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Market Discounts for Sinks:
A Concept for Restricting Forest Contributions in Accounting for Emission Reductions?

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Contents

Abstract

Forests are capable of the best and the worst when greenhouse gases are at stake. Their controversial contribution for helping developed countries to reach their emission reduction targets is largely responsible for the November 2000 failure of the Kyoto Protocol being enforced in the near future. Regarding the unit price of emission credits for fossil fuels, future transactions for carbon offsets associated with land use change and forestry projects may well reveal market discounts due to risks and uncertainties related to their evaluation and management. The author proposes to apply these market discounts for assessing *at intergovernmental level* the 'contributive' value of forestry activities eligible for meeting countries' emission reduction targets.

This proposal is preceded by an outline of the position of the forestry projects within the Kyoto treaty, as well as by an outlook on the establishment of a market for carbon offsets. Indications are given for correcting emission reductions and removal assessments by adjustments that are required when assuming that the 'true' contributive value of one CO_2-e ton to be retained may vary (1) according to the uncertainty degree associated to evaluations and (2) that this degree is closely related to project features and origins.

Fixing consensual rules for consideration and quantification of uncertainties associated with carbon uptakes and removal evaluations, including market appraisals as a last resort, has the potential of moving international negotiations from divergences in the eligibility of activities towards verification and penalty, in short to policing the Protocol. The chances for the treaty to be effective and successful would then be enhanced.

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About the Author

André Gabus is a former senior economist at Battelle, Geneva Applied Research Center, and a former ministerial advisor in tropical agriculture and forestry economics. His current research and consulting interest focuses on topics related to forest sustainable management and strategies for developing relative cost advantage to forest-produced goods and services (such as carbon sequestration).

Market Discounts for Sinks:
A Concept for Restricting Forest Contributions in Accounting for Emission Reductions? [1]

André Gabus

1 Introduction

Some countries have accepted the text of the Kyoto Protocol under the specific provision of including sinks, as this offers prospects of actually helping them to fulfill their commitments. More and more complex definitions of carbon offsets have been proposed for avoiding accounting tricks and loopholes. Aware that 'science could not bring them any further', negotiators are now trying to strike a deal on a quantitative cap for carbon sequestration — a drive that has its own problems (among which the equitable allocation of admissible projects and derived credits in the context of restricting activities). Not yet completely disregarded by policy makers, discounting for sinks by some means also opens prospects of searching for a necessary arrangement in accounting for enhancing carbon sequestration activities.[2]

Various ways are presently proposed for addressing the issue of the qualitative selection and quantitative restriction of sink activities; they have the common trait of resorting to market forces. Expected market discounts for the removed carbon regarding the reduction unit price of energy projects are approached and applied here in the context of the probably inescapable conversion of the national-issued emission permits into credits acceptable for compliance at intergovernmental level. Alternative solutions, with a more explicit reference to the environmental and social integrity projects, consist, for example, of installing a specific market for quality-ranked carbon sinks that are submitted to an auction procedure within the constraint of a politically-decided quantitative cap (Obersteiner *et al.*, 2001). These various proposals share a common feature: they aim at self-regulation and decentralizing the decision-making process, thereby intending to reduce the seemingly unresolvable complexity of the sink problem significantly.

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[1] The French version of this paper can be accessed on the Internet at the author's personal web site "Forêts et Dérivés (F&D)": http://www.dplanet.ch/users/agabus.

[2] A pragmatic selection of LULUCF activities and specific measures for dealing with carbon sinks are proposed by Barral *et al.* (2000), with brief considerations on their pros and cons in accounting for emission reductions (includes a reference to "discounts" and "carbon loans").

2 Importance of Forests for Containing Greenhouse Gases Emissions and Motivation for Finding a Way Out of the Sinks Issue

Over the past 150 years, deforestation has contributed an estimated 30% of the atmospheric build-up of CO_2 (WRI/IUCN, 1998). Tropical deforestation alone accounts for about 20% of total greenhouse gas emissions (Chomitz, 2000). The carbon offset strength of forests is however impressive. Over the past 35 years the mean yearly sink of Russian forests is estimated at approximately 240 million tons, whereas fossil fuel emissions amounts to 650 million tons (Nilsson *et al*., 2000; Obersteiner *et al*., 2000a). The carbon sink of trees in all European Union (EU) forests, reaches 63 million tons per year, compared to 880 millions tons from anthropogenic carbon dioxide emissions (Liski *et al*., 2000). This is almost as much as the emission reduction target of the EU under the Kyoto Protocol. These figures indicate that forests and land use changes are both part of the problem and part of the solution of climate change.

Should the Protocol be enforced, forest activities would however qualify for credits only if they are directly human induced since 1990 (the so-called 'Kyoto forests' defined by Article 3.3), i.e., established on land that has not been forested (afforestation) for a long time or on land that has been historically cleared (reforestation). Carbon in other trees, including naturally occurring native forests and replanting of areas that were forested in 1990, would not qualify. Carbon enhancement practices and measures against hazard releases in sustainably managed forests (in line with Article 3.4) could also be considered, but are controversial because of pending restrictive definitions.

Curiously, the forest conservation organizations[3] are particularly reserved for including carbon sequestration activities, especially when forests are at stake. In their revised global forest strategy, the International Union for the Conservation of Nature (IUCN) and the World Wildlife Fund (WWF) state: *"Governments must not abdicate their responsibility to reduce emissions at source by relying too heavily on the capacity of forests to sequester carbon"* (IUCN/WWF, 2000). This is a mild statement compared to the position taken by the Director of WWF's Climate Change Campaign: "*The only way to combat climate change is through deep cuts in emissions of global warming gases*" (Morgan, 2000). The US government, in its submission to Article 3.4, is suspected by a number of environmental groups of accounting tricks when proposing that forest activities such as nutrient fertilization, fire management, pest management and rotation length changes (for enhancing carbon storage or avoiding releases) should count for reduction targets; according to such groups, this would not require additional efforts to sequester carbon, but would rather give credit for those activities that have been underway for many years (NET, 2000).

Reducing concentrations of atmospheric carbon is considered as potentially cheaper via forests than via direct emission reductions at the source. A common estimate is that carbon will have a market price of US$ 10–30 per ton. The cost of producing carbon may be far less than this. A report by the Intergovernmental Panel on Climate Change

[3] 'Curiously' because they usually favor and support initiatives aiming at giving more economic and social value to forests as a means to help their preservation.

(IPCC) quotes costs between US$ 0.1 and 28 per ton in pilot carbon projects (Asquith, 2000). Thus important (although sometimes diverging) economic interests are at stake.

Kyoto forests have a differentiated bearing for participants. In the most forested countries of the EU (Austria, Finland, France, Germany, Italy and Sweden) the carbon sink of trees accounted for under Article 3.3 is minor, or the trees are even a carbon source. Land use change by afforestation or reforestation may seem therefore irrelevant as a means of achieving the reduction targets of carbon dioxide emissions in these countries, which account for 85% of the actual carbon sink of trees in the EU forests as a whole. However, Article 3.3 may have relevance for the carbon budget of individual countries: for instance, the carbon sink can be significant in countries where the present forest area is relatively small, leaving large areas available for afforestation and reforestation. For example, in Ireland and Portugal, the carbon sink of trees accounted for under Article 3.3 of the Kyoto Protocol was estimated to be equal to 7% of the anthropogenic carbon dioxide emissions (Liski *et al*., 2000). An example of another substantial potential contribution is that 22–36% of the required US emission reductions by 2010 could be derived from significant increases in forest and soil carbon stocks in applying a loose definition of Article 3.4 (NET, 2000).

Finding a way out of the forest issue that is currently blocking the implementation of the Kyoto treaty is then highly needed. Different strategies for arriving at some kind of compromise on forest sinks are currently devised: share limits in countries' assigned amounts, risk and uncertainty levies, mechanisms for insuring indefinite sequestration (Chomitz, 2000).

The flexibility allotted by the Protocol with emission trading could also offer some possibilities. As a way of reducing the cost of cutting global warming pollution, international trading also gives opportunities for regulations. With reference to the expected unit price of emission credits for fossil fuels, future transactions for carbon offsets associated with land use change and forestry projects may well reveal market discounts due to risks and uncertainties related to the evaluation and management of such projects. This discussion paper proposes to apply these market discounts for assessing and registering *at intergovernmental level* the contributive value of forestry activities eligible for meeting countries' reduction targets.

3 Main Features of Forestry Projects Aiming at Removing Atmospheric Carbon Dioxide and Implications of the Impermanence of their Storage Ability

Forestry projects, as a class, are sometimes considered as facing more difficulties than, e.g., energy projects in producing greenhouse gas emission reductions that are *real*, *measurable*, and *additional*. As for the assessment of their removal/uptake ability, storing pools would not be symmetrical to releasing pools. In contrast to preventing emissions, it would be difficult to assess whether a sinks project has resulted in a net gain for the atmosphere. For example, if a country receives credit for not logging one tract of forest but the demand for timber means logging occurs elsewhere anyway, there is no overall benefit to the atmosphere. Known as "leakage", this could present a severe

problem, especially if the rules for the Kyoto treaty allow sinks projects in developing countries (according to WWF, 2000).

Baseline determination (i.e., the projection of a 'business-as-usual' situation required for assessing eligible gains by difference) would also be controversial. Baseline estimations for carbon storage are sometimes considered as less reliable than those for emissions. Predicting the hypothetical without-project level is inherently difficult. The assessment of gains by technology-induced emission reductions is relatively trivial when changes of the existing situation are obvious with the definitive surrender of a given technology by introducing another more performing one. However, with some projects, the adoption of new processes or equipment would have taken place in any case (with or without Kyoto constraints), rendering such projects void for achieving reduction targets. By contrast, the assessment of carbon gains from planted trees on degraded forest land (where natural regeneration is unlikely over a few decades unless assisted) is easier to assess since the without-project situation is rather clear.

When considering criteria such as baseline and additionality determination, leakage assessment, and the measurement of actual emissions or sequestration, it has been shown that it is difficult to find generic distinction between forestry storage projects and energy emission reduction programs (Chomitz, 2000). The major difference between the two lies in that sinks are not permanent carbon stores. Carbon stored in trees is easily released back into the atmosphere through fires, pests, changes in land management, and as a consequence of climate change itself (WWF, 2000). Harvesting is a predictable carbon release, but with time lags not so easy to assess when life cycles of all timber and cellulose products are considered. As a rule, these various factors make reliance on forest sinks rather uncertain and risky.

The potential reversibility of sinks embodied in forestry (or/and land use changes) projects and the non-permanence of the stored carbon (in trees or in derived products) requires special attention with respect to accounting. For example, one should ensure that any credit for such enhanced carbon stocks is balanced by accounting for any subsequent reductions in those carbon stocks, regardless of the cause.

Acquittal of credits and/or permits would then be required in the commitment period 2008–2012 where:

- there were emissions associated with deforestation in the period, and
- there were net reductions in the carbon stock of Kyoto forests in the same period, by any means (human induced, such as harvesting or coppicing, or through a natural event) (AGO, 1999c).

To acquit credits and/or permits for emissions in these circumstances might not necessarily be the responsibility of the initial sequestered carbon rights owner (AGO, 1999d — see also *infra*, Section 5).

There are a number of existing and emerging strategies available to manage and minimize the risk associated with sequestering carbon. For example, in the case of 'accidental' destruction of the carbon sink (e.g., fire and other natural hazards), provision could be made to cover such losses by insurance. Furthermore, the

establishment of derivative markets for carbon sink activities would allow for risk mitigating strategies (e.g., hedging). Other strategies include planting additional trees as a buffer and pooling, where a number of sites are aggregated through an intermediary (AGO, 1999c). In short, investors would be able to manage risk through market mechanisms (e.g., insurance and hedging) as well as through pooling carbon and establishing a buffer (Blaser and Douglas, 2000).

As an alternative to strategies for ensuring indefinite sequestration, limited term commitments to carbon sinks may offer practical and political advantages. Various mechanisms to perpetuate these partial commitments into permanent sequestration have been proposed (see, Chomitz, 2000).

Whatever care is taken to ensure the eligibility and full counting of removals and emissions derived from forest management, forestry projects remain liable to a number of uncertainties in their carbon accounting (as are any uptake or removal programs). These cannot be ignored.[4]

4 Uncertainty in Carbon Accounting: A Crucial Issue to be Dealt with by the Treaty

Uncertainties associated with the estimation of emission reductions (*viz.* removals) from different sources (*viz.* sinks) are always likely to exist due to factors such as variability in biological systems, problems with observing emitter activity levels and the need to use proxies in assessing some emission/carbon pools.

Whichever is considered (fossil fuel or biospheric actions), uncertainty in carbon accounting is an issue.[5] Verification of emission reductions (on both the national accounts and project levels) is a necessary precondition for the functioning of the Protocol as such. Reductions have to be mutually recognized and accepted as "true" by all participating parties (Obersteiner *et al*., 2000b,c). Parties can underreport emissions just because of various uncertainties (and hence can overstate their reductions). The reported emissions plus the estimated unreported carbon emissions should then be below their Kyoto targets (Jonas *et al.*, 2000). Significant increased emission reduction costs that would result from integrating uncertainty into the reporting system could be substantially lowered by emission trading (see a convincing international simulation in Godal, 2000).

However, applicable concepts to quantify uncertainties have yet to be scientifically worked out (Obersteiner *et al*., 2000a). It is currently proposed that the emission reductions *as well as* uncertainty ranges be certified by an independent neutral third party. At project level, the auditor could verify that an appropriate proportion of forest carbon sequestered has been subtracted for covering uncertainties in the measurement

[4] For a detailed technical description of how to determine carbon credits in forestry projects, see Harkin and Bull (2000).

[5] IIASA research has investigated in great detail issues of uncertainty in carbon accounting and has dealt with the implications of verification, Nilsson *et al*. (2000).

and projection of the forest carbon balance (Holloway, 1999; Harkin and Bull, 2000). Alternatively or as a complement, different levels of precision associated with emission reductions/credits could be indicated by the certification entity.[6]

Generally speaking, the economic solution to the verifiability problem can be achieved by attaching an economic cost to uncertainty. Countries should be penalized for uncertainties and they could be allowed to reduce this penalty by reducing the level of uncertainty.[7] It has been argued that uncertainty can be priced and in this way included in a trading scheme (Obersteiner *et al*., 2000a). The present discussion paper develops this viewpoint in proposing that, via the national emission trading schemes, market appraisals (by price differentials) complement the professional uncertainty assessment indicated above.

Since doubts are often cast especially about the ability to quantify and verify the uncertainty in estimating carbon fluxes associated with land use changes and forestry, such a complementary approach is worth examination in its likely future context, namely that of emission trading markets.

5 Outline of an Emission Trading Market and the Operators' Liability Issue

5.1 Rationale for Introducing an Emission Trading Scheme

Apart from offering a non-prescriptive approach to greenhouse gas abatement, the development of national markets and a connected international system for trading emission credits is essential for reducing countries' commitment costs. It has been early demonstrated that the least cost solution of reaching the aggregate target of pollution reduction agreements can be realized though trading in emission permits (Montgomery, 1972). The global costs of achieving the Kyoto Protocol targets are estimated to be US$ 120 billion if each nation must satisfy its commitments purely through domestic actions, but drop to US$ 54 billion if trading is permitted among industrialized countries and further falls to US$ 11 billion if carbon reduction transfers from developing countries (CERs) are permitted and efficiently supplied (Ellerman *et al*., 1998, quoted by Chomitz, 2000).

5.2 Main Features of a National Emission Permit Market

On a national market, basic *demand* for a single tradable instrument (e.g., 'carbon equivalents units' or 'carbon credits') originates from operators in need of emission credits for meeting emission liabilities derived from exceeding their individual

[6] For example, the forest carbon accounting standard published by the State Forests of NSW (2000) in Australia, in conjunction with the Sydney Futures Exchange (2000a,b), defines three different levels of precision associated with carbon credit certification.

[7] An analogy can be found in, e.g., life insurance markets. A reduced rate is offered after medical examination; otherwise a flat rate is given.

allowable emission caps (emitters outside this 'cap and trade' system pay a carbon tax or/and must comply with prescriptive mandatory measures). The *supply* of tradable emission allowances comes forth from:

(i) surplus emission permits (or emission credits — ECs),

(ii) domestic (or other industrialized countries) carbon sequestration credits (CSCs),

(iii) free parts of other countries' assigned amounts (PAAs),

(iv) emission reduction units from joint implementation projects in economies in transition (ERUs), and

(v) certified emission reductions in developing countries (CERs) — under the proviso that the latter be recognized as accountable.

Emitters partaking in a 'cap and trade' system are required to acquit one carbon equivalent unit for each ton of carbon dioxide emissions, or their equivalents.[8] A carbon equivalent unit (from any origin) is surrendered by the governmental regulatory body, once the emission credit was used to authorize the emission. It is then no longer available for trading.

In such an emission trading system, trade is assumed to occur between market participants who have different costs and opportunities for reducing their emission output. The emergence of an emission credit market allows emitters who have exhausted their lower-cost abatement opportunities to buy additional emission credits at the prevailing price. Conversely, emitters with substantial low-cost abatement opportunities have an incentive to adopt them, and free-up permits for sale within the market. Equalizing the costs of abatement across sources in this way is expected to minimize the total costs of abatement (AGO, 1999a,b).[9]

5.3 Liabilities of Market Operators

Within a national emission trading market, carbon sink operators are supposed to voluntarily register to be incorporated into the system. As seen above (Section 3), the owner of the sequestered carbon is responsible for measuring, monitoring and reporting on the sequestered carbon as well as arranging appropriate verification processes. As a market supplier, he will remain liable for these operations.

As in any financial or commodity trading market, the carbon credits buyer is in principle not held liable for the product; he does face risks however. As a rule, the initial earner (supplier) of government-issued credits incurs (as project owner) a liability for

[8] The total supply of emission allowances issued by a national government in any given commitment period would need to be consistent with the country's assigned amount, supplemented by sequestration credit arrangements, to enable the nation to comply with its international commitments.

[9] A national emission trading system is supposed to be open to all legal entities including, but not limited to, specified emission sources and carbon sink operators. They could include private individuals, companies, societies (which could include environmental and other non-governmental organizations), industry groups, brokers and other service providers. The advantage of open entry of others to the market, including those from other countries, is that it would increase the number of participants, increase competition, and have the potential to reduce the cost of the country's emission reductions (AGO, 1999a).

the real carbon equivalents content that originated from his activity and hence for the real emission allowance value of the sold rights. Should the effective acquittal value of marketed credits reveal to be less than their face value (e.g., because of a subsequent deforestation), the buyer could climb the sellers' chain to the initial supplier and ask the latter to support the possible damage cost (e.g., in the event that the control and compliance authority would require the user of the purchased credits to acquit for non-covered accidental emissions or any other reasons).[10] For sure, a rule could establish that whoever is responsible for emissions from sinks (the supplier) would also be responsible for all connected costs of acquittal. Not necessarily, however, in ultimate cases where:

(i) the supplier is unable to pay,

(ii) credits from economies in transition or developing countries are accepted by domestic acquittal authorities only for a carbon equivalent content lower than their face value, and as a general rule

(iii) for any other reasons that could cause the receivable acquittal value to be less than the initial issued value (nominal value).

Credit buyers may then have difficulties to maintain that they share no product risk at all.[11]

6 Differentiated Market Prices for Carbon Offsets from Forestry Projects

As indicated in Section 3, forestry projects, as a class, do not face more difficulties than other activities in producing greenhouse gas emission reductions that are real, measurable, and additional. However, coverage by the initial owner of the sequestered carbon for (1) uncertainties and risks associated to project baseline evaluation, and (2) sink reversibility may well vary with respect to individual project features and project owner profiles.

With reference to the liability issue analyzed in Section 5, the *unique market price* (often announced by emission trading promoters) at a given time for the carbon equivalent unit may then well prove to be unlikely in direct reference to the *de facto* lack of homogeneity of the traded 'products'. It can be assumed that the origin of the latter (as for a number of agricultural commodities) will be taken into account by market operators.

It can then be expected that market appraisals will differentiate accordingly. It is suggested that price differentials be expressed in relation to the average price of one

[10] More generally, should the initial supplier fail to meet any additional obligations (in the case of accidents or other unforeseen events), the governmental regulatory body would be entitled to require the credit holder to pay for the uncovered part of acquittals.

[11] Nevertheless, the rule of the sellers' liability is worth defending. It would build confidence in the market in that all credits purchased by the buyers would be able, in principle, to be used to meet their emission commitments.

carbon equivalent unit granted for an emission reduction in fossil fuel substitution programs. Market discounts with regard to this reference price for emission allowances would be calculated according to standard methods within appropriate time periods (month, quarter, etc., according to transaction frequencies).

To offer some guidance to buyers, rating agencies (similar to financial analysis entities for stock exchange equities) could supply information related to project viability, owner profile of the sequestered carbon rights, repute of the certification entity, reliability of the issuing body, etc. Valuing and aggregating these various criteria could result in publishing some kind of 'carbon sink index'. Quotations of market discount would or would not reflect changes in these indicators.[12]

7 International Reporting with Correction (by market discounts) of the Contributive Value of the Currently Controversial Activities for Meeting Each Country's Assigned Amounts — Prospects for Less Stringent Eligibility Rules

7.1 A Dual Accounting System

For ensuring a credible and smooth functioning of emission trading markets, national compliance bodies have to consider that every certified ton is equal to 1000kg and the same ton of carbon absorbed by a sink (whatever its origin) allows, in principle, an equal amount of carbon to be emitted by burning fossil fuels (apart from exceptional cases of the types referred to in Section 5).

This rule at the *national* level does not preclude a possible *internationally* agreed convention whereby, in verifying a developed country's compliance with its commitments, certified declared values from (controversial) carbon sinks would be corrected downwards by observed market discounts (as an additional measure to quantify uncertainties and taking them into account in the compliance procedures for ensuring that countries meet their targets within an acceptable confidence margin).

Such a dual accounting agreement would not be an innovation in the management of international affairs. An analogy for a system that differentiates domestic/external levels can be found in the previous international monetary system of fixed exchange rates (when gold was exchanged between central banks at a fixed price or US$ 35 per ounce without considering its market price).

[12] A parallel could be found with the market of developing countries debts whereby discounts from their nominal reimbursement values are quoted and show a close correlation with countries' ratings.

This dual accounting system implies that transactions in emission credits are trackable and effectively tracked.[13] Furthermore, a method for observing and averaging market discounts should be agreed upon.

7.2 An International Control with Penalties for Non-compliance and Uncertainties

With or without specific accounting rules for sinks at the international reporting level, it has to be assumed that both an international compliance body and financial penalties will be introduced. By how much a country is over its target (in applying the above procedures) would be assessed by this compliance body and the penalty amount would be decided in accordance with the penalty rate (preferably above the currently estimated carbon price) agreed upon.

The proposed scheme would deter non-compliance, as well as allow more flexibility with eligibility rules of controversial activities (since their contributive value might be discounted).

Then, restrictive measures currently contemplated in some circles[14] (non-acceptance of sequestered carbon in sinks of developing countries, 'adaptation levy' on all Kyoto flexible mechanisms, restrictive fixed share of countries' assigned amounts allowed to be covered by listed activities, etc.) would no longer be justified. This can be illustrated by an example showing the advantages of such a discount system. Emission credits from a controversial sink in a given location might be accounted for, e.g., only 40% of their domestic acquittal value by the international compliance authority in the event that markets would reveal an average 60% discount for the purchase of credits from similar types in the same country (similar to bad debts of some developing countries that can be purchased at such a low price in view of their poor reimbursement performances[15]). Thus, market appraisals could advantageously replace activity exclusions or other restrictions currently proposed by contradictory interests among Kyoto Parties.

8 Summary and Conclusions

Forests can be a powerful ally to man for holding off global warming and its catastrophic consequences. However, they have this natural propensity to return to a steady state whereby the permanence of established carbon sinks is endangered. The

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[13] For example, within an electronic tracking system as envisaged by the Australian Greenhouse Office (see, AGO, 1999d).

[14] See, WWF (2000): "Developing countries may be able to host sinks projects in the Clean Development Mechanism (CDM)... WWF believes these projects should not be given credit [*emphasized by the author*] in the Protocol due to their impermanence and likely incentives to cut down native forests. ...The 'adaptation levy', a fixed charge of each trading transaction currently contemplated in the CDM, should be extended to Emissions trading and Joint Implementation, so as to ensure a level playing field for the three mechanisms...".

[15] …or just their low trust rating by investment agencies.

assessment of carbon-sequestered amounts is also associated with various uncertainties. Are these two reasons sufficient to disregard forestry activities in attempting to reduce greenhouse gas concentrations?[16] Perhaps yes, if — with reference to bad feelings raised by atmospheric pollution — the problem and its solution are reduced to a change in behavior. Certainly not, if this problem is defined as multidimensional and truly global, i.e., implying integrated responses of mankind and its environment.[17]

Predicating the admission of carbon sink contributions does not necessarily mean acceptance that Kyoto participating countries be allowed to overstate their reported reductions by accounting tricks or other loopholes. Mechanisms and procedures can be convened at intergovernmental level, so that non-permanence and uncertainty be duly taken into account with the view of ensuring that emission reductions are *real*, *additional* and *verifiable*.

For following this strategy, a single path has been outlined in this paper, as a complement to the currently contemplated procedures proposed — at national and project levels — as a remedy to weaknesses inherent to forest carbon sinks. As indicated in the introduction, other prospects are offered at the international level by a qualitative hierarchization of carbon sinks and the installation of a specific market for them (Obersteiner *et al.*, 2001). The recent proposals share a common trait in that they capitalize on the market ability to reveal trust or doubt appraisals about human activities by differentiated prices.

With reference to the unit price of emission allowances for burning fossil fuels (to be possibly chosen as standard), it can be anticipated that future transactions for carbon offsets associated with land use change and forestry projects may reveal market discounts due to risks and uncertainties related to the evaluation and management of such projects. It is certainly pertinent (except in ultimate cases) not to consider these discounts at *national* levels for emitters to acquit their environmental debt with carbon credits (a State does not question its currency as legal tender). At *intergovernmental* level, things can be quite different. Unconditional currency convertibility is a convention based on mutual trust between nations.[18] Instead of accepting the excessive price for convertibility possibly reached by highly restrictive definitions, it appears more sensible, in the international verification of results achieved by participating countries to meet their committed targets, to satisfy oneself with a downward adjustment of reported reductions related to controversial carbon sinks — and this in proportion to these market discounts.

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[16] Another issue not considered here (and mainly discussed in Europe) is the social controversy about the pertinence and admission of emission trading. For an economist, such a debate discloses the lack of gravity and urgency assigned to the problem. In global warfare, are not belligerents going to associate willy-nilly gun-traders and bankers to the war effort?

[17] On the nature of "authentic world problems" (in contradistinction to "generalized problems"), see, Fontela and Gabus (1976).

[18] On the convertibility of national emission credits and the need of a global authority for intergovernmental settlements, see, Appendix 1.

Such a system might develop towards more normative conversion rates, should the smooth functioning market be considered to be impaired by all or part of the governments' signatories to the treaty. The inescapable distortions due to such administered rates should most probably not be stronger than those to be expected from the current option aiming at rationing carbon sequestration by quantitative caps (even if minimized within appropriate market mechanisms as those proposed by Obersteiner *et al*., 2001).

Even if additional environmental precautions have to be respected, forests under man's influence[19] should only win by a better valuation of their capacity to absorb those costly human-activity-induced gases. In a predominantly merchantable society, no effort should be spared for these forests developing relative cost advantages for the goods and services they produce and thus improving their financial and social returns. Is it too ambitious to promote a strategy that delays both deforestation and global warming?

[19] Are there any forests that currently escape man's influence?

APPENDIX 1: Difficulties for National Emission Credits to Reach Universality

In early transactions on emission credits from pilot carbon sinks or emission reductions certified by independent third parties, the final and distant validity of the acquired permit is just a portion in the amount of incurred risks; this validity is part of the anticipation game. By contrast, the acceptability of purchased rights for acquitting an environmental debt could not tolerate any uncertainty in an established system.

In literature, emission trading is most often dealt with at either the national or international level. In both cases, their universal character is not questioned, since it is implicit by the definition itself of such rights as a way to reduce emission costs, either at the domestic level (AGO, 1999a), or worldwide (Ellerman *et al*., 1998; Godal, 2000). As a rule, a possible non-acceptance (by the treaty authority) of emission credits issued by a national control entity is not evoked, although sometimes suspected (see, Obersteiner *et al*., 2000c).[20]

Now, emission credits that would not be recognized by the control and monitoring authority of the country where the emitter operates would be of little purpose to the latter. The issuing function being distinct from the acquittal function, divergences in the validity of emission credits may arise, but should be easily bridged at the national level; it can be assumed that the delivery and compliance entities, even if institutionally separated, report to the same public power.

Except in agreements between parties, the situation is quite different at the international level. Acceptance (for extinguishing an environmental debt) of emission credits issued by a non-domestic entity is as a last resort in the competence of the national control authority where the emitter operates. Similar to a bank, this authority is not under obligation to recognize any foreign 'carbon offset currency' as legal tender; this might well be accepted, but at a discount for covering the risk of refusal by the international authority responsible for verifying that countries' reported emission reductions meet with their committed targets.

This is how the 'convertibility' issue of national emission credits may be expected to occur.

Similar to what is taking place for the international settlement of payments in non-convertible currencies between central banks (cf., the role of the Bank for International Settlements in Basel), the problems raised could find solutions within an appropriate "global entity for the intergovernmental settlements of national emission rights".

[20] "Approximately equal partners in a CCMS [Common Carbon Markets] will find themselves more willing to trade [emission credits]. Equality among partners in CCMS is defined by the physical and economic behavior of the underlying carbon systems trying to reach the agreed targets. Similar to the European monetary system, a single currency can only be successfully and sustainably established among approximately equal partners. If the partners participating in the same market are too different the socioeconomic system will show tendencies of disintegration".

Perhaps such an entity could also deal with the possible differentiation of these rights according to their physical origin and therefore help in the acceptance of carbon credits originating from forest sinks. With this problem distinct from the convertibility of national permits, we are back to the central issue of this document.

References

AGO (1999a). National Emissions Trading: Establishing the Boundaries. Discussion Paper No. 1. Australian Greenhouse Office (AGO), Canberra, Australia, March. Available on the Internet: http://www.greenhouse.gov.au. Accessed: January 2001.

AGO (1999b). National Emissions Trading: Issuing the Permits. Discussion Paper No. 2. Australian Greenhouse Office (AGO), Canberra, Australia, June. Available on the Internet: http://www.greenhouse.gov.au. Accessed: January 2001.

AGO (1999c). National Emissions Trading: Crediting the Carbon. Discussion Paper No. 3. Australian Greenhouse Office (AGO), Canberra, Australia, October. Available on the Internet: http://www.greenhouse.gov.au. Accessed: January 2001.

AGO (1999d). National Emissions Trading: Designing the Market. Discussion Paper No. 4. Australian Greenhouse Office (AGO), Canberra, Australia, December. Available on the Internet: http://www.greenhouse.gov.au. Accessed: January 2001.

Asquith, N. (2000). The Kyoto Protocol, ITTO and Tropical Forests. Center for International Forestry Research (CIFOR). In: *Tropical Forest Update*, International Tropical Timber Organization (ITTO) Newsletter, Volume 10, No. 3, p. 8, September. Tokyo, Japan.

Barral, J.P., E. Blaustein, C. Blanco and A. Karsenty (2000). Les actions possibles en matière de changement d'affectation des terres, d'usage des sols et de foresterie. Solargal Publications on their web site *EnviroDev*, Montpellier, France, September (in French). Available on the Internet: http://www.envirodev.org/archives/climat/debats/index.htm. Accessed: March 2001.

Blaser, J. and J. Douglas (2000). A Future for Forests? Issues and Implications for the Emerging Forest Policy and Strategy of the World Bank. In: *Tropical Forest Update*, International Tropical Timber Organization (ITTO) Newsletter, Volume 10, No. 4, p. 9, December. Tokyo, Japan.

Chomitz, K.M. (2000). Evaluating Carbon Offsets from Forestry and Energy Projects: How Do They Compare? Development Research Group, The World Bank, No. 2357, June. Available on the Internet: http://www.worldbank.org/research. Accessed: January 2001.

Ellerman, A. Denny, Henry D. Jacoby and Annelene Decaux (1998). The Effects on Developing Countries of the Kyoto Protocol and Carbon Dioxide Emissions Trading. Policy Research Working Paper 2019, The World Bank.

Fontela, E. and A. Gabus (1976). Current Perceptions of the World Problematique. In: C.W. Churchman and R.O. Mason (eds.) *World Modeling: A Dialogue*. North-Holland Publishing Company, Amsterdam/Oxford.

Godal, O. (2000). Simulating the Carbon Permit Market with Imperfect Observations of Emissions: Approaching Equilibrium through Sequential Bilateral Trade. Interim Report IR-00-060. International Institute for Applied Systems Analysis, Laxenburg, Austria. Available on the Internet: http://www.iiasa.ac.at. Accessed: January 2001.

Harkin, Z. and G. Bull (2000). Towards Developing a Comprehensive Carbon Accounting Framework for Forests in British Columbia. Interim Report IR-00-046. International Institute for Applied Systems Analysis, Laxenburg, Austria. Available on the Internet: http://www.iiasa.ac.at. Accessed: January 2001.

Holloway, R. (1999). Carbon Sequestration in Plantations. Lecture at the University of Melbourne, Australia, May.

IUCN/WWF (2000). Forests for Life: Reaffirming the Vision. A call for action from the International Union for the Conservation of Nature (IUCN) and the World Wildlife Fund (WWF), Gland, Switzerland, December.

Jonas, M., S. Nilsson, A. Shvidenko, V. Stolbovoi, M. Gluck, M. Obersteiner and A. Öskog (1999). Full Carbon Accounting and the Kyoto Protocol: A Systems-Analytical View. Interim Report IR-99-025. International Institute for Applied Systems Analysis, Laxenburg, Austria. Available on the Internet: http://www.iiasa.ac.at. Accessed: January 2001.

Jonas, M., M. Obersteiner and S. Nilsson (2000). How to Go From Today's Kyoto Protocol to a Post-Kyoto Future that Adheres to the Principles of Full Carbon Accounting and Global-scale Verification? A Discussion Based on Greenhouse Gas Accounting, Uncertainty and Verification. Interim Report IR-00-061. International Institute for Applied Systems Analysis, Laxenburg, Austria. Available on the Internet: http://www.iiasa.ac.at. Accessed: January 2001.

Liski, J., T. Karjalainen, A. Pussinen, G.-J. Nabuurs and P. Kauppi (2000). Trees as Carbon Sinks and Sources in the European Union. Press release, European Forest Institute, November. Available on the Internet: http://www.efi.fi. Accessed: December 2000.

Montgomery, D.W. (1972). Markets in Licenses and Efficient Pollution Control Programs. *Journal of Economic Theory,* 5, 395–418.

Morgan, J. (2000). Appraisal of the Report Prepared for Greenpeace/WWF with the title "The Clearcut Case: How the Kyoto Protocol Could Become a Driver for Deforestation". In: Arborvitae Newsletter — The IUCN/WWF Forest Conservation Newsletter, No. 16, p.12. Gland, Switzerland, December.

NET (2000). Legacy of Loopholes: U.S. Negotiating Positions Threaten Climate Change Treaty. Report authored by: National Environmental Trust, Natural Resources Defense Council, Union of Concerned Scientists, and World Wildlife Fund (WWF), November. Available on the Internet: http://www.panda.org/climate/summit. Accessed: February 2001.

Nilsson, S., A. Shvidenko, V. Stolbovoi, M. Gluck, M. Jonas and M. Obersteiner (2000). Full Carbon Account for Russia. Interim Report IR-00-021. International Institute for Applied Systems Analysis, Laxenburg, Austria. Available on the Internet: http://www.iiasa.ac.at. Accessed: January 2001.

Obersteiner, M., Y. Ermoliev, M. Gluck, M. Jonas, S. Nilsson and A. Shvidenko (2000a). Avoiding a Lemons Market by Including Uncertainty in the Kyoto Protocol: Same Mechanism — Improved Rules. Interim Report IR-00-043. International Institute for Applied Systems Analysis, Laxenburg, Austria. Available on the Internet: http://www.iiasa.ac.at. Accessed: January 2001.

Obersteiner, M., M. Jonas and S. Nilsson (2000b). The Political and Economic Costs of a Fully Verifiable Kyoto Protocol. Interim Report IR-00-062. International Institute for Applied Systems Analysis, Laxenburg, Austria. Available on the Internet: http://www.iiasa.ac.at. Accessed: January 2001.

Obersteiner, M., M. Jonas, S. Nilsson, A. Shvidenko and M. Gluck (2000c). Trading Flexibility for Predictability — Differential Emission Dynamics and the Formation of Common Carbon Markets. Interim Report IR-00-063. International Institute for Applied Systems Analysis, Laxenburg, Austria. Available on the Internet: http://www.iiasa.ac.at. Accessed: January 2001.

Obersteiner, M., E. Rametsteiner and S. Nilsson (2001). Cap Management for LULUCF Options: An Economic Mechanism Design to Preserve the Environmental and Social Integrity of Forest Related LULUCF Activities under the Kyoto Protocol. Interim Report IR-01-011. International Institute for Applied Systems Analysis, Laxenburg, Austria. Available on the Internet: http://www.iiasa.ac.at.

State Forests of NSW (2000). Draft Carbon Accounting Standard for Planted Forests. State Forests of NSW, Australia, March. Available on the Internet: http://www.carbontrading.com.au. Accessed: December 2000.

Sydney Futures Exchange (2000a). Trading Market. Available on the Internet: http://www.carbontrading.com.au. Accessed: December 2000.

Sydney Futures Exchange (2000b). Comments on the Department of Foreign Affairs and Trade (DFAT) Discussion Paper — International Emissions Trading: Allocation of Liability. March. Available on the Internet: http://www.carbontrading.com.au. Accessed: December 2000.

WRI/IUCN (1998). Climate, Biodiversity, and Forests: Issues and Opportunities Emerging From the Kyoto Protocol. World Resources Institute (WRI) and the International Union for the Conservation of Nature (IUCN), November. Available on the Internet: http://www.wri.org. Accessed: January 2001.

WWF (2000). Make-or-Break for the Kyoto Protocol. Climate Change Campaign of the World Wildlife Fund (WWF), August. Available on the Internet: http://www.panda.org/climate/summit. Accessed: January 2001.

Glossary[21]

afforestation
Defined by the Intergovernmental Panel on Climate Change (IPCC) as "*planting of new forests on land which historically has not been covered by forest*".

assigned amounts
Under the Kyoto Protocol, each industrialized nation is allocated an "assigned amount" of greenhouse gases for the 2008–2012 commitment period. Assigned amounts represent what a country can legally release during the five-year period; hence above-the-line emissions are committed to be reduced.

carbon budget
The balance of the exchanges (uptake and release) of carbon between carbon reservoirs (e.g., atmosphere and biosphere) in the carbon cycle.

carbon certification
The process by which properly qualified independent entities certify that the claimed carbon has been sequestered.

carbon credit
Carbon credits would be issued to owners of sequestered carbon based on the amount of carbon sequestered. Carbon credits would authorize the emissions of a specified mass of CO_2 equivalent gas over a specified time. In this respect, they are identical to emission permits.

carbon sink
A pool (reservoir) that absorbs or takes up released carbon from another part of the carbon cycle.

carbon tax
Tax on fossil fuels proportional to the carbon content of each fuel.

clean development mechanism
Article 12 of the Kyoto Protocol provides for the *clean development mechanism* whereby developed countries are able to invest in emission reducing projects in developing countries to obtain credits to assist in meeting their assigned amounts. The details of the clean development mechanism have yet to be negotiated at an international level. It should allow countries to use credits obtained from the year 2000 for the purposes of meeting their assigned amounts. Participation is voluntary, and open to private and public entities alike on a Party approved basis.

CO_2-e (CO_2 equivalent)
Non-CO_2 gases are converted into CO_2-e terms by multiplying the amount of gas by the appropriate global warming potential.

deforestation
Defined by the IPCC as "*conversion of land from forests or grasslands to pasture, crop land or other managed uses*".

emissions
The release of gases from industrial processes and vehicles as well as by living organisms.

emission permit
An authorization, license, or equivalent control document issued by an approved agency or government to implement the requirements of an environmental regulation.

greenhouse effect
The warming of the Earth's atmosphere caused by a build up of carbon dioxide and other gases. Many scientists believe that this effect is being significantly enhanced through various human activities (however they do not necessarily exclude enhancements by solar activities).

[21] Partly reproduced from AGO (1999c).

greenhouse gases (GHG)
Those gaseous constituents of the atmosphere, both natural and anthropogenic, that absorb and re-emit infra red radiation.

hedging
Take a position (i.e., buy or sell) in the future market as a means of reducing the risk of price fluctuation in the physical market.

international emissions trading
Article 17 of the Kyoto Protocol allows developed countries to participate in emission trading for the purposes of meeting their assigned amounts. However, it is required that any such trading shall be supplemental to domestic actions for the purpose of meeting quantified emission limitation and reduction commitments. As with the other Kyoto flexibility mechanisms, participation in emission trading is voluntary for Parties, and open to private and public entities alike on a Party approved basis.

Kyoto forest
Allowable sink activities under the Kyoto Protocol which are presently confined to forest related activities specifically afforestation, reforestation and deforestation since 1990.

reforestation
Defined by the IPCC as "*planting of forests on land which historically has contained forest but which has been used for another purpose since last being covered by forest*."

sequestration
Processes that remove carbon dioxide from the atmosphere and retain it (for some time) in a carbon sink (i.e., trees).

sink
Any process, activity or mechanism, which removes a greenhouse gas, an aerosol or a precursor of a greenhouse gas from the atmosphere.

sink verification
The periodic auditing of sequestered carbon data recorded by the sequestered carbon rights owner or an agent.

sources
Any process, activity or mechanism, which releases a greenhouse gas, an aerosol or a precursor of a greenhouse gas into the atmosphere.

steady state
Where the carbon uptake and release are more or less in balance.

value

acquittal/settlement value
Amount of carbon equivalents units accepted by the national control authority for acquitting emissions not covered by allocated quotas, independently from the initial "nominal value" or "face value".

'contributive' value
Amount of carbon equivalents units retained by the intergovernmental authority responsible for the verification of the country's reporting in compliance with its commitments. This unit amount can be less than the "acquittal value" at the national level with reference to agreed procedures for adjusting credits with controversial origins.

nominal/face value
Amount of carbon equivalents units indicated on the document extending emission credits/rights to its holder, as initially approved by the national issuing authority.