Climate Change Mitigation: Should "Avoided Deforestation" (REDD) Be Rewarded?[1]

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ABSTRACT The widely debated mechanism "avoided deforestation" (REDD), would benefit developing countries that reduce their deforestation rates, thereby generating at least two positive impacts : (i) a greater effectiveness of the global climate change mitigation efforts, and (ii) expected positive side effects on, e.g., biodiversity conservation.
Several proposals were designed for the mechanism, which implementation is challenging: firstly, sophisticated tools available to measure the reduction of emissions (e.g. remote sensing) might be ineffective when combined with national baselines; secondly, predictive baselines lack accuracy because of insufficient knowledge concerning the causes of deforestation, and the unpredictable evolution of key variables (e.g. agricultural commodity prices); thirdly, historical baselines lack legitimacy because they only refer to past trends; and fourthly, a reduction in deforestation rates is hardly connectable to specific public policies.
Based on our analysis, we recommend *not* promoting any mechanism within the Kyoto Protocol based on financial rewards for assumed national emissions reductions from deforestation. Two reasons justify our perspective: not only would the mechanism probably generate fake reductions ("hot air"), but undesirable side effects would also appear. Instead, we encourage use of funds made available as carbon finance (broadly speaking) for reinforcing multi- and bilateral instruments that relate to forest management in developing countries, with a focus on the correction of governance deficiencies. In addition, we support any initiative that mitigates perverse incentives from public policies in tropical and industrialized countries.

KEYWORDS Climate Change; avoided deforestation; REDD; tropical deforestation; economic incentives; additionality; biodiversity; forest; Kyoto Protocol

I. THE DEBATES ON THE INCLUSION OF FOREST CARBON SINKS IN THE KYOTO PROTOCOL

The Climate Convention (UNFCCC) resulted in the Kyoto Protocol with legally-binding targets for Greenhouse Gas (GHG) emissions in industrialized countries (Annex 1 countries) during the first commitment period running from 2008 to 2012. These countries may achieve

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their commitments at a lower cost using the flexibility mechanisms of the Kyoto Protocol, notably the Clean Development Mechanism (CDM) and the international carbon market.
One third of GHG emissions is generated by activities related to land use change (Houghton, 2005), but forestry activities can also potentially sequester carbon, especially through rehabilitation of natural forests or the establishment of plantations. Thus Annex 1 countries with commitments for the reduction of GHG emissions must take into account the evolution of carbon stocks in their own forests, and any reduction of these stocks during the commitment period has to be balanced with increased efforts in the other sectors.

Several categories of forestry projects are currently eligible for implementation in developing countries as CDM projects. The range of these activities has tended to be narrowed by international decisions, in order that Annex 1 countries may focus on reducing their own emissions as their main priority. A growing concern was that industrialized countries might try to "escape" their commitments and rely heavily on projects implemented in developing countries (Greenpeace, 2003). Agreements were reached in Bonn and Marrakech, in 2001, which limited forestry CDM projects to afforestation and reforestation activities for the first commitment period (UNFCCC, 2002).

Forest conservation or “avoided deforestation” projects are not eligible to CDM. Some reasons were key to this decision. "Leakage" is one such concern – if a forest conservation project is set up, forested areas outside project boundaries almost certainly face increased pressure, and there is a risk that displaced activities might offset the project’s carbon benefits. Another concern is related to the risk that forests could release part of the carbon sequestered in the long term because of the impacts of global warming on vegetation. In this respect, the publication in *Nature* by the Hadley Center research (Cox et al., 2000) was a major contribution to this debate and without doubt had an influence on final decisions. In one of the scenarios presented by the Hadley Center, the global temperature was expected to increase by 4° during the 21st century and most of the Brazilian Amazon would disappear. It should be noted that forest management projects such as Reduced-Impact Logging were also rejected, mainly because of poor knowledge relating to impacts of various management systems on carbon emissions.

So far, few afforestation projects have been registered under the CDM (Boyd *et al*, 2007). The Executive Board for CDM proved very conservative when dealing with these projects in order to secure its credibility in this controversial field – in particular when assessing "additionality", which refers to the idea that a project would not be implemented in a business-as-usual scenario (Kyoto Protocol, Art 12, § 5, al. 3). This criterion aims at preventing project proponents from benefiting from the financial incentive provided by the CDM in situations deemed unnecessary. Although this criterion is key to the environmental integrity of the Kyoto Protocol, and guidelines to assess additionality were released in their most sophisticated form in 2005 (CDM Executive Board, 2005), its assessment still remains subject to manipulations under certain conditions (Pirard, 2005). In the forestry sector, this translates as follows: how can one know for sure that the decision to establish a plantation would have resulted differently in the absence of the prospect of income from the sale of carbon credits? The answer to that question is not obvious, because various concerns can be key to the decision in addition to strict financial profitability at project level, such as the need to secure demand for fibre to operate mills.

II. "AVOIDED DEFORESTATION”: THE CONTEXT

"Avoided deforestation" consists of a voluntary reduction of deforestation rates in a given country. The widely-used term “Reduced Emissions from Deforestation and forest Degradation” (REDD) refers to emissions explicitly, but we employ whichever expression in this paper to name the mechanism that aims to reward the reduction of emissions from deforestation in developing countries with financial incentives.

Tropical deforestation broadly speaking - including permanent conversion of forests, shifting cultivation, and forest management - was responsible for emissions amounting to 15-35% of those generated by fossil fuels in the 1990s (Houghton, 2005). Since ignoring such a source of emissions would affect the effectiveness of the measures against Climate Change in Annex 1 countries, the formal inclusion of "avoided deforestation" in the Kyoto Protocol recently became a source of discussion again in international fora.

Moreover, monoculture tree plantations as CDM projects were controversial because of assumed adverse effects on biodiversity (Cossalter and Pye-Smith, 2003), which is an issue that natural forests address better. Lastly, it is reasonable to think that developing countries will face growing pressure to agree on legally-binding targets for the reduction of their emissions, due to their economic development and resulting emissions. Yet, the principle of "common but differentiated" responsibilities in Climate Change makes their formal participation hard to negotiate. In this context, "avoided deforestation" stands as a powerful means to integrate non-Annex 1 countries progressively, all the more so if the carrot and stick mechanism remains asymmetrical during the preliminary period in that these countries are rewarded for their efforts, but do not face sanctions.

This paper recapitulates the proposals available to date for such a mechanism. As we analyse how feasible their concrete implementation might be, we identify several key methodological challenges that we argue are insufficiently understood in the literature. These methodological challenges relate to the difficulty in estimating with enough accuracy the emissions' reductions to be rewarded (whether with direct payments or the allocation of marketable carbon credits). We conclude the paper with our own suggestions to lower tropical deforestation rates for the benefit of national economies and climate change alleviation altogether.

Table 1 Forest area and deforestation in key developing countries

	Forest area annual change rate 1990 – 2000 (1 000 ha)	Forest area annual change rate 2000 - 2005 (1 000 ha)	Total forest area in 2005	Forest area annual change rate 1990 – 2000 (%)	Forest area annual change rate 2000 - 2005 (%)
Brasil	2 681	3 103	477 698	-0,5	-0,6
Indonesia	1 872	1 871	88 495	-1,7	-2*
Sudan	589	589	67 546	-0,8	-0,8**
Myanmar	466	466	32 222	-1,3	-1,4
Zambia	445	445	42 452	-0.9	- 1
Tanzania	412	412	35 527	-1	-1,1
Nigeria	410	410	11 089	-2,7	-3,3
DR of Congo	532	319	133 610	-0,4	-0,2
Zimbabwe	313	313	17 540	-1,5	-1,7
Venezuela	288	288	47 713	-0,6	-0,6
Other countries (68)	3 257				

* underestimated because of forest plantations establishment
** as of FAO, 2007.
Source: FAO, 2007

III. SUBMITTED PROPOSALS FOR "AVOIDED DEFORESTATION"

Papua New Guinea (PNG) and Costa Rica both demanded a public debate about "avoided deforestation" within the UNFCCC, during COP11 in 2005 (UNFCCC, 2006). Contributions that resulted from this call for proposals were gathered in a public document, and were provided by Parties to the Convention or research institutes (UNFCCC, 2007). Some of these proposals address the precise modalities of this mechanism, whereas others just put forward general guidelines and principles.

In general, these contributions agree upon the necessity to use national accounts of carbon flows rather than those of field projects. It is also acknowledged that a compromise will be necessary concerning the methods of measuring emission reductions from deforestation, because sophisticated methods to achieve a high degree of accuracy will be costly. However, other points appear less consensual, such as how to design baseline scenarios that serve as a basis to estimate emission reductions.

Compensated Reductions (CR)

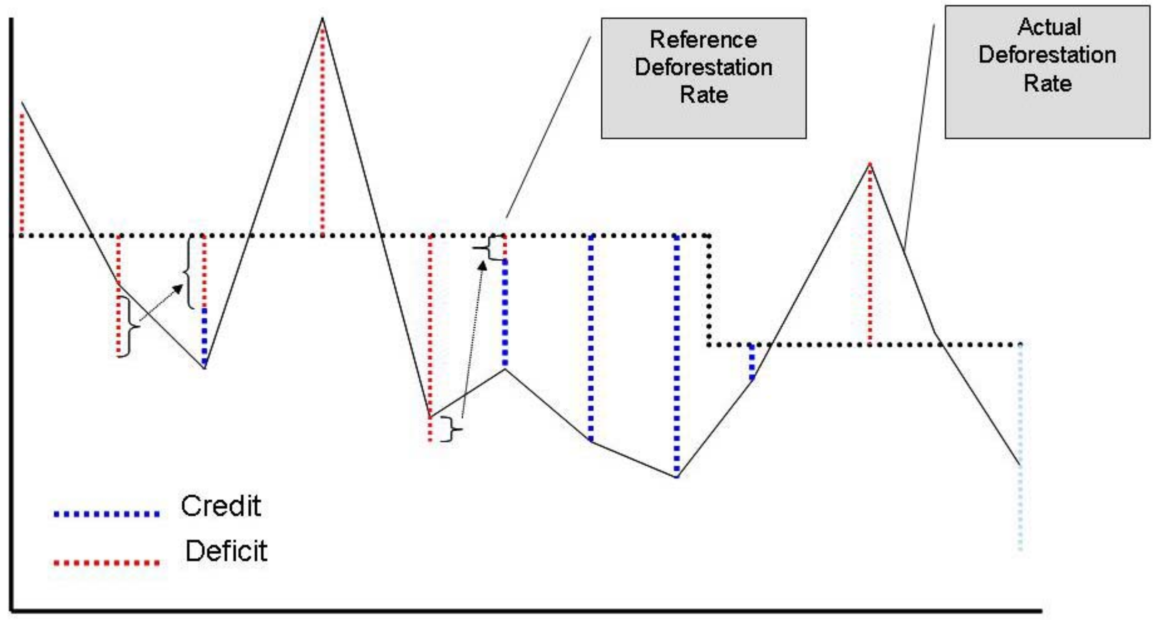
This proposal was initially presented at COP9 in 2003, but we refer to a more recent version published in 2005 in *Climatic Change* (Santilli et al., 2005).

Compensated Reductions (i) allow eligible countries to obtain tradable carbon credits similar to those issued *via* the CDM (Certified Emission Reduction, CER), (ii) account for national emission reductions from deforestation over the first five-year commitment period 2008-2012, and (iii) take as a baseline scenario the average deforestation rate during a period in the past and according to satellite imagery.

In addition to these general principles, the authors give more details about the implementation of the mechanism. First, baseline scenarios should take into account "regional dynamics" in host countries. For instance, Brazil could base its scenario on what happened in the 1980s because the forest cover is still large enough for the deforestation rate is sustained. For other countries which have so far enjoyed low rates (*e.g.*, Peru or Bolivia), baseline scenarios should be higher than past rates so that they may have an interest in joining the mechanism.

Concerning the risk that reductions are temporary only (which is true for any sequestration activity), the *Compensated Reductions* proposal suggests that host countries commit themselves to perpetuate emission reductions during following periods. In case they fail to comply, *i.e.*, if deforestation rates climb above the baseline scenario, these losses will have to be offset (see Figure 1).

Figure1 Carbon credits accounting: *Compensated Reductions* proposal



The proposal by the Joint Research Centre (JRC)

This research centre, which is affiliated with the European Commission, submitted a proposal presented at COP11 in Montreal (Achard *et al.*, 2005).

The core principles of this proposal are identical with those of the *Compensated Reductions*, and scenarios are also based on past deforestation rates. However, it suggests a distinction between countries that had past deforestation rates above or below the global average (which includes all tropical countries). The rationale is that "virtuous" countries (those already engaged in activities to curb their deforestation rates) would otherwise be disadvantaged. Indeed, and similarly to the *Compensated Reductions* proposal, the countries with higher deforestation rates the years before the adoption of the mechanism can expect that baseline scenarios will show higher rates (so easier targets), if based on past deforestation rates. If today Indonesia or Brazil accelerate deforestation, then a mechanism adopted, say in 2012, might elaborate the baseline scenario according to this higher current deforestation rate.
The proposal further innovates with the distinction between three categories of "forests" relative to their actual condition: intact forest, non-intact forest, and non-forest, in order to take into account their various carbon stocks. The proposal assumes that non-intact forests have half the carbon stocks of the intact forests. However, this rule does not distinguish

between forest biomes with different biomass densities. This innovation is detailed in a recent publication by Mollicone *et al* (2007).

In contrast with the *Compensated Reductions* proposal, the JRC approach suggests the use of temporary carbon credits: the permanence of the carbon stocks would be checked at repeated time intervals, and the carbon credits would be offset when releases are recorded.

Carbon Stock-Based Approach by CISDL

Researchers from the *Centre for International Sustainable Development Law* (CISDL) submitted a proposal to the UNFCCC (Prior *et al.*, 2007), with the rationale that tradable carbon credits could be issued to finance activities to protect forests in host countries. This proposal respects the following principles for a "cap-and-trade" approach:

- the amount of carbon stocks that exist in a country's forests are calculated prior to the crediting period
- the forest area is divided in two parts: a "reserve" that must not be degraded, and the remaining area that is expected to be converted in the future for development needs
- only forest conservation within the area outside the "reserve" can result in the issuance of tradeable carbon credits
- the loss of carbon due to force majeure (e.g. fires, flooding) events should not result in less carbon credits being issued
- net increases in carbon stocks do not allow for the issuance of carbon credits, as other mechanisms exist for such activities (e.g. Clean Development Mechanism for afforestation projects)

Apparently, this approach does not use simulations for the evolution of stocks, as the initial stock is measurable at the reference date (and measured once and for all). In contrast to the other proposals that follow the "baseline-and-trade" approach (credits are issued according to a reference scenario), this suggestion is based on a "cap-and-trade" approach (credits are issued according to an objective).

Reduced Emissions from Deforestation in Developing countries (REDD)

The government of Papua New Guinea proposed an approach (REDD) with limited innovations. This proposal suggests issuing tradable carbon credits that would be fungible with other types of existing credits, the negotiation of "robust" national baseline scenarios, and a strengthened commitment by Annex 1 countries for the reduction of their emissions (PNG, 2006).

Brazil's proposal

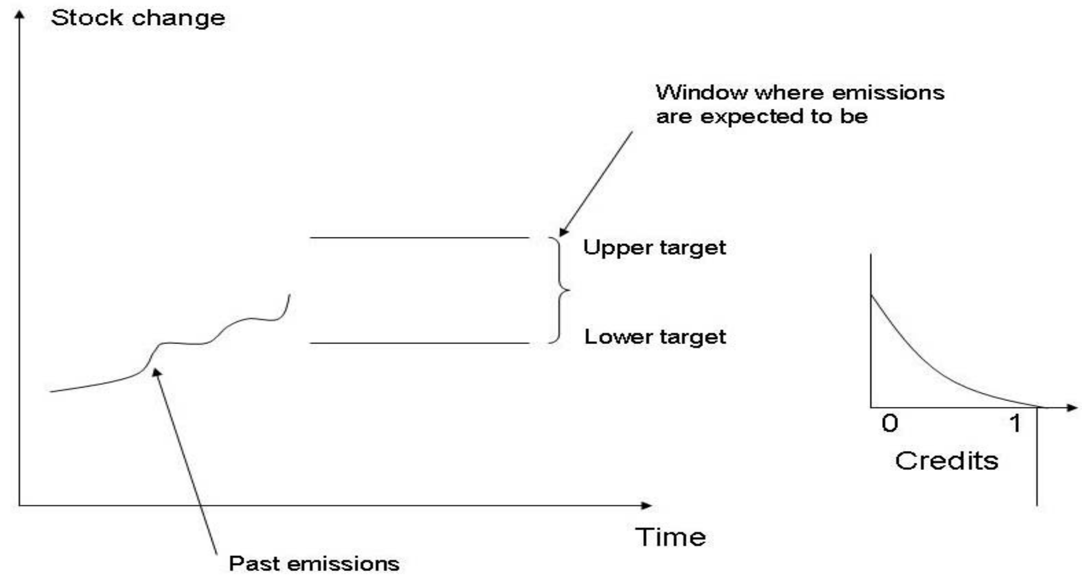
With a traditionally strong influence in tropical forest negotiations, the Brazilian government had opposed the inclusion of deforestation avoidance in negotiating sessions prior to COP9, where it "cautiously" supported the *Compensated Reductions* proposal (Schlamadinger *et al*., 2005, p. 54). Recently, the government presented a proposal that does not allow tradable carbon credits to be issued or to be fungible with other types of existing carbon credits, the rationale being that Annex 1 countries should not reduce emission reduction efforts on their own territory. In other words, developing countries would be paid to conserve their forests, but the Annex 1 countries would not gain recognition for their financial contributions in terms of achieving their own targets for emissions' reductions.

The baseline scenario would build on past deforestation rates, with periodic adjustments. Actual emissions from deforestation would be estimated according to the average carbon stocks per hectare for each biome (e.g. 90 t/ha for Amazon). Reduction efforts would be rewarded with financial incentives, in proportion to the recorded reductions, and coming from a multilateral Fund with contributions from Annex 1 countries (Brazil, 2006).

Other proposals

Schlamadinger *et al.* (2005) proposed to consider a "window" with upper and lower targets rather than a precise value for the evolution of the deforestation rates. If actual emissions from deforestation in the host country fall below the lower target, then the gap is fully converted into carbon credits. When these actual emissions are above the lower target, then only a fraction of the gap is converted into carbon credits. This fraction diminishes when emissions increase, which reflects the growing uncertainties concerning the real emission reductions compared to the baseline scenario. Above the upper target, credits are not issued anymore (see Figure 2).

Figure2 Carbon credits accounting: Schlamadinger *et al* (2005) proposal



Source : Schlamadinger *et al* (2005)

Lastly, one must note that many Parties emphasise the need to take into account activities already initiated to curb deforestation rates, i.e. those activities that are not specifically for the purpose of reducing carbon emissions (e.g. proposals by Costa Rica or Bolivia, UNFCCC, 2007). Indeed, these early activities might result in lower baseline scenarios and lower amounts of carbon credits to be issued. This claim could lead to issuing additional credits to these countries ("early credits"), in order to avoid encouraging these countries to accelerate the rate of deforestation before any agreement be negotiated.

The debate on “avoided deforestation” is still on-going, and no decision will be taken before COP13 in Bali in December 2007. Therefore, it is hard to make a prediction about which approach, if any, will be favoured at that time.

IV. INACCURATE ESTIMATIONS OF EMISSION REDUCTIONS: CAUSES AND CONSEQUENCES

Uncertainties in the estimations of emission reductions are usually acknowledged, although their magnitude has yet to be investigated. Another concern is that consequences of such uncertainties are not fully understood.

Inaccurate estimations of reductions of emissions from deforestation

The challenges for making accurate estimations of real emission reductions exist at two levels:

1. *Baseline Scenarios* (BSs) are necessary for they provide the values to be compared to actual emissions. These BSs are based on business-as-usual emissions, *i.e.*, without any specific action. Developing BSs poses methodological difficulties that are inherent to any prediction of a phenomena that depends on many variables: some of these variables can be simulated with limited margins of error (such as demographic evolution), but others are much more uncertain (notably the evolution of relative prices).

Three major alternative methods are proposed to develop BSs:

a. BSs can be developed on an aggregate and historical basis (average historical deforestation rates over a given period of time) – a simple calculation as it does not require any simulation, but which cannot pretend to be realistic as it only refers to past trends. A distinction should be made between the BSs that strictly extend past deforestation rates, and the BSs that adjust these past deforestation rates based on specific criteria.

b. BSs may also be developed in a more sophisticated way which one could refer to as “predictive” and which could distinguish (if deemed necessary) between sub-national zones depending on their own specificities: it would better take into account specific dynamics at a local level within one country. BSs might also take into account the evolution of a number of variables which have a strong impact on deforestation rates (*e.g.*, demographic and economic evolution, market prices for some agricultural and forest products). In this case, BSs closely depend on choices made by experts regarding the future values of the variables and their assumed impact on deforestation (as well as the interactions between variables). However, the most complete studies to date have solely identified which variables impact on deforestation, but cautiously abstained from weighting the importance of these variables quantitatively. In most cases, they even refrained from asserting hierarchies between identified variables (which might be explained by possible interactions between these variables). Box 1 illustrates these issues.

c. A third option is to take a single value for BSs, the same for all future periods (as in the CISDL proposal). This value refers to a national carbon stock that host countries would select as a target. This value can be equivalent to the initial stock, although not necessarily. The BS would probably be the outcome of a political negotiation between host country governments and experts, as this was the case for the determination of the "Kyoto objectives" for Annex 1 countries.

Table 2 Classification of the existing proposals based on methods for estimating emissions' reductions*

	Methods based on Baseline Scenarios (BSs) calculated before the crediting period			Method not based on a Baseline Scenario
	BS that strictly extends past deforestation rates	*BS that extends past deforestation rates with an adjustment factor*	*« Predictive » BS*	*Comparison of the « forest carbon stock» start of period / end of period, with a target negotiated at the start of period*
Proposals by countries (or groups of countries) in international fora	Brasil 2007 PNG & Costa Rica (COP 11, 2005)	Comifac (Central Africa) 2007 Bolivia and 16 other developing countries, 2007		
Proposals by NGOs or international organizations	Environmental Defense & IPAM, 2007	Joint Research Center (Achard et al 2005)	FAO, 2005	CISDL (« Carbon Stock Approach »)
Proposals in academic journals		« Compensated reductions» (Santilli *et al,* 2005) Mollicone *et al,* 2007 Schlamadinger *et al,* (2005)	Chomitz *et al*, 2007	

* The table includes four categories, because scenarios based on historical trends are either adjusted or not.

Box 1 Deforestation: a complex system of causes and drivers

Angelsen and Kaimowitz (1999) studied 140 economic models on the causes of deforestation and conclude as follows: "[Our study] *raises significant doubts about many conventional hypotheses in the debate about deforestation. More roads, higher agricultural prices, lower wages, and a shortage of off-farm employment generally lead to more deforestation. How technical change, agricultural input prices, household income levels, and tenure security affect deforestation - if at all - is unknown. The role of macroeconomic factors such as population growth, poverty reduction, national income economic growth, and foreign debt is also ambiguous*".

In a similar tone, Geist and Lambin (2001) conclude, based on their study of 152 deforestation cases worldwide, that "*Causes and drivers of tropical deforestation cannot be* *reduced to a single variable, or to a few variables even*". And, at March 2007' UNFCC meeting devoted to the issue of land-use changes in developing countries, A. Angelsen (2007) concludes its presentation by this statement: "[It is] *hard to state generally even qualitatively the deforestation impact of policies and incentives, let alone quantify the impact*".

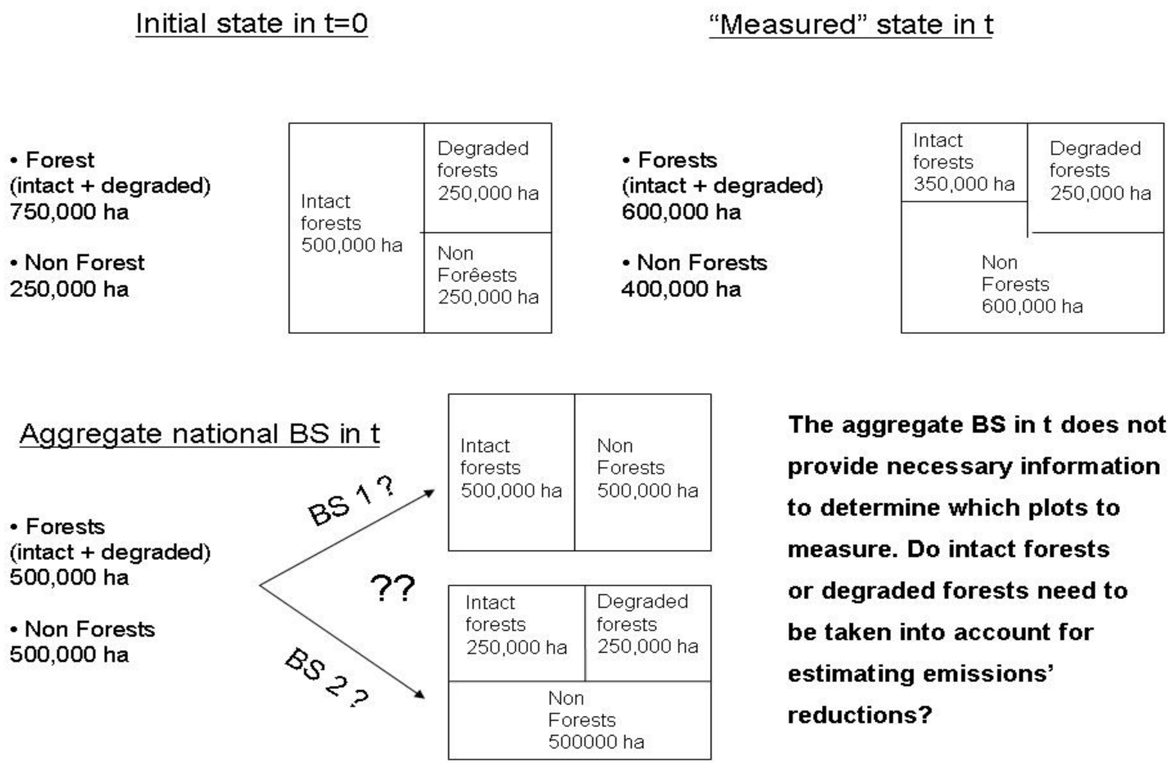
2. Measurement Methods (MMs) for emission reductions are necessary for they provide the values to be compared to Baseline Scenarios. Powerful technologies exist which are bound to further improve in the near future, so these measures are not to be considered a technical problem (DeFries *et al.*, 2005; Brown *et al.*, 2005). Even so, using 3D technologies or field inventories will generate high costs - a point not to be neglected in the process of allocating scarce financial public resources.

Three major alternative types of MM have been put forward to estimate emission reductions:

a. Estimations can be deduced from the rate of deforestation combined with an average carbon stock per hectare for the reference forest biome (*e.g.*, 90 t/ha). This option is easy to implement, but it says nothing of the potentially significant gaps between distinct biomes (and forest condition). As a result, quantification can only be inaccurate.
b. MMs may also distinguish between forest biomes for a number of biomes at the national level. This solution remains relatively simple and its accuracy and implementation costs depend on the number of biomes taken into consideration.
c. MMs can be virtually exhaustive if all plots are measured, with a combination of remote sensing, verifications on site, 3D technologies and site inventories. This option is satisfying for its accuracy, but it results in high financial and human costs. One should remember that this option is not compatible with aggregate national scenarios for BSs, as explained below.

Several options exist to combine BSs and MMs, although not all of these combinations are possible in practice (see Table 4 in Annex). Even the most sophisticated and precise versions of MM (MMs number 3, virtually exhaustive) do not help when combined with BSs based on aggregate national data. It should be pointed out that this issue was not addressed in recent discussions or proposals on "avoided deforestation": on the one hand, proposals usually defend the option of using aggregate national baselines for the sake of simplicity, and on the other hand these proposals point to the existence of accurate MMs to promote the mechanism. It must be stressed that a combination of aggregate BSs and sophisticated MMs is a logical contradiction: aggregate data indicate the number of hectares of "avoided deforestation" but do not indicate which plots are responsible for this achievement. This results in uncertainties regarding the designation of the plots where emission reductions should be measured. Figure 3 illustrates this point.

Figure 3 Illustration of the problems related to using aggregate BS



The incompatibility between aggregate BSs and sophisticated MMs is actually verified whatever the quality of the available information on initial carbon stocks. However, this quality might not be perfect in practice, and low quality information about these stocks could even further contribute to inaccuracy of estimates. In the absence of any reliable national inventories for the initial period (e.g. 1990), it seems pretty daring to calculate a volume of CO_2 based on deforestation rates (translated in deforested areas) during the reference period (e.g. the 1990s). It is also risky to compare assumed emission volumes with those resulting from actual deforestation: the latter will be probably measured with sophisticated remote-sensing tools, but the former can only be obtained with other collecting methods.

To these uncertainty factors one should add the classic problem of the threshold effect: the assessment of deforestation according to the FAO criterion (canopy cover below 10%) could be carried out over a continuum of situations (from intact primary to logged-over forests), but resulting CO_2 emissions would be very different in all cases. Only the CISDL proposal would escape such a weakness as it requires a complete evaluation of the current and future carbon stocks with sophisticated remote-sensing tools. But as already noted, this proposal is restricted to a simple comparison between two periods, with the negotiation of an agreed target for emissions. This proposal differs from the Baseline Scenario approach

Why inaccurate estimations are a problem

To study the consequences of inaccurate estimations of the emissions' reductions, we need to distinguish between *two cases*:

- Either avoided deforestation is implemented within the Kyoto Protocol, and results in issuing carbon credits tradable in the international carbon market; or
- Avoided deforestation is implemented independently of the Kyoto Protocol (although possibly within the UNFCCC) and is supported financially by a multilateral Fund.

In the first case, inaccurate estimations are a threat to the environmental integrity of the Climate Convention because "fake" carbon could be issued and traded, thus leading to lower efforts among Annex 1 countries that would not be offset elsewhere. Fake carbon credits refer to credits that are not related to emissions reductions in addition to business-as-usual scenarios. In other words, fake carbon credits refer to emissions' reductions that would have occurred in a world without the mechanism for "avoided deforestation", for any reason, and, consequently, deserve no reward. This issue of "hot air", namely an arbitrary or somehow lax Baseline Scenario, has already been a matter of debate: the case of Russia (an Annex 1 country) was widely discussed already because its reduction targets were based on emissions in 1990, just before the economy collapsed. A mechanism for avoided deforestation ought to focus on reducing new opportunities for such phenomena rather than bringing new risks into the business.

In the second case, inaccurate estimations are not a threat to the environmental integrity of the Climate Convention but, similarly with the first case, there remains a risk of misallocating scarce financial resources. Of course, any type of financial support to developing countries with commitments to curb deforestation rates is, in theory, better than not taking any action. However, three elements should be considered seriously for any such mechanism: (1) the ability to be accurate with predictive BSs, (2) the relevance of extrapolating past trends with *historical* BSs, and (3) the capacity to associate any precise reduction of deforestation rates with specific public policies.

Table 3 Comparison of the methods to estimate emissions reductions based on the level of risk to issue "fake credits"

	Methods based on Baseline Scenarios (BS) calculated before the crediting period			Methods not based on a Baseline Scenario	
	BS that strictly extends past deforestation rates	*BS that extends past deforestation rates with an adjustment factor*	*« Predictive » BS*	*Comparison of the « forest carbon stock» start of period / end of period, with a target negotiated at the start of period*	*Net relative impact of public policies that is measured a posteriori**
Countries where forest conversion is well-advanced (e.g. Indonesia, Malaysia)	High Risk	Variable Risk: depends on the outcome of the negotiation regarding the adjustment factor	Indeterminate Risk (depends on the assumptions used by the models, and the happening of unpredictable events)	The level of risk will depend on the outcome of the negotiation regarding the « reserve » area	Moderate Risk
Countries where forest conversion is low (e.g. Central Africa)	Low Risk (potential for reduced deforestation rates compared to historical rates is low)				
Countries where forest conversion might continue at a high level (e.g. Brasil)	Variable Risk				

* This method is elaborated by Combes *et al* (2007). It consists of distinguishing between deforestation that is due to the public policies that a country implements (whether or not it is aimed at reducing deforestation), and deforestation that is due to structural factors (demographic growth, export commodity prices, etc.). It is relative in the sense that the impacts of public policies are compared among countries participating in the mechanism for a given period.

Problems with the first of these three elements (1) are related to the fact that deforestation rates depend on a number of variables, of which some are relatively predictable (*e.g.*, demography, road infrastructures, economic growth), but others are stochastic phenomena, such as agricultural commodity prices on speculative markets, conflicts, massive human migrations and climate. In a recently published World Bank study (Chomitz *et al*., 2006: p.63), significant correlations are suggested between deforestation rates in the Brazilian Amazon, the price of beef – but also rainfall over the 2001-2003 period. In consequence the reliability of predictive scenarios appears to be questionable, to say the least.

Dynamic baselines could be considered, with periodic adjustments based on the changing context. For instance, a fall in the soy market might explain a reduction in activities along the Brazilian pioneer front. However it would add complexity in the process and it implies that host countries could be deprived of expected financial rewards merely because of an external shock beyond their control. Frequent revisions of BSs would also multiply the opportunities for political pressures during the negotiation process, which would seriously undermine the credibility of the mechanism.

The second of these three elements (2) faces the problem of lack of credibility of roughly extrapolated baselines. This option does not take into account phenomena similar to the Kuznets Environmental Curve, which suggests that deforestation rates are related to economic development and other factors such as demography and agricultural intensification. Another concern relates to the "premium" given to countries with high deforestation rates in the 1980s (*e.g.*, Southeast Asia) and decreasing access to forests. In contrast, economic development in Africa would logically increase deforestation rates because of (among other factors) easier access to forests owing to new or rehabilitated road infrastructures. Problems concerning the first element (1) are also valid in the present case, including the risks of political pressures if BSs were to be adjusted through negotiations (cf. "*early credits*" or *Compensated Reductions* proposal).

Problems with the third of these elements (3) are valid in all cases as they question the rationale of allocating financial incentives based on the assessment of public policies related to land use decisions in a developing country. Tropical deforestation is the global outcome of many decision-making processes, often decentralized and resulting from the actions of a broad range of individuals and institutions. Measuring the impact of public policies in terms of how many hectares are deforested constitutes a genuine challenge. In a context of multiple changing variables, this excludes any business-as-usual approach. In developing countries, it is common knowledge that governments have limited abilities to enforce decisions and to impact significantly on deforestation, which constitutes a complex phenomenon. With globalization and the liberalization of commodity markets, this ability further decreases.

For these reasons, two risks can be identified: (i) countries might be rewarded for lower deforestation rates that are due to external reasons (*e.g.*, a drop in soy market prices or higher rainfall), and (ii) real voluntary efforts are not rewarded due to the adverse impact of external factors.

Measurement and imputation

As suggested by table 3, minimizing risks of "hot air" creation would be the one method capable of identifying **afterwards** precisely the "net impact" of public policies and incentives that a government could decide to implement to tackle deforestation **or for any other purposes** (Combes *et al*, 2007). In some cases, one might consider this evaluation to be feasible and quite straightforward. For example, Global Forest Coalition (2007) argue that, in Paraguay, the Government has succeeded in reducing deforestation rate by, at least, 85% in the eastern part of the country between May 2004 and May 2005, by imposing a ban on deforestation. Here, the lowest deforestation seems directly imputable to the government action. While much more difficult to ascribe and even more to quantify change of deforestation rates resulting from policies outside the forest sector and without intention related to the forest cover (such as change of the exchange rate), it is feasible to identify countries with relatively virtuous policies when exogenous factors are taken into account *a posteriori*.

The table below suggests an analysis framework of various factors types likely to have an influence on deforestation, distinguishing what would be imputable to a direct or indirect action and to what extent one can quantify the avoided deforestation imputable to the action.

Table 4 Possibility of measurement and imputation of various factors influencing deforestation

	Exogenous factors	Non intentional endogenous factors	Intentional endogenous factors	Private initiatives and private/public partnerships
Type of measures	*Examples:* Change in agricultural commodity prices Extended climate disorders	*Examples:* Modification of the interest rate Cut in fertilizers subsidies	*Examples:* Stringent enforcement of land-use change laws Criteria for the allocation of forest conversion permits	Roundtable with soy producers to reduce forest conversion in Brazil Domestic programs for certification
Possibility to impute the deforestation reduction to the public action	Non imputable	Imputable	Imputable	Case-specific
Possibility to quantify the net impact on deforestation	(N.A.)	Difficult /Very difficult	Possible	Case-specific

Quantifying this imputable avoided deforestation afterwards (i.e. at the end of the commitment period) is challenging from a methodological standpoint because impacts of various factors should be disentangled. The solution might be to estimate first the impacts of widely agreed structural factors in an econometric model (population, GDP, export commodity prices, remaining forest area, terms of trade…), and to equal imputable actions eligible to compensations with the residual avoided deforestation in the model (Combes *et al*, 2007). With this solution, the difficulty would be political: the experts would have to agree on which structural factors to account for in the model. which in turn would have a direct incidence on the amount of financial assets they would be compensated with. In the context of a non-binding multilateral process and, recalling the principle of States sovereignties, it is quite unlikely that Governments would accept to see their national policies implicitly evaluated by a college of independent experts. Thus, it is more likely that governments will prepare themselves, before the commitment period, their countries' baselines scenarios, based on a methodology approved by a technical body of the Climate Convention. The "less-risky" evaluation method (vis-à-vis the issuance of "fake" credits) is also the politically less feasible.

Ethical considerations

One should not forget to mention the perverse effects that a mechanism for "avoided deforestation" might generate for some populations. To achieve significant impacts regarding deforestation in developing countries, it seems that the most promising public policies should focus on reducing areas devoted to agro-industrial activities (soy, oil palm, cattle-ranching, etc.). Unfortunately, regions where these measures would deliver best results, like Brazil, Malaysia or Indonesia, are those that have partially based their economic development on the export of agricultural products, included an aggressive strategy for biofuels in both Brazil and Indonesia (Central Africa shows a different picture, with forests being relatively “preserved” owing to insufficient public investments and a lack of security for private investors). In this context, financial prospects from the sale of carbon credits would certainly be insufficient in provoking policy changes. However, it could happen that governments might reduce their investments in remote areas (such as those favouring road infrastructure), in order to reap the benefits of lower deforestation due to a lack of access to markets in these remote areas. Yet, proposals for "avoided deforestation" have so far failed to address these issues. It appears that only deforestation rates are taken into account, without paying attention to such ethical considerations.

V. ALTERNATIVE SOLUTIONS

Drawing the lessons from our analysis, we recommend *a minima* not to implement "avoided deforestation" through a mechanism formally included in the Kyoto Protocol (KP). Preventing this from happening would secure the environmental integrity of the KP by avoiding the issuance of fake carbon credits ("hot air"). The latter risk is mainly caused by inaccurate estimations of emission reductions from deforestation. It even increases when targets are negotiated with host countries governments: e.g. during the COP7 in Marrakech, after the USA rejected the KP, European countries agreed with Russia to augment the threshold of accountable forestry carbon in Russia from 17.6 to 33.0 million tons. We argue that there is already enough “hot air” existing in international carbon markets for Climate Convention Parties not to take the risk to add any more. Indeed, according to a European Union study most European countries emitted less CO_2 in 2005 than the quotas allocated by their governments to 9,400 industrial plants, with reduced market prices for these credits; this in turn lowered the incentive for the plants to be virtuous (BBC News, consulted 15 May 2006 on news.bbc.co.uk).

If a mechanism that results in the issuance of tradeable carbon credits is not desirable, then one might question the relevance (or the “added value”) of a mechanism based on quantified objectives in terms of reduced emissions from deforestation, compared to any other mechanism restricted to the direct financial support of policies and projects in the host countries. Indeed, the main benefit of a mechanism included in the KP is to raise funds (carbon finance) through the marketing of carbon credits by public or private investors. If this opportunity disappears, it seems more relevant to design and implement specific and best policies and activities to improve the management (regarding carbon releases) of forest resources in host countries. If not, scarce public financial resources would be misallocated because of limited capacities to predict Baseline Scenarios, and the impossibility to connect reduced deforestation rates to specific public policies. Another way could be considered with a fully independent mechanism financed by private bodies (philantropic or for marketing and image reasons). In this case, our critique does not hold because this mechanism would have its own rules without adverse impacts on the environment or public resources.

We see no justification for already existing mechanisms aimed at promoting combined climate and biodiversity objectives to be substituted with such a "false good idea", *i.e.*, to reward voluntary efforts to curb deforestation based on the reduction of emissions. The already existing mechanisms have limited financial resources, notably the Operational Program 12 managed by the Global Environmental Fund or international initiatives to fight illegal logging and governance problems, but this could be improved.

Besides, rejecting "avoided deforestation" in its current proposed form does not prevent policy makers from suppressing obvious perverse incentives, such as incentives for deforestation, incentives for overinvestment in the timber and paper industry, land tenure that favors agricultural activities, tax systems that lead to the degradation and conversion of natural forests, weak governance with poor law enforcement, etc. Note that these perverse incentives are also present in industrialized countries, those that suggest subsidizing developing countries to curb tropical deforestation and access carbon credits (Sizer *et al* 2000 listed the various subsidies allocated by G8 countries to developing countries, with negative impacts on deforestation trends).

The adoption of good practices, for agriculture or forestry, depends on revising sectorial policies, field activities, education and training farmers. Therefore, the financial

compensation for implementing sectorial policies could be considered as an alternative to compensation for reducing deforestation. This idea is close to one of the potential mechanisms that Benndorf *et al* (2007) described for the inclusion of land-use, land use change and forestry in future climate change agreements. This mechanism would be based on “Cause-oriented commitments” for “non-quantified Policies and Measures”, which is rather equivalent to financing efforts rather than results regarding the reduction of deforestation.
An alternative is to use an econometric model to estimate residual efforts by virtuous countries relatively to the other countries for a given period. By isolating structural factors on which countries have no grip, this method allows assessors to evaluate *a posteriori* specific domestic efforts that reduce deforestation (Combes *et al*, 2007).

With respect to compensating efforts, an analysis of activities promoted by the World Bank is meaningful. The World Bank does not finance forestry projects anymore, at least in a direct way, but insists on sectorial policies and the improvement of governance when designing its "conditionalities" for financial support. Indeed, insufficient law enforcement is largely responsible for forest degradation and deforestation in developing countries. Collaboration between governments and civil society in designing mechanisms and better public systems to face these law enforcement problems would benefit forests but also these countries as a whole. Note that this is the official *raison d'être* of the FLEGT (Forest Law Enforcement, Governance and Trade) program managed by international agencies and governments. If these activities translate into a sustainable improvement of governance issues and improve the quality of economic growth in these developing countries, one could expect better results for forests due to Environmental Kuznets Curve-related effects. Climate Change mitigation, without doubt, would also be strengthened.

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Annex

Table 4 Analysis of the potential combinations between Baseline Scenarios (BSs) and Measurement Methods (MMs)

		Type of Baseline Scenario (BS)		
		Scenarios based on historical trends: aggregate and calculated before the crediting period	Predictive scenarios: potentially detailed and calculated before the crediting period	Comparison of the « forest carbon stock» start of period / end of period, with a target negotiated at the start of period
Measurement Methods for carbon stocks (MMs)	Average stock/ha based on one reference biome (Satellite imagery)	This BS/MM combination is a low cost option and easy to implement, but is questionable regarding the accuracy of the estimations.	This BS/MM combination is a relatively low cost option (except for transaction costs which are not addressed here) and easily implemented. However, sophisticated BSs are unusable when combined with extremely simplified MMs.	This BS/MM combination is hard to justify, because over-simplified and aggregate MM do not provide relevant information to estimate total carbon stocks.
	Average stock/ha based on principal biomes in the country (Satellite imagery)	This BS/MM combination is a low cost option, but does not improve the estimations based on one reference biome only, because it is impossible to determine which biome the avoided deforestation took place in.	This BS/MM combination is a relatively low cost option (except for transaction costs which are not addressed here) and easily implemented. Sophisticated BSs are justified to distinguish between forest biomes, but not at the plots scale in order to improve the cost efficiency of this approach.	This BS/MM combination can be justified if the number of forest biomes is large enough to provide precise information in terms of carbon flows in all plots.
	Detailed measurements for all plots	This BS/MM combination is paradoxical, because aggregate BSs do not allow to take advantage of detailed data on carbon stocks. The plots deemed responsible for reduced deforestation cannot be identified.	This BS/MM combination is the most detailed and precise and thus the most credible. However, it generates high financial and human costs, while not providing any guarantee for the accuracy of the estimations because of an uncertain BS.	This BS/MM combination is rational, notwithstanding the high financial and human resources needed for the MM, and the lack of realism of the BS.