Compensation for carbon stock maintenance in forests as an alternative to avoiding carbon flows

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One of the most heated topics negotiated during the 1997 UNFCCC Conference of Parties in Kyoto was whether forest conservation should be eligible for participation in the CDM, in the form of avoided deforestation (AD) projects. At the time, the advocates of AD believed in the promise that markets could channel unprecedented financial flows to the forestry sector, harnessing entrepreneurial initiative and investor appetite while generating other highly desirable social and biodiversity benefits.

The adoption of AD as a compliance activity for the objectives of the UNFCCC and the Clean Development Mechanism (CDM) was rejected following the Kyoto negotiations in 1997. One of the principal objections to the use of AD at the time were the perceived challenges related to meeting the technical requirements of baseline setting, determination of additionality, prevention of leakage, and the guarantee of permanence. In spite of much scientific data to the contrary (a good summary is found in the IPCC Special Report on Land use, land use change and forestry, IPCC 2000), such tasks were perceived as insurmountable barriers jeopardising the environmental integrity of the CDM.

One of the reasons why all these technical issues are viewed as barriers is that the theoretical construct of AD is based on an activity that will never happen. By definition, AD is based on the avoidance of a flow of greenhouse gases (GHGs) from forest carbon stocks to the atmosphere. Consequently, these can never be measured but, instead, must be inferred from theoretical or empirical assumptions. It is evident, therefore, that the use of an avoided carbon flow approach for the treatment of AD will always be subject to a certain amount of uncertainty.

As the negotiations engage again in trying to find ways to include deforestation in a future climate regime, it is important to learn from the experiences of the last 10 years of the CDM and analyse different options for the treatment of forest conservation in the context of GHG mitigation. This short note describes an alternative approach to the treatment of forest conservation based on the remuneration for maintenance of carbon stocks as opposed to avoided carbon flows.

Key project design concepts adopted in traditional GHG mitigation projects

In order to ensure the environmental integrity of GHG mitigation projects, a series of project design concepts were created and used starting in the early 90s. A review of these is found in Moura-Costa et al. (2000) and a brief discussion on their challenges is given below.

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Baselines and additionality

In the context of the Kyoto Protocol, no project can claim carbon offsets unless its proponents can reasonably demonstrate that the project's practices are 'additional' to the 'business-as-usual' or 'baseline' scenario. This baseline scenario is broadly described as the collective set of economic, financial, regulatory and political circumstances within which a particular project is implemented and will operate. The validity of any particular project rests upon the case made that environmental performance -- in terms of carbon offsetting -- exceeds historical precedents, legal requirements, likely future developments, or a combination of the three.

Establishing the baseline scenario thus requires historical knowledge of conventional practices in the project area, the local socio-economic situation, and wider (national, regional or even global) economic trends which may affect the outputs of a project. These factors are then used to create projections for the future. Consequently, baseline scenarios are necessarily based on assumptions. Once the baseline is established, a project must prove that it satisfies the *additionality* requirement. This is done by showing that the project's carbon balance differs from that of the baseline and that this difference is attributable to the project's activities.

Given this counterfactual nature of a baseline (i.e., a description of a future scenario), the demonstration of additionality is inherently uncertain. A significant bulk of work exists, however, to enable the determination of forest baselines with acceptable levels of uncertainty (IPCC 2000). Furthermore, this uncertainty is common to all classes of GHG mitigation projects and does not appear to be more significant in land use projects than in energy systems (Chomitz 2002, Moura Costa et al. 2002). Indeed, doubtful additionality is the main reason for the high frequency of project reviews and rejections observed in the CDM (see http://www.iges.or.jp/en/cdm/report_cdm.html#reject), mostly not based on land use activities. Irrespective of the similar nature of this challenge to other project classes, this has been one of the main reasons for the exclusion of AD from the CDM.

Leakage

Leakage occurs when the carbon offset benefits from a project are partially negated by GHG emissions taking place elsewhere, as a consequence of the project (Brown et al., 1997). In the same way as for the demonstration of additionality, detection and quantification of leakage is also based on theoretical constructs and assumptions of future behaviour. In essence, it requires establishing a causal effect between an activity taking place as a consequence of the same activity being stopped in the project area. In terms of forest conservation, it requires determining whether deforestation activities in a region are due to the displacement of the deforestation agents previously acting in the project area.

As with baselines, the counterfactual nature of these assumptions makes the identification and quantification of leakage very uncertain. Again, leakage is a challenge to all classes of GHG mitigation projects, not only those based on land use activities (Chomitz 2002). While leakage in AD can be identified, estimated and reduced (Aukland et al. 2003), leakage is seen as a major risk related to the inclusion of AD in a GHG compliance regime.

Permanence

While both additionality and leakage are requirements common to all classes of GHG mitigation projects, permanence is an issue more specific to terrestrial carbon stocks. There is a clear requirement in the Kyoto Protocol that land use, land use change and forestry projects must result in long-term changes in terrestrial carbon storage and CO_2 concentrations in the atmosphere, i.e., that such changes must be 'permanent'. On one hand, there is the expectation that, if forests are used to counter GHG emissions from fossil fuels, they have to be maintained in perpetuity. On the other hand, there is a concern that any obligation to preserve forests in perpetuity is inherently flawed or politically undesirable.

A series of papers has been written over the last few years proposing different ways for addressing the temporary nature of forest carbon stocks, including a section in the IPCC Special Report on Land Use, Land Use Change and Forestry (IPCC*,* 2000) outlining various carbon accounting methods that can be used for dealing with permanence issues. However, the possible reversibility of the GHG benefits accruing from forestry projects has raised questions about the environmental integrity of land-use based mitigation projects, to the extent that the activities currently eligible under the Clean Development Mechanism of the Kyoto Protocol do not include AD.

Philosophical and political objections to AD

In addition to the technical arguments listed above, the concept of avoiding deforestation has raised a series of objections based on moral or political grounds. These include:

- Perverse distribution of benefits rewarding the champions of deforestation as opposed to the champions of forest conservation. Indeed, some of the most pro-active countries in the forest conservation space include Costa Rica and Guyana, both of which have developed case-model carbon offset projects but are hindered from benefiting from AD finance by their historically low deforestation rates (and consequently avoided deforestation gains);

- Environmental blackmailing – the perception that carbon finance provides a mechanism to render forests hostage to those agents of threat (i.e. that countries or projects might threaten to cut forests in order to generate a justification to be paid not to cut) so that baselines are inflated and the resulting carbon benefits from conservation enhanced;

- Neglect of enforcement of forest protection regulations unless carbon finance is secured to finance it;

- Infringement of national sovereignty, as a result of foreign parties gradually acquiring control of forest lands in developing countries and interfering with their national security and development plans;

- Inequity of distribution of carbon finance, benefiting urban elites and in detriment of disenfranchised land users.

Such objections have been raised from both developed and developing countries, and stem from two main causes – concern about the concept of providing rewards for avoiding a negative environmental impact and concern related to requirements for long term land use commitments.

An alternative: compensation for carbon stock maintenance

Most of the technical and political challenges related to the inclusion of AD into a GHG mitigation compliance regime are based on the fact that compensation is given to the avoidance of GHG flows to the atmosphere. If, alternatively, the system was based on rewarding the conservation of forests and their carbon stocks, most of these challenges would not be relevant. In essence, the carbon stock maintenance approach is more closely aligned with the concept of paying for environmental services, as opposed to paying for not impacting the environment, and consequently avoids many of the pitfalls of the latter.

The approach proposed is based on providing a payment for all forest carbon stocks, irrespective of level of threat, for as long as they remain in place. Payments are made on a frequent basis, based on the carbon stocks quantified through monitoring. If carbon stocks are seen to be lower in a subsequent monitoring period, payments are adjusted accordingly.

An advantage of the carbon stock maintenance concept is that it allows carbon storage to be treated as a service that can be stopped at any time, therefore requiring less long-term guarantees between the contracting parties. This is important since governments are often reluctant to adopt measures with indefinite consequences. An example would be to halt the logging of a given area for a certain period of time, "leasing" the forest in this area as a repository of carbon, without any assumption that this forest will not be logged after the period agreed (see a discussion on carbon leasing in Moura Costa 1996 and Prior et al. 2006). A similar analogy was made by Cattaneo (2009), who refers to carbon stocks as assets that provide dividend flows over time. Provided that carbon stocks are still in the forest, they can be leased for another period of time, and so on.

Additional advantages of using the carbon stock maintenance approach include:

- It does not require determination of additionality – i.e., the approach is based on rewarding for existing forests as opposed to avoiding forest loss;

- Consequently, it does not require baseline setting and the determination of credible threats, which are considered the main challenges in proving additionality;

- There is no risk of leakage, as payments are made for stock maintenance as opposed to preventing deforestation agents from operating inside the project area with the risk that they simply move outside the project boundaries;

- There is no requirement to ensure long-term permanence of carbon stocks, as payments are made only for existing stocks on an *ex post* basis.

In addition, the use of this approach would also address some of the political and ethical concerns previously raised, for the following reasons:

- It is a positive approach, based on payment for the provision of environmental services, as opposed to halting negative environmental impacts. It remunerates countries for providing a public good (forests and environmental services) as opposed to rewarding them for a change in behaviour;

- It rewards countries with historically low deforestation rates, while also creating incentives for countries with high deforestation rates to reduce rates in order to maintain their carbon stocks;

- It removes perverse incentives associated with creating forest threats to inflate baselines;

- It encourages law enforcement as a means to safeguard a national asset (forests and carbon stocks);

- As it does not require long term commitments to maintain forests, it does not infringe on sovereign rights to determine long term land use and development strategies. Furthermore, it does not create any liabilities associated with lengthy obligations;

- Given that it explicitly rewards good forest stewardship, it could clearly be structured in ways that have positive distributional effects for carbon finance generated.

In summary, payment for carbon stocks creates an opportunity cost for forests, which currently tend to be assessed only through the opportunity cost of alternative land uses.

The stock maintenance approach may also provide a tool for the integration of national and sub-national initiatives. Currently, there are many proposals for restricting the development of AD activities to the national level, given the ease of setting up baselines and controlling leakage at a national scale. As these technical challenges are not present when using the carbon stock maintenance approach, this is compatible with the adoption of national, sub-national or nested approaches for AD project development. If such revenues were collected or coordinated at a national level, though, responsible governments should transfer carbon finance to those forest stewards that assist in protecting stocks, divert some of the funds to creating conducive frameworks for forest protection (e.g., legal, fiscal, etc.), and enable the participation of a wider range of entities (state governments, NGOs, private sector) to participate in projects directly, 'nested' into the national framework (see Pedroni and Streck 2007 for a discussion on the "nested approach").

An obvious question, though is why should forest carbon stocks be paid for and not other forms of carbon stocks (e.g., fossil fuel reserves). The answer to this question should be related to the wider values of forests related to the environment (i.e., the biodiversity and hydrological benefits of maintaining these carbon stocks), society (their importance to the livelihoods of many stakeholders), as well as climatic systems. With relation to the latter, unlike other sources of carbon stocks, the loss of forests creates additional impacts on global climate beyond the direct effect of GHG emissions. In particular, the impact of forests on evaporation and rainfall systems, albedo levels, and in the maintenance of their own sequestration capacity, all justify attributing a higher value for the maintenance of forests in relation to other stocks of carbon.

At the same time, it is also necessary to find long-term solutions for reducing GHG emissions from forests and society as a whole. This would require intensification of production on existing agricultural land, developing sustainable alternative livelihoods, and improving governance. In parallel, it is important to develop and discover alternative technologies to abate emissions, promote fossil fuel assets replacement, and provide a means for developing countries with the opportunity to follow other future development pathways. If compensation for forest carbon stock maintenance was used within a finite time horizon, this would create a window during which solutions for other sources of emissions would be tackled, while halting the irreversible process of forest loss.

Payment unit – what should be the value of carbon stocks with relation to carbon flows?

The key to making the carbon stock approach work is that payments should be made for a limited period of carbon storage, as opposed to for the maintenance of carbon stocks in perpetuity. It is evident, therefore, that the value of a tonne of CO_2 stored for a finite period of time is worth much less than one that will be kept out of the atmosphere forever, as it is assumed for projects based on the avoidance of fossil fuel emissions: the latter is a permanent asset while the former represents a service rate.

So, what should be the value of a carbon stock unit? To start, the quantification of the value of carbon stock maintenance should incorporate the time factor and the unit used should be tCO_2/year rather than tCO_2. The concept of a ton-year unit has been proposed by many authors (Moura-Costa, 1996; Fearnside, 1997; Tipper and de Jong, 1998; Dobes *et al*., 1999; Moura-Costa and Wilson, 2000; Fearnside et al., 2000; Maclaren, 2000, Chomitz, 2000; Dutschke 2001). The general concept of the ton-year approach is the application of a factor to convert the climatic effect of temporal carbon storage to an equivalent amount of avoided emissions, thereby establishing an exchange rate between tCO_2/year and tCO_2.

An approach to determine such exchange rate is to use the '*equivalence time'* concept. This is defined as the length of time that CO_2 must be stored as carbon in biomass or soil for it to prevent the cumulative radiative forcing effect exerted by a similar amount of CO_2 during its residence in the atmosphere (Moura-Costa and Wilson, 2000). Using this concept, the determination of an '*equivalence factor'* has been attempted and suggests a range from 0.007 to 0.02 (Dobes *et al*., 1999; Tipper and de Jong, 1998; Moura-Costa and Wilson, 2000). I.e., according to these studies, 1 ton-year should be worth between 0.7% and 2% of a 'permanent' carbon credit from fossil fuel avoidance.

Applications to tropical forest countries

The analysis presented below aims at demonstrating the impact of adopting a system of compensation for carbon stock maintenance as opposed to payments for avoided flows in terms of distribution of carbon finance among key tropical forest countries, which in aggregate represent ca. 36% of global deforestation emissions (IPCC 2007). The analysis was based on figures presented in Strassburg et al. (2008, in Cattaneo 2009), and the following assumptions:

- An equivalence factor of 0.35, i.e., a ton-year is worth 0.35% of a permanent carbon credit – conservatively chosen to be half of the lower value in the equivalence range shown above;
- Forest conservation efforts would only reduce deforestation rates by 50% in the countries analysed;
- Carbon credit price of U$ 5/tCO_2.

The results are shown below:

			CO_2 credits using each approach (Gt CO_2/yr)		CO_2 revenue using each approach (mi US$/yr)	
Countries	Forest carbon stocks (Gt CO_2)	Current emissions from deforestation (Gt CO_2/yr)	Avoided flow	Stock maintenance	Avoided flow	Stock maintenance
Brazil	215,774	1,183	591.5	755.2	2,958	3,776
DR Congo	82,127	246	123.0	287.4	615	1,437
Indonesia	32,296	597	298.5	113.0	1,493	565
Papua New Guinea	17,561	88	44.0	61.5	220	307
Totals	347,758	2,114	1057.0	1,217.2	5,285	6,086

As shown, the use of the stock maintenance approach greatly rewards countries with relatively low deforestation rates with relation to the total forest stocks (e.g., DR Congo and Papua New Guinea) while it still providing a significant incentive to reduce deforestation in countries with high deforestation rates (e.g., some U$ 500 mi per year to Indonesia).

In terms of total financing to tropical forest countries, at US$ 5/tCO_2, the carbon stock maintenance approach would require the transfer of some U$ 17 billion per year, in line with the lower estimates in the Eliasch Review (Eliasch, 2008). Such financial resources are expected to provide enough incentives at the national and sub-national levels to promote forest conservation in relation to alternative land uses in many circumstances. While the determination of carbon credits generated by this method is derived from the environmental services generated by standing forest (i.e., the climatic effect of temporal carbon storage), an equivalence factor of 0.35% would create similar volumes of credits as if using the current global deforestation rate (0.33% per year, FAO 2006).

The example given above, and the assumptions used, are all based on inputs that would need to be determined through a political process. As adherence to this scheme would likely be voluntary and carbon credit supply would be driven by opportunity costs in different countries and regions, price would ultimately be dictated by supply and demand dynamics. The impacts of the supply of these levels of carbon credits into international carbon markets would need to be analysed, as well as the potential to control price effects through manipulation of demand (i.e., increasing targets) or through the creation of separate schemes for including forest conservation credits (for instance, as in the Dual Markets Approach proposed by CCAP, 2007). It not is appropriate, though, that price control is achieved by restricting supply (i.e., limiting potential sources of mitigation). Rather, it could be achieved through an increase in demand (i.e., by adopting higher emission reduction targets worldwide). Indeed, if the world aims at adopting significantly more ambitious GHG emission reduction targets, this has to be coupled with high volume low cost abatement options.

Conclusions

It is proposed here that the carbon stock maintenance approach should replace, instead of complementing, the use of the avoided carbon flow approach currently under debate. If carbon stock maintenance was to be used in parallel to the avoided flow approach, it would simply add an additional layer of technical difficulties to the current negotiation process.

Considering the higher environmental importance of forests in relation to other sources of GHG emissions, the task of controlling deforestation should be treated with an upmost sense of urgency. Given its simplicity, though, the carbon stock maintenance approach could enable a rapid deployment of incentives for preventing forest loss in developing countries while longer term solutions to global emissions are found and agreed.

In conclusion, carbon stocks maintenance may provide a solution to many of the current technical, political and philosophical challenges facing the inclusion of forest conservation in the suite of measures adopted for a future GHG mitigation regime worldwide.

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