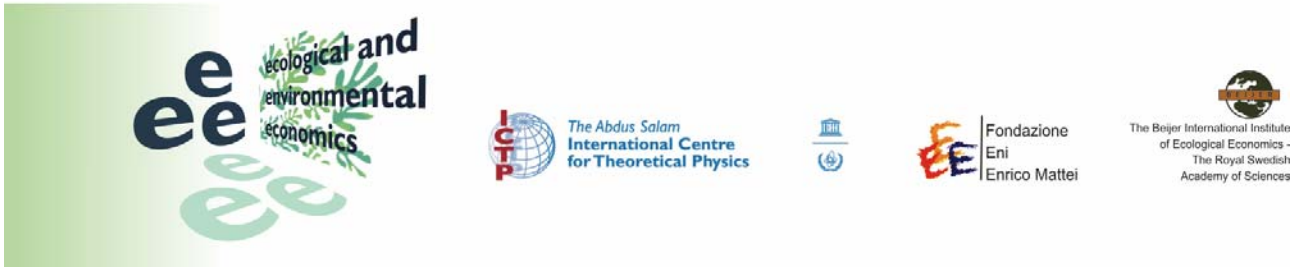

Climate Change Mitigation Measures in

the Agro-Forestry Sector and Biodiversity Futures

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ECONOMICS OF AVOIDING DEFORESTATION

Michael Obersteiner

International Institute for Applied Analysis, Austria

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Economics of Avoiding Deforestation

Michael Obersteiner, Georg Kindermann, Ewald Rametsteiner, Brent Sohngen

Abstract
Deforestation is estimated to cause about one quarter of anthropogenic carbon emissions. Only late, in 2005, Parties to the United Nations Framework Convention for Climate Change decided to start exploring approaches to reduce emissions from this major source. We carried out a global analysis of the potential effects of financial mechanisms to avoid deforestation. Avoiding deforestation is a low cost option that could have considerable leverage in mitigating climate change. Our model results indicate that a 50% reduction of carbon emissions from deforestation over the next 20 years would require financial resources of some US$33 bn per year. Expectations that financial flows through international climate policy mechanisms would provide a golden opportunity to turn around a 20 year history of gridlock and indecision in international fora addressing deforestation, however, appear inflated.

Introduction

Deforestation is considered the second largest source of greenhouse gas emissions (1) and is expected to remain a major emission source. The deforestation issue has been at the centre of the international environmental debate for two decades. Yet, despite a large number of studies, commitments, initiatives and strategy papers, this activity has had little impact on deforestation rates: deforestation continues at a rate of about 13 million ha per year (2). Apart from the loss of carbon, deforestation typically is associated with *inter alia* loss of biodiversity, disturbed water regulation and the destruction of livelihoods for many of the world's poorest (3).

Government and non-governmental attempts to slow down, or even reverse, current trends of disappearing forests have not been successful as the result of many pressures, both local and international. While the more direct causes are rather well established as being agricultural expansion, infrastructure extension and wood extraction (4-6), indirect drivers of deforestation are made up of a complex web of interlinked and place-specific factors.

Some see a glimmer of hope for more effective policies with the rise of innovative financial mechanisms under a global climate policy regime (7-10, 20). Indeed, in 2005, Papua New Guinea has proposed to the UNFCCC that carbon credits be provided to protect existing native forests[1]. The proposal triggered a flurry of discussion on the topic. The potential for synergies between forest and carbon policies is quite substantial. For instance, Soares-Filho et al. (11) suggest that protecting around 130 million hectares of land from deforestation in the tropical Amazon could reduce global carbon emissions by 17 GtC over the next 50 years. What is unclear, however, is how much it would cost to achieve this, and which types of policies could be most effective. This paper we use scenario modeling approaches to assess the costs of reducing global deforestation and examine different financial mechanisms to combat deforestation.

Costs of cutting deforestation in half

[1] FCCC/CD/2005?misc.1 11 November 2005.

Baseline deforestation is estimated to be close to 212 million ha or around 5% of today's forest area between 2006 and 2025 resulting in a release of some 17.5 GtC. The maximum allowable base-line deforestation rates were estimated statistically using forest share, agricultural suitability, population density and economic wealth as independent variables. Sub-Saharan Africa is modeled to be responsible for about 50% of global deforestation emissions over the coming 20 years, while Latin America contributes 35% and Asia 12% respectively (Table 1 and Figure 1). When aiming to reduce the deforestation rate by 50% until 2025, the financial resources required to balance out net present value differences on exactly those forests that would otherwise be converted rise from some US$0.16bn in 2006 to US$2.9bn in 2025 due to increasing geographic coverage of the carbon incentive scheme. The lack of precise information on areas that are about to be cut and principal-agent problems between parties involved, make it impossible to design a perfectly targeted instrument. In the contrarian case of complete absence of information on deforestation pressure, a global forest carbon conservation program aiming at avoiding half of baseline deforestation would require financial resources in the much higher order of US$197 bn in 2006 and US$188 bn in 2025 (i.e. on average US$6/tC/5years (Table 1)). More realistic assumptions of targeted payments to identifiable deforestation agents in areas of high deforestation pressure would cut average annual cost to an estimated US$33.5 bn per year. This large difference in costs indicates the magnitude of costs to be saved by designing targeted incentive schemes.

Carbon tax schemes do not suffer as much from an information problem, as global earth observation systems can detect deforestation with some reliability already today. In tax scenarios, e.g. simulated introduction of a forest clearance tax, an average carbon tax of US$9/tC would reduce emissions from deforestation by half if we assume deforestation by slash and burn. If the carbon from the harvested wood is assumed to be temporarily sequestered in a timber products pool, a timber sales tax of US$25/tC would have a similar effect. In practice these two taxes would be additional, i. e. a timber sales tax on top of a land clearance tax. Revenues from such carbon taxes on deforestation would result in annual revenues in the magnitude of US$5.9 bn in 2006 declining to US$4.2 bn in 2025 (Table 1 and Figure 1). Results from the scenario analysis show that almost independent of the financial mechanism (incentive payments or tax), more than half (53%) of the forest carbon would be saved in sub Sahara Africa 30% in Latin America and 16% in Asia.

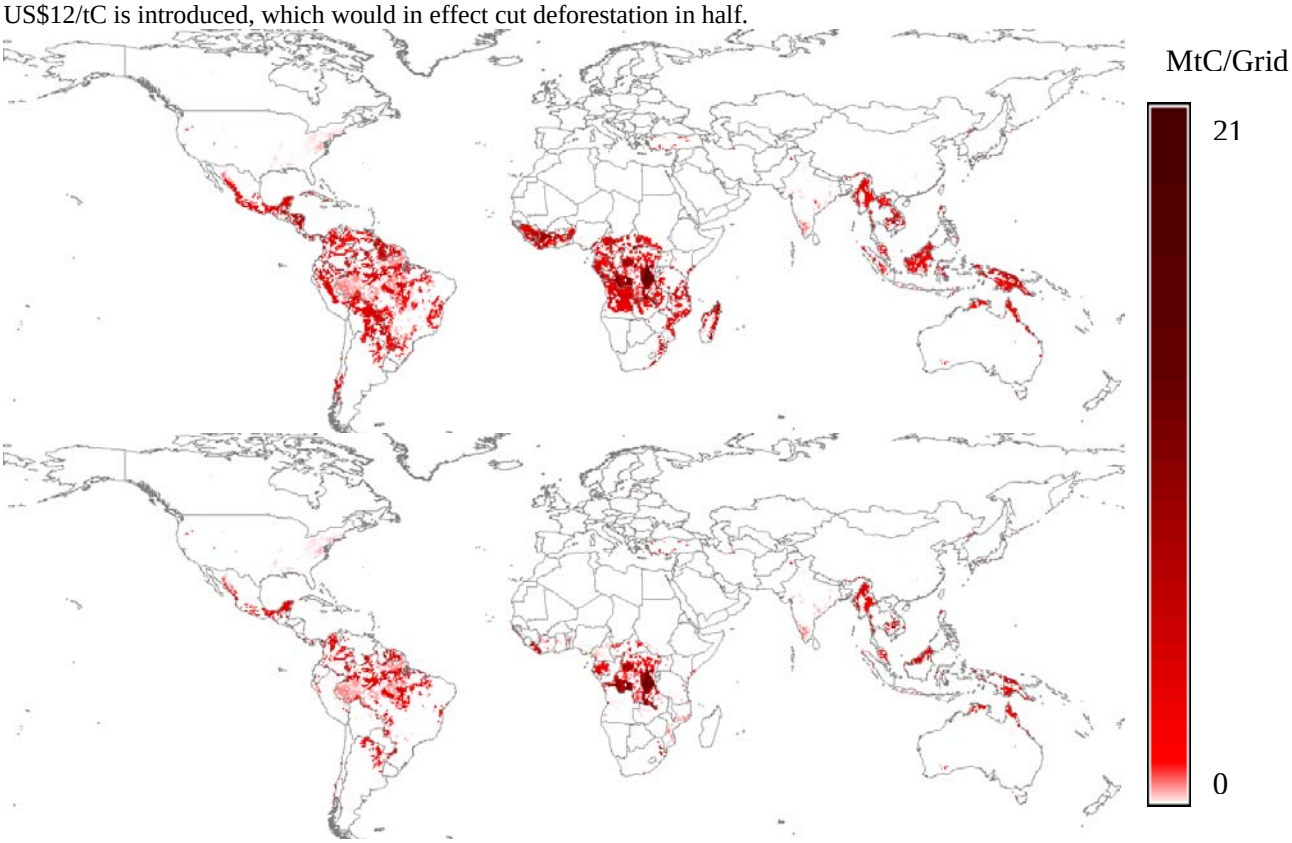
Table 1: Scenarios of forest biomass saved according to financial mechanism.

Deforestation Baseline shows the amount of forest biomass (GtC) lost through deforestation over the coming 20 years. *Incentive payment* and *Carbon tax* give the amount of avoided deforestation in GtC per 20years at the price/tax levels indicated. *Slash-burn* and *timber sales* assume that 100% of the biomass will either be burned on the spot or a harvested wood products pool respectively. *Sale/burn* is a more realistic and geographically differentiated combination of slash-burn and the wood products pool. The share is region specific, based on empirical evidence of region-specific deforestation drivers (2-3).

Region	Deforestation Baseline	Incentive payment US$6/tC/5yr	Carbon tax US$9/tC (slash-burn)	Carbon tax US$25/tC (timber sales)	Carbon tax US$12/tC (sale/burn)
	GtC Deforested	GtC saved in 20 Years			
Pacific	0.00	0.00	0.00	0.00	0.00
Caribbean	0.02	0.02	0.01	0.02	0.01
Europe	0.02	0.00	0.00	0.00	0.02
Asia	2.19	1.49	1.50	1.41	1.32
Australia	0.22	0.06	0.03	0.12	0.17
Latin America	6.22	2.75	2.55	2.65	3.02
North America	0.04	0.00	0.00	0.00	0.00
Sub Saharan Africa	8.82	4.90	4.77	4.67	4.08
North Africa	0.00	0.00	0.00	0.00	0.00
Sum	17.54	9.22	8.86	8.85	8.63

Figure 1: Carbon loss and avoided carbon loss in forests caused by deforestation until 2025

The upper figure shows the geography of baseline deforestation up to 2025 assuming no carbon policy (no incentive payments, no tax) and the low figure illustrates the saved carbon assuming a carbon tax of US$12/tC on deforestation. The lower figure shows that large areas could be saved from deforestation if a carbon price of US$12/tC is introduced, which would in effect cut deforestation in half.



Funding sources and tailored funding mechanisms

Incentive payments needed to cut deforestation in half would require annual payments of at least US$33.5 bn. This would require funds that are more than double the total annual global

investment in forestry, currently at around US$18 bn (12). Only a small fraction of the current investment in forestry is non-domestic, i.e. private foreign direct investment or official development assistance (ODA) or official aid (OA). According to UNCTAD (13), the worldwide foreign direct investment (FDI) in the agriculture, forestry, hunting and fishing activities combined reached US$ 1.8 billion in the period 2001-03, i.e. US$ 600 million per year, most of which is dedicated to agriculture. Recent data from the Organisation for Economic Cooperation and Development (14) on the total ODA/OA commitments to forestry by OECD countries and multilateral agencies shows an annual average commitment to forestry of US$ 564 million between 1996-2004. Even if all current FDI and ODA funding for forestry combined would be redirected to reduce emissions from deforestation, this would reach only around 3.5% of the funding required to cut emissions from deforestation in half while around 40% of all ODA would be needed to achieve the same goal.

Financing "Avoided Deforestation" through the Clean Development Mechanism (CDM) or other climate policy related financing mechanisms seem unlikely to be sufficient to convince deforestation agents and their respective governments to curb deforestation. In fact, given current realpolitik, international financial flows are likely to remain below 10% of the US$33.5 bn needed to cut deforestation in half in the foreseeable future. For instance, in 2005 the overall value of the global aggregated carbon markets was estimated at over US$10 bn. Around 93.5 MtC (374 million tCO_2e), mainly of Certified Emissions Reductions (CERs), were transacted at a value of US$2.7 bn (with an average price of around US$1.8/tC (US$ 7.23/tCO_2e) in the same year)[2] (15). Thus, even if half of the funds generated through CERs had been earmarked to avoid deforestation it would have covered less than 10% required to cut deforestation by 50%.

It becomes apparent that existing international sources and mechanisms, including carbon trading, can only contribute to a limited extent to fund avoided deforestation. Thus, contrary to the expectations of many in the policy debate, climate policy will not nearly be THE silver bullet that solves the deforestation problem. A wide range of existing and new instruments is needed, both international and domestic (Table 2). Given the magnitude of funding required, financial resources will have to be generated first and foremost from domestic sources. Obviously, developing countries cannot be expected to generate sufficient funding alone, particularly in Africa and parts of Asia. International funding will be needed, particularly to develop and support national mechanisms.

Table 2: Domestic and international financial policy instruments targeting deforestation. Incentive type instruments provide greenhouse gas (GHG) related revenues while tax type instruments would create costs to potential deforestation agents.

	Incentives type	**Tax type**
International funding	• ODA funding support to national "avoided deforestation" policies • Carbon credits trading	• International agreements: payment above negotiated deforestation level
Domestic funding	• "avoided deforestation" policies financed through	• Land clearance tax • Timber sales tax

[2] European Union Allowances (EUAs) worth US$8.2 billion traded in 2005, which corresponded to 322 million tons of carbon dioxide equivalent (tCO2e).

subsidies.
- Redistributive budget schemes
- Environmental services payment
- Non-renewable energy tax
- Emission tax

Domestic financial incentives need to be based on programs that target and are adjusted to diverse and often small-scale local and regional deforestation and forest degradation contexts. Such incentives need to address and reach people that drive forest cover changes because of subsistence needs such as food, energy or living space, be it legal or unauthorized. Decentralized and smaller-scale redistributive financial mechanisms that work on a national and sub-national scale and are supported through international funds pose many problems, including transaction costs and leakage of funds. However, a large pool of experience is available on how to address small-scale diversity and needs, such as through micro-finance infrastructures and payments for environmental services of forests (16, 17).

Existing international incentive channels, including bilateral and multilateral ODA and specific funds, such as the GEF Trust Fund, can be used to fund baskets of national measures aimed to address local and regional drivers of deforestation. If the annual amount of total ODA spent on forestry were tripled from 2004 levels to US$1.6 bn, i.e. from 0.7% to 2.1% of total annual ODA, this would result in 1.7GtC of saved carbon corresponding to an area avoided from deforestation of 26.5 million ha. In addition, existing and emerging carbon credit based transfer schemes with appropriate rules to channel funds from larger-scale (e.g. CDM-type) projects towards avoided deforestation could emerge, given appropriate policy signals (18).

Tax type of payments based on international agreements seem to be difficult to negotiate now and in the future. On the domestic (national) level, redistributive financial mechanisms, such as taxing land clearance and timber sales in combination with earmarked re-routing of revenues to promote financing of forest conservation and sustainable forest management programs, might turn out to be the most effective policy instrument to address deforestation Given that in practice the by far largest part of forests is government-owned (2), domestic taxes such as land clearance tax or timber sales taxes can be set up through voluntary budget allocation and balance mechanisms within different levels of government. In addition, tax income from private land clearance and timber sales could be channeled back to support keeping other forests to remain or targeted at the roots of deforestation.

Conclusion

Reducing emissions from deforestation, a major source of CO_2, could potentially be a highly cost-effective option for climate policy. Comparatively low amounts of financial flows could save millions of hectares from deforestation. Equally important is that, if appropriately spent, such financial flows would be a highly welcome tool to help reducing poverty by improving livelihoods of some of the hundreds of millions forest-dependent people in the developing world and secure many of the forests' ecosystem services. However, it appears that only a fraction of the funding needed, estimated in the magnitude of US$33 bn per year, can be realized in the context of climate policies. A basket of financial mechanisms will be needed to properly address the avoided deforestation challenge. Finally, a functioning and trust worthy global forest

monitoring system which we consider as a precondition for any effective implementation of a globally concerted deforestation policy, is yet to be built.

Methods

The impact of economic incentives to reduce deforestation is calculated by comparing net present values (NPV) of competing forms of land use to existing forest land. We use a spatially explicit biophysical and socio-economic land use model (20-23) with inter alia current forest area, net primary productivity, population density, agricultural suitability, gross domestic product, deforestation rates all the way to quality of governance as exogenous inputs. Two financial mechanisms implementing avoided deforestation incentives are modeled. First, a "tax" type payment which is assumed to be enforceable and detectable by an impartial agency only ex post. Second, a "compensation" contract which is issued to known deforestation agents ex ante. Model results for the two financial mechanisms show ranges of the potential magnitude of avoided deforestation as well as illustrates to value of information from a global forest monitoring system in avoidance contracts. The incentives examined are within the range of recently observed carbon prices such as for Certified Emission Reduction (CER) Units within the Clean Development Mechanism (CDM).

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