities* according to which the historical polluters of the atmosphere should initiate emission reductions. Consequently, developing ("Non-Annex 1") countries do not have any quantified obligations to cut emissions.

In order to reduce the overall compliance costs, the KP contains three flexible mechanisms through which emission reductions can be implemented where this is most economically efficient. These are:

- *Emission Trading*, which allows for the trading of emission allowances between Annex 1 governments,

- *Joint Implementation* (JI), which allows crediting of emission reduction projects implemented in other Annex 1 countries, and the
- *Clean Development Mechanism* (CDM), which allows crediting of projects implemented in Non-Annex 1 countries.

Certified emission reductions (CERs) achieved by CDM projects, including forestry projects, can be used by developed countries to meet their emissions reductions target. CERs are fully exchangeable (*fungible*) with other carbon credits under Kyoto (UN, 1992, UNFCCC, 1998, UNFCCC, 2005a).

Under current Kyoto regulations, conserving tropical forests cannot be used to gain carbon credits and only planting of new forests qualifies under the rules of the CDM. In addition, a maximum of one percent of an industrialised country's base-year emissions may be offset annually by CDM forestry projects, and, importantly, forestry is the only sector for which "temporary" carbon credits were developed. These types of credits impose a replacement liability on the buyer, making forestry carbon credits less attractive than "normal" CERs (Chomitz and Lecocq, 2003, Pedroni, 2005).

There are several reasons for the restrictive handling of forestry CDM activities and for the exclusion of project-level forest conservation. The negotiations which eventually lead to the Marrakech Accords in 2001 were embroiled in a controversial and heated debate about *sinks* (as opposed to *sources*) for GHG emissions in the land-use sector. The suggestion to include sinks, mainly in the form of forests[3], was made when emission targets were already set by Kyoto Parties. This led to fears that forestry activities would simply "off-set" other mitigation efforts, thereby not leading to a net reduction in emissions but furthermore delaying the necessary re-structuring of our fossil-fuel based economies (expressed by the NGO slogan "Don't sink Kyoto!"). Projections of vast quantities of cheap forestry credits *flooding* the carbon markets and depressing the price of tradable emission permits led to similar concerns. Cheap credits, while commercially desirable, would decrease incentives to invest into energy-related emission abatement and *crowd out* such activities. In addition, *leakage* – the displacement of emission-generating activities outside of the project boundaries without actually reducing them – seemed impossible to quantify or to prevent.

The same applied to the risk of reversal, or *non-permanence*, of emission reductions if sinks were to be destroyed, e.g. by burning or cutting down forests. There were also fears of creating perverse incentives by punishing "good" behaviour (low emissions from deforestation) in the past while rewarding projected "bad" performance (high emissions). Added to this were uncertainties in monitoring and measuring carbon fluxes from land-use and forestry, as well as sovereignty concerns: Paying poor developing countries for keeping certain areas under forest cover for a long time and thereby restricting other development options on these lands was

[3] Trees sequester CO_2 and store it as carbon in their biomass.

portrayed by some as a form of expropriation and neo-colonialism (see Dessai et al., 2005, Fearnside, 2001).

The new proposal, submitted at the last Conference of the Parties (COP 11) to the UNFCCC, in Montréal in November 2005, implicitly aims at incorporating emission credits from AD into global carbon markets. The declared objective by the "Rainforest Coalition" and its supporters is to either open up the CDM for forest conservation by revising the Marrakech Accords, to create a new mechanism for AD credits by amending the KP, or to develop a linked 'optional protocol' under the UNFCCC (Rainforest Coalition, 2006).

In simple terms, the approach which has also been labelled "Compensated Reductions" (CR) (Santilli et al., 2005), would reward countries which demonstrate a reduction of country-wide deforestation below a baseline, based on average historical *national* deforestation rates (see Figure 2). Using satellite based remote sensing imagery, real reductions would be measured *post facto* over an agreed monitoring period. The avoided carbon emissions would be calculated based on the conserved forest area and participating countries would be issued with internationally tradable emission allowances. To ensure permanence of emission reductions, host nations would make a "continued commitment" to stabilise and reduce deforestation in the future. In addition, a portion of the allowances, rather than being immediately tradable, may be held in a carbon banking mechanism which credits early action and debits compliance failures during later years (UNFCCC, 2005c). In contrast to current CDM projects, host countries would maintain full autonomy over how to achieve emission reductions through AD. Whereas the monetary incentives to lower deforestation are to be provided on an international level, the choice and implementation of measures by which to achieve this target would be a decision of sovereign domestic policy-making. In principle, national-level policies and measures span a wide range of options from command-and-control approaches to market-based incentives, and they could consist of the strict enforcement of land-use regulations to sophisticated schemes of payments for environmental services (PES).

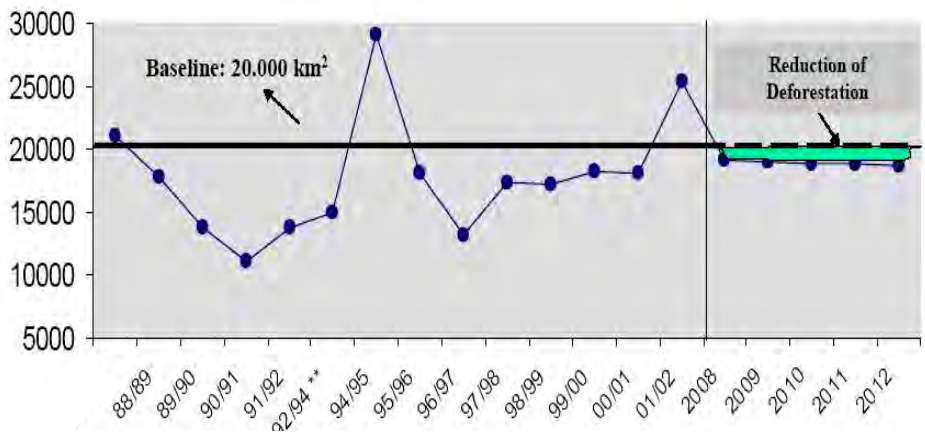

Figure 2 – Crediting for avoided deforestation against a (hypothetical) base period.

The Montréal AD proposal has led to an ongoing consultation and negotiation process, including initial submissions of positions by governments, intergovernmental organisations and NGOs in early 2006, as well as expert workshops, and dedicated sessions during UNFCCC meetings (UNFCCC, 2005b, UNFCCC, 2006a). The general aim is to include crediting for AD into a post-2012 Kyoto regime. Many developing and industrialised countries, as well as most NGOs have adopted generally supportive positions and some of the previous opponents of *sinks* are now among the most committed supporters (see UNFCCC, 2006b, as well as NGO submissions). The CR proposal addresses what many perceive as a major gap in the current Kyoto framework while circumventing some earlier problems of project-based approaches, and it provides hope for large-scale financing of biodiversity conservation and development. However, some stakeholders favour project-based approaches over national level accounting for a number of reasons (see Section 6) and the option of creating a modified CDM-type crediting approach is still on the negotiation table.

1.3. Research objective and overview

While the CR proposal is a big step forward and has generated considerable excitement, there are still many open questions and potential obstacles. Whether a system of international monetary incentives for AD will be established, and in what form, is thus far unclear. The challenges relate to technical aspects (regarding forestry definitions, methodologies for carbon accounting, monitoring, etc.) on the one hand and political and economic issues (such as financing, targets and commitments, baseline setting, etc.) on the other hand. Arguably, the latter are more decisive for reaching an international agreement. Technical disagreements could be resolved given sufficient political will and adequate perceived benefits for individual countries.

The general aim of this thesis is to provide a comprehensive and unbiased assessment of the most widely discussed policy options for including AD in an international climate change mitigation strategy. Furthermore, it seeks to identify the main hurdles to reaching an international agreement and proposes workable solutions which address existing concerns of key stakeholders.

After introducing my research methodology (Section 2), I will evaluate a range of options for a prospective mechanism of CR regarding

- The international legal framework (Section 3)
- Financing mechanisms (Section 4)
- Carbon crediting for avoided deforestation (Section 5).

I will assess implications of these alternative options along three dimensions:

1) Environmental effectiveness for climate change mitigation

2) Economic attractiveness and political acceptability for different stakeholders
3) Technical feasibility of implementation.

Incorporating the results of this analysis, I will seek to identify and explain the positions and interests of the main players in the international negotiations and to identify alliances between them. This will provide the basis for identifying key obstacles to reaching an international agreement, i.e. potential "deal breakers" (Section 6). In the subsequent section, I will propose ways to overcome most of these obstacles and conclude by outlining areas for urgently needed future research and policy advice (Section 7).

Although I endeavour to give a comprehensive overview of the range of proposed policy options, I will focus on the ones which have generated most discussion and/or received most support. For example, while I will outline a range of possible financing tools, I will dedicate most room to exploring options and implications of linking AD to international carbon markets. In the same way, I will mainly explore options of integrating AD into a post-2012 climate regime, as opposed to other possible time frames. I will discuss technological questions and those relating to the natural science base of carbon forestry but only to the extent necessary for understanding their political and economic implications. Other studies have already dealt with many of these aspects (see e.g. DeFries et al., 2005, Schlamadinger et al., 2005) and in many ways the political framework determines the scope of methodological problems that need to be resolved. The effective national-level implementation of AD targets is obviously crucial for realising emission reductions and co-benefits from forest conservation on the ground. However, the focus of this dissertation is on design-options for an *international* system of incentives for emission reductions from deforestation, and questions regarding translating them into domestic policies and measures can only be touched upon.[4]

[4] See (Moutinho and Schwartzman, 2005) for more detailed assessments of respective policy options, including estimations of opportunity costs and necessary monetary benefits from an international carbon finance approach.

2. RESEARCH APPROACH AND METHODOLOGY

This dissertation follows a mixed-methods approach and incorporates a literature review, expert interviews, statistical analysis, and modelling approaches (Crestwell, 2003). I reviewed scientific publications and grey literature on climate change policy, tropical deforestation and forest ecosystem dynamics, carbon forestry, and carbon markets. This included policy documents and submissions made to the UNFCCC in response to the Montréal proposal by and on behalf of about 70 governments and over a dozen NGOs and intergovernmental organisations (IGOs). I extracted recurrent statements and concerns from the various submissions, identified main themes and compiled an overview matrix (see Appendix 2)[5] to identify positions and policy preferences of Parties and other organisations. I complemented and clarified stakeholder positions during key informant interviews (see below).

During a three-day expert workshop on "Reducing Emissions from Deforestation in Developing Countries" in May 2006, I conducted informal interviews with a number of participants and observed the discussions and emerging negotiations. In addition, I carried out 48 semi-structured expert interviews with key stakeholders from around the world in between May and August 2006. These were selected by identifying key informants within organisations likely to be affected by the issue, by reviewing publications and other contributions to the discussion, and by recommendations by other experts. Table 1 gives an overview of the stakeholder groups and the sample size in each.

Stakeholder group	Sample size (N)
Government agencies	7
Research organisations and universities	14
NGOs	8
Intergovernmental organisations (IGOs)	10
Private sector consultancies, and project developers	9

Table 1 – Interviewee sampling by stakeholder group

Initial contact to most informants was established via e-mail in which I outlined the purpose of the study, identified myself as a consultancy intern and university student. At the beginning of each interview, I assured interview partners of strict confidentiality to increase chances of obtaining sensitive political information. Interviewees were partly conducted in person and over the phone, in English, Spanish, and German language. In carrying out interviews, I followed an interview guide focussing on interviewees' individual expertise. All interviews were anonymised, roughly transcribed and subsequently organised by questions and themes. A list of all interviewees and their affiliations is provided in the Appendix; however, statements and

[5] This builds upon meticulous work by Environmental Defense (unpublished), which I gratefully acknowledge.

information cannot be traced back to individual interviewees. I relied mainly on advice given by Bernard (2002) and Crestwell (2003) in designing the questionnaire and for conducting and analysing interviews.

I modelled potential carbon incomes for developing host countries using Excel and SPSS software and carried out a range of statistical analyses, e.g. on correlations between forest carbon densities, governance capacities and income potentials. I used FAO data for land-use change, the forestry sector, biomass and carbon dynamics, IPCC reports for GHG emission data, carbon market intelligence generated by PointCarbon, the World Bank, EcoSecurities and LEBA, macro-economic indicators provided by IMF, UNDP and the World Bank, governance indicator data calculated by the WBI, and I complemented all this information with data from scientific literature and expert interviews. Computing methods used for generating specific graphs and tables are described in the respective sections which also contain detailed references for all data sources. Six countries were dropped from the dataset because no information was available for two or more indicators. This mainly concerns small island states but also Cuba, and North Korea. Together these countries account for less than 1.5 percent of global deforestation and omitting them did therefore not introduce significant inaccuracies error into the statistical analysis. Where this was feasible, missing data-points were extrapolated from existing data.

The study thus follows a "hybrid" research approach, combining advantages of quantitative empirical analysis with those of qualitative investigation (Brady and Collier, 2004, King et al., 1994). The former allowed me to include a large sample of country-specific data (close to 100 percent of developing countries), thereby reducing error and increasing accuracy and generalisability of findings. The latter provided room for more open-ended probing during interviews and in-depth assessment of select study cases (countries, positions, etc.).

Limitations of research

Limitations of research for this paper arise mainly from the fact that most interviews were carried out over the phone. This probably created confidentiality issues with some interviewees, especially regarding sensitive information related to ongoing negotiations. However, I conducted a number of face-to-face interviews and had previously met about a third of the informants contacted by phone. Overall, I knew roughly half of the informants before respective interviews took place and this helped to reduce data gaps and biases.

In addition, there is a clear over-representation of certain segments of the epistemic community as most interviewees were either based or trained in Western industrialised countries and most of the cited literature originated there. This probably caused a bias towards certain kinds of preferred policy options and regarding the evaluation subjective information. Finally, researching a topic which is in the midst of a dynamic policy process invariably carries the risk of missing important developments or relying on outdated information. I tried to counter this risk by cross-checking information with multiple sources and by maintaining contact with several key interviewees to obtain updates on recent developments.

During the course of this study, I worked in close association with staff from EcoSecurities, a CDM developer and carbon trading company in Oxford. This collaboration provided me with valuable, difficult-to-access information on the carbon market and project development and greatly facilitated the contact with a number of interviewees. At the same time, however, some industry and government informants were less willing to share insights with a potential "competitor" or partisan stakeholder. However, the dual role of a "neutral" university-based researcher and private-sector consultant generally proved beneficial.

3. OPTIONS FOR AN INTERNATIONAL POLICY FRAMEWORK

The legal form of an international agreement will pave the way regarding the nature of a mechanism for avoided deforestation (AD). If and where the proposed mechanism fits into the existing UNFCCC architecture will largely determine the financing sources and incentives for avoided tropical deforestation but also the importance of many methodological issues. For example, whether or not a new compensation scheme can rely mainly on donor financing as opposed to carbon markets is directly linked to the legal policy framework. Similarly, resolving questions regarding baseline setting and carbon accounting is only crucial under approaches involving trading of emission credits. This section will assess the main options for an international policy framework (see Table 2):

- Option 1: Creating an additional trading mechanism under the Kyoto Protocol for crediting in the post-2012 commitment period
- Option 2: Creating a separate protocol to the UNFCCC, possibly involving trading of a special type of credits
- Option 3: Creating a new dedicated fund for measures to combat deforestation under the UNFCCC.

In addition, I will discuss the fallback option of:

- Option 4: Relying on voluntary carbon markets in the absence of an intergovernmental agreement,

as well as briefly outlining

- Option 5: Additional theoretical options of international arrangements which are not at the centre of the discussion but relevant for a complete picture.

For each option, I will discuss the implications for possible sources of financing. A detailed assessment of the scale and likelihood of these funding sources is presented in Section 4.

Table 2 provides an overview of the aforementioned options, as well as of their implications for the source of AD financing. I will address both of these in turn.

Legal option for avoided deforestation incentives	Financing implications
1.1. New Kyoto mechanism (national non-Annex 1 crediting)	Fungible with Kyoto carbon markets
1.2. Modified CDM approach	Fungible with Kyoto carbon markets
2.1. Additional UNFCCC protocol	Not fungible with Kyoto carbon markets Possibly separate forestry carbon market or donor funding
3. Dedicated funding	Not fungible with carbon markets Donor funding (ODA type)
4. Voluntary markets (i.e. no inter-governmental agreement)	Not fungible with Kyoto carbon markets Private carbon and biodiversity markets

Table 2 – Legal options for an international agreement on avoided deforestation.

3.1. Option 1 – Creating an additional Kyoto mechanism

Including avoided deforestation in a post-2012 Kyoto framework is the policy option which takes up most room in the current international discussion and, at the same time, seems to enjoy the support of most Parties and stakeholders (see Section 6). It is also the solution implicitly favoured in the original Montréal proposal. The idea is to create a completely new flexible mechanism for AD in developing countries next to the existing ones (the Compensated Reduction (CR) proposal, see Section 1.2).

This could be done in a reformed version of the current Kyoto Protocol or a successor protocol for the second commitment period which is currently being negotiated. Tradable carbon credits would be generated by accounting for reduced emission from deforestation either on a national level – the original proposal, which resembles a sectoral CDM approach – or on a project level (see Section 5). The latter case would most likely involve modifying the Marrakesh Accords which specify activities eligible under the CDM by including forest conservation projects. In either case, these credits from AD would be fungible, i.e. fully interchangeable and equal in value, with existing types of carbon credits.

It is the implications for the source of funding for forest protection which make this approach so attractive in the eyes of many. Fungibility of credits means that, in principle, the full extent of existing Kyoto carbon markets would be accessible for tropical forest conservation. This is a market which, even at its current "fledgling" stage, is worth several billion euros a year and is projected to grow significantly (see below). Integrating AD into Kyoto is the only way to make this market directly accessible for forest conservation activities. Almost all the other policy options discussed below would require fairly complex structures in order to establish links to existing carbon markets which may not, realistically, be politically feasible. The most challenging hurdle to the Kyoto option, however, is that it would require the consent of all 164

current Parties to the protocol, which would have to sign an ensuing agreement (UN, 1969, UN, 1992) (Interviews: 2, 11, 43).

3.2. Options under the UNFCCC and outside of Kyoto

3.2.1. Option 2 - Creating a separate protocol to the UNFCCC

If parties cannot agree to include AD in the existing or a modified Kyoto agreement, another option would be the creation of a separate protocol to the climate framework convention. One advantage would be that not all of the current Parties to Kyoto would have to sign the new agreement and the latter could just include supportive nations (UN, 1969, UN, 1992). This option would give the specialised "forestry protocol" the same legal status as the current Kyoto Protocol. Such a protocol would provide signatory Parties with a range of options for establishing reward mechanisms for AD. Most importantly, signatories could establish targets for reductions of emission from deforestation which could be met by specialised AD carbon credits. Here again, both national baseline and project-level crediting would be options. The architecture of such an agreement could follow the current KP and the proposed CR mechanism in that industrialised countries would take on binding emission reduction targets – however, only for emissions from tropical deforestation in this case – which they could meet by purchasing carbon credits from developing country governments or project developers (respectively for national and project-level accounting options).

The described additional protocol and carbon crediting would effectively create a second carbon market next to the existing Kyoto market. To the degree that signatory parties overlap, it would in fact be a parallel market with the same players. In theory, signatories of each protocol could agree on a linking accord that would allow credits generated under another protocol into the KP market (Interviews: 11, 43).[6] However, this is not very likely to happen given that the need for a separate protocol in this scenario arises precisely from the inability to reach an agreement on whether to allow crediting for forest conservation. Nevertheless, a different kind of *indirect* linkage could arise if there is sufficient overlap between the Parties to each of the protocols which accept emission reduction obligations. One could imagine that, e.g., Annex-I countries take into consideration their obligations accepted under the different protocol when they negotiate their (post-) Kyoto targets. In this way, there would in fact be a certain degree of merging of the two markets, which could even be reflected in prices of credits (see Section 4.3.1). Nonetheless, these are hypothetical and fairly uncertain "linkages" and would not represent the same degree of access to finance and reliability as the option of including AD directly under Kyoto.

[6] To a certain extent this would be similar to the Directive linking the EU emissions trading scheme with Kyoto (2004/101/EC).

Negotiating a separate Annex C to the Kyoto Protocol (in addition to the current Annex A and B, which specify the accounted for GHGs and the national emission targets respectively) is an alternative option with similar implications as creating an additional protocol to the convention. Such an annex could only include a subset of Kyoto Parties that agree on a trading approach for AD. The same problems would arise because parties would have to agree on the fungibility of credits and on linking markets, or create a separate, restricted market.

3.2.2. Option 3 – Establishing a new international fund

The main alternative to the aforementioned trading approaches is the establishment of a new international fund dedicated to avoided tropical deforestation. This could be a specialised fund, directly linked to the UNFCCC mandate, or involve the extension of existing financing initiatives, such as the Global Environmental Facility (GEF). This new fund would have to rely on contributions from governments or other donors. Some stakeholders favour the creation of a novel funding source through, e.g., the taxation of international aviation or similar market-based non-trading approaches, but this appears unlikely to be supported by a majority (see Section 6).

In contrast to mechanisms relying on the trading of quantified carbon credits, an ODA-type approach would most likely not be coupled to specific carbon emission reductions but would fund a broader set of policies and measures. However, in principle, financial incentives could also be linked to quantified reductions in deforestation or their equivalent in carbon emissions.

3.3. Option 4 – Using voluntary markets

Voluntary carbon markets are the most important fallback option in case of a failure to reach an inter-governmental agreement. Such markets exist in a variety of forms and shapes and rely on individual companies, consumers, or state agencies wishing to voluntarily "offset" all or part of their carbon emissions. Various project developers and traders offer them the option to buy "verified emission reductions" (VERs, as opposed to the Kyoto-based "certified emission reductions", CERs, both representing 1 t CO2e). This is a market which does not arise directly from government regulations and relies on private sector initiatives. It consists mainly of bilateral deals between market participants, although a few more centralised trading points exist (Taiyab, 2005). In addition to carbon emission markets, there are also emerging non-governmental markets for ecosystem services, frequently linked to biodiversity (Scherr et al., 2004), which could also be tapped into for avoided tropical deforestation.

3.4. Option 5 – Additional options

Apart from the policy options outlined above, there are additional alternatives that are sometimes mentioned in the international discussion. None of them are at the focus of the current debates and negotiations because they are either not politically desirable or practicable, or because they do not seem technically feasible.

One possibility is to promote the inclusion of AD in regional, geographically limited markets, such as the EU ETS, domestic US American carbon markets, or a future Asian-Pacific market. In principle, these markets could be linked through reciprocal agreements. This approach would have the advantage of not needing an agreement by all current Kyoto Parties which could greatly facilitate the negotiation and implementation process. On the other hand, the geographical limitation would also restrict the scope and scale of respective markets and any linking accord would in turn need the consent of all members to the different regional agreements, making this equally unlikely as some of the alternatives. Nevertheless, given the uncertainties regarding the future of the Kyoto Protocol and potential difficulties to reaching a "global" agreement, regional markets may be a pragmatic solution. The source of funding under such regional arrangements would entirely depend on their internal regulations, such as whether they rely on voluntary reductions or government-mandated targets and how emission allowances are allocated.

In an extension of the current Annex-1 obligations under Kyoto, developing countries could, in theory, accept binding targets under a prospective agreement. However, most Non-Annex 1 governments have made it clear that this is not an acceptable policy option at present and that the UNFCCC's principle of "common but differentiated responsibilities" excludes any obligations for non-industrialised countries at the current stage (UNFCCC, 2006b).

4. FINANCING OPTIONS

The preceding section has demonstrated the implications of different forms of an international agreement for the *source* of finance for avoided deforestation. The main differences relate to the kind of potential carbon markets on the one hand, and to the distinction between any carbon markets and donor funding on the other. In the following sections I will assess the scale of funding which could become available through the various options and elaborate on some effects of introducing credits from AD to carbon markets and interdependencies between such markets and forest conservation efforts. Because of the relative importance in the international discussion of the policy option of including AD in Kyoto carbon markets, I will discuss implications of this option in greatest depth and start by examining the alternatives – dedicated funds, voluntary carbon markets, and non-Kyoto regulatory carbon markets - more briefly.

4.1. Dedicated funds

As mentioned above, possible sources of funding for tropical deforestation avoidance outside of carbon markets would be new dedicated funds or the extension of existing ones. It is possible that the current momentum and policy attention surrounding GHG emissions from deforestation may increase governments' willingness to provide increased funds for that purpose. . It is important to keep in mind that similar claims for increased public finance have been and are being made by adherents to a range of different causes, including global poverty alleviation, the eradication of tropical diseases and biodiversity conservation. Some of these overlap with the deforestation and climate change agenda but it is obvious that even large international campaigns have only managed to raise fairly limited amounts of money and that any newly established international fund would have to compete for scarce public resources Similar hurdles apply to non-governmental funds generated through proposed novel mechanisms such as taxing international aviation. In theory, levying a one cent tax on each litre of the 101 million tons of fuel consumed by airlines globally each year (Lee et al., 2004)[7] could generate over US$ 1 billion per year. Political resistance is likely to be prohibitive due to the same reasons that have allowed the current tax-free status of kerosene to persist in virtually all countries.

To get a sense of the potential magnitude of publicly available funds, it is helpful to consider figures of current bi- and multilateral government funding for forestry and biodiversity conservation. While exact numbers are very difficult to establish, a recent UN study concluded that international funding for forestry totalled about US$ 1.1 billion annually during the last decade (Tomaselli, 2006). This number includes investments into the forest industry and expenditures on forest protection are probably much lower. A different study, carried out by Conservation International estimated overall ODA funding for biodiversity conservation to be

[7] Data distinguishing international from domestic fuel consumption in aviation is not available.

about $ 800 million per year, of which a significant proportion was spent on tropical forest ecosystems (Conservation International 2003).

While these sums may seem considerable in absolute terms their relative potential impact becomes much less significant when one considers the vast extents of tropical forests and the opportunity costs to conservation arising from competing land uses, particularly agriculture. In addition, many observers note the poor historical record of forestry measures funded through international donors. The acting director of the Rainforest Coalition calls it "ODA and pray!"[8], a phrase which captures the feelings and frustrations of many involved in tropical forest conservation.

This is not to say that funds which are not linked to carbon markets do not have a useful role to play; crucial components of most trading approaches rely on donor funding. For example, establishing credible satellite-based monitoring systems, as well as initiating certain forest conservation measures involves significant up-front investments which may be difficult to afford for some of the poorest nations. Maturing carbon markets are beginning to provide sophisticated financial products when established technologies and reputable project partners are concerned. However, when it comes to including future contracts for carbon credits which have not yet been generated, it is unlikely that funding will be available on a sufficient scale for the prospective and very risky markets for emission credits from AD (Interview: 19, 38, 4).

4.2. Voluntary carbon markets

Compared to regulatory carbon markets, e.g. Kyoto markets, and donor funding, the scale of funds available in voluntary markets is even more difficult to predict. The market size depends on decisions by countless individual actors, such as companies or consumers, to purchase emission offset credits (VERs). Voluntary carbon markets are much more amorphous than regulatory ones because they are not contained in any overarching framework. For this reason it is very challenging to estimate even their present size (Taiyab, 2005).

The largest existing trading hub for VERs is the Chicago Climate Exchange, which in 2005 had transactions of 1.4 Mt CO_2e at US$ 2.8 million. Although this number is growing, it only amounts to a tiny fraction of the estimated US$ 12 billion brokered on regulatory carbon markets over the same period (see below). There are no published estimates on the total volume of direct, bilateral transactions (between project developers / brokers, and customers), which make up a significant share of the total voluntary carbon market (PointCarbon, 2006). In principle, voluntary emission markets could be complemented with biodiversity- and ecosystem-service markets; however, these markets are still in a nascent stage and both are unlikely to reach drastically increased volumes in the foreseeable future.

[8] Kevin Conrad, during an expert workshop in Bad Blumau, Austria, 12 May 2006.

It is mainly because of the limited size of both public international conservation funds and voluntary markets that so many stakeholders favour funding options for AD which rely on regulatory carbon markets, preferably under the Kyoto framework. Many observers have been frustrated by the limited availability and effectiveness of existing funds over the past few decades and the hopes placed on carbon markets, in many ways, provide the rationale for the Montréal proposal (Interview: 44, 4, 36, 12, 38).

4.3. Regulatory carbon markets

Regulatory, as opposed to voluntary, carbon markets are founded on a public policy framework. There are currently several of these markets, among which the EU ETS and Kyoto trading systems are the most significant (World Bank, 2005). Placing a proposed compensation mechanism for AD within markets created under the UNFCCC or KP would involve issuing fungible, i.e. tradable, carbon credits for emission reductions.

Including AD as an additional emission abatement option would lower the aggregate marginal and total costs of climate change mitigation. This is especially true if (and it is a big "if") reducing emissions from deforestation proves to be considerably cheaper than the main existing alternatives, as is alleged by critics and praised by supporters (see below). Figure 4 contains hypothetical marginal abatement cost curves for emission abatements in the fossil fuel sector, the forestry sector, and a combination of the two. The concept of "marginal" abatement costs (MAC) refers to the cost of abating the "next" ton of carbon, e.g. by burning one ton of coal or cutting one tree less. Because it becomes more costly to reduce this extra ton of carbon the more has already been achieved, MAC curves slope upward. The total abatement cost (TAC) is represented by the area underneath each curve. Avoiding deforestation is assumed here to be cheaper than fossil fuel-based abatement, but even if this were not true, average aggregate abatement costs curves would drop by incorporating additional mitigation options.

The current mitigation target under Kyoto (Q1) is to be achieved without emission credits from CR. This leads to a certain per unit cost (P1) on the fossil fuel MAC curve, corresponding to the TAC. By incorporating avoided deforestation as a mitigation option, the total cost of reaching Q2 could be reduced by the area depicted in Figure 3. By the same token, a more ambitious reduction (Q2) could be achieved for the same total cost (Figure 3).

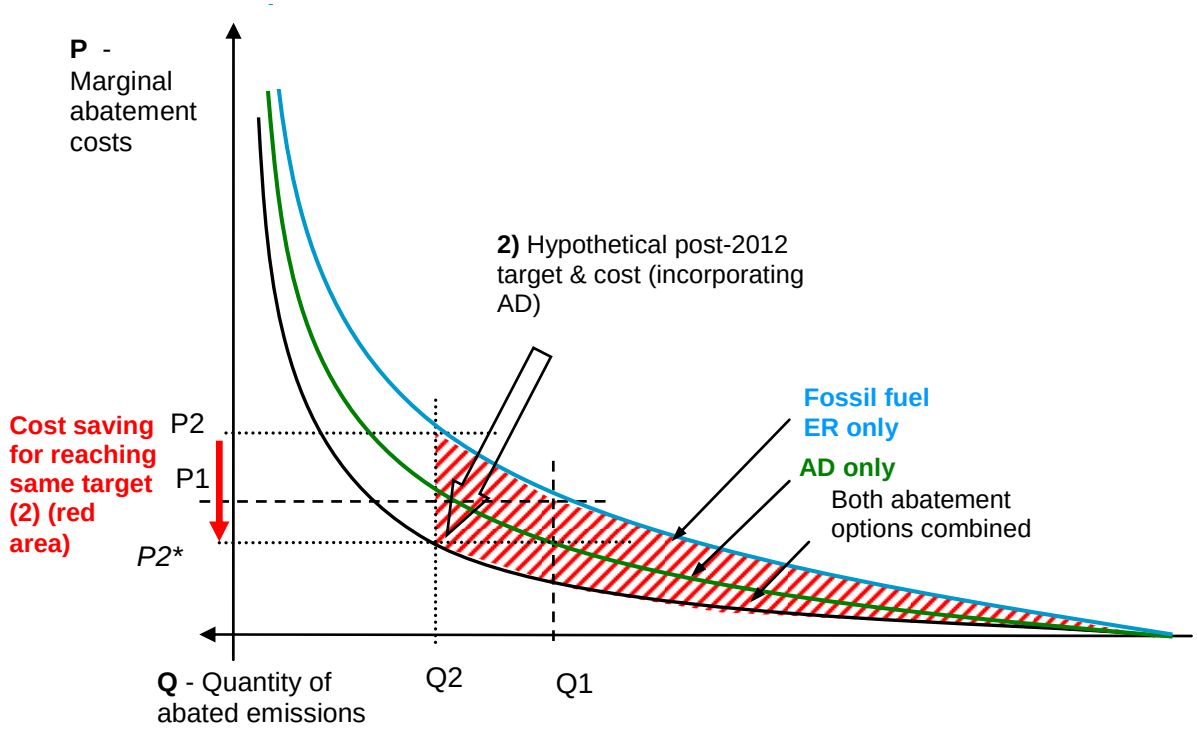

Figure 3 – Cost savings through incorporating Avoided Deforestation.

Note direction of axes.

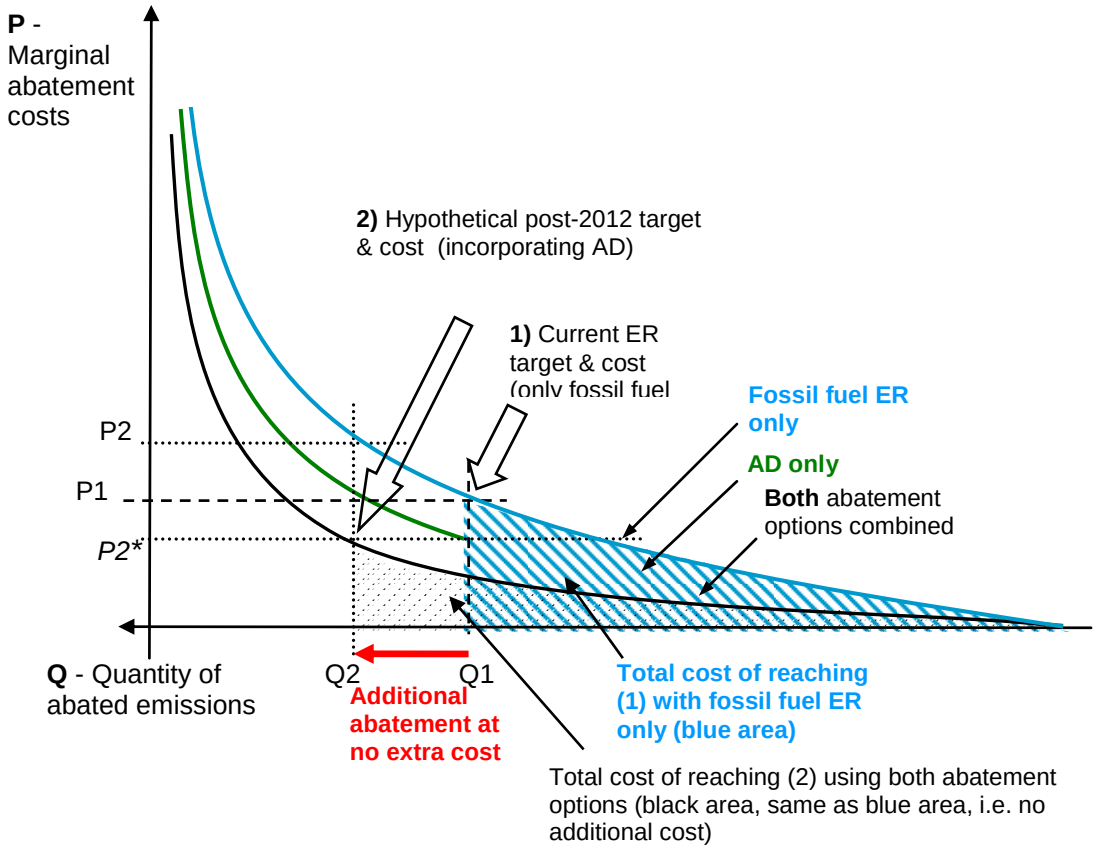

Figure 4 – Costs of different abatement strategies.

4.3.1. Potential market volume of CR credits (Kyoto option)

The graphs in the preceding section contain hypothetical abatement cost curves for AD. Unfortunately, no one knows the real shape of these curves, i.e. the costs of reducing deforestation on an aggregate, global or regional level. Abstract as they may be, MAC curves translate into the supply of carbon credits from CR at a given (or expected) carbon price, i.e. they represent the scale by which deforestation and associated emissions could be reduced under a trading regime. Costs of reducing forest conversion mainly depend on opportunity costs of foregoing other land-use options, such as agricultural or logging, in favour of forest protection (Angelsen and Kaimowitz, 1999), and these vary in space and time, and between actors (e.g. large agro-businesses producing soy *versus* shifting cultivation of *cassava*).

Even the authors of the very few efforts to model price incentive responses on a global level acknowledge that these are very crude and omit important factors, such as transaction costs, due to missing data on this (Interview: 8, 14, 4). Several more sophisticated studies exist for opportunity costs on the level of specific projects or local settings (e.g. Chomitz et al., 2005, Ferraro and Simpson, 2002), but it is difficult to extrapolate from those findings to larger spatial scales (Interview: 4, 24). A number of interviewees indicated that this lack of information might significantly hamper negotiations of emission targets and create market uncertainty (Inverview: 38, 42, 14). An additional complication arises from the fact that carbon prices fluctuate and cannot be usefully estimated beyond a time frame of a few years. More importantly, no one can predicts prices beyond the first Kyoto commitment period Interview(9, 10) – when a prospective CR mechanism would most likely be launched – because the demand for carbon credits depends on politically negotiated emission reduction targets.

On the other hand, it is crucial to develop an idea of the potential scale of CR credits entering the market in order to both judge the likelihood of "market flooding" (see following section), and, more importantly, to take this additional source of emission reductions into account when considering global post-2012 emission caps. I have therefore developed a scenario range which I based on three values for emission reductions from AD (10, 20, and 50 percent). For this, I considered all Non-Annex 1 countries that currently experience a net forest loss. This slightly under-estimates total global deforestation because gross forest area loss in some countries is partially "off-set" by regeneration and plantation programmes on a national level. The following values can therefore be considered as conservative approximations. As I discuss elsewhere, no one knows by how much deforestation could be reduced on a global scale when providing monetary incentives. My scenarios therefore span a fairly large range. Estimates towards the low end may be more realistic on a global average; however, it is certainly possible that some countries could achieve drastic reductions in deforestation when given the right incentives. In order to arrive at estimates of global emission reductions from AD, I applied the following formula:

Equation 1.

(1) $TER = \sum D \times C \times \frac{R}{D} \times 3.67 \times 1{,}000{,}000$

Where,

TER = Total emission reductions (Mt CO_2)

D = Country-specific average annual deforestation rate (ha/yr)

C = Country-specific average carbon-density of forested land (tC/ha), based on IPCC (2003)

R = Possible reductions in deforestation rate (ha/yr)

Multiplying conserved carbon (tC) by 3.67 yields emission reductions as expressed in tons of CO_2 (molecular mass ratio)

Similarly important are the potential market size of respective carbon credits and associated income streams for developing countries. I used a range of three potential carbon prices, considering average contractual prices in present-day CER sales (medium risk forward contracts – low 5 € estimate) (World Bank, 2005), recent EU ETS emission allowance market prices (05-08/2006 – medium 15 € estimate), and high-end EU ETS prices before this year's market "crash" which also match certain price forecasts for the 2008-12 trading period (2005/06 – high 30 € estimate) (LEBA, 2006, NCF, 2006). To calculate the potential market size and income streams, I used:

Equation 2.

(2) $TMV = \sum D \times C \times \frac{R}{D} \times 3.67 \times 1{,}000{,}000 \times P$

Where,

TMV = Total market volume /income (€ million)

P = Potential carbon prices (€/tCO_2e)

	Potential emission reductions and income from carbon trading at ...								
	Carbon price of € 18/tC (€5/tCO_2) and ...			Carbon price of € 55/tC (€ 15/tCO_2) and ...			Carbon price of € 110/tC (€ 30/tCO_2) and ...		
	- 10 % in deforestation	- 20 % deforestation	- 50 % deforestation	**- 10 % in deforestation**	- 20 % deforestation	- 50 % deforestation	**- 10 % in deforestation**	- 20 % deforestation	- 50 % deforestation
Reduced emissions (Mt C)	**82.75**	165.50	413.75	**82.75**	165.50	413.75	**82.75**	165.50	413.75
Reduced emissions (Mt CO_2)	**303.41**	606.83	1,517.07	**303.41**	606.83	1,517.07	**303.41**	606.83	1,517.07
Total market volume / income from AD credits (Mt CO_2 / € million)	**1,517.07**	3,034.14	7,585.34	**4,551.21**	9,102.41	22,756.03	**9,102.41**	18,204.82	45,512.05

Table 3 – Potential aggregate emissions reductions and income from AD carbon trading

Note: Scenario ranges for the total global market volume /income of AD carbon credits include only data of countries with net deforestation after 1990. Source: Author's calculations; see text for formulas and data sources.

Results from the ensuing nine scenarios are presented in Table 3. Values obtained from computing reduction scenarios range from about 300 to 1,500 Mt CO_2. In comparison, global carbon markets traded roughly 800 Mt in CO_2 in 2005 (PointCarbon, 2006), and the current CDM pipeline contains validated projects with a total projected emission reduction volume of 1,137 Mt CO_2e for the five years from 2008 to 2012 (UNEP, 2006). Regarding potential monetary transfers from AD, these range from about € 1.5 to € 45 billion in the above calculations. This compares to € 9.4 billion in current carbon markets, although all of the above values are expected to grow rapidly (PointCarbon, 2006). Avoided deforestation and resulting global market volumes on this scale may be unrealistic in the near term. Nevertheless, the theoretical potential of an AD trading mechanism is considerable and could be fulfilled eventually.

4.3.2. Potential market volumes under alternative agreements

As discussed above, carbon markets for AD could also be created outside of Kyoto under a UNFCCC umbrella. It is not possible to model market volumes for this policy option because they would most likely depend on specific reduction targets for forestry-related emissions, adopted by Annex-1 Parties. Such markets would therefore be capped in volume regarding emission reductions, while prices for these separate credits would still follow the laws of supply and demand. In principle, however, detached AD markets may still be partially "merged" with Kyoto markets in practice. The reason is that Annex-1 countries could take into account targets accepted under an AD agreement when negotiating their emission caps under a Kyoto-successor.

This also means that prices for the two kinds of credits (Kyoto versus AD) should approach in the long run as Parties re-adjust their respective obligations under both agreements.[9]

4.3.3. Crowding out and market flooding

"Market flooding" and "crowding out" are two aspects of the same concern, arguably phrased in pejorative terms. In this line of reasoning, the large potential of avoided deforestation to contribute to climate change mitigation turns into a reason for concern. If protecting forests were significantly cheaper, on average, than reducing emissions from other sources then a large number of low-cost AD carbon credits could be created. Given a temporarily *fixed demand* for these credits, the additional supply could quickly saturate ("flood") the global markets, arresting prices at relatively low levels, and effectively reducing investments into even lower cost and money-saving energy efficiency measures. Other, higher-cost energy-based emissions abatement would become uncompetitive from a strictly carbon mitigation perspective. Critics of unconstrained limits on achieving carbon mitigation through prevention of deforestation argue that this crowding out of other mitigation efforts by lower cost credits delays the necessary restructuring of society's fossil-fuel-based economies. Of course, no one knows if the necessary dramatic reduction in deforestation rates could be achieved at a competitively lower price, yet the sheer speculation of this occurring has been used to 1) argue that AD would effectively halt many other, more costly abatement efforts, and 2) that this would be bad. Again, this concern arises from a limited demand for carbon credits caused by a political decision to aim at relatively meagre emission reductions over a short time span (by 2012).

From the point of view of environmental effectiveness and economic efficiency, this argument seems somewhat out of place. Clearly, tackling any source of GHG emissions serves the ultimate goal of preventing catastrophic climate change and tropical deforestation's large contribution to global emissions makes avoided deforestation an obvious candidate for mitigation measures. If it turns out to be cheaper – all the better. Of course, emission reduction efforts need to be placed in a comprehensive, *long-term* mitigation strategy. From this perspective, reducing deforestation and economic restructuring are both integral actions, not mutually exclusive trade-offs. Let us therefore look at the argument in more detail.

The scenario calculations in the previous sections have demonstrated that AD has the *potential* to rival present-day emission markets in terms of volume, at least by the same order of magnitude. Admittedly, the CDM pipeline and carbon markets can be expected to continue their rapid growth, as they have done over the last few years.[10] In addition, more ambitious ER targets in a post-2012 agreement may lead to much higher carbon prices and market volumes. (Interview: 38, 10) Nevertheless, the numbers illustrate that avoided deforestation has the potential to contribute impressively to climate change mitigation and this might justify the

[9] I am grateful to Ian Noble for drawing my attention to this point.

[10] In the first quarter of 2006 alone, global emission trading had a net value of US$ 7.5 billion, compared to a total of US$ 10 billion in all of 2005 (NCF 2006).

enthusiasm of its proponents, as well as concerns by critics. Before discussing whether such large numbers of emission reductions can realistically be expected to occur in the short term, let us consider the risk of crowding out of other mitigation investments on a conceptual level.

The benefit of reaching a more ambitious ER target for the same cost, as illustrated in the previous section, entails what can be perceived as a disadvantage. Some of the overall investment now flows into forest conservation rather than into more expensive mitigation options in other sectors. This is represented by the shaded areas in

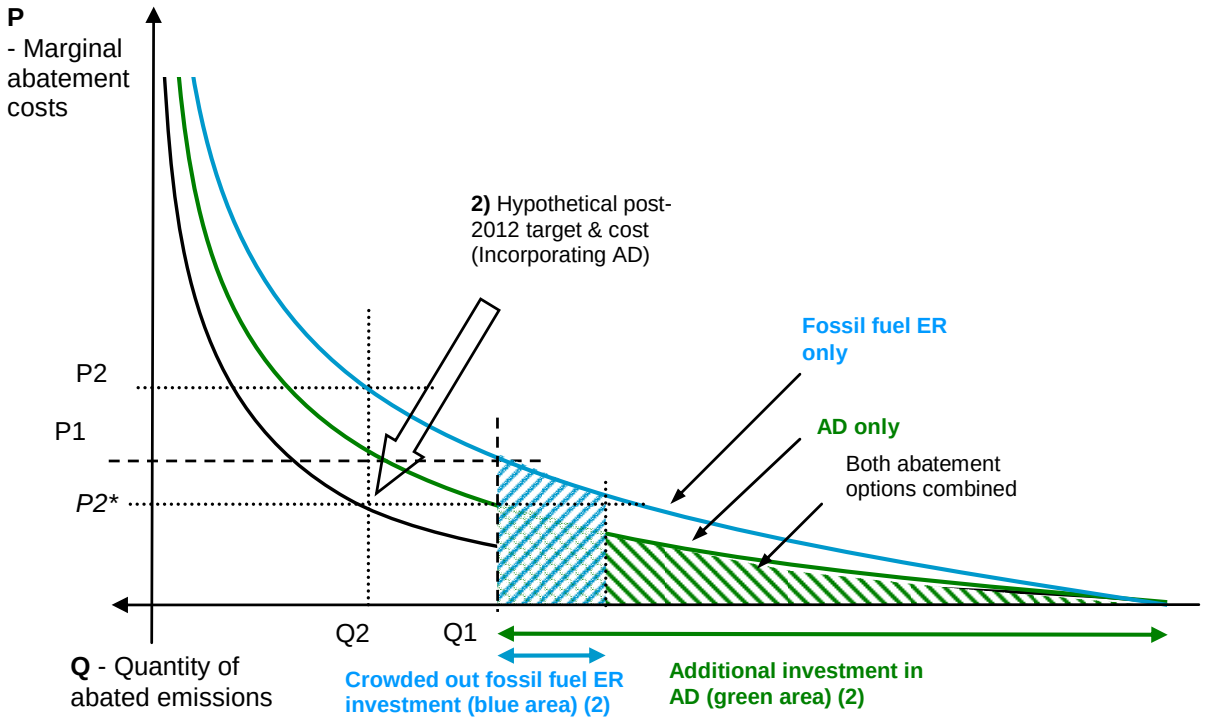

Figure 5 – Crowding out of fossil-fuel related abatement investment.

Note direction of axes.

It is largely a normative, political decision whether the added environmental benefit justifies a certain redirection of investment flows. If the international community strives towards greater emission reductions, an additional mitigation option will provide more opportunities to achieve this. In addition, an even stricter emission target (to the left of Q2) would easily undo any crowding out. In this context, it should be noted that extremely cheap reductions in HFC and N_2O emissions are in fact eligible under the current Kyoto regulations. This has led to a situation where 46 percent of the current CDM mitigation potential is achieved through projects reducing these two gases and another 20 percent from reducing land-fill (CH_4) and cement-related emissions (UNEP, 2006). It is easy to imagine the scale of crowded out investment through these activities, which do not significantly reduce reliance on fossil-fuels – and which do not provide the truly enormous co-benefits associated with the conservation of tropical rainforests.

As discussed above, how many carbon credits from avoided deforestation can realistically be generated is a very difficult question. The actual costs of reducing deforestation are not known but incentives for AD increase with the price of carbon, which in turn depends on the demand for credits, determined mainly by the level of emission reduction targets, and on the cost of other mitigation options. One interviewee from an international conservation NGO argued that "(…) all this talk about market flooding will be over once people wake up to the reality of how difficult reducing deforestation is!" (Interview: 4). Another seasoned negotiator said that although better models and numbers would be useful, "[knowing these] doesn't matter anyways because from my experience, targets are decided from a gut feeling in the end" (Interview:12).

On a different note, it seems very unlikely that all tropical countries would engage in ambitious AD policies immediately after carbon finance incentives are created. A relatively slow and incremental start of a new international mechanism seems more realistic, considering the internal political-economy of many countries in which powerful stakeholder groups, e.g. land-owners and timber companies, may see threats to profitable economic activities (Interview: 1, 24, 45). For example, the potential scale of AD carbon markets would be cut by about 25 percent if Brazil, responsible for the same share in global deforestation rates (FAO, 2006) decided to opt out of an agreement – by all indications not an unlikely option (see Section 6.1). It is also worth mentioning that any carbon credits from AD would only be issued after a specified verification period (probably spanning several years to overcome uncertainties from fluctuations in annual deforestation rates, see below).

It deserves mention that significant hurdles would have to be overcome in the real world to harness the potential of carbon trading for AD. Many governments have struggled for decades in trying to reduce unlawful land-use conversions and illegal logging and are frequently hampered in their attempts by a lack of institutional capacity and rampant corruption (FAO, 2006, Fearnside, 2005, Smith, 2002). Some of the countries with the highest deforestation rates also score very low in governance indicators, a problem which is particularly severe in forest frontier areas (Noble, 2006). Section 5.1.2 takes up this issue and compares country-specific governance ratings with theoretical potentials for AD.

This is not to say that AD does not represent a large untapped mitigation potential; but a flood of cheap carbon credits from this source appears questionable at the very least. Furthermore, the relative scale of tradable credits has to be put into perspective with projected increases in fossil fuel based GHG emissions in developing countries (see Figure 1 and Figure 6). These will present enormous mid-term abatement opportunities.

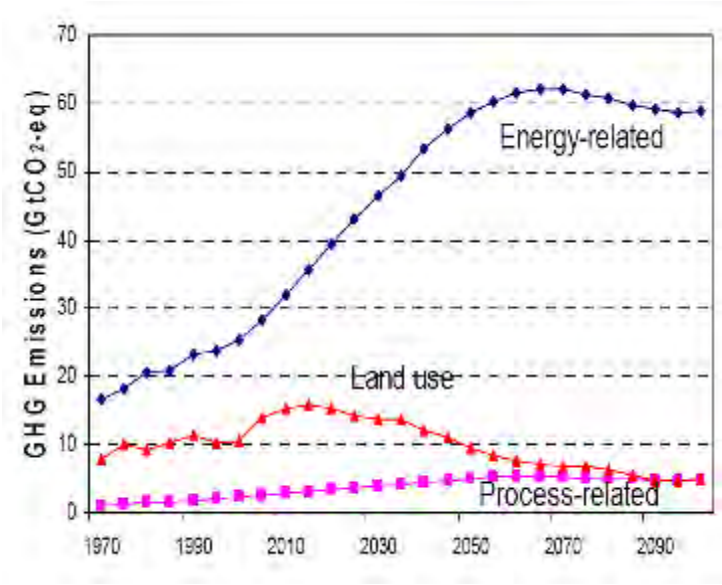

Figure 6 – Projected trends in GHG emissions by sector

Source: (CNRS/LEPII-EPE et al., 2003)

Despite all these arguments, negotiators may still be concerned about "risks" of market flooding – or they may raise this issue as a negotiation ploy, which some interviewees expected (Interview: 38, 17). Fortunately, there are relatively easy ways to counter the theoretical possibility that AD credits would distort international carbon markets. Among others, one could imagine a conversion factor for credits from AD – such that they would only be worth, e.g., 1/3 of "regular" credits –, a cap on the maximum of tradable credits from AD, or a combination of both. In particular the capping approach may be appropriate to address any perceived risk of market flooding (see Section 7.2). As participating countries gather experience with the new mechanism and as stricter targets create more demand for credits, a cap could either be revised or scrapped. Experience from the one percent cap on A/R CDM credits (see Section 1.2) shows that such a cap may never be reached as fears of market flooding prove to be unrealistic. Ultimately, however, agreeing on more ambitious emission reduction targets would certainly be a far better option.

5. CARBON CREDITING FOR AVOIDED DEFORESTATION

The implicit assumption of this paper is that the success of the Montréal proposal depends mainly on political will and preferences, as well as on economic benefits of a potential new carbon trading instrument. Methodological and scientific obstacles and uncertainties could, in this view be resolved once Parties agree on fundamental goals. However, reaching some of these goals directly depends on methodological approaches regarding carbon accounting and crediting. For example, using avoided deforestation as an effective tool to counter global warming is conditional on whether this approach generates real and additional emission reductions, which is in turn influenced by aspects of monitoring and carbon measurement, among others. On the other hand, many developing countries presumably will support a new mitigation mechanism more strongly if they stand to gain from it in economic turns and might block an agreement if they do not. This latter question strongly depends on the setting of baselines against which AD – and any associated carbon finance – is measured.

In this chapter, I discuss how both environmental effectiveness and economic attractiveness of a prospective carbon trading approach for avoided deforestation depend on the setting of baselines (5.1). Furthermore, I assess the technical feasibility of monitoring and measuring carbon emissions from deforestation (5.2), the risks of carbon leakage under different crediting approaches (5.2), and concerns about the permanence of emission reductions that are achieved through forest conservation (5.3). The latter are important from the viewpoint of environmental effectiveness emission-reduction measures, and the potential implications for long-term land-use restrictions and obligations which affect their political acceptability.

5.1. Baselines in project and national-level crediting

Baselines represent business-as-usual (BAU) scenarios of any emissions that would have taken place in the absence of emissions reducing activities. Therefore, a specific activity is only "additional" if it reduces emissions below the projected baseline level. In the case of AD, the difference in emissions from deforestation between an unrestricted, BAU deforestation scenario and the emissions occurring after implementing forest conservation programmes for instance would define "additional" reductions.

Since baseline activities are hypothetical and *per se* unobservable (Ellis and Bosi, 1999, Chomitz, 1998), defining them poses certain difficulties. For example, as with emissions from fossil fuels a dynamic as opposed to a static baseline may be more appropriate for establishing additionality of abatement measures. When emission levels would change in the future even in the absence of emission-reducing activities, simply extrapolating current emissions may over- or under-estimate "actual" emissions and therefore produce skewed measures of additionality.

For example, the ordinary modernisation of installations can lead to reductions in fossil-fuel base emissions due to energy efficiency improvements that are not the consequence of specific climate change policies or mitigation activities. The same is true for "forest transitions" (Rudel et al., 2005) in countries where deforestation rates decrease and may eventually reverse in the course of long-term economic development (see section 5.3). Assuming a static baseline in such cases would generate "hot air" and create the risk of issuing carbon credits for emission "reductions" which would have occurred also under BAU developments. On the other hand, economic growth, or shifts in agricultural demand, may lead to future emission increases (Chomitz, 1998). Additional emission reductions from abatement activities could therefore go unrecognized and projects or countries may not be credited appropriately.

Establishing dynamic baselines is difficult in any sector, including forestry, because economic decisions by individual actors and aggregate trends involve a multitude of factors which cannot be easily predicted. For example, comprehensively modelling an area's future deforestation is not feasible, despite recent advances (e.g. Soares-Filho et al., 2006). It is therefore common practice to use static baselines in existing Kyoto carbon accounting methodologies for both forestry and energy-related projects (Chomitz, 2002). These baselines are based on historical emission levels in a base year (1990 for most purposes).

The question remains of '*how, and at what level'* should baselines be set in an agreement on avoided deforestation. It is conceivable that generally baseline estimates over a larger spatial extent would be more reliable because they capture much of the micro-level variation. Therefore, measuring emission reductions from avoided deforestation by using national-level averages would produce more accurate results than accounting at the level of smaller-scale projects and would increase the environmental integrity of associated carbon credits.

Figure 7 illustrates a further challenge: Countries can exhibit large inter-annual variability of emissions from deforestation; for example in Brazil emissions from the land-use sector can vary by over 20 percent[11] within two years. Arguably, incentives from carbon income could lead to more consistent policies and enforcement and greatly decrease such fluctuations. Nevertheless, extrapolating baseline emissions from one base year could create uncertainty and using multi-year averages would be advisable (Santilli et al., 2005). From a scientific and statistical viewpoint the base period should be longer the greater the inter-annual variability in a country's deforestation emissions. From a pragmatic political viewpoint, determining a common base period for which data is available, e.g. the 1990s, for all countries may be preferred. To reduce uncertainty and increase environmental integrity, baselines should be set conservatively, i.e. lower than calculated value. Any adjustments to baseline values should be done in a transparent and predictable manner to minimise market uncertainties regarding the supply of credits (Olander et al., 2006).

[11] The average inter-annual variability of deforestation rates in the Brazilian Amazon is 21.5 percent (1988-2005).

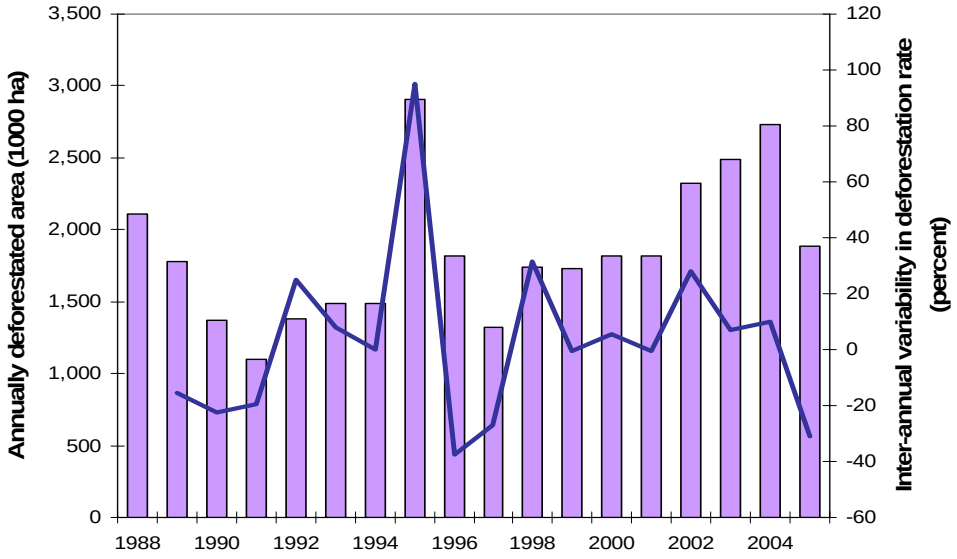

Figure 7 – Deforestation in Brazilian Amazon (Amazônia Legal).

Source: Author's elaboration with data from (INPE, 2006)

In principle, baseline emission levels could be determined most consistently, transparently, and efficiently in a centralised top-down approach by an international working group, e.g. under UNFCCC auspices. Using the same standardised methods for baseline setting would contribute to environmental integrity of credits and greatly increase the acceptability among many Parties and NGOs (Interview: 38, 17, 36). However, host countries may perceive such a process as an infringement of their sovereignty and demand more say. Engaging Non-Annex 1 Parties in baseline setting may also be crucial to ensure their trust in the computed data and boost support for the proposed compensation mechanism (Interview: 22, 34).[12]

5.1.1. Baseline setting – cheating and perverse incentives

Far from being a pure computing exercise, setting emission baselines can be highly political because it directly determines potential incomes from carbon trading between countries. When establishing BAU scenarios against which project or national level activities are compared, there is an economic incentive to inflate these baselines so as to be able to claim more credits from emission "reductions". A well-known example is the setting of Kyoto emission targets for Russia, but other countries engaged in similar political haggling.[13] Although it was obvious that the economic collapse after 1990 would lead to a drastic drop in CO_2 emissions, Russia's emission baseline was set at historical 1990-levels (UNFCCC, 1998) in order to induce the

[12] See Olander et al. (2006) for further options and advantages of a de-centralised approach, e.g. national capacity building.

[13] Consider, e.g., the economic restructuring in East Germany, the British "dash for gas", and the inflated land-use sink data for Australia and Canada (see Depledge 2000).

country's participation in the Kyoto system. This way, Russia may be able to claim 150 - 500 million tons CO_2-e of emission reductions that are effectively "boreal hot air" (Bernard et al., 2003, Paltsev, 2000).

At least two factors create a risk of "tropical hot air" in setting baselines for avoided deforestation:

- Deforestation rates which are assumed to follow past trends could in fact decrease because of forest transitions or other developments unrelated to specific policies (see above).
- Baseline rates could be artificially inflated to entice Parties whose current deforestation rates leave them no or only a limited potential to reduce emissions from *deforestation* and that consequently stand to gain little from compensation mechanisms based on strict baseline definitions (see following section).

This applies to countries which

1) succeeded in essentially halting deforestation some time ago, e.g. the Dominican Republic
2) managed to reverse past trends and are now gaining forest cover through plantation programmes, e.g. Vietnam, Costa Rica
3) are still "forest rich" and have low deforestation rates (but may be heading towards major agricultural expansion), e.g. Gabon
4) are "forest poor" and have low rates of forest area loss because past deforestation left few forests to clear, e.g. Thailand.

See Figure 10 for examples 3) and 4) and Appendix 3.1 for detailed country data.

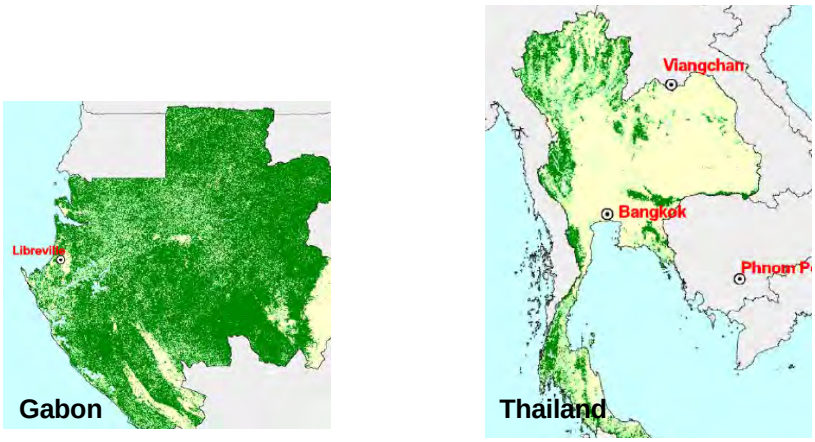

Figure 8 – Forest cover in Gabon and Thailand.

Note: Images not to scale. Source: Adapted from FAO (2006)

Several interviewees, as well as Party submissions (see Annex …) argue that countries' good past performance should be rewarded by using more generous baseline scenarios. Others suggest

applying global averages as reference values so as to reward "good performers" (Achard et al., 2005) (Interview: 27, 31). While one may support these arguments on grounds of equity and fairness, any carbon crediting for non-additional activities would effectively represent hot air and might seriously undermine the environmental effectiveness of a compensation mechanism. Conversely, some criticise that crediting emission reductions relative to historical base periods "perversely" rewards countries with high emission levels, whereas "good performers" with low historical (or future) emissions, are "punished" (Interview: 24, 37). Again, there is a trade-off between political attractiveness, possibly based on equity concerns, and environmental integrity of accounting methodologies.

Setting baseline reference points in the future would indeed create perverse incentives. If Parties increased emissions up to that point, emission "reductions" could be undertaken more profitably by starting from a higher baseline level. Evidence that this is not a merely hypothetical process emerges from the existing Kyoto regime; one example is China where there is evidence that HFC producers significantly increased their emissions during the baseline period in order to artificially claim inflated emission reduction credits later (Wara, 2006).

In project-based crediting, another perverse incentive can arise from the need to demonstrate "additionality" of emission reductions. The implementation of policies which lower energy-related emissions or deforestation can mean that abatement activities which would otherwise have been additional do not qualify as such any longer. There are claims that the desire to not forgo potential investment from CDM projects has hampered more stringent environmental legislation in countries such as South Africa, Mexico, China, and Brazil (Wara, 2006, Worthington, 2005) (Interview: 22, 33, see section 6.2 regarding Brazil).

5.1.2. Income potentials for developing countries

Past and present rates of forest area change directly influence the potential monetary benefit countries could reap from avoided deforestation and carbon trading. In this section, I evaluate conceptually what this means for certain categories of countries, and I present results of an empirical analysis of income potentials for all developing countries which currently experience deforestation. This analysis disaggregates the scenarios regarding potential global monetary transfers and market volumes in Section 4.3.1 It is based on data from the FAO Global Forest Resource Assessment (2001, and, 2006). These data have been criticised as imprecise because they are partly based on self-reporting by governments. However, they represent the only globally comprehensive dataset with national-level information. Furthermore, data quality has improved substantially due to the inclusion of remote-sensing imagery in their compilation (Mayaux et al., 2005).

As indicated above, rates of forest area change fall into three main categories. Figure 9 illustrates these by depicting changes in forest carbon stock. The level of carbon stored in a country's forest is

A) Static – when neither deforestation nor afforestion occur
B) Deteriorating – when forests are cut or degraded
C) Improving – when natural regeneration or afforestation measures lead to net increases in forest cover.

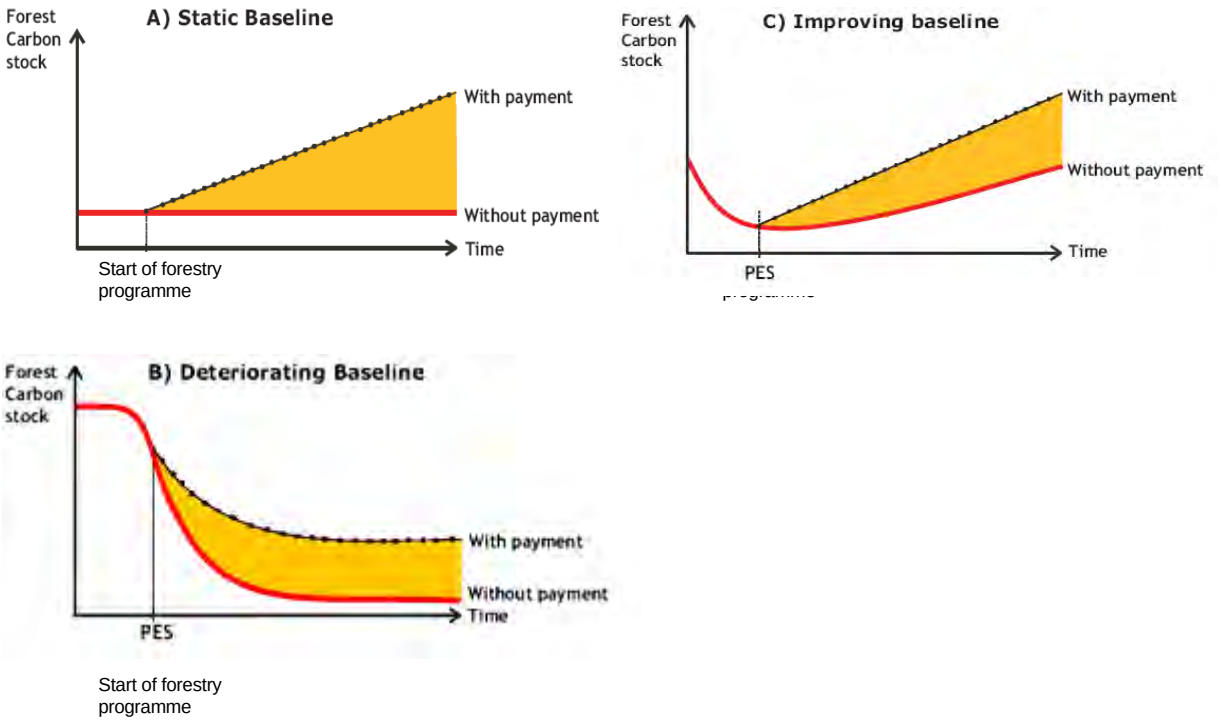

Figure 9 – Baseline scenarios for changes in forest carbon stocks over time.

Note: The orange area represents the additionality of a programme aimed at reducing emissions or at sequestering carbon. Source: Adapted from Wunder (2005).

Although Parties have not yet ruled out the possibility of accounting for any changes in a host country's forest cover, i.e. to also reward net gains, the general consensus is to create a mechanism for rewarding reductions in emissions from deforestation, preferably by conserving natural forests. In this case, only countries in the above category (B) could benefit from carbon trading approaches and even for those, carbon finance is only attractive if deforestation rates are substantial at a national level. Unfortunately, many countries do undergo rapid deforestation.

Table 4 provides examples for each of the three categories described above and illustrates them with data on current forest cover, changes in forest cover since 1990, and extrapolations for the year in which countries would have lost 50 percent based on current trends. Countries are labelled so as to associate them with the above categories.

	Total forest area	Forest cover	Annual change in forest area	Annual change in forest area	Year of 50 % forest area loss at current trend
	(1000 ha)	(Percent of land area)	(1990-2005 average, 1000 ha)	(1990-2005 average, percent)	(1990 base year)
A - Dominican Republic	1,376	28.2	0	0	Never
A - Gabon	21,775	81.3	-10	-0.05	2685
B - Papua New Guinea	29,437	63.6	-139	-0.5	2120
B/C - Costa Rica	2,391	46.8	-11.67; + 3	-0.35; 0.1	2140; Never
C - Vietnam	12,931	39.0	238	2.15	Never

Table 4 – Trends in forest area change for selected countries

Note: The second value for Costa Rica refers to annual averages in the 2000-05 period only, illustrating a forest transition and indicating the need for revisions of baseline base periods. Data source: FAO (2006).

Using similar assumptions as for estimating the potential market size of CR carbon credits (Section 4.3.1), one can predict potential incomes for individual countries. Here, I computed several scenarios based on a range of carbon prices and reductions in deforestation rates. Rather than using global averages, I calculated country-specific carbon densities of forests from FAO data (2001). The results of this analysis for the 30 countries which are projected to gain most from AD carbon trading are presented in Table 5. For the complete dataset see Appendix 0 – again, only countries with an average annual net forest loss after 1990 were included in the analysis. Potential gains from prospective AD emissions markets vary substantially between countries.

Potential income (€ million) from carbon trading at ...

	Carbon price of € 18 /tC (€ 5 /tCO$_2$) and ...			**Carbon price of € 55 /tC (€ 15 /tCO$_2$) and ...**			**Carbon price of € 110 /tC (€ 30 /tCO$_2$) and ...**		
Country	**10 % reduction in defor. rate**	20 % reduction in defor. rate	50 % reduction in defor. rate	**10 % reduction in defor. rate**	20 % reduction in defor. rate	50 % reduction in defor. rate	**10 % reduction in defor. rate**	20 % reduction in defor. rate	50 % reduction in defor. rate
Bolivia	**45.33**	90.67	226.67	**136.00**	272.00	680.01	**272.00**	544.00	1,360.01
Brazil	**541.08**	1,082.15	2,705.38	**1,623.23**	3,246.45	8,116.14	**3,246.45**	6,492.91	16,232.27
Congo, DR	**95.17**	190.34	475.84	**285.50**	571.01	1,427.52	**571.01**	1,142.01	2,855.03
Gabon	**1.26**	2.51	6.28	**3.77**	7.54	18.85	**7.54**	15.08	37.71
Indonesia	**233.55**	467.09	1,167.73	**700.64**	1,401.28	3,503.20	**1,401.28**	2,802.56	7,006.40
Mexico	**15.79**	31.58	78.94	**47.37**	94.73	236.83	**94.73**	189.46	473.65
Papua NG	**7.40**	14.79	36.98	**22.19**	44.38	110.95	**44.38**	88.76	221.91
Peru	**21.13**	42.26	105.65	**63.39**	126.78	316.95	**126.78**	253.56	633.90
Sudan	**6.48**	12.97	32.42	**19.45**	38.91	97.27	**38.91**	77.82	194.55
Thailand	**2.84**	5.69	14.22	**8.53**	17.07	42.66	**17.07**	34.13	85.33
Total of Non-Annex I	**1,517.07**	3,034.14	7,585.34	**4,551.21**	9,102.41	22,756.03	**9,102.41**	18,204.82	45,512.05

Table 5 – Potential income benefits from avoided deforestation

Source: Author's calculations with data from various sources (see text).

In order to better conceptualise the spread of potential monetary gains between countries, I plotted these incomes against deforestation rates and forest carbon densities, among else. For all these graphs I used a mid-range scenario, based on a 10 percent reduction in deforestation rates and a carbon price of € 15. If different values were assumed for these variables, the relative relationships between countries would not change.

To put the following analysis into context, Figure 10 depicts areas with the highest relative forest loss. Table 6 provides complementary country-specific data for net area losses in the top 10 countries belonging to this category. It becomes apparent that the Amazon Basin, West Africa, and South-East Asia / Oceania have high annual decreases in forest cover above 0.5 percent, and that in addition, forest area loss are high in North and Central Africa.

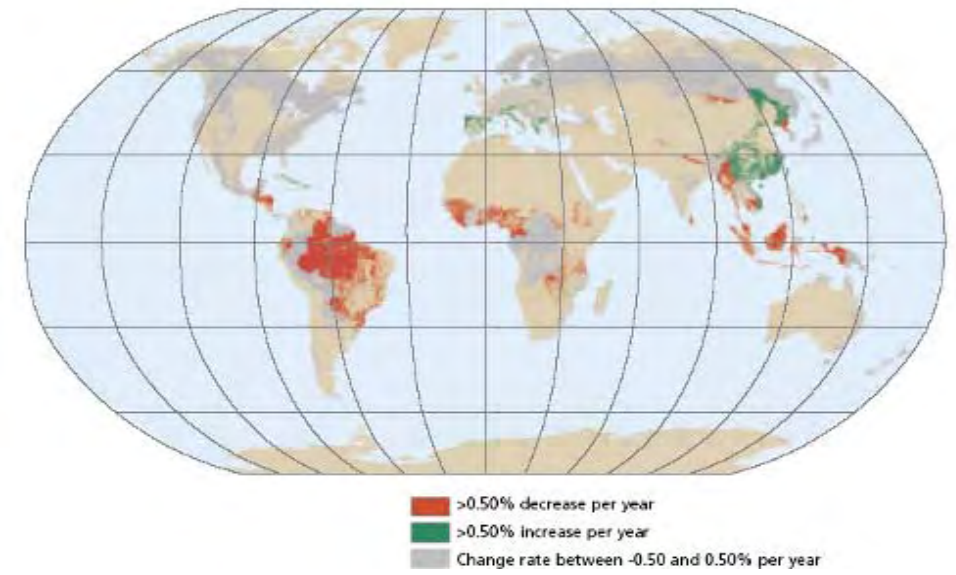

Figure 10 – Relative change in forest cover (annual averages 2000-2005)

Source: FAO (2006)

Country	Deforested area (1000 ha/y, average 1990-2005)	Trend 1990-2000 to 2000-05
Brazil	2,822	↑
Indonesia	1,872	–
Sudan	589	–
Myanmar	467	–
DR Congo	461	↓
Zambia	445	–
Tanzania	412	–
Nigeria	410	–
Zimbabwe	313	–
Venezuela	288	–
Other 68 countries	3,257	?

Table 6 – Countries with highest annual deforestation rates (ha/yr)

Source: Adapted from FAO (2006)

This is where the analysis becomes interesting. One might expect those countries with the highest deforestation rates to also be the principal beneficiaries of a potential CR payment system. However, when plotting projected income from carbon trading against net forest area losses (Figure 11), the connection becomes much less straightforward (R^2 = 0.47)[14]. Many countries do not display any obvious correlation between deforestation rates and income potential at all. For example, five of the African countries which the above list clearly identifies as having some of the highest deforestation rates do not stand to gain significantly from carbon trading based on reduced deforestation.

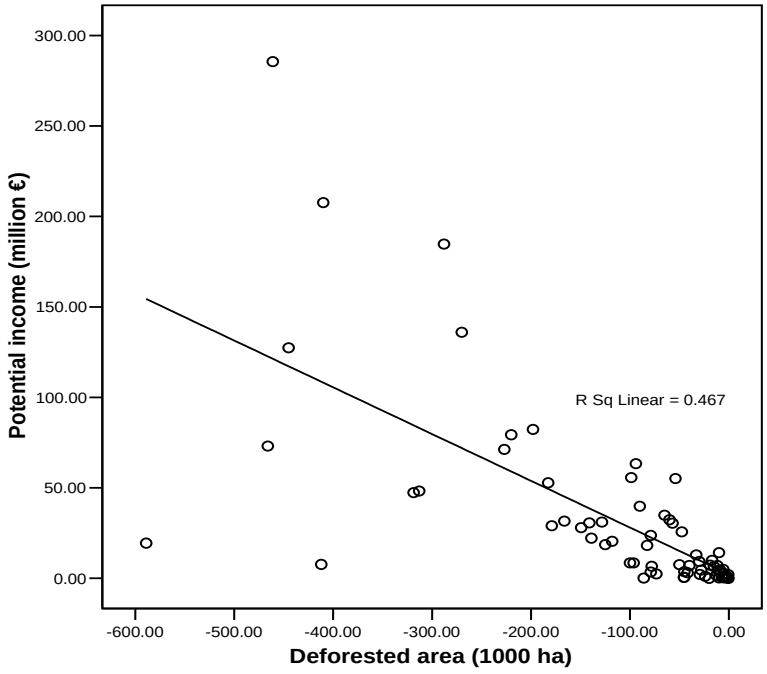

Figure 11 – Income potential through CR in relation to deforestation rates (area)

Note: This excludes values for Brazil and Indonesia because the scale of forest area loss in these countries makes it difficult to fit them on the same graph. Including them does not significantly change the numerical results.

This is because carbon densities vary between regions (Equation 1 in Section 4.3.1).It emerges that variability in forest carbon density explains less of the variability in projected incomes (R^2 = 0.15), but it is nevertheless an important factor and it does explain why some of the countries with the highest deforestation rates, e.g. Sudan, would not reap substantial monetary benefits from a prospective CR scheme.

[14] This value is R^2 = 0.64 when Brazil and Indonesia are included.

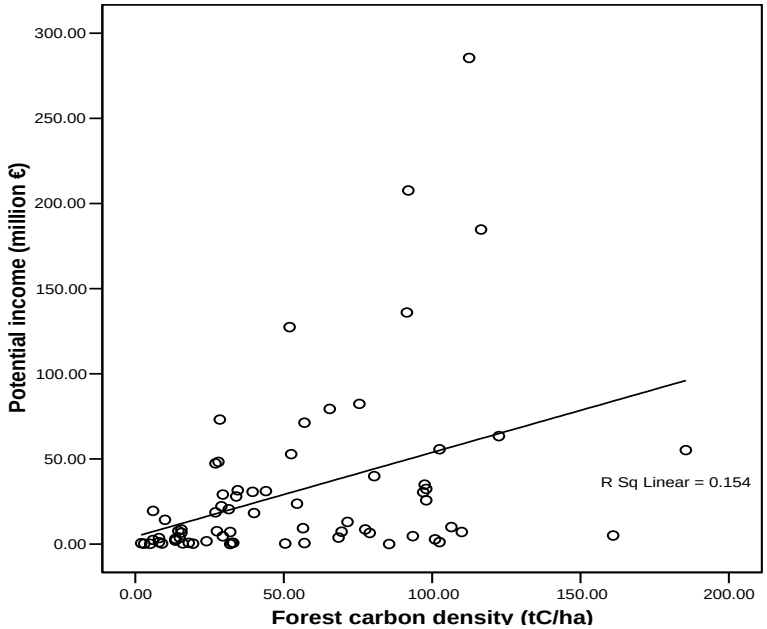

Figure 12 – Income potential through CR in relation to forest carbon stock densities.

When judging the financial attractiveness of AD carbon trading for individual countries and governments, it is probably not enough to only look at absolute numbers of projected incomes. These may have to be put into perspective by considering the size of a nation's economy. Figure 13 plots absolute income potentials against country-specific gross domestic product (GDP) values. The substantial spread in the closeness of correlation between the two values ($R^2 = 0.13$) indicates that projected absolute monetary benefits may not be very substantial for many individual countries. Annex 3.2. gives detailed values for all Non-Annex 1 Parties.

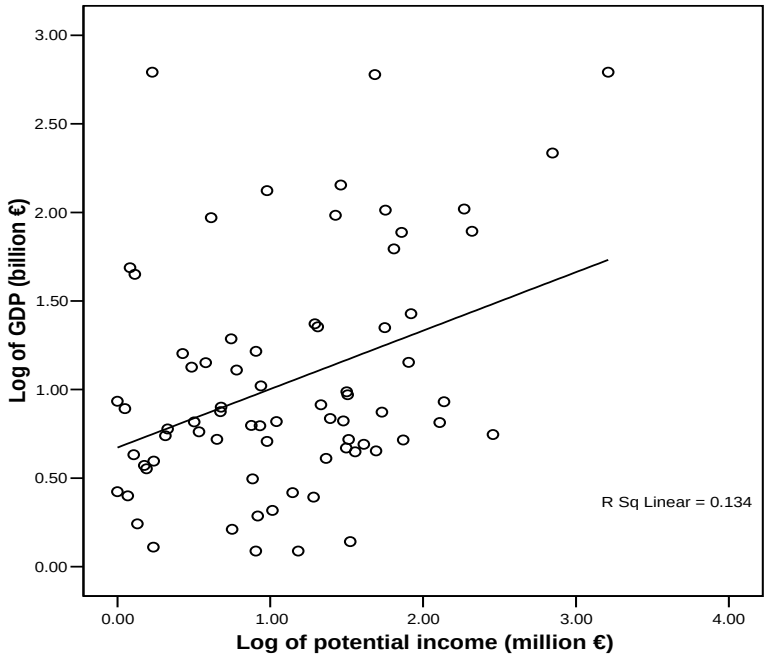

Figure 13 – Projected income from AD carbon trading in relation to GDP.

(Graph includes all countries with net deforestation.)

The analysis can be taken one step further. Projected theoretical incomes are obviously not identical to the ones that may be achieved in reality. These ultimately depend on how successfully countries implement AD strategies and this, in turn, will be influenced by their ability to, e.g., enforce laws and land-use regulations, set up and implement PES schemes, and restructure incentives for forestry, agriculture, and other land-uses – in short, on governance.

The World Bank Institute (WBI) has attempted to capture this somewhat amorphous term by constructing governance indicators, based on hundreds of different variables, such as funding for law enforcement agencies and corruption perception indices, for in individual countries (Kaufmann et al., 2005, WBI, 2005).[15] For my analysis, I chose the two of these aggregate indicators capturing law enforcement and corruption and calculated an average. Figure 14 illustrates the relationship between the resulting indicator (adjusted for illustration purposes) and relative income potentials (CR as a share of GDP) for individual countries. The most striking result is that most of the countries which could in principle achieve the most substantial relative incomes through CR trading, also score lowest on a scale concerning governance capacity.

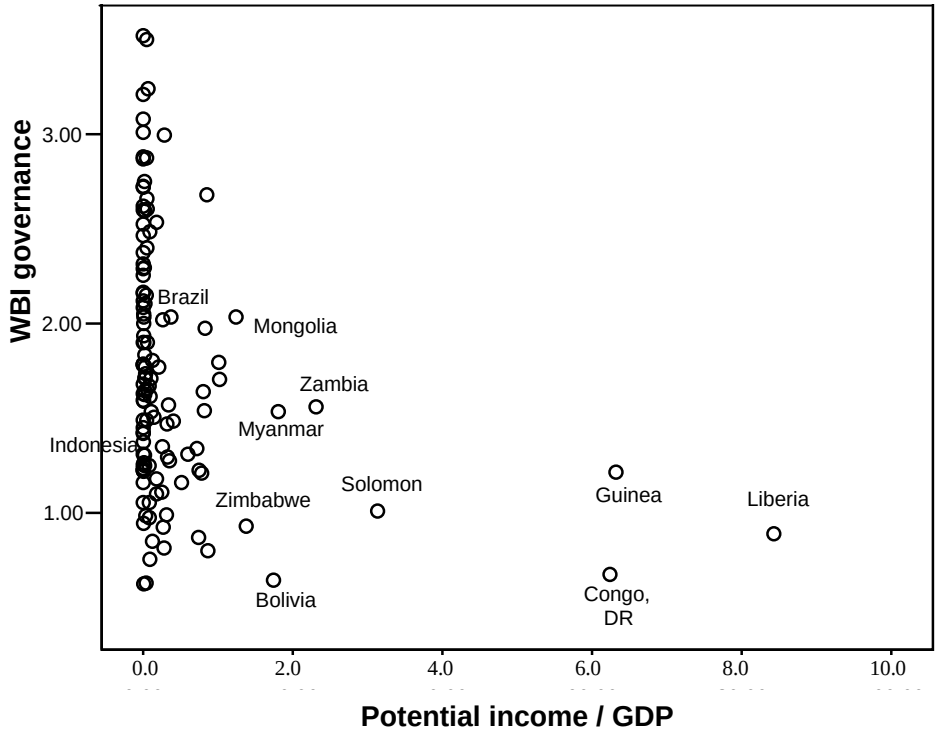

Figure 14 – Governance indicators in relation to relative potential income from CR (percent).

Figure 15 highlights a selection of countries where the combination of high relative incomes and governance scores might make substantial emission reductions a tangible outcome. Note that Guinea, Libera, and the DR Congo were not included in the calculations for Figure 15 (because of illustration purposes) and display a very unfavourable ratio between potential income and the governance used here. This is important to keep in mind particularly with reference to the DR

[15] I am extremely grateful to Ian Noble (World Bank) for drawing my attention to this set of data.

Congo which ranks fifth among the world's top deforesting countries (see above) and thus has a high theoretical potential to contribute to global emission mitigation efforts.

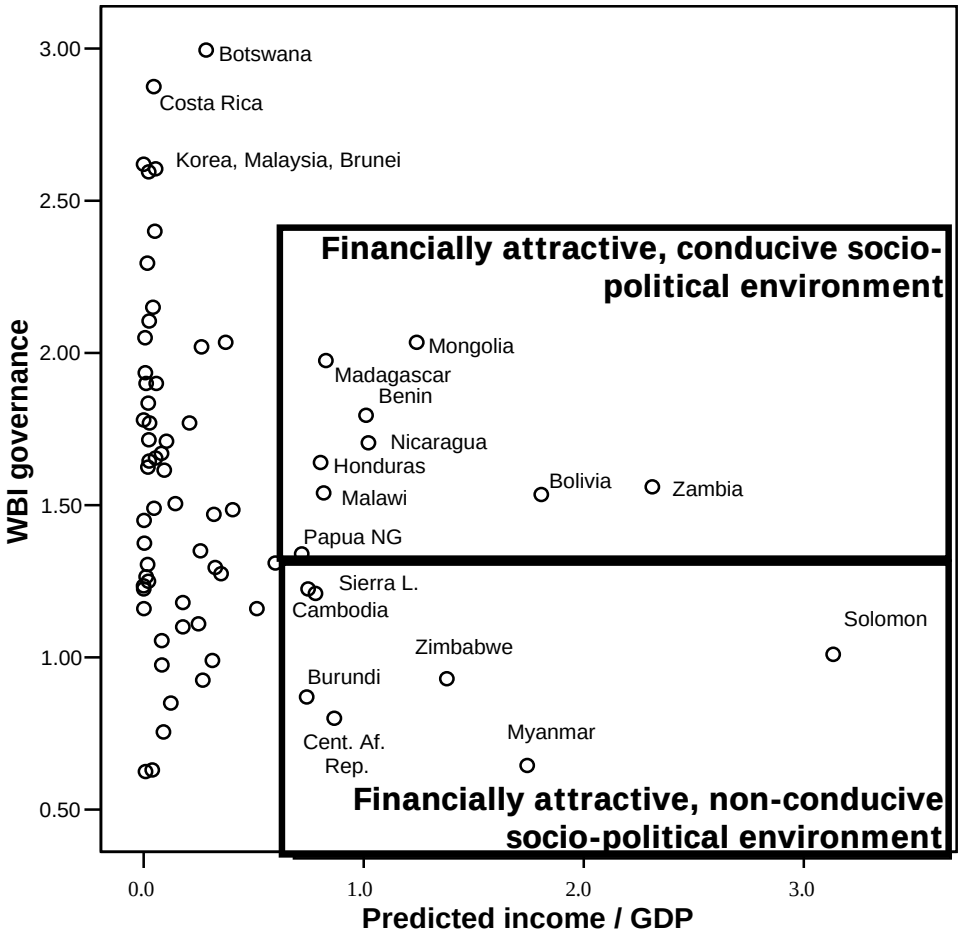

Figure 15 - Governance indicators in relation to relative income potential from CR.

Note: Graph excludes three countries with very high predicted income/GDP values, Guinea, DR Congo, and Liberia for illustration purposes

5.2. Measurement uncertainties and carbon leakage

It is beyond the scope of this study to present a detailed account of the level of scientific understanding regarding carbon dynamics in tropical forests, as well as the state of technologies necessary for measuring and monitoring emissions from forest conversion and degradation. These issues are discussed comprehensively in several recent technical papers that were prepared within the context of the current discussion on avoided deforestation and climate change (see Ebeling et al., 2006, Gibbs, 2006, Olander et al., 2006, DeFries et al., 2005).

For the present purpose, it suffices to summarise those publications in saying that existing technologies, combined with conservative accounting approaches can sufficiently address existing **measurement uncertainties** regarding deforestation rates, carbon densities of different forest types, and emission factors from forest conversion and degradation. The latter has been subject to much debate as carbon losses from degradation are much more difficult to grasp by

remote-sensing and field-sampling approaches. However, pragmatic approaches, such as discounting carbon values of non-intact forests (Achard et al., 2005) can be implemented. Four fifths of the experts consulted on these questions (N = 23), including several of the field's leading scientists, stated that existing methods and technologies are sufficient to implement a comprehensive AD compensation scheme. With a relatively small amount of seed funds, sophisticated monitoring systems, such as Brazil's PRODES system (INPE, 2006) , could be rapidly scaled up.

Carbon leakage, the increase of emissions outside of a project boundary due to emission reduction activities within, was one of the main concerns in the debate on sinks and forestry activities in the past. Leakage can be subdivided into two basic categories, namely leakage between locations ("activity shifting"), and indirect "market leakage" (Aukland et al., 2003, Niesten et al., 2002). This can occur at all different scales: "regional" or "sub-national" leakage, as well as "international" or "inter-annex leakage"(Niesten et al., 2002)

A decrease in the production of a certain good and services may trigger shifts in demand and supply elsewhere and thus indirectly produce an increase in emission outside of a project or national boundary (Aukland et al., 2003, Schwarze et al., 2002). Forest conservation may prevent people from clearing forests as well as from producing timber and growing crops on the protected lands. Consequently, markets for those products will tighten and increased timber and crop prices encourage intensifying forestry and agricultural production, as well as providing an additional incentive to clear forests. Leakage at the level of a small-scale conservation project can be considerable and off-set up to 100 percent of carbon benefits if it is not controlled, e.g. when farmers simply move on to clear an adjacent forest plot.

When considering emission reductions from avoiding deforestation at the national level, market leakage becomes irrelevant in terms of carbon accounting, because off-site impacts would be reflected in the same system. On a global level, however, if only some countries participate in a regime reducing deforestation, markets may shift supply and demand patterns for timber or agricultural commodities across borders (Dauvergne, 1997, Rudel, 2002). Predicting the scale of such potential" international leakage" is very difficult but unlikely to be larger than similar processes in the industrial sector (see the debate on "pollution havens" in a different context) (Wheeler, 2002).

Furthermore, critics often overlook that avoiding deforestation does not mean reducing forest conversion to zero. Consequently, incentives from carbon markets would firstly address low-cost conservation options (see Section 4.3.1.), likely marginal lands with low opportunity costs to conservation. These are unlikely to generate cross-boarder market leakage as they involve low production volumes of commodities and mainly local actors and consumption. Overall, it is somewhat surprising that international carbon leakage is sometimes so prominent in the discussion on AD, given that it is not accounted for regarding any of the existing mitigation and trading options under Kyoto.

5.3. Permanence in avoided deforestation

Permanence of emission reductions was one of the main issues of controversy during earlier design stages of the Kyoto-Regime when the inclusion of carbon sinks was debated. The concern is the following: when emissions are reduced by implementing a fuel-switch or an energy efficiency measure in the field of fossil-fuel consumption, this will have a permanent impact. Even if, e.g., an installation producing electricity from solar energy goes out of service after several years and the old oil-fired power station comes back online, the emission reductions that have been achieved will not become undone and there is – permanently - less CO_2 in the atmosphere (see Chomitz, 2002, Dutschke, 2005). In contrast, planting a forest as a carbon store creates a reversal risk: if the newly created sink burns, all the sequestered CO_2 will be released back into the atmosphere and there will be no emission reduction in the end.

When comparing this situation to AD, however, there is one crucial difference. Reducing deforestation decreases a source of emissions, rather than creating a sink for them. In this view, emissions from deforestation are not inherently different from emissions created through the combustion of fossil fuels, and neither are there fundamental differences in the respective mitigation measures. Protecting carbon stocks in existing forests now can mean that the stored CO_2 is emitted later, thereby merely delaying emissions from a defined source – but the same argument can be made for fossil fuels. Let us look at this line of reasoning in detail by considering the illustrations in Figure 16.

Both figures represent the cumulative effect of GHG emissions from different sources in a country over time. Each year, additional emissions increase the concentration of CO_2 and other gases in the atmosphere. The black, solid line represents the business-as-usual (BAU) scenario of unabated emissions. In Figure 16 (left) the blue line represents an abatement scenario where annual emissions are reduced. This leads to a slower rate of change; however, cumulative emissions still increase over time because CO_2 and other GHGs are “stock pollutants” with a long atmospheric residence time. The same situation is presented (Figure 16, right) for emission reductions from avoided deforestation.

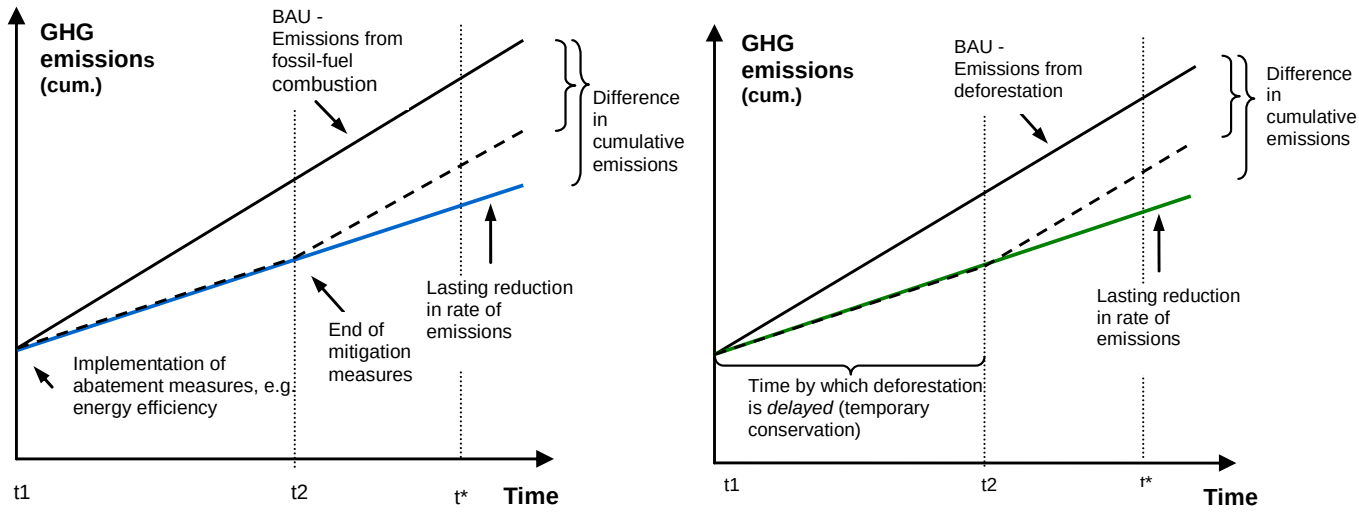

Figure 16 - Permanence of emission reductions: fossil-fuel vs. deforestation

In both situations, an end of the mitigation measures is conceivable: a solar electricity installation could be retired and replace by a fossil-fuel plant and land-use planning regulations, restricting the conversion of forest to agriculture, could be reversed. The result in each case is a reversal back to historical emission rates as in the BAU scenario. Note, however, that this development does not correspond to a reversal of the achieved emission reductions. At any point in time after the end of mitigation measures, the atmospheric concentration of GHGs is lower than would otherwise be the case. Although the same barrel of oil or the same tree will be burnt just a few years later than in the BAU scenario, the time by which this is delayed corresponds directly to permanent benefits for the global climate.

Critics maintain that there still is an inherently higher risk in conserving forest carbon stocks for climate change mitigation. The argument put forward is the possibility of a rebound in deforestation after the end of temporary conservation measures, destroying the carbon stock which had been conserved. If a much higher deforestation rate occurred than compared to the BAU scenario and to what happened before the implementation of forest conservation measures this could actually reverse the achieved emission reductions. This scenario is depicted in Figure 17.

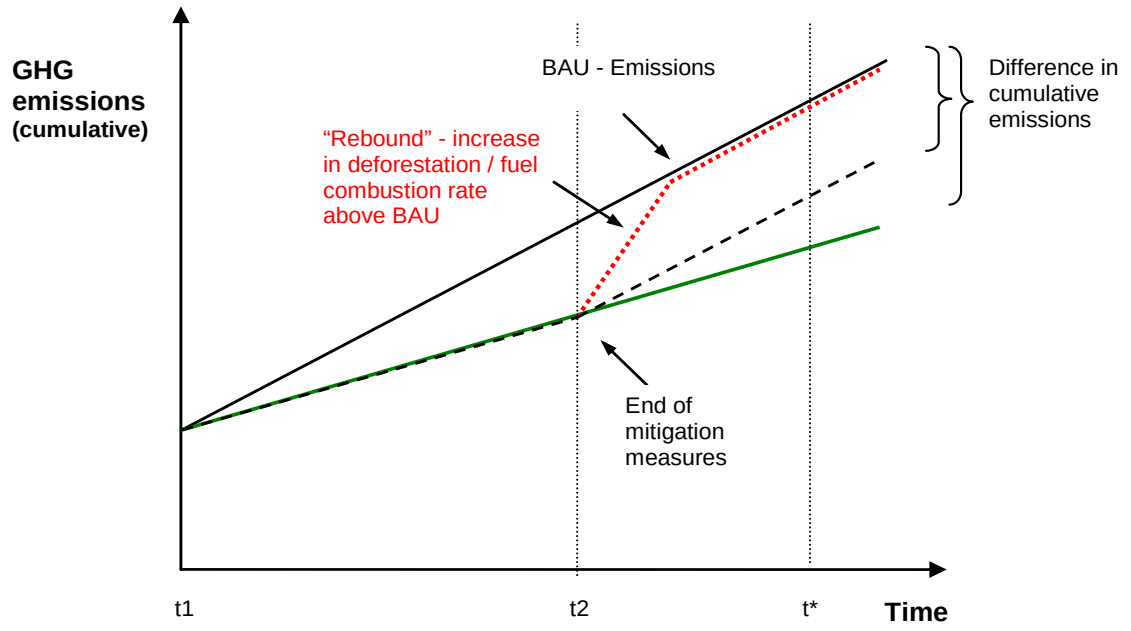

Figure 17 – "Rebound" scenario for temporary emission reductions

The likelihood of such a "repercussion" admittedly seems small but one could imagine cases of this in both fossil-fuel and deforestation based mitigation strategies. …. A hypothetical example could be the case of agricultural expansion and associated emissions where deforestation is restrained through restrictive land-use regulations. If these policies were abandoned after a few years, there might be a large inflow or reflow of capital into the agricultural sector, leading to an exceptionally rapid increase in forest conversion rates. A more plausible scenario, however, would be a simple return to previous deforestation rates because resources that could not be used during land-use conversions would have already been spent elsewhere, rather than being saved up for "compensatory" forest destruction.

In such cases, time may be the crucial factor. If mitigation measures are reversed after a short time, the socio-economic system will probably not yet have adjusted to the new framework and fall back into old patterns. If, on the other hand, the new framework has been stable and in place for long enough, individual actors and societies will have moved along a learning curve and adjusted their strategies, for example by seeking off-farm employment or intensifying production in existing agricultural areas. It is conceivable that such longer term shifts would occur in a more predictable and reliable way on a larger spatial scale, i.e. rebounds should be less likely and permanence less at risk when accounting for emission reductions on a national rather than on a project level.

Another type of permanence risk is said to arise from the effects climate change itself might have on tropical. One influential study in particular predicted high temperature rises and drops in precipitation across the Amazon region and this created fears of a massive forest "die-back" due to increased drought and fire risks (Cox et al., 2000). However, this study and others have since been dismissed because of flawed modelling approaches (Cochrane, 2006) and a large positive climate feedback for emissions from forests seems unlikely. In contrast, even mature tropical

forests continue to be a net GHG sink (Raich et al., 2006) and their carbon stocks appear resilient to warming conditions (Baker et al., 2004).

There are additional benefits of temporary forest protection measures, especially if they delay deforestation and associated emissions for several decades. The first arises from the possibility of national-level forest transitions: A number of countries demonstrate trends of decreasing deforestation rates over time, which may eventually reverse into increases in forest cover, because of the shifts in labour markets and demands for environmental services from forests associated with economic development (Rudel et al., 2005, Ewers, 2006). This means that forest which is conserved through "temporary" conservation measures faces a lower conversion pressure once these measures end. The result is the permanent conservation of a certain portion of this forest even if mitigation measures are only temporary (Dutschke, 2005). This is illustrated in Figure 18.

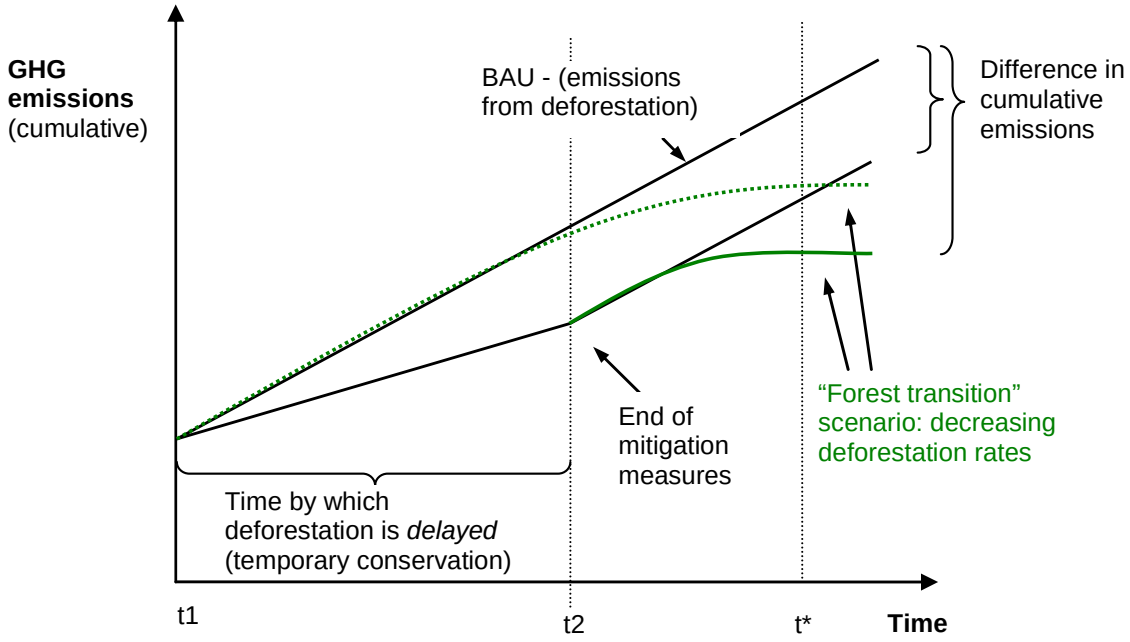

Figure 18 - Effect of forest transitions on permanence of emission reductions

In summary, there are several ways in which the environmental effectiveness of AD, and by the same mechanisms, fossil-fuel based climate change mitigation measures could be undermined, ranging from politically motivated base-line setting to inappropriate measurement approaches and carbon leakage. All of these would endanger the integrity of any emission reduction credits created as a result of these mitigation activities. Fortunately, knowledge about these risks allows managing most of them reasonably well. Ensuring the environmental integrity of carbon credits can come at an economic or political cost, however, and trade-offs with the economic and political attractiveness of an international agreement can exist.

6. THE POLICY PROCESS

During past climate negotiations loose country groupings have formed along major issues, such as stringency of emission targets and funding for development and adaptation. Apart from the very broad division in Annex 1 (i.e. industrialised) and Non-Annex 1 (i.e. developing) countries, the most important of these groupings have been the following:

- The European Union
- The "Umbrella Group", a loose alliance of non-EU Annex 1 States including among others Australia, Russia, and the United States
- The "Group of 77 + China" (G77), an alliance of over 130 developing countries
- Two issue-specific sub-groupings within G77: the "Association of Small Island States" (AOSIS) and the "Organisation of Petroleum Exporting Countries" (OPEC).

To give a few illustrative examples, in very general terms, the EU, along with AOSIS and most of the G77 have regularly pushed for more ambitious climate mitigation goals, while the Umbrella Group has held an opposing position. The G77 has demanded greater support for mitigation and adaptation measures in poor countries, and the United States and others have called for a more "meaningful" participation of non-Annex 1 countries in climate change mitigation (see Pandey, 2004, Dessai, 2004).

One of the intriguing observations when considering responses to the Montréal proposal is that avoided deforestation seems to be an exceptionally cross-cutting negotiation item. While the North-South division has become blurred also in other international environmental negotiations, it is not at all recognisable in the debate on avoided deforestation.

Although many government positions are still evolving and the exact preferences of countries, as well as international NGOs and other stakeholders are not clearly defined yet, I will outline the preliminary positioning of countries and emergent alliances regarding fundamental and hotly debated issues. In a second step, I attempt to explain some of these fundamental differences in positions by investigating the potential aims and interests of the respective countries. This is based on interviews as well as the analysis presented in the preceding chapters. Although a multitude of aspects are being discussed, in the following I focus on three fundamental issues regarding avoided deforestation:

1) The form of an international agreement in as far as it determines the mode of financing
2) The scale of accounting for emission reductions – national level reference baselines *versus* project crediting
3) The setting of baselines and how this takes into account countries' past deforestation trends.

Other issues, particularly potential benefits for biodiversity, rural development, and contributions to combating desertification, monitoring questions, etc. will be mentioned but not discussed in depth.

6.1. Negotiating positions

One important initial general finding from analysing official submissions to the UNFCCC by Parties and accredited observers is that none of the stakeholders which have declared their opinion in this way oppose the inclusion of avoided deforestation into an international climate regime. This does not mean that there is no disagreement regarding the way in which this should be accomplished, nor can one rule out the possibility that some of those parties and stakeholders without an officially declared position might indeed oppose the idea. Nevertheless, it seems clear that the proposal has significant support and that the issue is discussed in a more positive light than has been characteristic for the land-use sector in the past, particularly regarding sinks.

When analysing the individual country positions and interests in more detail, several major groupings and issue-specific divisions become apparent. Among Non-Annex 1 countries, the most important fault line runs between the Rainforest Coalition (the initiator of the Montréal CR proposal) and Brazil.

The **Coalition for Rainforest Nations** presently includes five Latin American, four African, and four Asian-Pacific countries[16]. Apart from these formal members, the positions of several African countries, organised in the "Commision des Forêts d'Afrique Centrale" (Comifac)[17], as well as further Latin American and Asian countries, e.g. Mexico and Peru, Indonesia and Malaysia, are closely aligned with the Coalition's goals. The Rainforest Coalition and their allies clearly favour the inclusion of Avoided Deforestation as a new Kyoto mechanism, based on quantified carbon credits and national-level carbon accounting. Most members of this group are, however, open to discussing other options, such as project-level crediting, separate non-Kyoto carbon trading under the UNFCCC, and also non-trading approaches. Regarding the setting of baselines, a number of submissions and individual negotiators have stressed that countries which have already achieved low deforestation rates in the past should not be "disadvantaged". These "good past performers" do not form a clearly delineated group in the negotiations, but they seem to converge around the wish to incorporate "rewards" when establishing reference baseline scenarios (Interviews: 27, 17, 34, 46).

In open and direct contrast, **Brazil** strongly rejects any kind of carbon trading approach that would help Annex 1 countries reach their Kyoto targets. Brazilian negotiators are also opposed to measuring and crediting deforestation emission reductions on a national level. This goes along with the country's strict opposition to any kind of "goals, targets and timeframes". Instead, Brazil favours additional transfers of funds and technologies from Annex 1 countries (Interviews: 29, 34, 33, 17, 2).

---

[16] The Rainforest Coalition formally includes Bolivia, Chile, Costa Rica, Guatemala, Nicaragua, Panama, the Dominican Republic, Congo, the Democratic Republic of Congo, the Central African Republic, Gabon, Papua New Guinea, the Fiji Islands, the Solomon Islands, and Vanuatu (Rainforest Coalition 2006).

[17] The COMIFAC formally includes Burundi, Cameroon, the Central African Republic, Chad, Congo, the Democratic Republic of Congo, Equatorial Guinea, Gabon, Rwanda, and Sao Tomé and Principe (COMIFAC 2006).

Most **other developing countries** have not declared their position publicly and, judging from interviews, many of them may not yet have decided on one. Interestingly, this includes two of the most "advanced" developing countries, India and China, which clearly hold a key position in determining the future course of international mitigation efforts. While India presumably has not yet developed a position on the issue (Interview: 37)[18], China has watched the developments closely, including an intervention in the final hours of the COP in Montréal, but seems to not see any reason to oppose them. There are thus no indications that any of the developing countries without formal position statements are intending to block an agreement (Interviews: 2, 37, 17).

Among Annex 1 countries, the most obvious camps are that of the EU and the United States. The EU's position is fairly compatible with that of the Rainforest Coalition, and the same is generally true for the USA. However, the position of the latter meets head on with that of Brazil.

The **European Union** supports trading under a new Kyoto mechanism, based on quantified carbon credits and national-level accounting. Negotiators are also open to consider non-Kyoto and non-trading approaches, although only as a fall-back option. The EU is, however, clearly opposed to re-negotiating the Marrakesh Accords regulating the CDM, i.e., the EU rejects project-level crediting. Member state representatives also stress that an inclusion of AD should lead to measurable additional climate benefits and thereby oppose a generous setting of baselines and implicitly call for stricter overall targets (Interviews: 38, 42, 2).

The **United States**, although hardly touching upon any of the respective issues in their official submission, support carbon trading and quantified crediting approaches in various forms – as long as this remains restricted to the Kyoto framework. The country opposes any trading approaches under the UNFCCC and holds the opinion that it is already engaged sufficiently in tropical forest conservation initiatives. While generally supporting voluntary financial contributions by government and private actors, negotiators do not support the creation of a new international fund for avoided deforestation. Since baseline setting and other methodological issues only become important under trading approaches, the US has not voiced an opinion on these (Interview: 2, 25, 26,17, 27).

Other industrialised countries, namely Japan, Canada, Russia, Australia, and New Zealand have dodged critical issues in their submissions and not yet developed a clear position. These countries, however, are generally supportive of the initiative.

On a side note, most major **NGOs**, along with many **private sector** actors support a trading approach under Kyoto. Among NGOs, this includes several organisations that fervently rejected such considerations in previous negotiations, e.g. the World Wide Fund for Nature. Other outspoken and supportive NGOs include Conservation International, The Nature Conservacy, and Environmental Defense. Some Brazilian groups, such as the "Brazilian Forum of NGOs and

[18] Note (4 November 2006): Indian delegates have since raised the issue of increasing forest cover, i.e. improving baselines, and have called for similar rewards for countries with a variety of historical baselines.

Social Movements for Environment and Development" have also adopted a different position than their government and support trading approaches based on national baseline crediting. Most NGOs have stressed the need to ensure clear and additional climate benefits with regard to the setting of baselines. Their support is conditional on a new mechanism leading to clear additional emission reductions on a global level, rather than merely providing countries with a cheaper way to reach their targets (Interviews: 4, 12, 26, 44; 18, 34, 48, 40). Table 7 summarises positions regarding these three fundamental aspects.

Overall, it thus appears that a remarkable majority of countries and other stakeholders is supportive of core elements of the Montréal proposal. Of course, important options and details have to be determined, and a painful lesson from past negotiations is that some of those "details" may prove hard to agree on. The major problem which becomes apparent from a comparison of country positions is the strong opposition of Brazil to a Kyoto-trading approach combined with the insistence of the USA on just that. This situation does have the potential to create an impasse in the negotiations. However, there are recent signs that the Brazilian government may be preparing a gradual shift in positions by soon announcing a new proposal suggesting national-level deforestation carbon accounting. This might also move the country closer to accepting trading approaches (Interview: 33). [19]

Country / Group	UNFCCC or Kyoto – Carbon trading vs. donor funding	Crediting – National base period vs. project-level	Baseline setting – Additionality vs. rewards for past actions
Non-Annex 1			
CRN[1] and allies	Open to both, favour Kyoto trading	Open for both, favour national-level crediting	Rewards, some Parties open to both
Brazil	No trading, not under Kyoto	Projects or non-quantified programmes (no national-level targets)	Additional emission reductions
others	*No clear position*	*No clear position*	*No clear position*
Annex 1			
EU	Open to both, favour Kyoto trading	Only national-level crediting (in a trading approach)	Additional emission reductions
USA	Favour trading but only under Kyoto	--	--
others	*No clear position*	*No clear position*	*No clear position*
NGOs	Open to both, favour Kyoto trading	Open for both, favour national-level crediting	Additional emission reductions

Table 7 – Summary of positions in the policy debate

[19] Note (4 November 2006): Meanwhile, Brazil has announced a proposal to for a fund-based solution to compensate countries which achieve *quantified* reductions of deforestation based on *historical baselines*. This represents a certain rapprochement of positions; however, the country continues to oppose any solution linked to carbon trading. The Brazilian proposal is to be officially presented at the COP in Nairobi in November 2006.

6.2. Underlying goals and interests

During an expert workshop, it clearly emerged that the previously described preferences and positions of stakeholders are linked to a variety of aims and interests among which climate change mitigation is only one component. Certainly, avoiding catastrophic climate change is the overarching driving force for many. As one negotiator said, "If we don't get deforestation in now, and if we can't include the main emitters [of GHGs], we will have a disaster! The science is clear and countries are starting to realise this." (Interview: 38). Similar statements were made by several country and NGO representatives (Interview: 36, 27, 31, 44). Nevertheless, mitigating climate change, while being a sincere concern, also serves as a useful discourse by which to promote other goals. Particularly important among the latter are the creation of new income sources for countries, NGOs, etc., as well as advancing the biodiversity conservation agenda, spreading the burden and responsibility of climate change mitigation among a greater number of actors, and promoting market-based environmental tools (as opposed to command-and-control approaches). Many of these goals are complementary; others may work against one another.

It is evident that many countries in the **Rainforest Coalition** have been attempting to tackle deforestation for many years. In many cases, these attempts have been hampered by a lack of resources. For example, Bolivia only had 68 field officers in 2005 to enforce its exemplary forest law over an area of several million ha (Ebeling, 2005). In many cases, lacking monetary valuation of natural forests in turn leads governments to favour agricultural production at the cost of environmental protection measures.

A number of interviewees expressed the hope that the forestry sector in their countries would gain a higher profile and that conservation measures and law enforcement could be better funded if forests could generate direct revenue streams through carbon trading (Interviews: 1, 33, 45). Indeed, as my calculations in Section 5.1.2 show, even moderate success in avoided deforestation measures could generate substantial incomes for many countries. For example, PNG could potentially earn € 22 million per year from achieving a 10 percent reduction in deforestation rates. This would represent 0.7 percent of the country's GDP and about 10 percent of its annually received ODA.[20] Using the same assumptions, the DR Congo could, in principle, receive € 285 million, or 6.2 percent of its annual GDP, through carbon trading. Table 8 contains sample data for the 30 countries which could potentially receive the greatest national income as a proportion of GDP from AD and carbon trading (for the complete data set see Appendix 3.2). Not surprisingly, a number of these are also vocal supporters of the AD proposal, e.g. DR Congo, Bolivia, and PNG. In addition, as one interviewee pointed out, several tropical African countries have only been able to attract very limited investment through existing CDM channels and now place great hopes on a new CR mechanism through which they may be able to turn their natural-resource based economies and high rates of land-use conversion into a comparative advantage (Interview: 2).

[20] See UNDP (2005) for data on ODA payments. PNG received US$ 266 million (€ 207 million) in 2004.

Figure 19 illustrates the relationship between deforestation rates and income potentials for all countries with a net forest area loss, grouped by geographical regions. The lines of best fit (linear regression) and slope values clearly show differences between regions with carbon rich forests, such as West African countries (b = -0.49), as opposed to regions with mainly dry or semi-arid forests, such as North Africa (b = -0.029).

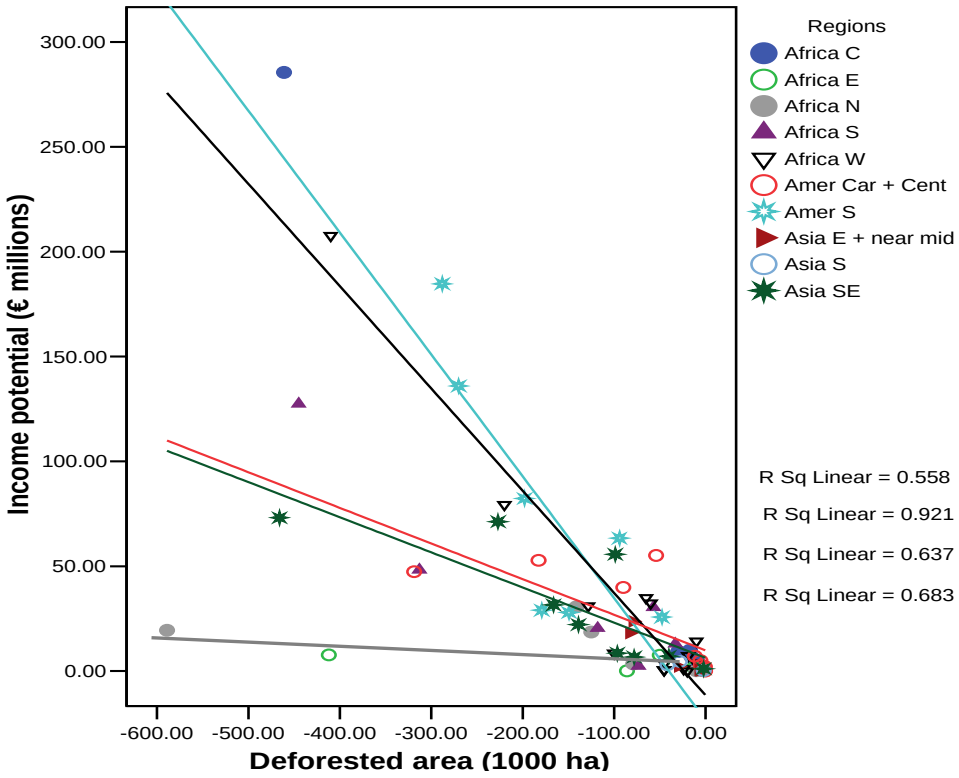

Figure 19 – Predicted AD income for geographical regions in relation to deforestation rates

Note: Lines of best fit (linear regression) for South America and West Africa (blue and black) and for North Africa, Central America /Caribbean and South East Asia /Oceania (grey, red and green). Brazil and Indonesia are omitted for illustrative purposes.

One certainly has to keep in mind the assumptions these numbers depend on, in particular governance capacities to achieve significant reductions in deforestation rates. The values provided in the last column of Table 8 do indicate that some of the countries with the greatest potentials for income benefits also have significant governance problems. Nonetheless, the potential magnitude of monetary benefits explains the attractiveness of the Montréal proposal for some countries. Arguably, some deficiencies in forestry governance could be improved given sufficient monetary incentives and the financial resources to increase administrative capacities.

On the other hand, countries with low recent deforestation rates stand to gain much less from the same approach in baseline setting and carbon trading. Using the same calculations as above, Costa Rica, one of the two core supporters of the Montréal proposal along with PNG, would only gain € 7 million annually, or 0.05 percent of its GDP (see Section 5.1.2 and Appendix 3.2). This explains why countries with very low deforestation rates, or net increases in forest cover (categories A and B in Section 5.1) are demanding rewards for past actions, either through a

more generous setting of reference scenarios or other kinds of compensation (Interviews: 17, 38, 4). Costa Rica, on the other hand, may be seeking international recognition for championing the much-lauded initiative, rather than direct monetary benefits, as one government insider indicated (Interview: 27).

	Country (Non-Annex I, net deforestation)	Potential annual income at .. 10 % defor. red., € 15 / tCO2 (€ million)	Potential annual income as share of GDP at ... 10 % defor. red., € 15 /tCO2 (percent)	WBI governance indicators Mean of 2 indicators
1	**Liberia**	32.37	**8.43**	-1.31
2	**Congo, DR**	285.50	**6.24**	-1.53
3	**Solomon Islands**	7.05	**3.14**	-1.19
4	**Thailand**	8.53	**2.49**	-0.15
5	**Zambia**	127.39	**2.31**	-0.64
6	**Togo**	0.00	**2.06**	-0.97
7	**Bolivia**	136.00	**1.81**	-0.67
8	**Myanmar**	73.11	**1.74**	-1.56
9	**Zimbabwe**	48.25	**1.38**	-1.27
10	**Mongolia**	18.20	**1.24**	-0.17
11	**Nicaragua**	39.88	**1.02**	-0.50
12	**Benin**	34.89	**1.01**	-0.41
13	**Central African Rep.**	9.33	**0.87**	-1.40
15	**Madagascar**	30.44	**0.83**	-0.23
16	**Honduras**	52.79	**0.82**	-0.66
17	**Malawi**	12.99	**0.80**	-0.56
18	**Sierra Leone**	7.27	**0.78**	-0.99
19	**Cambodia**	31.59	**0.75**	-0.98
20	**Burundi**	4.63	**0.74**	-1.33
21	**Papua New Guinea**	22.19	**0.72**	-0.86
22	**Cameroon**	79.33	**0.60**	-0.89
23	**Guinea**	14.22	**0.55**	-0.95
24	**Paraguay**	29.07	**0.51**	-1.04
25	**Nepal**	23.70	**0.40**	-0.72
26	**Ghana**	31.08	**0.37**	-0.17
27	**Ethiopia**	30.66	**0.35**	-0.93
29	**Indonesia**	700.64	**0.33**	-0.91
30	**Ecuador**	82.29	**0.32**	-0.73

Table 8 – Potential income from avoided deforestation credits (top 30 countries).

Note: WBI governance indicators used were those for "Rule of Law" and "Corruption". Lower values represent greater governance problems (Indicator range is -2.5 to 2.5 for all countries, including Annex 1).

Source: Author's calculation with data from FAO (2006) and WBI (2005).

Brazil's position, which isolates the country from practically all other G77 states, is the cause of much speculation among negotiators and observers. The official reasoning states unresolved issues regarding monitoring and carbon accounting methodologies (Interview: 47). However, none of the other interviewees found this plausible. The country stands to gain the lion's share of any compensation for avoided deforestation based on carbon trading, a theoretical € 1,600

million, following the above calculations. Brazil is responsible for almost one quarter of all deforestation occurring globally, making it the biggest emitter of GHGs in this category (see section 5.1.2). So why does the country so fervently oppose the Rainforest Coalition's proposal?

In the past, Brazil has been concerned about any international interference with its development plans for the Amazon, where most deforestation occurs and has made this a central issue of national sovereignty and security. In the eyes of many Brazilian strategists and politicians, economic development of the Amazon is the key to the country's overall growth potential and thereby to its place among the world's powerful nations (Interview: 29, 34). Until today, the Amazon is seen by many as a "Green Dorado, full of amazing riches" in the form of minerals, fossil fuels and agricultural potential (Interview: 29). The whole region is fraught with delicate geo-political questions surrounding territorial claims, and, in the words of a conservationist, "the last thing the government wants is some indigenous people cutting deals with external organisations and getting in the way of development plans" (Interview: 23).

A somewhat related account is the country's concern over future emission caps. In its official submission, Brazil stresses that "the emissions of Non-Annex 1 Parties are expected to grow so as to accommodate their needs for development … and poverty eradication [which] are the first and overriding priorities…." (see Appendix 2). During past and current negotiations, the country has made it clear that it rejects any kind of targets for developing countries, also in a post-2012 regime, and it may be worried that too much international attention on Amazonian deforestation will highlight the already substantial contribution to global emissions by Brazil and other non-Annex 1 countries. Including emissions from deforestation might just be the first step towards comprehensive targets and caps for developing countries. Meanwhile, Brazil may feel that industrialised countries have by no means contributed their fair share to global emission reductions (Interview: 34, 2, 17, 23).

A different potential explanation is that the Brazilian government is genuinely worried about the high deforestation on its territory, which it has tried to tackle with various ambitious initiatives and the world's leading monitoring system (DeFries et al., 2005). Brazil may find it impossible to control forest conversion at the agricultural frontier and be weary of being in the spotlight of the global conservation movement. However, other observers reject this explanation and point to dramatic successes in reducing illegal land-use conversions through recent government programmes, demonstrating that it is political will that matters (Interview: 33, 17, 36).

While all of these considerations probably play a role, most interviewees found an alternative explanation most convincing: Brazil's fear of losing income from existing CDM investment channels as some of the global demand for carbon credits may shift towards emission reductions from avoided deforestation. Figure 20 illustrates that Brazil is a prime recipient of CDM investments. It currently hosts 179 CDM projects - 18 percent of the global and 50 percent of the Latin American total – and the projected carbon credits for the first Kyoto commitment period, if sold at € 5-10, are worth € 725-1,450 million. Assuming that the number of projects will continue on its growth trend, this could more than double by 2012. The country may be able to leverage similar funds through trading forestry credits (see section 5.1.2) but, as one Brazilian

investor put it, "the government thinks that forestry is a primitive activity and wants investment in modern technology and industrialisation" (Interview: 34). And there may be another layer of interests: some influential individuals seem to work as CDM consultants and developers, giving them a personal stake in the current framework. "The – sad – joke here, also in the government, is that you can't do anything about deforestation or any kind of climate legislation because it will upset CDM prospects."[21]

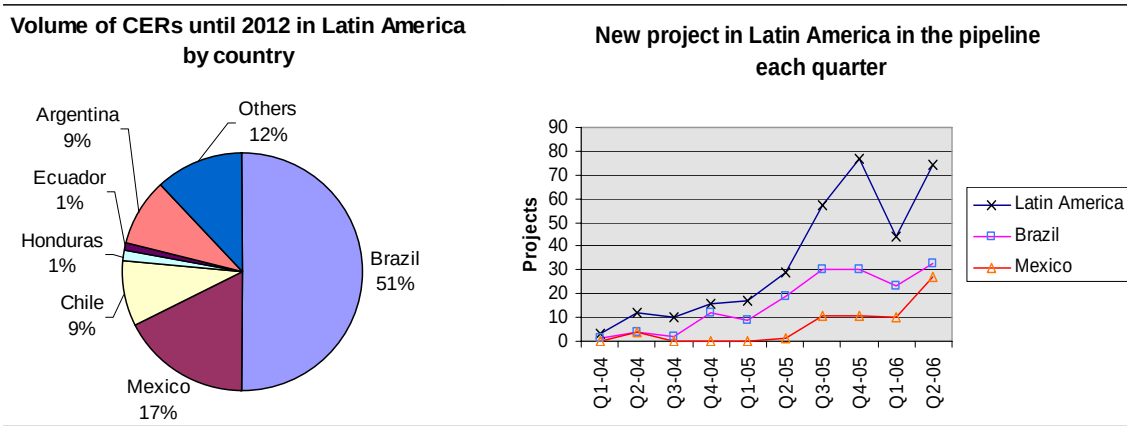

Figure 20 - Brazil's share in CDM projects in Latin America (left). Regional growth rates (right).

Source: UNEP, 2006

Finally, Brazil's economy is growing rapidly. It already ranks 11th in the world. The potential income from carbon trading, impressive as it may be, represents only 0.3 percent of Brazil's GDP (using the aforementioned scenario assumptions) and may not justify restricting the development path envisioned by parts of the government. However, the fact that the country opposes a *voluntary* trading approach so passionately does not fit well with this logic and can probably only be explained by less tangible political and psychological aspects, as well as domestic political processes.[22]

India and China both display high net gains in forest cover. China is in fact the world leader with over 4 million ha being planted annually (FAO, 2006). Both would gain no financial benefits from a trading approach that only credits reductions in *deforestation* but, rather than demanding a rewards for net afforestation, they seem to "lean back and watch for now" (Interview: 46). As with Brazil, the potential sums may be marginal relative to both countries' economies. However, they also do not seem to subscribe to Brazil's supposed concern over diverted non-forestry CDM investments. Several informants suggested that, given the enormous growth rates in industrial production and related emissions in these countries, the respective CDM potential would dwarf the mitigation potential from avoided deforestation elsewhere and that China and India may simply judge this more rationally than Brazil (Interview: 37, 2, 17).

[21] Interview no. 33, scientist from Brazilian national research institution.

[22] See Putnam (1988) and his depiction of "2-level games", one on the international and one on the domestic arena.

Is the issue simply irrelevant for both countries? Some interviewees believe this is the case, others suspect that China in particular may be following developments very closely. The two countries have recently become engaged in the so-called "G8 + 5 Climate Change Dialogue", an initiative that aims to more meaningfully involve the largest developing countries in a post-2012 climate regime.[23] China's main interest in the AD debate may relate to the latter's repercussions regarding binding post-2012 emission targets for Non-Annex 1 countries. The government may see avoided deforestation as a benign way to enter this "unavoidable" route through a sector that leaves China unaffected and, furthermore, provides opportunities to field-test *sectoral* CDM approaches (Interview: 27). On the other hand, it may decide to block the proposal at any time if it perceives "the dawn of unwelcome targets" (Interview: 17, 12).

The **European Union**, along with many NGOs and, in principle, the United States, probably pursue precisely this latter point by so strongly supporting the inclusion of AD. While being firm on the demand for clear additional climate benefits, the EU's negotiating position is very flexible regarding the eventual form of an agreement and attempts to include all major emitters and sources. In addition to pressure from domestic industries, which demand a greater contribution from developing countries to climate change mitigation, the self-prescribed goal of limiting global warming to 2 °C seems to have an effect. This target may be impossible to reach without addressing emissions from deforestation among other sources (Interviews: 38, 42, 2, 12).

In addition, and this again points to potentially far-reaching implications of the proposal, negotiators hope to increase the chances of the **United States** joining a future climate regime by providing both a potentially cheap source of tradable credits, and a meaningful participation of developing countries. The US have insisted on all these points during past negotiations. The participation of the world's main GHG emitter would provide great climate change benefits, and the inclusion of the EU's main trading partner would, at the same time, address industry concerns over skewed competition due to transatlantic differences in compliance costs with environmental legislation. The current US government, however, appears firm in its rejection of any engagement in cap-and-trade schemes (Interviews: 25, 17). Nevertheless, the increasing domestic civil society pressure and the independent launch of various state-level climate initiatives and trading systems makes it impossible for the federal government to remain silent on the issue. The fact that "many conservative Senators deeply care about the rainforest" (Interview: 2) may allow the powerful imagery associated with avoided deforestation to contribute to a slow change in the overall US position towards climate change policy.

The strong support by most **environmental NGOs** for the Montréal proposal is conditional on ensuring real climate benefits of a potential new (post-) Kyoto mechanism. Representatives demand that forest conservation must be a way to achieve stricter global emission targets, rather than a means to reach the current, modest ones more cheaply. Many NGOs may withdraw their support should the political "game" lead to significant "fiddling with baselines" (Interview: 26, 44). The NGO community seems split over the question of whether and how to include

[23] See http://www.globeinternational.org/about.html

additional concerns, such as community development benefits and biodiversity conservation into a formal mechanism. It is obvious that these "secondary" aims are a main motivation for a number of development and conservation-minded organisations that see a unique opportunity to advance their own agenda. On the other hand, over-burdening the climate mitigation agenda in this regard may lead to overly complex negotiations, a dissipation of efforts and eventual failure (Interviews: 4, 36, 24).

Private sector actors, such as **project developers and carbon traders** have not yet been prominently engaged in the discussions. However, one can assume that most of them would strongly welcome additional routes for carbon projects and derived financial products. In fact, numerous plans for pilot projects for AD already exist as developers see opportunities for individual conservation projects which could contribute to national-level AD targets (Interviews: 24, 4). Some financial institutions are said to be "willing to gamble 50 million USD into avoided deforestation, as a high risk investment in a larger environmental market portfolio". Large payoffs for such "venture capital" investments could occur if governments eventually agreed on a scheme allowing for tradable carbon credits from AD and early crediting mechanisms (Interview: 40, 48).

7. CONCLUSION

This paper set out to provide a comprehensive assessment of the most widely discussed policy options for including avoided deforestation into an international climate change mitigation strategy. It sought to identify potential hurdles to reaching an international agreement by investigating the positions and interests of key stakeholders and to explore design options which could address the most frequently voiced concerns.

The analysis presented in the preceding chapters evaluated a range of proposed policy options regarding the international legal framework, possible sources of finance for AD, and carbon crediting methodologies. Criteria for this assessment were environmental effectiveness, economic and political attractiveness, and technical feasibility. The results of this assessment were compared to the positions and preferences stated by Parties and other stakeholders during the ongoing policy debate. A number of potential deal breakers emerge from this comparison. In the remaining sections, I first outline the fundamental components of these disagreements and conflicts of interests and, in a second step, make suggestions on how they could be overcome. In these recommendations on design options for an international agreement, I strive for a realistic balance between the aforementioned three criteria, particularly regarding potential trade-offs between economic attractiveness and environmental integrity of carbon crediting approaches for reducing emissions from deforestation. Finally, I outline areas for future research which could provide valuable input into efforts to develop an effective climate change mitigation tool, as well as realising the multiple co-benefits associated with avoiding deforestation.

7.1. Potential deal breakers

In official submission to the UNFCCC by Parties and accredited observers, as well as during expert interviews, the following issues emerged as points of concern for many stakeholders. These are ranked by their relative prominence in the current debate.

- **Carbon trading** – Should international incentive schemes for AD be based on quantified emission reductions from deforestation, i.e. should achievements be measured in tons of avoided emissions of CO_2? And should rewards come from selling the resulting carbon credits on international markets? This is directly related to whether a prospective mechanism should be placed within or outside of the Kyoto framework and / or the UNFCCC.
- **Baseline setting** – Should the focus be on ensuring additionality and environmental integrity of potentially issued emission-reduction credits? Or should accounting approaches primarily ensure “equitable” rewards for good performance in the past?
- **Longer-term targets for developing countries** – Should an international agreement contain only “no regret” options for Non-Annex 1 countries, or should rewards be linked to obligations to maintain low emission rates from deforestation, as a way to ensure permanence? What would such obligations imply for the longer-term prospect of emission targets for developing countries?

- **Market flooding and crowding out** – How likely is it that existing emission abatement activities, both in Annex 1 countries and under the CDM, will be "crowded out" by more cost-competitive AD efforts? And how could such concerns be addressed?
- **Scale of carbon accounting** – Should emission reductions through AD be measured on a national or a project level? Is the risk of carbon-leakage prohibitive for project-level crediting?
- **International leakage** – Is there a significant risk that AD measures in countries participating in respective schemes will lead to the displacement of actors and drivers of deforestation, thereby increasing forest conversion and degradation in non-participating nations?
- **Permanence and insurance of emission reductions** - Are emission reductions from deforestation likely to be permanent or merely temporary? Are they equivalent in this regard to fossil-fuel based emission reductions or will special insurance mechanism have to be created?
- **Monitoring methods and technologies** – Are measurement and monitoring methods sufficiently accurate and reliable to allow crediting for emission reductions from deforestation? How important is forest degradation (as opposed to deforestation) and how can this be accounted for?
- **Co-benefits** – Are there trade-offs between emission reductions and other goals related to forest conservation, and how can synergies be created and promoted?
- **Timing** – Should crediting for AD begin after 2012 or earlier? Should early action be eligible, combined with the option to bank ensuing carbon credits?

It is apparent from the above list that a multitude of issues are raised by participants in the international policy discussion. Fortunately, the analysis in the previous chapters (3 to 5), as well as the evaluation of Parties' positions suggests that most of these can probably be addressed with solutions that should be acceptable for most stakeholders. These potential solutions are outlined in the next sub-section in the form of policy recommendations.

However, there may be three hurdles among the aforementioned concerns which cannot be overcome as easily, namely:

- **Kyoto carbon trading or non-trading mechanisms**
- **Baseline setting**
- **Longer-term targets for developing countries**

The analysis presented here suggests that these three issues might become deal breakers, i.e. they could decide whether or not Parties can agree on an international policy framework for AD or whether such attempts will be foiled. Based on the aforementioned three-dimensional analytic criteria, certain design options for these key questions appear preferable, and I will elaborate on these in the next section. However, when judged by different, normative principles – and from the viewpoint of individual countries and stakeholders – such assessments and preference rankings are likely to differ. Ways to overcome these potential deal breakers may depend on larger political-economic considerations, power games, and bargaining.

It is not unlikely that a host of items without any direct connection to the issues at stake will be brought into negotiations, such as demands by individual countries, or wider issues related to trade policies or development funding. The fact that each of the current Parties to the UNFCCC or the KP respectively would have to sign and ratify a derived AD agreement gives individual countries and groupings significant bargaining power.

In particular, the clash of the US and Brazilian position may prove difficult to resolve as both have opposing preferences regarding the international legal framework and ensuing sources of finance. Similarly, the insistence of environmental NGOs and European countries to ensure the environmental integrity of carbon credits and avoid creating "tropical hot air" may be very difficult to reconcile with the demand by a number of Latin American countries for rewarding past forest conservation efforts. In economic terms, this may be called a conflict of "intra-annex benefit sharing" as it is closely related to the distribution of potential monetary benefits between developing countries.

Finally, the dawn of post-2012 emission targets which some developing countries perceive in the AD proposal – and which other stakeholders, particularly NGO representatives evidently hope for – has implications far beyond the debate examined here. Certainly, a discussion on the necessity to accept targets has already begun in several of the more economically advanced developing economies. This includes China and Brazil where even some government officials are openly advocating a more meaningful participation of these countries in global mitigation efforts (consider, e.g., recent statements by the Environment Secretary Goldemberg, 2006). But this question of "inter-annex burden sharing" is likely to be a much longer-term debate and may prove impossible to resolve in the limited time-frame that is available for agreeing on an AD policy framework.

7.2. Summary and policy recommendations

Policy framework and carbon trading

Of the options considered in this study and under the assumptions made, regulatory carbon markets under a post-2012 Kyoto agreement appear as the preferable option. Not only are international carbon markets likely to provide the greatest scale of funding for AD measures, translating into the greatest volume of emission reductions. Fungible AD credits would also enable the international community to achieve emission reductions at the lowest cost and provide most incentives to host countries for tackling deforestation. Leaving aside potential caps on credits, the scale of funding under this option is, in theory, only limited by the size of the carbon market itself and the latter is presumably much larger than any amount which could realistically be provided by donor funding or voluntary markets.

However, carbon markets are unlikely to work on their own, and they should instead be combined with bi- and multilateral donor funding to provide the necessary monitoring and trading infrastructure, as well as providing seed money for deforestation avoidance programmes.

In addition, there may be trade-offs between the greatest economic efficiency of emission reductions and biodiversity conservation and development goals on the other hand. The former is largely a function of opportunity costs and forest carbon densities and this may not coincide with priority areas for conservation, rural development, etc. This suggests using co-financing from non-carbon-market sources in order to enable countries to achieve multiple benefits when working towards reducing emissions from deforestation.

Finally, and perhaps most importantly, non-market funding may play a crucial role in providing rewards for the prospective "losers" of a pure carbon market approach, i.e. countries with low deforestation rates which stand to gain little or nothing under options crediting only strictly additional emission reductions.

Baseline setting

For setting baselines, the use of historical reference data seems to be the best available option. Multi-year averages would effectively address uncertainties arising from inter-annual variability. Baselines should be revised at fixed intervals to account for changes in trends and magnitudes of country specific deforestation rates. Any remaining uncertainties could be tackled by banking a portion of generated credits from avoided deforestation and only allowing the remainder to be traded immediately after issuance. In any year when deforestation rates exceed the baseline average, the excess would be debited from this carbon bank (see Noble, 2006). This would, at the same time, address remaining concerns regarding the permanence of emission reductions from deforestation.

The best balance between environmental effectiveness and political acceptability of host countries could probably be achieved by a combination of standardised calculation procedures and consideration of country-specific circumstances in collaboration with national governments. In any case, base years or base periods need to be set in the past. Parties should not be tempted into defining baselines too generously to create benefits for past "good performers" through a carbon trading approach. Other reward mechanisms, not based on tradable credits, should be devised to promote an equitable sharing of benefits with these countries (see above).

On the other hand, however, Parties ought to consider weighing the benefits of strict integrity and additionality of carbon crediting against the risk of discouraging countries from participating in AD approaches at all and tackle their deforestation rates or, even worse, risking no agreement at all. For overall environmental benefits it may in fact be preferable to allow a limited amount of "hot air" into the system in order to broaden the support base for an emission reduction approach. Once developing countries have joined the scheme, they would have an incentive to over-achieve targets, no matter how these were defined in the first place. Especially – and this is a hint at the bigger picture of what may be at stake – if a prospective AD climate agreement facilitates future emission caps for rapidly industrialising developing countries, the disadvantages of some hot air may be greatly outweighed in the long run. Such considerations obviously mean treading a very fine line and demand very carefully conducted negotiations.

Market flooding and crowding out

Concerns regarding market flooding and crowding out are of a political nature and reflect a normative preference for certain mitigation options.[24] From a pure climate change mitigation viewpoint, large amounts of low-cost credits are desirable and create scope for efficient and effective abatement measures. If credits from avoided deforestation do in fact prove to be cheaper, this will allow for the setting of stricter emission caps and for cost savings in reaching targets. Certain amounts of crowding out of investment in conventional fossil fuel abatement by avoided deforestation activities seems plausible, albeit at a much smaller scale than portrayed by critics and almost certainly less than currently occurs though HFC and N_2O abatement.

In realistic terms, market flooding seems unlikely but if the idea causes significant concern during negotiations this could be addressed by simple countermeasures, such as dynamic caps. However, when deciding on ways forward, negotiators should judge them by the – literally – vital importance of curbing global warming. In this light, increasing the global demand for carbon credits through stricter mitigation targets – which are obviously urgently needed – would be a far better solution. Overall, cheapness should be seen as a virtue and one can hope that the additional abatement option that avoided deforestation offers will in turn facilitate a more ambitious climate change strategy. Ideally, global targets should be set after Parties have agreed on eligible mitigation activities and any emission reductions from tropical deforestation could then be factored into overall caps. This would ensure a net reduction in global emissions and would circumvent concerns raised in earlier policy discussions, where legitimate concerns were raised that additional mitigation options in the land-use sector would automatically reduce other abatement activities because overall targets had already been defined.

Permanence

Permanence, when considered without the shadows looming from *sinks*-debates of earlier years, does not appear as a particularly critical issue. This is because even temporary forest conservation would lead to lasting climate benefits. Nevertheless, the risk of "rebounds" above the business-as-usual (BAU) scenario ought to be addressed. In addition, the aforementioned banking mechanism would effectively insure achieved reductions and corresponding carbon credits.

The comparison in this study also shows that emission reductions from the two main sources of GHGs – fossil fuel combustion and deforestation – do not fundamentally differ with regard to permanence. Both kinds of mitigation activities decrease the rate of emissions which in turn leads to lower cumulative emissions and lower atmospheric concentrations of GHGs. Abatement measures can come to an end, i.e. be only "temporary", in both cases but they nevertheless

[24] Whether consciously recognized or implicitly assumed, such normative viewpoints can encompass economic, ecological, intra- and inter-generational equity, or security. Weighting some of these more than others by different stakeholders triggers much of the political debate on climate change mitigation strategies (see Bond and Dada, 2005).

create a lasting net benefit for the climate by lowering atmospheric GHG concentrations. In the case of avoided deforestation, there may be an additional benefit when forest transitions occur because these decrease conversion pressures on forests saved through seemingly "temporary" conservation measures.

Nevertheless, if perceptions of non-permanence risks in the political debate cannot be adequately addressed, additional safe-guards and insurance mechanisms, e.g. banking of carbon credits, are available (see above). Such banking schemes are much more likely to be acceptable for host countries than alternative options like contractual long-term obligations and seller-liabilities. Risks of "rebounds" above the BAU scenario could be reduced by accompanying policies and measures which facilitate forest transitions if such policies encourage sustainable shifts in economic patterns, for example different land-use practices, agricultural policies, and road-planning.

Monitoring technologies and carbon-accounting level

To address monitoring and measurement uncertainties, conservative carbon accounting should be applied where appropriate. In particular, uncertainties in carbon stocks arising from forest degradation should be addressed by discounting carbon contents of affected forests. This could be done by using a rough discounting factor for all forests which show any signs of human intervention (see Achard et al., 2005). As available technologies improve such discounting factors and forest classifications could be refined. While improved satellite-based monitoring systems should be deployed for assessment of forest cover dynamics, the available historical imagery needs to be processed rapidly using standardised methods.

In terms of establishing reliable baselines and ensuring additionality of emission reductions, national-level accounting provides clear advantages because it largely circumvents risks of carbon leakage. In addition, it is likely to be more cost effective and more precise due to economies of scale in monitoring efforts and because it could smoothen out smaller scale variations in emissions from deforestation. Furthermore, as is the case for other types of mitigation activities, participation by a greater number of nations – ideally 100 percent of non-Annex 1 countries – would effectively counter any risk of international leakage.

In summary, creating an international AD scheme based on tradable emission reductions seems perfectly feasible on a technical and methodological level. Many signs from the incipient formal negotiations are encouraging and indicate a broad support for the CR proposal. Nevertheless, it is also evident that ensuring environmental integrity and effectiveness of emission reductions can mean trade-offs with the political and economic attractiveness of solutions. In order to achieve viable and effective international agreements, the three aspects of technical feasibility, environmental integrity and political and economic attractiveness need to be balanced in a transparent manner.

It is helpful to keep in mind that many issues similar to the ones discussed above were unresolved when Parties signed the Kyoto Protocol in 1997. In fact, uncertainties regarding measuring of emissions were larger and carbon accounting methodologies were far less advanced than they are at present. It may in fact be sufficient to provide a clear incentive-based framework, together with options for early crediting, and to resolve particular questions regarding detailed carbon accounting at a later date. In addition, stepwise approaches can be imagined, in which initially crude, conservative accounting methods are gradually replaced with more sophisticated alternatives, in line with improvements in the scientific base and available technologies.

7.3. Outlook and future research needs

Although the presented analysis suggests that most contentious issues can in fact be resolved pragmatically, it is equally clear that several key questions urgently need the attention of the research and policy community. This is particularly true for questions relating to the national-level implementation of AD schemes, problems of limited governance capacity and issues in scaling up PES schemes. Governance is not only crucial for implementing and enforcing command-and control approaches to curbing deforestation. In fact, implementing market-based PES schemes on a national or provincial level may require even higher levels of governance capacity and more stable political and economic frameworks.

A first indication of the importance and potential effectiveness of focussing on governance issues for forestry-based climate change mitigation is given by Figure 21 which depicts the rate of forest area change versus governance potential in all developing countries (including those with a net gain in forest area). This gives a fairly clear indication of the potential for climate change mitigation in the forestry sector through sources *and sinks* of GHGs which individual governments and the international community could realise by investing into the governance capacity of key developing countries.

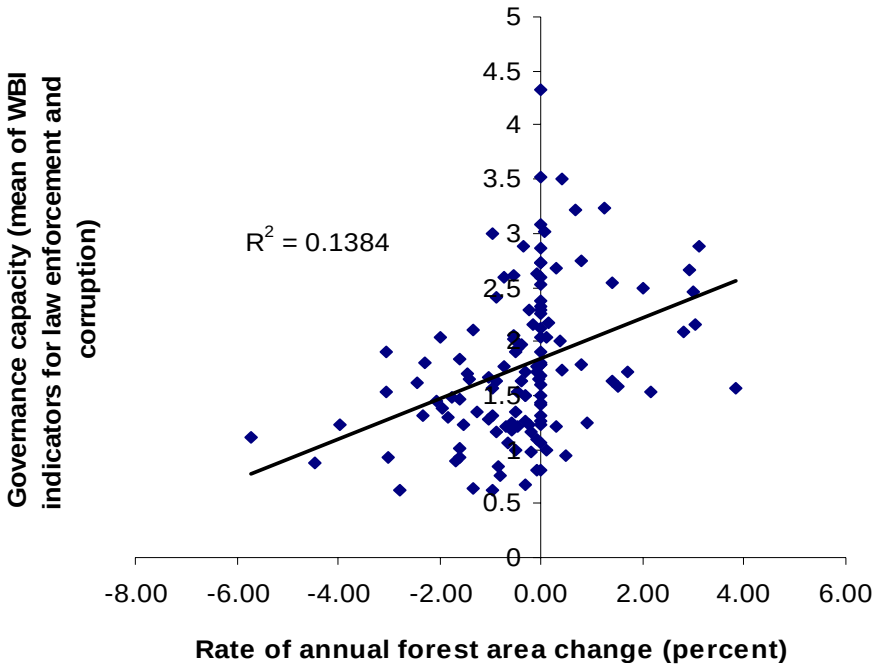

Figure 21 – Rate of forest area change in relation to governance capacity
Source: Author's elaboration with data from FAO (2006) and WBI (2005)

One other central theme of future research efforts ought to be the actual cost curve of avoiding deforestation on a national, regional and on a global level as this determines the eventual scale of achievable emission reductions. Enhanced understanding of this issue would also aid the negotiation of longer-term and more ambitious emission reduction targets because it would remove some of the existing uncertainties regarding costs and feasibility of AD efforts and lingering concerns about market flooding.

I discussed above that despite the great potential of carbon markets to attract and distribute finances efficiently and at a scale superior to other mechanisms, they will probably only be able to achieve this potential if they are combined with targeted external funds. In designing such co-financing and top-up approaches, different donors and stakeholders may wish to incorporate goals beyond pure climate change mitigation. This is particularly obvious regarding the pressing need to devise effective biodiversity protection strategies. In order to use these donor-funds (or those coming from markets for environmental services) most effectively, future research should aim to provide conservationists with a better idea of how to select specific target countries and areas.

The graphs in Figure 22 give a preliminary indication of the relationship between deforestation rates and threats to biodiversity on a country-level, based on a composite "biodiversity threat index" (CELP and CIESIN, 2005).[25] While a detailed analysis of individual countries was

[25] The aggregate index is composed of the following indicators:
ECORISK Percentage of country's territory in threatened eco-regions

outside the scope of this thesis, the graphs do show very clearly that deforestation rates do *not* correlate closely with the level of threats to biodiversity. This means that carbon finance from AD would not automatically achieve proportional biodiversity benefits. Conservation co-funding targeted at certain countries (and presumably specific areas within these countries) could achieve much greater biodiversity benefits than a simple shotgun approach. Incorporating the concept of conservation hotspots, would be an example of this. Such hotspots are not only characterised by high levels of species diversity and endemism but also by a high threat of land-use conversion (Myers et al. 2000). The latter usually translates directly into high land-use opportunity costs. Carbon finance alone may not be able to outweigh benefits from alternative land-uses but a combination with conservation funds from donors or voluntary markets could potentially achieve this aim.

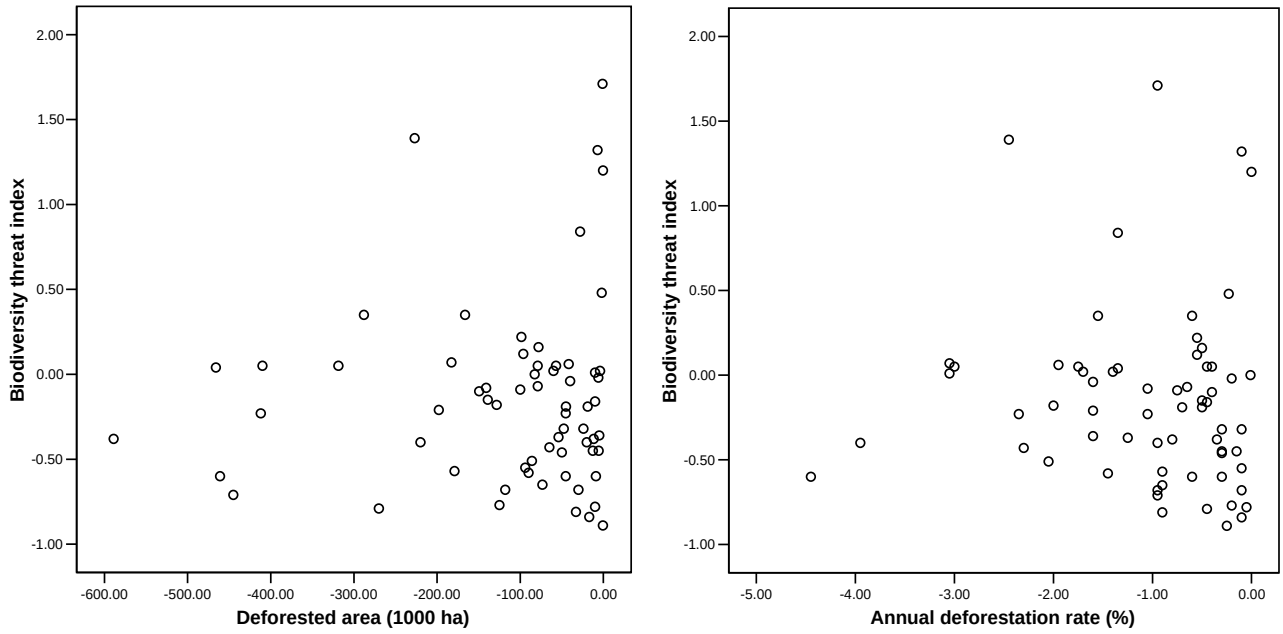

Figure 22 – Relationship between deforestation rates and threat to biodiversity on a national level

Note: Calculations in the left graph omit Brazil and Indonesia for illustrative purposes. Source: Author's elaboration with data from (CELP and CIESIN, 2005).

A similar logic applies to co-benefits in the realm of combating land degradation and desertification. As shown in Section 5.1.2, carbon densities of forests are a crucial factor in determining potential incomes from AD and carbon crediting. Some of the regions with the highest rates of forest conversion, for example Sudan, which ranks third in the global picture (see Table 6), mainly contain arid or semi-arid forests and woodlands. Such forests have relatively low carbon values and could thus only leverage modest funds through carbon trading.

PRTBRD	Threatened bird species as percentage of known breeding bird species in each country
PRTMAM	Threatened mammal species as percentage of known mammal species in each country
PRTAMPH	Threatened amphibian species as percentage of known amphibian species in each country
NBI	National Biodiversity Index

However, conserving such forests could greatly contribute to global efforts to halt desertification, particularly in many parts of Africa.

Next to biodiversity and soil conservation, poverty relief and rural development may be fields in which considerable co-benefits from avoided deforestation could arise. Public development agencies, as well as NGOs and foundations are likely to make demands for some of the money which could be generated through a novel carbon-trading regime. For a preliminary analysis on this, presented in Figure 23, I calculated potential per capita income from CR, based on the same assumptions as in the above sections. The results were graphed against an index of human vulnerability. I used an index measuring health (UNDP, 2005), but other indicators may prove equally useful for specific purposes.[26] Again, as in the case of biodiversity conservation, there is a large scattering of countries, indicating the potential effectiveness of targeting development finance towards certain regions in order to enhance and ensure co-benefits from carbon income.

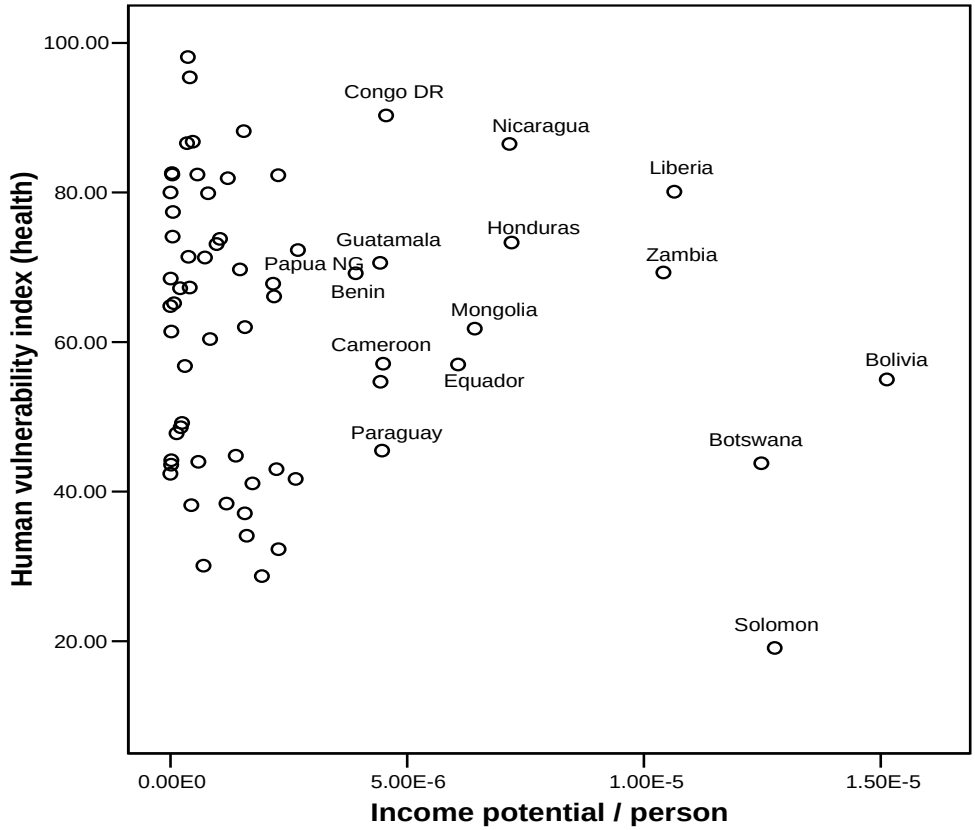

Figure 23 – Potential per capita income from CR in relation to human vulnerability on national level

Source: Author's elaboration with data from UNDP (2005).

In all these cases, one can develop a first understanding of the ways in which AD carbon finance could be used to achieve synergies between the UNFCCC and other international conventions and targets, such as the Millennium Development Goals (MDGs), the Convention on Biological

[26] I am indebted to Mai Yasue (University of Victoria) for her fantastic input concerning the above relationships and illustrations.

Diversity (CBD), and the Convention to Combat Desertification (UNCCD). More research may generate many more insights and possible applications.

There is a different area of emerging potential research which concerns broader conceptual questions, such as the locking in of monetary incentive- and market-based solutions to environmental problems, and the "commodification of the atmosphere" (Castree, 2003), that may soon extend to tropical forests. Furthermore, establishing novel mechanism for monetary transfers of considerable magnitudes may lead to new dependencies, but also to shifts in international (power) relations.

Implementing national-level PES schemes in order to distribute international carbon payments may also have substantial repercussions in the internal political economy of certain countries. Such payments would probably to a certain extent be based on land-ownership and this may translate into shifts in income distribution between different social or ethnic groups - associated with changes in levels of economic and political influence. One interviewee pointed out that one of many possible effects might be for governments of certain forest-rich countries to reverse recent decisions to devolve large areas of land to indigenous peoples (White and Martin, 2002). The reasoning is that parts of the established political class may not wish to disperse significant funds to those groups and try to retain land titles for vast forested areas on which the latter have claims (Interview: 34). Such risks should be identified early enough by researchers so that unintended consequences of well-meant efforts can be addressed from the beginning.

Including avoided deforestation into international climate change mitigation strategies by providing carbon financing to tropical countries provides a unique opportunity to bridge the notorious gap between global (climate) benefits and local (opportunity) costs (Kremen et al., 2000). The mandate of the UNFCCC is clear and demands that international emission reduction efforts should consider "different socio-economic contexts, be comprehensive, cover all relevant sources, sinks and reservoirs of greenhouse gases" (UN, 1992, Art. 3.3)

Sufficient political will provided, there is no reason why a regime providing carbon finance for avoided tropical deforestation should not be agreed upon and become operational soon. All technical issues could be resolved in the near term. In view of the imminent danger of catastrophic climate change and the obvious difficulties of most countries to achieve sufficient reductions in GHG emissions, it seems imperative to finally include all major sources of emissions (and emitters!) in forthcoming international climate regimes. The world cannot afford to ignore an emission source as large as tropical deforestation. Given this need, all the discussed concerns dwindle in importance and certainly do not justify running a much larger risk, namely unabated planetary climate change. Considering the multiple co-benefits tropical forest conservation can offer – global biodiversity conservation, protection of soil and water resources, improving rural livelihoods, and many others – providing carbon finance for avoided deforestation is an excellent investment for the international community.

BIBLIOGRAPHY

ACHARD, F., BELWARD, A. S., EVA, H. D., FEDERICI, S., MOLLICONE, D. & RAES, F. (2005) Accounting for avoided conversion of intact and non-intact forests - Technical options and a proposal for a policy tool. Joint Research Centre of the European Commission, Institute for Environment and Sustainability.

ANGELSEN, A. & KAIMOWITZ, D. (1999) Rethinking the causes of deforestation: Lessons from economic models. *World Bank Research Observer,* 14**,** 73-98.

AUKLAND, L., MOURA COSTA, P. & BROWN, S. (2003) A conceptual framework and its application for addressing leakage: the case of avoided deforestation. *Climate Policy,* 3**,** 123-136.

BAKER, T. R., PHILLIPS, O. L., MALHI, Y., ALMEIDA, S., ARROYO, L., DI FIORE, A., ERWIN, T., KILLEEN, T. J., LAURANCE, S. G., LAURANCE, W. F., LEWIS, S. L., LLOYD, J., MONTEAGUDO, A., NEILL, D. A., PATINO, S., PITMAN, N. C. A., M. SILVA, J. N. & VASQUEZ MARTINEZ, R. (2004) Variation in wood density determines spatial patterns inAmazonian forest biomass. *Global Change Biology,* 10**,** 545-562.

BERNARD, A., PALTSEV, S., REILLY, J. M., VIELLE, M. & VIGUIER, L. (2003) Russia's Role in the Kyoto Protocol. *Report No. 98.* Cambridge, MA, MIT Joint Program on the Science and Policy of Global Change.

BERNARD, H. R. (2002) *Research Methods in Antropology*. (3rd ed.).

BOND, P. & DADA, R. (Eds.) (2005) *Trouble in the air - Global warming and the privatisation of the atmosphere,* Johannesburg, Center for Civil Society.

BRADY, H. E. & COLLIER, D. (2004) *Rethinking Social Inquiry. Diverse Tool, Shared Standards,* Lanham, MD, Rowman and Littlefield.

CASTREE, N. (2003) Commodifying what nature? *Progress in Physical Geography,* 27**,** 273-297.

CELP & CIESIN (2005) Environmental Sustainability Index: Benchmarking National Environmental Stewardship. New York, New Haven, Yale Center for Environmental Law and Policy, Yale University and Center for International Earth Science Information Network (CIESIN), Columbia University.

CHOMITZ, K. M. (1998) Baselines for Greenhouse Gas Reductions: Problems, Precedents, Solutions. Washington DC, Carbon Offsets Unit, World Bank.

CHOMITZ, K. M. (2002) Baseline, leakage and measurement issues: how do forestry and energy projects compare? *Climate Policy,* 2**,** 35-49.

CHOMITZ, K. M., ALGER, K., THOMAS, T. S., ORLANDO, H. & VILA NOVA, P. (2005) Opportunity costs of conservation in a biodiversity hotspot: the case of southern Bahia. *Environment and Development Economics,* 10**,** 293-312.

CHOMITZ, K. M. & LECOCQ, F. (2003) Temporary Sequestration Credits: An Instrument for Carbon Bears. *World Bank Policy Research Working Paper No. 3181.* Washington D.C., World Bank.

CNRS/LEPII-EPE, RIVM/MNP, ICCS-NTUA & CES-KUL (2003) Greenhouse Gas Reduction Pathways in the UNFCCC Process up to 2025. European Commission.

COCHRANE, M. A. (2006) Is the Amazon really at risk of dieback under projected climate change? Prepared for the Coalition for Rainforest Nations, South Dakota State University.

COMIFAC (2006) Commision des Forêts d'Afrique Centrale.

COX, P. M., BETTS, R. A., JONES, C. D., SPALL, S. A. & TOTTERDELL, I. J. (2000) Acceleration of global warming due to carbon-cycle feedbacks in a coupled climate model. *Nature,* 408**,** 184-187.

CRESTWELL, J. W. (2003) *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches,* Thousand Oaks, Sage Publications.

DAUVERGNE, P. (1997) *Shadows in the Forest. Japan and the Politics of Timber in Southeast Asia,* Cambridge, Mass., MIT Press.

DEFRIES, R., ASNER, G., ACHARD, F., JUSTICE, C., LAPORTE, N., PRICE, K., SMALL, C. & TOWNSHEND, J. (2005) Monitoring tropical deforestation for emerging carbon markets. IN MOUTINHO, P. & SCHWARTZMAN, S. (Eds.) *Tropical deforestation and climate change.* Belém, Brazil, IPAM - Instituto de Pesquisa Ambiental da Amazônia, Washington DC: Environmental Defense.

DEPLEDGE, J. (2000) Tracing the origins of the Kyoto Protocol: an article by article textual history. Technical paper FCCC/TP/2000/2. United Nations Framework Convention on Climate Change.

DESSAI, S. (2004) An Analysis of the Role of OPEC as a G77 Member at the UNFCCC. Report for WWF. Geneva, World Wide Fund for Nature.

DESSAI, S., SCHIPPER, L. F., CORBERA, E., KJELLEN, B., GUTIÉRREZ, M. & HAXELTINE, A. (2005) Challenges and Outcomes at the Ninth Session of the Conference of the Parties to the United Nations Framework Convention on Climate Change. *International Environmental Agreements,* 5**,** 105-124.

DUTSCHKE, M. (2005) Forestry and the ultimate objective of the Climate Convention. *Climate+ Paper 2/2005.* Hamburg, Germany, Hamburg Climate Change Cluster.

EBELING, J. (2005) Market-based conservation and global governance: Can forest certification compensate for poor environmental law enforcement? Insights from Ecuador and Bolivia. M.A. Thesis. Freiburg i.Br., Albert-Ludwigs Universität.

EBELING, J., NEEFF, T. & FEHSE, J. (2006) Similarities and Differences in Climate Change Mitigation: Fossil Fuel Reduction and Reducing Emissions from Deforestation and Degradation (REDD) in Developing Countries. Prepared for the Coalition for Rainforest Nations, EcoSecurities - Oxford.

EC (2005) Winning the Battle against Global Climate Change. COM (2005) 35. Brussels, European Commission.

ELLIS, J. & BOSI, M. (1999) Options for project emission baselines. Paris, OECD, IEA.

EWERS, R. M. (2006) Interaction effects between economic development and forest cover determine deforestation rates. *Global Environmental Change,* 16**,** 161-169.

FAO (2001) Global forest resources assessment 2000. Main report. Rome

FAO (2006) Global forest resources assessment 2005. Rome, Food and Agriculture Organization of the United Nations.

FEARNSIDE, P. M. (2001) Saving tropical forests as a global warming countermeasure: an issue that divides the environmental movement. *Ecological Economics,* 39**,** 167-184.

FEARNSIDE, P. M. (2005) Deforestation in Brazilian Amazonia: History, Rates, and Consequences. *Conservation Biology,* 19**,** 680-688.

FERRARO, P. J. & SIMPSON, R. D. (2002) The cost-effectiveness of conservation payments. *Land Economics,* 78**,** 339-353.

GIBBS, H. (2006) Estimating Tropical Forest Carbon Stocks and Emissions from Deforestation. Prepared for the Coalition for Rainforest Nations, University of Wisconsin-Madison.

GOLDEMBERG, J. (2006) Os limites do planeta Terra. *O Estado de São Paulo.* São Paulo.

HOUGHTON, R. A. (2005) Tropical deforestation as a source of greenhouse gas emissions. IN MOUTINHO, P. & SCHWARTZMAN, S. (Eds.) *Tropical deforestation and climate change.* Belém, Washington DC, IPAM - Instituto de Pesquisa Ambiental da Amazônia /Environmental Defense.

INPE (2006) Monitoramento da floresta amazônica brasileira por satélite - Projeto PRODES. São José dos Campos, Brasil, Instituto Nacional de Pesquisas Espaciais.

IPCC (2000) Land use, land-use change and forestry. Special report. IN WATSON, R. T., NOBLE, I. R., BOLIN, B., RAVINDRANATH, N. H., VERARDO, D. J. & DOKKEN, D. J. (Eds.) Geneva, Intergovernmental Panel on Climate Change (IPCC).

IPCC (2001) *Climate Change 2001: The Scientific Basis. Contribution of WG I to the Third Assessment Report of the IPCC,* Cambridge, Cambridge University Press.

IPCC (2003) Good practice guidance for land use, land-use change and forestry. Kanagawa, Japan, Institute for Global Environmental Strategies, Intergovernmental Panel on Climate Change (IPCC).

ISSC (2005) Avoiding Dangerous Climate Change. IN COMMITTEE, I. S. S. (Ed.) *International Symposium on the Stabilisation of Greenhouse Gas Concentrations, 1-3 February 2005.* Exeter, UK.

KAUFMANN, D., KRAAY, A. & MASTRUZZI, M. (2005) Governance Matters IV: Governance Indicators for 1996–2004. Washington D.C., World Bank Institute.

KING, G., KEOHANE, R. O. & VERBA, S. (1994) *Designing Social Inquiry: Scientific Inference in Qualitative Research,* Princeton, NJ, Princeton University Press.

KREMEN, C., NILES, J. O., DALTON, M. G., DAILY, G. C., EHRLICH, P. R., FAY, J. P., GREWAL, D. & GUILLERY, R. P. (2000) Economic Incentives for Rain Forest Conservation Across Scales. *Science,* 288**,** 1828-1832.

LAURANCE, W. F., COCHRANE, M. A., BERGEN, S., FEARNSIDE, P. M., DELAMÔNICA, P., BARBER, C., D'ANGELO, S. & FERNANDES, T. (2001) The future of the Brazilian Amazon. *Science,* 291**,** 438-439.

LEBA (2006) London Energy Brokers' Association - Carbon Indices.

LEE, J. J., LUKACHKO, S. P. & ET AL. (2004) Aircraft and Energy Use. *Encyclopedia of Energy,* 1**,** 29-38.

MAYAUX, P., HOLMGREN, P., ACHARD, F., EVA, H., STIBIG, H. & BRANTHOMME, A. (2005) Tropical forest cover change in the 1990s and options for future monitoring. *Philosophical Transactions of the Royal Society B: Biological Sciences,* 360**,** 373-384.

MOUTINHO, P. & SCHWARTZMAN, S. (Eds.) (2005) *Tropical deforestation and climate change,* Belém, Brazil, Washington DC, IPAM - Instituto de Pesquisa Ambiental da Amazônia, Environmental Defense.

MYERS, N. et al. (2000) Biodiversity hotspots for conservation priorities. *Nature,* 403, 853-858.

NCF (2006) EU ETS Deep-Dive Analysis - July 2006. London, UK, New Carbon Finance.

NIESTEN, E., FRUMHOFF, P. C., MANION, M. & HARDNER, J. J. (2002) Designing a carbon market that protects forests in developing countries. *Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences,* 360**,** 1875-1888.

NOBLE, I. (2006) Some notes on avoided deforestation in the UNFCCC (unpublished). WorldBank.

OLANDER, L. P., MURRAY, B. C., GIBBS, H. & STEINIGER, M. (2006) Establishing Credible National Baselines for Efforts to Reduce Emissions from Degradation and Deforestation. Prepared for the Coalition for Rainforest Nations, Duke University, University of Wisconsin-Madison and Conservation International.

PALTSEV, S. V. (2000) The Kyoto Protocol: 'Hot Air' for Russia? Boulder, CO, Center for Economic Analysis, University of Colorado.

PANDEY, N. (2004) Equity in climate change treaty. *Current Science,* 86**,** 272-281.

PEDRONI, L. (2005) Carbon accounting for sinks in the CDM after CoP-9. *Climate Policy,* 5**,** 407-418.

POINTCARBON (2006) Carbon 2006. Towards a truly global market. IN HASSELKNIPPE, H. & RØINE, K. (Eds.) Copenhagen.

PUTNAM, R. D. (1988) Diplomacy and Domestic Politics: the Logic of Two-Level Games. *International Organization,* 42**,** 427-460.

RAICH, J. W., RUSSELL, A. E., KITAYAMA, K., PARTON, W. J. & VITOUSEK, P. M. (2006) Temperature influences on carbon accumulation in moist tropical forests. *Ecology,* 87**,** 76-87.

RAINFOREST COALITION (2006) Initiatives: Reducing Carbon Emissions. Coalition for Rainforest Nations.

RUDEL, T. K. (2002) Paths of destruction and regeneration: Globalization and forests in the tropics. *Rural Sociology,* 67**,** 622-636.

RUDEL, T. K., COOMESB, O. T., MORANC, E., ACHARD, F., ANGELSENE, A., XUF, J. & LAMBIN, E. (2005) Forest transitions: towards a global understanding of land use change. *Global Environmental Change,* 15**,** 23-31.

SANTILLI, M., MOUTINHO, P., SCHWARTZMAN, S., NEPSTAD, D., CURRAN, L. & NOBRE, C. (2005) Tropical Deforestation and the Kyoto Protocol. An editorial essay. *Climatic Change,* 71**,** 267-276.

SCHELLNHUBER, H. J., CRAMER, W., NAKICENOVIC, N., WIGLEY, T. & YOHE, G. (Eds.) (2006) *Avoiding Dangerous Climate Change,* Cambridge, Cambridge University Press.

SCHERR, S., WHITE, A. & KHARE, A. (2004) For services rendered. The current status and future potential of markets for the ecosystem services provided by tropical forests. *ITTO Technical Series.* ITTO.

SCHLAMADINGER, B., CICCARESE, L., DUTSCHKE, M., FEARNSIDE, P. M., BROWN, S. & MURDIYARSO, D. (2005) Should we include avoidance of deforestation in the international response to climate change? IN MURDIYARSO, D. & HERAWATI, H. (Eds.) *Carbon forestry: who will benefit?* . Bogor, Indonesia, CIFOR.

SCHWARZE, R., NILES, J. O. & OLANDER, J. (2002) Understanding and Managing Leakage in Forest-Based Greenhouse Gas Mitigation Projects. Washington D.C., The Nature Conservancy.

SMITH, W. (2002) The global problem of illegal logging. *Tropical Forest Update,* 12**,** 3-5.

SOARES-FILHO, B. S., NEPSTAD, D. C., CURRAN, L. M., CERQUEIRA, G. C., GARCIA, R. A., RAMOS, C. A., VOLL, E., MCDONALD, A., LEFEBVRE, P. & SCHLESINGER, P. (2006) Modelling conservation in the Amazon basin. *Nature,* 440**,** 520-523.

SUGIYAMA, T. & LIU, D. S. (2004) Must developing countries commit quantified targets? Time flexibility and equity in climate change mitigation. *Energy Policy,* 32**,** 697-704.

TAIYAB, N. (2005) Exploring the Market for 'Development Carbon' through the voluntary and retail sectors. London, UK, International Institute for Environment and Development (IIED).

TOMASELLI, I. (2006) Brief study on funding and finiace for forestry and forest-based sector. United Nations Forum on Forests.

TOTTEN, M., PANDYA, S. I. & JANSON-SMITH, T. (2003) Biodiversity, climate, and the Kyoto Protocol: risks and opportunities. *Frontiers in Ecology and the Environment,* 1**,** 262-270.

UN (1969) Vienna Convention on the Law of Treaties. United Nations.

UN (1992) United Nations Framework Convention on Climate Change. United Nations.

UNDP (2005) Human Development Report. Statistics - Country Data. New York, United Nations Development Programme.

UNEP (2001) Global Biodiversity Outlook. Montréal, Secretariat of the Convention on Biological Diversity.

UNEP (2006) CDM Pipeline Overview. UNEP Risoe Centre on Energy, Climate & Sustainable Development.

UNFCCC (1998) Kyoto Protocol to the Convention on Climate Change. Bonn, Germany, United Nations Framework Convention on Climate Change.

UNFCCC (2001) The Marrakesh Accords & The Marrakesh Declaration. United Nations Framework Convention on Climate Change.

UNFCCC (2005a) Caring for climate. A guide to the Climate Change Convention and the Kyoto Protocol. Bonn, United Nations Framework Convention on Climate Change.

UNFCCC (2005b) FCCC/CP/2005/L.2 - Reducing emissions from deforestation in developing countries: approaches to stimulate action. Draft conclusions proposed by the President. *Conference of the Parties, 11th Session.* Montréal, Canada, United Nations Framework Convention on Climate Change.

UNFCCC (2005c) FCCC/CP/2005/MISC.1 - Agenda item 6. Reducing emissions from deforestation in developing countries: approaches to stimulate action. Submission by the governments of Papua New Guinea and Costa Rica. *Conference of the Parties, 11th Session.* Montréal, Canada, United Nations Framework Convention on Climate Change.

UNFCCC (2005d) Key GHG Data. Greenhouse Gas (GHG) Emissions Data for 1990 – 2003 submitted to the UNFCCC. United Nations Framework Convention on Climate Change.

UNFCCC (2006a) FCCC/SBSTA/2006/L.8 - Twenty-fourth session, agenda item 6. Reducing emissions from deforestation in developing countries. Draft conclusions proposed by the Chair. Bonn, UNFCCC Subsidiary Body for Scientific and Technological Advice.

UNFCCC (2006b) FCCC/SBSTA/2006/MISC.5 - Twenty-fourth session - item 6 of the provisional agenda. Issues relating to reducing emissions from deforestation in developing countries and recommendations on any further process. Submissions from Parties. Bonn, UNFCCC Subsidiary Body for Scientific and Technological Advice.

WARA, M. (2006) Measuring the Clean Development Mechanism's Performance and Potential. *Working Paper No. 56, July 2006.* Center for Environmental Science and Policy, Stanford University.

WBI (2005) Governance Indicators: 1996-2004. Washington DC, World Bank Institute.

WHEELER, D. (2002) Beyond pollution havens. *Global Environmental Politics,* 2**,** 1-10.

WHITE, A. & MARTIN, A. (2002) Who Owns The World's Forests? Forest Tenure And Public Forests In Transition Washington D.C., Forest Trends and Center for International Environmental Law

WORLD BANK (2005) *State and Trends of the Carbon Market 2005,* Washington DC, World Bank.

WORTHINGTON, R. (2005) Double-edged sword of the Kyoto Protocol. IN BOND, P. & DADA, R. (Eds.) *Trouble in the air - Global warming and the privatisation of the atmosphere.* Johannesburg, TNI, CCS.

WUNDER, S. (2005) Payments for environmental services: Some nuts and bolts *CIFOR Occasional Paper 42*.

APPENDICES

A. 1. List of interviews

Name	Last Name	Organisation	Position	Stakeholder Group	Type of Interview
Andrasko	Kenneth	US Environmental Protection Agency	Advisor on land-use and climate change	Government	Phone
Badiozamani	Ghazal	UNFF Secretariat	Programme Officer	IGO	Phone
Benndorf	Rosemarie	German Federal Environment Agency	Programme Officer	Government	Phone
Blaser	Jürgen	Intercooperation	Director, project manager	Private sector	In person & phone
Bosquet	Benoît	World Bank	Director BioCarbon Fund	IGO	Phone
Peredo-Videa	Bernardo	Oxford University / Freelance	PhD researcher and consultant	Research	Phone + mails
Castro	José	EcoSecurities	Project Manager	Private sector	In person
Creighton	Ken	WWF US	Coordinator World Bank-	NGO	In person & phone
Cronkleton	Peter	CIFOR, Bolivia	Director	IGO/NGO	In person
Dutschke	Michael	BioCarbon Consult /Hamburg Institute of International Economics	Senior Consultant	Private sector /Research	Phone
Estrada	Manuel	Mexican Ministry of Environment /	Climate Change specialist / Consultant	Government	In person & phone
Forner	Claudio	CIFOR	Policy coordinator	IGO/NGO	In person & phone
Frumhoff	Peter	Union of Concerned Scientists	Director of Global Environment Program	Research	In person
Hepburn	Cameron	Oxford University	Environmental economist	Research	In person
Houghton	Richard A.	Woods Hole Research Center	Senior scientist	Research	Phone
Hutton	John	WCMC UNEP	Director	IGO	Phone
Johns	Tracy	Joanneum	Policy researcher	NGO	In person & phone
Krug	Thelma	Brazil National Institue for Space Research,	Climate change negotiator, researcher	Government /Research	In person
Lecocq	Franck	Engref Laboratory of Forestry Economics	Economist	Research	Phone
Lemos	Maria Carmen	University of Michigan	Climate Change and Latin America researcher	Research	In person
Malhi	Yadvinder	Oxford University	Tropical forestry and climate change research	Research	In person
Martens	Jan-Willem	Ecosecurities	Head of Consultancy	Private sector	In person
Mason	Mike	Climate Care	Managing Director	Private sector	In person
Moura Costa	Pedro	EcoSecurities	Managing Director	Private sector	In person

Name	Last Name	Organisation	Position	Stakeholder Group	Type of Interview
Moutinho	Paulo	IPAM - Instituto de Pesquisa Ambiental da	Senior researcher	Research	Phone
Noble	Ian	World Bank	Director BioCarbon Fund	IGO	In person & phone
O'Niles	John	Coalition for Rainforest	Chief technical advisor	IGO	Phone
Oberthür	Sebastian	Institute for European Studies	International relations researcher	Research	Phone
Oliveira	Haroldo de	Brazil Ministry of Science and Technology	Interminist. Comm. on Global CC	Government	In person
Pedroni	Lucio	CATIE	Research director	Research/ Private	Phone
Penman	Jim	UK Dept. for Env., Food & Rural Affairs	Climate Change specialist	Government	In person & phone
Persson	Martin	Physical Resource Theory, Chalmers Univ. of Technology	Researcher	Research	In person
Petsonk	Annie	Environmental Defense	Policy Director	NGO	Phone
Prado	Antonio do	UNFF Secretariat	Policy and Trade Officer	IGO	Phone
Ravindranath	Nijavalli H.	Indian Institue of Science	Chief researcher, LULUCF and climate	Research	Phone
Sari	Agus P.	EcoSecurities Indonesia	Country Manager	Private sector	In person
Schlamadinger	Bernhard	Joanneum	Research director	Research	Phone
Schöne	Dieter	FAO	Senior Forestry Officer	IGO	Phone
Seaton	Robert	Brinkman & Ass. Reforestation	Assistant Director	Private sector	In person & phone
Singer	Stephan	WWF Europe	Programme Director	NGO	In person
Sohngen	Brent	Ohio State University	Agricultural economist	Research	In person & phone
Villiers	Chris	EcoSecurities	Carbon trader	Private sector	In person
Vitale	Ben	Conservation	Senior Finance Director	NGO	In person & phone
White	Rodney	University of Toronto	Environmental Finance and Geography researcher	Research	In person
Wolf	Reinhard	GTZ Germany	Climate Change programme manager	Government	In person & phone
Wong	Jenny	UNFCCC Secretariat	Programme Officer	IGO	Phone
Wunder	Sven	CIFOR, Brazil	Senior Economist	Research /NGO	In person & phone

A. 2. Submissions to the UNFCCC

Country	Submission	AD emission trading ?	Compensation through non carbon trading ?	Legal framework (Kyoto vs. UNFCCC)
Burundi Cameroon Congo Gabon Equatorial Guinea Dem. Rep. of Congo Rwanda Sao Tome & Principe Chad	**COMIFAC**[1]	"To achieve significant GHG emissions reduction from deforestation, Central African countries think that positive incentives should be based on market mechanisms, linked with substantial emissions reduction commitments in developed countries" "... based	Fees on carbon intensive commodities and services in developed countries to achieve GHG emissions reductions from deforestation might be developed; ODA, bilateral and multilateral agreements, public-private partnerships or other mechanisms to initiate act	"The discussion […] should continue under the UNFCCC. However, the option of potentially introducing GHG emissions from deforestation" in the KP "should not be excluded"; "Capacity building issues, policy approaches and positive incentives should be adres
Central African Rep.	Comifac & CoRF			
Papua New Guinea	**CoRF**[2]	"Parties must consider a multifaceted and flexible set of incentive" that should not be "mutually exclusive": ODA approach, Sectoral CDM approach, Annex C National Approach (market approach), bilateral or multilateral Emissions Trading agreements and Opti		"The discussion […] can continue under the UNFCCC. However, the option of potentially introducing GHG emissions from deforestation" in the KP "should not be excluded"; "Capacity building issues, policy approaches and positive incentives should be adressed
Dominican Republic	Supported CoRF			
Solomon Islands	Supported CoRF			
Bolivia	CoRF & Peru			
Costa-Rica	CoRF & Peru			
Nicaragua	CoRF & Peru			
Peru Argentina Colombia Chile Ecuador El Salvador Guatemala Honduras Mexico Panama Uruguay	**PERU**	"Positive incentives should be based on market mechanisms …	… or on other innovative financial approaches, such as fees on carbon intensive commodities and services in Annex 1 countries" ; ODA, bilateral and multilateral agreements, public-private partnerships or other mechanisms to initiate action and create cap	"The discussion […] should continue under the UNFCCC. However, the option of potentially introducing GHG emissions from deforestation" in the KP "should not be excluded"; "Capacity building issues, policy approaches and positive incentives should be adres
Brazil	**BRAZIL**	"... Brazil does not envisage any mechanism related to reducing emissions from deforestation in developing countries that could be used by Annex I countries to meet their ... commitments under the Kyoto Protocol."	"...incentives should encompass the provision of new and additional financial resources and transfer of technology, as well as capacity building and enhancement of endogenous capacities, to be channeled to government programmes"	"...considered solely under the Framework Convention on Climate Change."
EU	**EU**	"A range of instruments has to be considered"		"The EU looks forward to discussing options for the possible development of an international framework aiming at encouraging and facilitating national efforts to reduce emissions from deforestation in developing countries, and would also be willing to dis
Bulgaria Romania Croatia Albania Bosnia & Herzegovina Serbia & Montenegro Macedonia Turkey	supported EU			
USA		"to the extent that such discussions involve crediting mechanisms they should occur under the auspices of the Kyoto Protocol."	"countries need to be able to approach avoided deforestation using technical, market, and policy tools that are appropriate and realistic for their national circumstance" List range of options (not carbon trading, but legal wood under market tools)	

Country	Type of targets ?	Longer-term emission targets	Scale of carbon accounting ?	Baseline / base period	Timing ?
Burundi Cameroon Congo Gabon Equatorial Guinea Dem. Rep. of Congo Rwanda Sao Tome & Principe Chad Central African Rep.	"Not only should the Parties' participation to reduce or avoid deforestation be voluntary, they alone should decide how to implement measures to that end"		Sectorial approach on national or regional level for the market approach	"Reference scenarios […] should not disadvantage countries that have taken early actions"; "reducing GHG emissions from degradation offers an opportunity to consolidate and amplify actions that have already started"	"Any delay in adressing emissions from deforestation is counterproductive for pursuing the objective of the UNFCCC" "The discussion on technical issues should not delay or prevent the adoption of policy approaches"
Papua New Guinea Dominican Republic Solomon Islands Bolivia Costa-Rica Nicaragua	"Not only should the Parties' participation in efforts to reduce emissions from deforestation should be voluntary, Parties alone should decide how to implement specific measures"		Project, national and/or regional scale according to the different mechanisms	"The parties must develop policies and incentives that encourage and support bold early actions by Parties that might later effect baseline formulation"	"....allow due consideration of emissions reductions from deforestation for the second Commitment Period" of the KP; "The discussion on technical issues should not delay or prevent the adoption of policy approaches"
Peru Argentina Colombia Chile Ecuador El Salvador Guatemala Honduras Mexico Panama Uruguay	"Not only should the Parties' participation in efforts to reduce emissions from deforestation should be voluntary, Parties alone should decide how to implement specific measures"		"Actions to curb GHG emissions from deforestation should be implemented at the project level; a project may be implented up to the regional or national scale"	"Reference scenarios […] should not disadvantage countries that have taken early actions"	'"The option of eventually addressing GHG emission from deforestation in the second commitment period of the KP should not be excluded"; "The discussion on technical issues should not delay or prevent the adoption of policy approaches"
Brazil	"...efforts undertaken by developing countries to reduce emissions from deforestation in their territories can only be characterized as voluntary and, therefore, cannot be linked or associated to goals, targets and timeframes"	"the emissions of non-Annex I Parties are expected to grow so as to accommodate their needs for development ... the extent to which developing country Parties ....implement their commitments under the Convention will depend on the effective implementation			
EU Bulgaria Romania Croatia Albania Bosnia & Herzegovina Serbia & Montenegro Macedonia Turkey			"Addressing deforestation at national level provides an interesting basis for considering methodological issues"... "However, ... relevant decisions (e.g. Marrakesh Accords, decisions in the context of afforestation and reforestation under the CDM) should	"Baselines should be assessed in a fair way […] to achieve broad participation" … and "not penalize early actions"	"The EU would be willing to discuss possibilities for promoting actions before 2012" "An international policy regime […] will require considerable scientific, technical and methodological inputs"
USA			"... comprehensive accounting of all greenhouse gas (GHG) sources and sinks" "emissions related to deforestation and uptake from regeneration should be reported in Parties' national inventories"		

A. 3. Country data for statistical analysis

A. 3.1. Complete source data

Country	Forest area	Forest / land area	Average annual forest area change	Average annual forest area change	Average forest carbon density	Potential annual income from carbon	GDP	Potential income as share of GDP at ...	WBI governance indicators (adjusted)	WBI governance indicators (adjusted)
(Non-Annex I)	1000 ha	%	1990-2005 (1000 ha)	1990-2005 (%)	tC/ ha	10 % defor. reduction, €15 / tCO_2 (€ million)	2005 (€ million)	10 % defor. reduction, €15 /tCO_2 (%)	(mean of 5 indicators)	(mean of 2 indicators)
Afghanistan	867	1.33	-29.33	-2.80	13.5	2.18	5,568	0.04	0.57	0.63
Algeria	2,277	1.00	32.33	1.50	37.5	6.67	79,580	0.01	1.38	1.59
Angola	59,104	47.40	-125.00	-0.20	27.0	18.58	22,511	0.08	1.04	0.98
Argentina	33,021	11.88	-149.33	-0.40	34.0	27.95	141,696	0.02	1.86	1.63
Armenia	283	9.50	-4.00	-1.40	33.0	0.73	2,944	0.02	1.77	1.65
Azerbaijan	936	11.33	0.00	0.00	52.5	0.00	9,798	0.00	1.24	1.26
Bahamas	515	133.07	0.00	0.00	50.0	0.00	4,696	0.00	3.33	3.52
Bangladesh	871	6.05	-2.00	-0.23	19.5	0.21	47,750	0.00	1.24	1.23
Barbados	2	4.65	0.00	0.67	50.0	0.00	2,469	0.00	3.33	3.21
Belize	1,653	71.99	0.00	0.00	105.5	0.00	833	0.00	2.57	2.29
Benin	2,351	20.88	-65.00	-2.30	97.5	34.89	3,452	1.01	1.91	1.80
Bhutan	3,195	67.98	11.00	0.30	89.0	5.39	633	0.85	2.28	2.68
Bolivia	58,740	53.47	-270.00	-0.45	91.5	136.00	7,527	1.81	1.77	1.54
Botswana	11,943	21.10	-118.00	-0.95	31.5	20.46	7,200	0.28	3.00	3.00
Brazil	477,698	56.10	-2821.67	-0.55	104.5	1,623.23	618,293	0.26	2.21	2.02
Brunei	278	48.18	-2.00	-0.75	102.5	1.13	4,991	0.02	2.63	2.60
Burkina Faso	6,794	29.00	-24.00	-0.30	8.0	1.06	4,484	0.02	1.79	1.72
Burundi	152	5.46	-9.00	-4.45	93.5	4.63	625	0.74	0.80	0.87
Cambodia	10,447	57.71	-166.33	-1.55	34.5	31.59	4,227	0.75	1.44	1.23
Cameroon	21,245	44.68	-220.00	-0.95	65.5	79.33	13,253	0.60	1.33	1.31
Cape Verde	84	20.84	2.00	2.00	63.5	0.70	775	0.09	2.55	2.49
Central Africa	22,755	36.53	-30.00	-0.10	56.5	9.33	1,077	0.87	0.81	0.80
Chad	11,921	9.50	-79.00	-0.65	8.0	3.48	4,236	0.08	1.08	1.06
Chile	16,121	21.31	57.00	0.40	134.0	42.05	88,886	0.05	3.45	3.50
China	197,290	20.56	2676.67	1.70	30.5	449.42	1,735,353	0.03	1.71	1.71
Colombia	60,728	53.32	-47.67	-0.10	98.0	25.72	95,370	0.03	1.65	1.77
Comoros	5	2.90	-4.00	-5.70	32.5	0.72	289	0.25	1.37	1.11
Congo	22,471	65.70	-17.00	-0.10	106.5	9.97	5,592	0.18	1.08	1.10
Congo, DR	133,610	56.98	-461.00	-0.30	112.5	285.50	4,575	6.24	0.51	0.68
Costa Rica	2,391	46.79	-11.67	-0.35	110.0	7.06	15,430	0.05	2.97	2.88
Côte d'Ivoire	10,405	32.27	12.33	0.10	65.0	4.41	12,639	0.03	0.82	0.99
Djibouti	6	0.20	0.00	0.00	23.0	0.00	548	0.00	1.47	1.43
Dominican Re	1,376	28.24	0.00	0.00	26.5	0.00	22,783	0.00	1.95	1.68
Ecuador	10,853	38.27	-198.00	-1.60	75.5	82.29	25,788	0.32	1.55	1.47
Egypt	67	0.10	2.00	2.80	53.0	0.58	72,575	0.00	1.74	2.09
El Salvador	298	14.16	-5.00	-1.60	101.0	2.78	13,182	0.02	2.14	1.84
Equatorial Gui	1,632	58.18	-15.00	-0.85	79.0	6.52	5,267	0.12	1.05	0.85
Eritrea	1,554	15.40	-4.00	-0.30	16.0	0.35	744	0.05	1.22	1.49
Ethiopia	13,000	11.90	-141.00	-1.05	39.5	30.66	8,716	0.35	1.19	1.28
Fiji	1,000	54.73	1.33	0.10	32.0	0.23	2,232	0.01	2.03	2.04
Gabon	21,775	81.35	-10.00	-0.05	68.5	3.77	6,955	0.05	1.73	1.66
Gambia	471	41.68	2.00	0.40	11.0	0.12	358	0.03	1.90	1.74
Georgia	2,760	39.60	0.00	0.00	48.5	0.00	4,990	0.00	1.40	1.31
Ghana	5,517	23.13	-128.33	-2.00	44.0	31.08	8,341	0.37	2.12	2.04
Guatemala	3,938	36.16	-54.00	-1.25	185.5	55.14	21,345	0.26	1.55	1.35
Guinea	6,724	27.35	-45.33	-0.60	57.0	14.22	2,571	0.55	1.23	1.25
Guinea-Bissau	2,072	57.36	-10.00	-0.45	10.0	0.55	225	0.25	1.33	1.22
Guyana	15,104	70.26	0.00	0.00	126.5	0.00	610	0.00	2.02	1.79
Haiti	105	3.78	-1.00	-0.95	50.5	0.28	3,285	0.01	0.61	0.63
Honduras	4,648	41.47	-182.67	-3.05	52.5	52.79	6,455	0.82	1.69	1.54
India	67,701	20.59	251.00	0.37	36.5	50.43	604,820	0.01	1.94	2.00
Indonesia	88,495	46.46	-1871.67	-1.85	68.0	700.64	215,283	0.33	1.47	1.30
Iran	11,075	6.72	0.00	0.00	74.5	0.00	153,199	0.00	1.25	1.49
Jamaica	339	31.30	-0.40	0.00	85.5	0.00	7,589	0.00	2.15	1.78
Jordan	83	0.93	0.00	0.00	18.5	0.00	10,032	0.00	2.24	2.53
Kazakhstan	3,337	1.22	-6.00	-0.20	9.0	0.30	43,749	0.02	1.38	1.16
Kenya	3,522	6.20	-12.67	-0.30	24.0	1.67	14,964	0.01	1.47	1.27
Kiribati	2	2.74	0.00	0.00	32.0	0.00	49	0.00	2.33	2.32
Korea	6,265	63.12	-7.00	-0.10	18.0	0.69	618,595	0.00	2.81	2.62
Kuwait	6	0.34	0.20	3.10	10.5	0.01	58,186	0.00	2.50	2.88
Kyrgyzstan	869	4.35	2.00	0.30	10.0	0.11	1,904	0.00	1.40	1.22

Country	Forest area	Forest / land area	Average annual forest area change	Average annual forest area change	Average forest carbon density	Potential annual income from carbon	GDP	Potential income as share of GDP at ...	WBI governance indicators (adjusted)	WBI governance indicators (adjusted)
(Non-Annex I)	1000 ha	%	1990-2005 (1000 ha)	1990-2005 (%)	tC/ ha	10 % defor. reduction, € 15 / tCO_2 (€ million)	2005 (€ million)	10 % defor. reduction, € 15 /tCO_2 (%)	(mean of 5 indicators)	(mean of 2 indicators)
Laos	16,142	68.17	-78.00	-0.50	15.5	6.66	2,133	0.31	1.04	0.99
Lebanon	136	13.08	1.00	0.80	11.0	0.06	17,201	0.00	1.65	1.79
Lesotho	8	0.30	0.20	3.05	17.0	0.02	991	0.00	2.18	2.16
Liberia	3,154	28.32	-60.00	-1.70	98.0	32.37	384	8.43	0.58	0.89
Libya	217	0.10	0.00	0.00	10.0	0.00	30,213	0.00	1.26	1.42
Madagascar	12,838	22.10	-57.00	-0.40	97.0	30.44	3,676	0.83	2.08	1.98
Malawi	3,402	36.20	-33.00	-0.90	71.5	12.99	1,616	0.80	1.65	1.64
Malaysia	20,890	63.35	-98.67	-0.55	102.5	55.67	102,021	0.05	2.58	2.61
Mali	12,572	10.30	-100.00	-0.75	15.5	8.53	4,099	0.21	2.04	1.77
Mauritania	267	0.30	-10.00	-3.05	3.0	0.17	1,512	0.01	1.99	1.90
Mexico	64,238	32.80	-318.67	-0.45	27.0	47.37	599,381	0.01	2.24	1.94
Mongolia	0	0.00	-82.67	-0.01	40.0	18.20	1,467	1.24	2.25	2.04
Morocco	4,364	9.80	5.00	0.15	20.5	0.56	40,549	0.00	2.01	2.17
Mozambique	19,262	24.60	-50.00	-0.30	27.5	7.57	5,248	0.14	1.81	1.51
Myanmar	32,222	47.62	-466.00	-1.35	28.5	73.11	4,195	1.74	0.46	0.65
Namibia	7,661	9.30	-73.33	-0.90	6.0	2.42	4,774	0.05	2.55	2.40
Nepal	3,636	24.70	-79.00	-1.75	54.5	23.70	5,862	0.40	1.26	1.49
Nicaragua	5,189	39.92	-90.00	-1.45	80.5	39.88	3,906	1.02	1.88	1.71
Niger	1,266	1.00	-45.33	-2.35	2.0	0.50	2,725	0.02	1.54	1.31
Nigeria	11,089	12.00	-410.00	-3.00	92.0	207.65	77,335	0.27	0.99	0.93
Oman	2	0.01	0.00	0.00	8.5	0.00	23,654	0.00	2.69	3.08
Pakistan	1,902	2.39	-41.67	-1.95	13.5	3.10	92,408	0.00	1.18	1.38
Panama	4,294	56.86	-5.67	-0.15	161.0	5.02	11,883	0.04	2.36	2.15
Papua New Gu	29,437	63.60	-139.00	-0.50	29.0	22.19	3,089	0.72	1.48	1.34
Paraguay	18,475	45.42	-179.00	-0.90	29.5	29.07	5,653	0.51	1.42	1.16
Peru	68,742	53.49	-94.00	-0.10	122.5	63.39	61,289	0.10	1.85	1.71
Philippines	7,162	23.87	-227.00	-2.45	57.0	71.23	76,169	0.09	1.79	1.62
Puerto Rico	408	45.59	0.27	0.07	50.0	0.00	50,700	0.00	3.12	3.01
Rwanda	480	18.22	11.00	3.85	93.5	5.66	1,664	0.34	1.49	1.57
Samoa	171	60.21	2.67	1.40	32.0	0.47	262	0.18	2.66	2.54
São Tomé and	27	28.13	0.00	0.00	58.0	0.00	55	0.00	1.88	1.60
Saudi Arabia	2,728	1.27	0.00	0.00	6.0	0.00	240,061	0.00	1.82	2.38
Senegal	8,673	44.09	-45.00	-0.50	15.0	3.72	6,499	0.06	2.02	1.90
Seychelles	40	88.90	0.00	0.00	24.5	0.00	541	0.00	2.05	2.12
Sierra Leone	2,754	38.39	-19.00	-0.70	69.5	7.27	931	0.78	1.30	1.21
Singapore	2	2.94	0.00	0.00	102.5	0.00	91,948	0.00	3.82	4.33
Solomon Islan	2,172	75.16	-40.00	-1.60	32.0	7.05	225	3.14	1.17	1.01
South Africa	9,203	7.60	0.00	0.00	40.5	0.00	186,532	0.00	2.63	2.60
Sri Lanka	1,933	29.46	-28.00	-1.35	29.5	4.55	18,341	0.02	1.96	2.11
St. Kitts and N	5	13.89	0.00	0.00	50.0	0.00	353	0.00	2.78	2.73
St. Lucia	17	27.42	0.00	0.00	99.0	0.00	644	0.00	2.88	2.72
St. Vincent an	11	28.21	0.13	0.80	86.5	0.06	329	0.02	2.88	2.75
Sudan	67,546	28.40	-589.00	-0.80	6.0	19.45	21,605	0.09	0.68	0.76
Suriname	14,776	90.50	0.00	0.00	126.5	0.00	1,049	0.00	2.25	2.26
Swaziland	541	31.50	5.00	0.90	57.5	1.58	1,975	0.08	1.52	1.25
Syria	461	2.49	6.00	1.40	14.0	0.46	20,625	0.00	1.29	1.63
Tajikistan	410	2.88	0.13	0.00	5.0	0.00	1,803	0.00	1.07	1.06
Tanzania	35,257	39.90	-412.00	-1.05	14.5	7.69	9,490	0.02	1.75	1.67
Thailand	14,520	28.30	-96.33	-0.55	77.5	8.53	131,644	2.49	2.23	2.05
Togo	386	6.80	-20.00	-3.95	32.0	0.00	1,649	2.06	1.24	1.24
Tonga	4	5.33	0.00	0.00	64.5	0.21	171	0.00	1.94	1.81
Trinidad and T	226	44.05	-0.60	-0.25	13.5	2.06	12,379	0.00	2.50	2.30
Tunisia	1,056	6.80	27.67	3.00	1.5	0.00	23,544	0.00	2.19	2.47
Turkmenistan	4,127	8.46	0.00	0.00	81.5	38.58	13,779	0.00	0.67	0.82
Uganda	3,627	18.40	-86.00	-2.05	5.0	0.12	6,794	0.00	1.57	1.45
United Arab Er	312	3.73	4.47	1.25	30.0	68.04	104,339	0.01	2.89	3.24
Uruguay	1,506	8.55	39.67	2.90	29.5	6.44	12,422	0.05	2.74	2.66
Uzbekistan	3,295	7.36	17.00	0.50	5.0	0.47	9,114	0.01	0.74	0.95
Vanuatu	440	36.10	0.00	0.00	32.0	0.00	259	0.00	2.15	1.90
Venezuela	47,713	52.31	-288.00	-0.60	116.5	184.70	103,621	0.18	1.23	1.18
Vietnam	12,931	38.99	237.67	2.15	33.0	43.18	39,702	0.11	1.60	1.54
Yemen	549	1.04	0.00	0.00	9.5	0.00	11,851	0.00	1.15	1.23
Zambia	42,452	57.10	-445.00	-0.95	52.0	127.39	5,511	2.31	1.68	1.56
Zimbabwe	17,540	45.30	-313.00	-1.60	28.0	48.25	3,503	1.38	0.66	0.93

A. 3.2. Income scenarios for all developing countries from carbon trading

Country	Potential income (€ million) from carbon trading at ...								
	Carbon price of € 18/tC (€5/tCO$_2$) and ...			Carbon price of € 55/tC (€ 15/tCO$_2$) and ...			Carbon price of € 110/tC (€ 30/tCO$_2$) and ...		
Non-Annex I (all countries - also those with net gain in forests)	**- 10 % in deforestation**	- 20 % deforestation	- 50 % deforestation	**- 10 % in deforestation**	- 20 % deforestation	- 50 % deforestation	**- 10 % in deforestation**	- 20 % deforestation	- 50 % deforestation
Afghanistan	**0.73**	1.45	3.63	**2.18**	4.36	10.90	**4.36**	8.72	21.80
Algeria	**2.22**	4.45	11.12	**6.67**	13.35	33.37	**13.35**	26.70	66.75
Angola	**6.19**	12.39	30.97	**18.58**	37.16	92.90	**37.16**	74.32	185.79
Argentina	**9.32**	18.63	46.58	**27.95**	55.90	139.75	**55.90**	111.80	279.51
Armenia	**0.24**	0.48	1.21	**0.73**	1.45	3.63	**1.45**	2.91	7.27
Azerbaijan	**0.00**	0.00	0.00	**0.00**	0.00	0.00	**0.00**	0.00	0.00
Bahamas	**0.00**	0.00	0.00	**0.00**	0.00	0.00	**0.00**	0.00	0.00
Bangladesh	**0.07**	0.14	0.36	**0.21**	0.43	1.07	**0.43**	0.86	2.15
Barbados	**0.00**	0.00	0.00	**0.00**	0.00	0.00	**0.00**	0.00	0.00
Belize	**0.00**	0.00	0.00	**0.00**	0.00	0.00	**0.00**	0.00	0.00
Benin	**11.63**	23.26	58.15	**34.89**	69.78	174.44	**69.78**	139.55	348.88
Bhutan	**1.80**	3.59	8.98	**5.39**	10.78	26.95	**10.78**	21.56	53.89
Bolivia	**45.33**	90.67	226.67	**136.00**	272.00	680.01	**272.00**	544.00	1,360.01
Botswana	**6.82**	13.64	34.10	**20.46**	40.92	102.31	**40.92**	81.85	204.62
Brazil	**541.08**	1,082.15	2,705.38	**1,623.23**	3,246.45	8,116.14	**3,246.45**	6,492.91	16,232.27
Brunei	**0.38**	0.75	1.88	**1.13**	2.26	5.64	**2.26**	4.51	11.29
Burkina Faso	**0.35**	0.70	1.76	**1.06**	2.11	5.28	**2.11**	4.23	10.57
Burundi	**1.54**	3.09	7.72	**4.63**	9.26	23.16	**9.26**	18.53	46.32
Cambodia	**10.53**	21.06	52.65	**31.59**	63.18	157.95	**63.18**	126.36	315.90
Cameroon	**26.44**	52.88	132.21	**79.33**	158.65	396.64	**158.65**	317.31	793.27
Cape Verde	**0.23**	0.47	1.17	**0.70**	1.40	3.50	**1.40**	2.80	6.99
Central African Republ	**3.11**	6.22	15.55	**9.33**	18.66	46.65	**18.66**	37.32	93.31
Chad	**1.16**	2.32	5.80	**3.48**	6.96	17.40	**6.96**	13.92	34.79
Chile	**14.02**	28.03	70.08	**42.05**	84.09	210.24	**84.09**	168.19	420.47
China	**149.81**	299.61	749.03	**449.42**	898.84	2,247.10	**898.84**	1,797.68	4,494.19
Colombia	**8.57**	17.14	42.86	**25.72**	51.43	128.58	**51.43**	102.86	257.16
Comoros	**0.24**	0.48	1.19	**0.72**	1.43	3.58	**1.43**	2.86	7.16
Congo	**3.32**	6.64	16.61	**9.97**	19.93	49.83	**19.93**	39.87	99.67
Congo, DR	**95.17**	190.34	475.84	**285.50**	571.01	1,427.52	**571.01**	1,142.01	2,855.03
Costa Rica	**2.35**	4.71	11.77	**7.06**	14.13	35.32	**14.13**	28.26	70.65
Côte d'Ivoire	**1.47**	2.94	7.36	**4.41**	8.83	22.07	**8.83**	17.65	44.13
Djibouti	**0.00**	0.00	0.00	**0.00**	0.00	0.00	**0.00**	0.00	0.00
Dominican Republic	**0.00**	0.00	0.00	**0.00**	0.00	0.00	**0.00**	0.00	0.00
Ecuador	**27.43**	54.86	137.16	**82.29**	164.59	411.47	**164.59**	329.18	822.94
Egypt	**0.19**	0.39	0.97	**0.58**	1.17	2.92	**1.17**	2.33	5.84
El Salvador	**0.93**	1.85	4.63	**2.78**	5.56	13.90	**5.56**	11.12	27.80
Equatorial Guinea	**2.17**	4.35	10.87	**6.52**	13.05	32.62	**13.05**	26.09	65.23
Eritrea	**0.12**	0.23	0.59	**0.35**	0.70	1.76	**0.70**	1.41	3.52
Ethiopia	**10.22**	20.44	51.10	**30.66**	61.32	153.30	**61.32**	122.64	306.60
Fiji	**0.08**	0.16	0.39	**0.23**	0.47	1.17	**0.47**	0.94	2.35
Gabon	**1.26**	2.51	6.28	**3.77**	7.54	18.85	**7.54**	15.08	37.71
Gambia	**0.04**	0.08	0.20	**0.12**	0.24	0.61	**0.24**	0.48	1.21
Georgia	**0.00**	0.00	0.00	**0.00**	0.00	0.00	**0.00**	0.00	0.00
Ghana	**10.36**	20.72	51.81	**31.08**	62.17	155.42	**62.17**	124.34	310.85
Guatemala	**18.38**	36.76	91.91	**55.14**	110.29	275.72	**110.29**	220.57	551.44
Guinea	**4.74**	9.48	23.71	**14.22**	28.45	71.12	**28.45**	56.90	142.25
Guinea-Bissau	**0.18**	0.37	0.92	**0.55**	1.10	2.75	**1.10**	2.20	5.51
Guyana	**0.00**	0.00	0.00	**0.00**	0.00	0.00	**0.00**	0.00	0.00
Haiti	**0.09**	0.19	0.46	**0.28**	0.56	1.39	**0.56**	1.11	2.78
Honduras	**17.60**	35.20	87.99	**52.79**	105.59	263.96	**105.59**	211.17	527.93
India	**16.81**	33.62	84.06	**50.43**	100.87	252.17	**100.87**	201.74	504.34
Indonesia	**233.55**	467.09	1,167.73	**700.64**	1,401.28	3,503.20	**1,401.28**	2,802.56	7,006.40
Iran	**0.00**	0.00	0.00	**0.00**	0.00	0.00	**0.00**	0.00	0.00
Jamaica	**0.00**	0.00	0.00	**0.00**	0.00	0.00	**0.00**	0.00	0.00
Jordan	**0.00**	0.00	0.00	**0.00**	0.00	0.00	**0.00**	0.00	0.00
Kazakhstan	**0.10**	0.20	0.50	**0.30**	0.59	1.49	**0.59**	1.19	2.97
Kenya	**0.56**	1.12	2.79	**1.67**	3.35	8.37	**3.35**	6.69	16.74
Kiribati	**0.00**	0.00	0.00	**0.00**	0.00	0.00	**0.00**	0.00	0.00
Korea	**0.23**	0.46	1.16	**0.69**	1.39	3.47	**1.39**	2.77	6.94
Kuwait	**0.00**	0.01	0.02	**0.01**	0.02	0.06	**0.02**	0.05	0.12
Kyrgyzstan	**0.04**	0.07	0.18	**0.11**	0.22	0.55	**0.22**	0.44	1.10

Non-Annex I (all countries - also those with net gain in forests)	Carbon price of € 18/tC (€5/tCO$_2$) and ...			Carbon price of € 55/tC (€ 15/tCO$_2$) and ...			Carbon price of € 110/tC (€ 30/tCO$_2$) and ...		
	- 10 % in deforestation	- 20 % deforestation	- 50 % deforestation	**- 10 % in deforestation**	- 20 % deforestation	- 50 % deforestation	**- 10 % in deforestation**	- 20 % deforestation	- 50 % deforestation
Laos	**2.22**	4.44	11.09	**6.66**	13.31	33.28	**13.31**	26.62	66.56
Lebanon	**0.02**	0.04	0.10	**0.06**	0.12	0.30	**0.12**	0.24	0.61
Lesotho	**0.01**	0.01	0.03	**0.02**	0.04	0.09	**0.04**	0.07	0.19
Liberia	**10.79**	21.58	53.95	**32.37**	64.74	161.85	**64.74**	129.48	323.69
Libya	**0.00**	0.00	0.00	**0.00**	0.00	0.00	**0.00**	0.00	0.00
Madagascar	**10.15**	20.29	50.73	**30.44**	60.87	152.19	**60.87**	121.75	304.37
Malawi	**4.33**	8.66	21.65	**12.99**	25.98	64.95	**25.98**	51.96	129.89
Malaysia	**18.56**	37.12	92.79	**55.67**	111.35	278.37	**111.35**	222.70	556.74
Mali	**2.84**	5.69	14.22	**8.53**	17.07	42.66	**17.07**	34.13	85.33
Mauritania	**0.06**	0.11	0.28	**0.17**	0.33	0.83	**0.33**	0.66	1.65
Mexico	**15.79**	31.58	78.94	**47.37**	94.73	236.83	**94.73**	189.46	473.65
Mongolia	**6.07**	12.14	30.34	**18.20**	36.41	91.02	**36.41**	72.81	182.03
Morocco	**0.19**	0.38	0.94	**0.56**	1.13	2.82	**1.13**	2.26	5.64
Mozambique	**2.52**	5.05	12.62	**7.57**	15.14	37.85	**15.14**	30.28	75.69
Myanmar	**24.37**	48.74	121.85	**73.11**	146.22	365.56	**146.22**	292.45	731.12
Namibia	**0.81**	1.61	4.04	**2.42**	4.84	12.11	**4.84**	9.69	24.22
Nepal	**7.90**	15.80	39.50	**23.70**	47.40	118.51	**47.40**	94.81	237.02
Nicaragua	**13.29**	26.59	66.47	**39.88**	79.77	199.42	**79.77**	159.53	398.84
Niger	**0.17**	0.33	0.83	**0.50**	1.00	2.50	**1.00**	2.00	4.99
Nigeria	**69.22**	138.43	346.08	**207.65**	415.30	1,038.24	**415.30**	830.59	2,076.49
Oman	**0.00**	0.00	0.00	**0.00**	0.00	0.00	**0.00**	0.00	0.00
Pakistan	**1.03**	2.06	5.16	**3.10**	6.19	15.48	**6.19**	12.39	30.97
Panama	**1.67**	3.35	8.37	**5.02**	10.04	25.11	**10.04**	20.09	50.22
Papua New Guinea	**7.40**	14.79	36.98	**22.19**	44.38	110.95	**44.38**	88.76	221.91
Paraguay	**9.69**	19.38	48.45	**29.07**	58.14	145.35	**58.14**	116.28	290.69
Peru	**21.13**	42.26	105.65	**63.39**	126.78	316.95	**126.78**	253.56	633.90
Philippines	**23.74**	47.49	118.72	**71.23**	142.46	356.15	**142.46**	284.92	712.29
Puerto Rico	**0.00**	0.00	0.00	**0.00**	0.00	0.00	**0.00**	0.00	0.00
Qatar	**0.00**	0.00	0.00	**0.00**	0.00	0.00	**0.00**	0.00	0.00
Rwanda	**1.89**	3.77	9.44	**5.66**	11.32	28.31	**11.32**	22.65	56.62
Samoa	**0.16**	0.31	0.78	**0.47**	0.94	2.35	**0.94**	1.88	4.70
São Tomé and Príncipe	**0.00**	0.00	0.00	**0.00**	0.00	0.00	**0.00**	0.00	0.00
Saudi Arabia	**0.00**	0.00	0.00	**0.00**	0.00	0.00	**0.00**	0.00	0.00
Senegal	**1.24**	2.48	6.19	**3.72**	7.43	18.58	**7.43**	14.86	37.16
Seychelles	**0.00**	0.00	0.00	**0.00**	0.00	0.00	**0.00**	0.00	0.00
Sierra Leone	**2.42**	4.85	12.12	**7.27**	14.54	36.35	**14.54**	29.08	72.69
Singapore	**0.00**	0.00	0.00	**0.00**	0.00	0.00	**0.00**	0.00	0.00
Solomon Islands	**2.35**	4.70	11.74	**7.05**	14.09	35.23	**14.09**	28.19	70.46
South Africa	**0.00**	0.00	0.00	**0.00**	0.00	0.00	**0.00**	0.00	0.00
Sri Lanka	**1.52**	3.03	7.58	**4.55**	9.09	22.74	**9.09**	18.19	45.47
St. Kitts and Nevis	**0.00**	0.00	0.00	**0.00**	0.00	0.00	**0.00**	0.00	0.00
St. Lucia	**0.00**	0.00	0.00	**0.00**	0.00	0.00	**0.00**	0.00	0.00
St. Vincent and the Gre	**0.02**	0.04	0.11	**0.06**	0.13	0.32	**0.13**	0.25	0.63
Sudan	**6.48**	12.97	32.42	**19.45**	38.91	97.27	**38.91**	77.82	194.55
Suriname	**0.00**	0.00	0.00	**0.00**	0.00	0.00	**0.00**	0.00	0.00
Swaziland	**0.53**	1.06	2.64	**1.58**	3.17	7.91	**3.17**	6.33	15.83
Syria	**0.15**	0.31	0.77	**0.46**	0.92	2.31	**0.92**	1.85	4.62
Tajikistan	**0.00**	0.00	0.01	**0.00**	0.01	0.02	**0.01**	0.01	0.04
Tanzania	**2.56**	5.13	12.82	**7.69**	15.38	38.45	**15.38**	30.76	76.90
Thailand	**2.84**	5.69	14.22	**8.53**	17.07	42.66	**17.07**	34.13	85.33
Togo	**0.00**	0.00	0.00	**0.00**	0.00	0.00	**0.00**	0.00	0.00
Tonga	**0.07**	0.14	0.36	**0.21**	0.43	1.07	**0.43**	0.85	2.13
Trinidad and Tobago	**0.69**	1.37	3.43	**2.06**	4.11	10.28	**4.11**	8.22	20.56
Tunisia	**0.00**	0.00	0.00	**0.00**	0.00	0.00	**0.00**	0.00	0.00
Turkmenistan	**12.86**	25.72	64.31	**38.58**	77.17	192.92	**77.17**	154.34	385.85
Uganda	**0.04**	0.08	0.20	**0.12**	0.25	0.61	**0.25**	0.49	1.23
United Arab Emirates	**22.68**	45.36	113.40	**68.04**	136.08	340.21	**136.08**	272.17	680.42
Uruguay	**2.15**	4.29	10.74	**6.44**	12.88	32.21	**12.88**	25.77	64.42
Uzbekistan	**0.16**	0.31	0.78	**0.47**	0.94	2.34	**0.94**	1.87	4.68
Vanuatu	**0.00**	0.00	0.00	**0.00**	0.00	0.00	**0.00**	0.00	0.00
Venezuela	**61.57**	123.14	307.84	**184.70**	369.41	923.52	**369.41**	738.82	1,847.04
Vietnam	**14.39**	28.78	71.96	**43.18**	86.35	215.88	**86.35**	172.70	431.76
Yemen	**0.00**	0.00	0.00	**0.00**	0.00	0.00	**0.00**	0.00	0.00
Zambia	**42.46**	84.92	212.31	**127.39**	254.77	636.93	**254.77**	509.54	1,273.86
Zimbabwe	**16.08**	32.16	80.41	**48.25**	96.49	241.23	**96.49**	192.98	482.46
Total income from crediting avoided deforestation	**1,517.07**	3,034.14	7,585.34	**4,551.21**	9,102.41	22,756.03	**9,102.41**	18,204.82	45,512.05
Total income from crediting all forest area changes	**1,738.48**	3,476.96	8,692.41	**5,215.45**	10,430.89	26,077.24	**10,430.89**	20,861.79	52,154.47