

CAN TROPICAL FORESTRY BE MADE PROFITABLE BY 'INTERNALISING THE EXTERNALITIES'?

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This paper discusses the potential and constraints of a range of 'innovative incentive mechanisms' for stimulating sustainable (natural) forest management and conservation, including those like carbon offset trading which attempt to capture the global public good values (or externalities) of tropical forests and internalise them into positive incentives for forest users or managers.

Policy conclusions

- Forest exploitation and degradation happen because it is profitable; the main causes of this are market and policy failures, including weak regulation. Innovative incentive mechanisms should aim to tackle market and policy failures and bring private returns into line with social returns as far as possible.
- No innovative incentive mechanism can be successful without effective regulation. At the international level, without environmental regulations there is insufficient demand or willingness to pay. At the national level, increasing the profitability of forestry would also increase forest exploitation without effective regulation. 'Innovative financing' can help to build the regulatory framework.
- Fiscal market-based instruments, such as forest pricing incentives and charges made on the principle of the 'polluter and beneficiary pays', score highly in terms of bringing private costs closer to social costs, but demand strong political commitment. Donors could encourage them more by funding research to establish optimum tax levels and likely economic and environmental impacts, and by helping to build the administrative capacity required to implement and monitor them.
- Efforts to encourage sustainable forestry should be complemented by measures to make forest-degrading activities less attractive, especially by tackling extra-sectoral causes of forest degradation and investing in social capital and labour-intensive agriculture.

The problem

It is now widely accepted that one of the main problems, if not the main problem, for attempts at sustainable (natural) forest management (SFM) and conservation is that it is only rarely a viable financial proposition – while forest exploitation, like one-off logging, and deforestation continue to be highly profitable activities.

The opportunity cost of SFM or conservation is what can be earned from forest exploitation (e.g. one-off logging) and alternative land uses. The high cost of 'time' in SFM, stemming from slow biological growth and high discount rates, encourages these non-sustainable options. Weak incentives for SFM and conservation raise the problem of how to 'give value' to forests, especially forests with high global public good values associated with environmental functions and biodiversity conservation. A considerable effort has been put into estimating the additional financial needs of the tropical forestry sector, although one view is that the forestry sector could be self-financing through effective taxation of the forest rent (Repetto and Sizer, 1996). In our view, the main issue is how to provide appropriate financial incentives for forest users, while accepting that 'innovative financing' has a vital role to play in institutional strengthening and developing the regulatory framework for private sector forestry.

Here we use the term 'innovative incentive mechanisms' (IIMs) to refer to a range of instruments or policy measures which attempt to increase the attractiveness of SFM and conservation, particularly by incorporating non-market costs and benefits into the financial returns of forest users or managers ('internalising the externalities'). Table 1 classifies IIMs into the three main approaches discussed in this paper:

- A transfer payments approach involving the transfer of costs or benefits between different stakeholders; within this approach, national actions involving a range of fiscal 'market-based instruments' (MBIs) can be distinguished from international transfer payments.
- The promotion of market or trade-based solutions involving

global public good values.

- A property-rights approach in which rights over forest resources and utilisation are created, clarified or modified.

Because the emphasis is on incentives rather than financing, the potential for public-private partnerships to remove barriers that currently prevent the channelling of private international finance into SFM is not assessed here, but is discussed in detail in Moura Costa et al., 1999.

Why is SFM generally unprofitable? Most discussions of the causes of deforestation and biodiversity loss highlight market, policy and institutional failures (Box 1). Market and policy failures mean that forest products are undervalued in the market place, while for forest services there is usually no market place. This discourages long-term investment in the resource and favours alternative land uses. However, the converse that higher values encourage long-term investment in forestry is far less certain, since they can encourage forest exploitation when the regulatory capacity is weak. Even if market prices better reflect 'true' private costs and benefits, they favour short-term profit generation and pay no attention to irreversibilities or other environmental and social considerations. Therefore, the real challenge is how to bring private returns and actions closer to socially desirable returns and actions, and to make sustainable forestry more attractive than alternative land uses. This implies the need for regulation over the freedom to pursue short-term profit objectives. Failure to intervene to close the gap between private and social returns can be viewed as a major aspect of policy failure.

Domestic fiscal MBIs and subsidies

'Polluter or beneficiary pays' taxes in a forestry context are based on the idea that those causing environmental and social costs felt by others, for example through unsustainable logging, should pay taxes or charges that increase the (private) costs of their actions, and that 'downstream' beneficiaries should compensate upstream forest managers for the benefits

provided. The main principle of MBIs is that they ‘internalise’ social costs and benefits into private returns, and this should cause people to modify their economic behaviour. ‘Polluter and beneficiary pays’ charges are being used to finance environmental service payments to forest owners in Costa Rica. A high potential, but little used, MBI is differential land-use taxation in which the idea is to tax pasture or newly-cleared land more heavily than forests or long-settled farmland. But approaches to MBIs have generally been tentative in the face of political resistance and the charges have often been set too low to influence user incentives.

For state-owned or managed forest, the most important incentive mechanism is forest pricing or the setting of forest fees combined with concession tenure. Forest prices can be set by regulation (administered prices) or by the market. The former usually results in underpricing and rent-seeking behaviour by concessionaires. Competitive bidding for forest concessions is arguably the most effective incentive and revenue collection mechanism, and some countries are moving in this direction, but it requires strong market competition for forest products, absence of collusion, and good transparent information.

Performance bonds or deposits involve the concessionaire depositing a refundable lump sum or bond at the beginning of the concession in an account of the Forestry Department. The latter would make regular field inspections and gradually return the value of the bond, and any interest to the concessionaire, providing good practice is followed. By ensuring concessionaires receive their income towards the end of the felling cycle, it brings the return from logging a new area, also subject to the bond, roughly into line with the net present value of a second harvest (see Figure 1). This greatly reduces the opportunity cost of staying on for a second cut and tackles the discounting or time problem of forestry. However, weak public administrative capacity has limited the effectiveness of this approach to date.

International transfer payments

‘International transfer payment’ is a rather generic term which implies a (non-market) transfer of financial resources from consumer nations in recognition of the global public good values of forests, and does not restrict itself to fiscal approaches. Debt-for-nature swaps involve an agreement between a donor or environmental non-governmental organisation (NGO) and a debtor country for the cancellation of debt in exchange for environmental commitments. Early debt swaps suffered from weak implementation capacity, but there have been some successes in Latin America when policies and institutions have been supportive.

Box 1 Market and policy failure, and extra-sectoral influences

Market failure occurs due to absent, distorted or malfunctioning markets in which forest goods and services are undervalued or not valued at all. Sources of market failure include:

- negative externality effects which are not ‘internalised’ in market prices
- missing markets for environmental and other ‘open-access’ public goods
- market imperfections, such as lack of information

Policy failure occurs both when the state fails to take action to correct market failures, and when policies are implemented which further distort prices and cause disincentives for sustainable management. Common examples of policy failures are:

- land tenure legislation which encourages clearance
- weak state control over its forest estate; e.g. illegal logging
- low forest fees which underprice forest products from state land
- protection of forest industries through trade restrictions
- subsidised inputs and credit for land-extensive farming

Extra-sectoral influences, especially those coming from macro-economic policies or adjustments, cause unpredictable social, environmental and economic impacts. These policies may be necessary for a healthy economy but can have negative effects on SFM (e.g. where devaluation encourages agro-export farming). Forest-specific corrective policies are therefore politically complex.

The Global Environment Fund (GEF) was set up in 1991 with the objective of funding the ‘incremental’ domestic cost of projects which protect the global environment. It is the financing mechanism for the International Conventions on Climate Change and Biological Diversity. About half the funding has been for biodiversity conservation projects. As with debt swaps, the GEF has been used to leverage private sector financing; by putting small amounts into venture capital funds, GEF funds have generated between five and twenty times more equity finance. But recent evaluations report that GEF biodiversity projects have suffered from an over-scientific and non-participatory approach and that the GEF has failed to ‘green’ the donors.

National Environmental Funds (NEF) – including conservation trust funds, endowments and green funds – are an important adjunct to international transfer payments and have been set up in about 20 tropical countries and almost all the transitional economies of Eastern Europe. An equivalent suggestion at the international level is the International Rainforest Fund proposed by the United Nations Environment Programme (UNEP) based on a charge proportionate to the Gross National Product of each country.

Table 1 Classification of innovative incentive mechanisms

	Mainly domestic	Mainly international
A. Transfer payments approach	<i>Fiscal MBIs and subsidies:</i> 'polluter and beneficiary pays' taxes differential land-use taxes <i>Innovative forest pricing:</i> concession bidding, performance bonds tax-exempt bonds	<i>International transfer payments:</i> debt-for-nature swaps global Environmental Fund conservation trust funds international timber trade taxes area-based payments to forest managers other international taxes
B. Market approaches based on public good benefits	water commoditisation protection rights ecotourism charges	carbon offset trading certification of forest products bioprospecting deals fair-trade
C. Property rights approach	community usufruct rights partial privatisation	tradeable development rights intellectual property rights

Taxing the tropical timber trade, or redirecting existing taxes, so that a transfer is made from consumer to producer countries, has several attractions but faces political opposition from importing nations and difficulties in ensuring the money is well spent. One idea has been to make area-based payments to forest managers to compensate the additional costs of SFM, but this approach is likely to suffer from difficulties of definition (of SFM) and monitoring. Many forms of international taxation have been proposed to help finance tropical forestry and biodiversity conservation like the Tobin tax on international foreign exchange transactions, carbon taxes, and air travel taxes. But these remain a distant prospect without appropriate international environmental legislation.

Market and trade-based approaches internalising global externalities

The two most important market-based IIMs are forestry-based carbon offset trading and the certification of timber or non-timber forest products (NTFPs). Carbon offset trading is the IIM most in the limelight and is discussed in Annex 1.

The main rationale for certification from 'sustainably' or well-managed forests is that an environmentally discriminating market and the expectation of more stringent environmental regulations will gradually force non-sustainable managers to move towards SFM. An important assumption is that consumers are prepared to purchase forest products preferentially from well-managed forests. This would boost the 'green market' effect. Certification also has wider benefits; it can contribute to increased transparency and accountability in the forest industry, and thus provide an important complement to state regulation. These attractions have ensured strong donor support. But tropical forestry certification suffers from a basic demand and supply problem: most consumers remain unwilling to pay the green premium, and temperate forestry is better placed to satisfy the niche market. The fair trade movement is a parallel set of efforts to develop markets in which consumers recognise the importance of equity issues and so pay a 'social' premium. While environmental issues have not been emphasised much in the past, fair trade seems an obvious vehicle for benefiting forest-dependent peoples. However, it remains limited, and like certification, it could fall foul of World Trade Organisation (WTO) regulations.

Bioprospecting (e.g. for pharmaceutical products) continues to raise hopes, but even in the best cases payments to forest users tend to be modest (Southgate, 1998). Also, genetic engineering developments have reduced the need to re-supply from the source. As with intellectual property rights, the future for bioprospecting deals depends on the

development of appropriate international regulations, mechanisms and institutions, including a system for settling disputes over patent rights and exclusive licensing agreements.

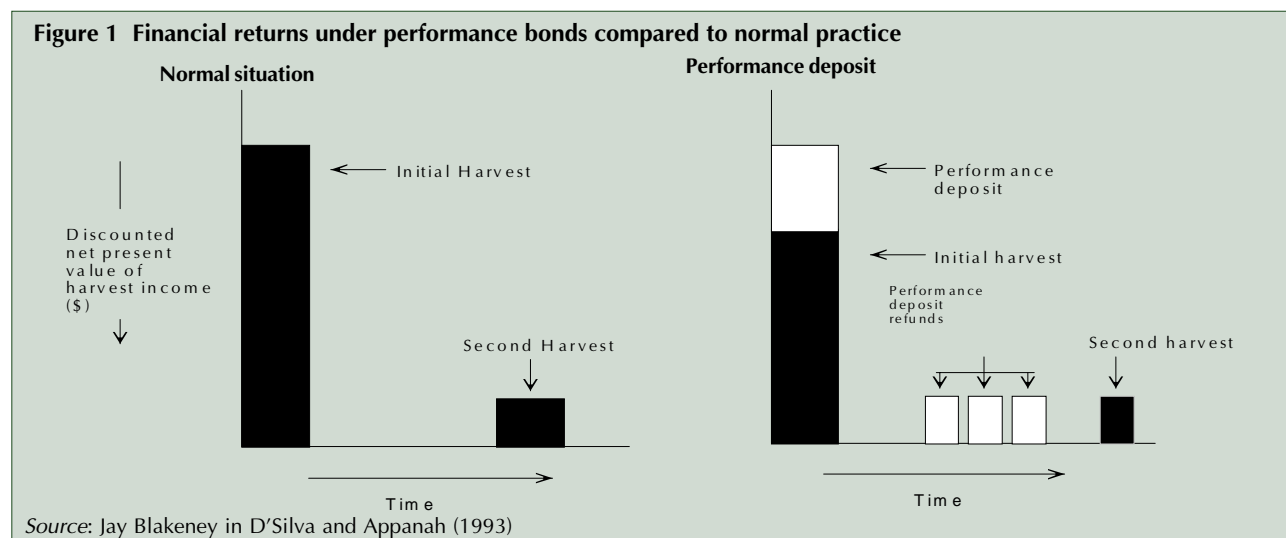
The property-rights approach

Few would question that insecure property rights are a serious impediment to investment in forestry. Secure property rights reduce the risk of free riding, facilitate contractual arrangements with outsiders (for example, allowing payments for externality benefits), and lower the discount rates of owners. But nothing prevents land users who have secure property rights from behaving in ways that impose social costs on others, and SFM or conservation is only likely when market incentives make it a more attractive livelihood or investment option than alternative land uses. Thus, in Costa Rica, it is recognised that forest owners also need environmental service payments to convince them of the economic case for forest retention.

The most common situation in which weak or ill-defined property rights lead to deforestation is in open-access forest where the state lacks the capacity to manage, and common pool regimes are absent or in decline. In the case of industrial forestry, concession agreements often last shorter than a full rotation cycle, encouraging over-exploitation. Where long-term usufruct rights have been granted to communities to encourage SFM, continued outside financial and institutional support is essential in the face of weak market incentives. But in Nepal, more subsistence-oriented community forestry has proven less dependent.

Tradeable development rights (TDRs) are one of the most innovative, but least implemented, IIMs with the potential to capture public good values. TDRs are rights to development in areas designated for conservation that can be sold to public or private sector environmental interests, e.g. international environmental NGOs, or exchanged for development rights on land outside the restricted use areas. The sale of TDRs provides the financial means to compensate the 'attenuated' property rights. It is only the development rights that are sold or exchanged, not the land itself; thus communities or owners can continue non-degrading activities like ecotourism.

The exchange value of TDRs should reflect a balance of the buyer's willingness to pay (WTP) for the public good values, and the seller's estimate of the foregone development benefits; over time a market for TDRs could be established. But the only examples of TDRs in a forestry context are from North America, precisely because environmental regulations have created sufficient WTP. Like other IIMs, TDRs are demanding of research and information, and involve



measurement and monitoring difficulties. A variation on TDRs would be a system of tradeable logging rights, by which forest concessionaires could sell these rights to other parties. This would create an incentive to reduce damage to forests during logging operations.

Discussion and conclusions

The main reason deforestation or forest degradation occurs is because people find it profitable, and the main causes of this are market and policy failures. This includes failure to close the gap between private and social returns and to regulate state-managed resources. It is particularly important to reduce the opportunity cost of sustainable forestry, for example by tackling the discounting problem by providing early and/or interim returns in between long rotation cycles. This points to the importance of MBIs, especially 'polluter and beneficiary pays' taxes and forest pricing approaches, but these require considerable domestic political will and administrative capacity. Donors might do more to encourage them, for example by funding research to establish optimum tax levels.

Among the IIMs which attempt to capture global externalities, carbon offset trading has most potential, but doubts remain about the range of forestry activities to be included in the Clean Development Mechanism (assuming Kyoto is ratified), a question linked to the political and technical complexities of carbon offset trading. Although not without potential, timber certification faces problems of a thin market and competition from temperate forests. Bioprospecting has even fewer prospects.

Market incentives and institutional support must be in place if more secure property rights are to stimulate sustainable forestry. A priority area is the promotion of international legislation and institutions to safeguard intellectual property rights and create the necessary demand for TDRs. Donor-driven finance-raising approaches such as the GEF, debt swaps and the associated NEFs have fewer political and technical constraints, but are not tied to specific values and have little or no impact on user incentives. They are not market-based, and there can be political and technical problems in ensuring the money is effectively spent.

The potential of innovative commercial financing sources is related to progress on the policy and regulatory front, which can remove or greatly reduce the incentives that currently encourage exploitation forestry, and would create the demand for forestry's public good values.

There are difficulties of effective regulation at the national level in the face of negative public sector incentives and attitudes. A major conclusion is that no IIM can work without effective national and international regulation and institutions, and there is a major role for coordinated donor support to these. For every demand-based incentive, there is a necessary supply-side control. Higher prices or stumpage values of most forest products also increase the attractiveness of forest exploitation in the absence of effective regulation. Market-driven certification schemes can complement the state in this role, and encourage a range of IIMs. In the case of most non-market values, international regulation is essential to create the demand and WTP for them. This is why the future of carbon offset trading depends on the negotiations to limit carbon emissions. Similarly, wider involvement of international private sector finance will only become effective with stricter international environmental regulations.

Much, if not most, deforestation is a side-effect of non-forest policies. Econometric evidence suggests scope for reducing 'inappropriate' deforestation via extra-sectoral approaches (Kaimowitz and Angelsen, 1998). Priorities include investing in social capital to raise the opportunity costs of

forest-degrading activities; increasing the productivity of labour-intensive agriculture away from the frontier; more careful appraisal of roads and other transport infrastructure, which as well as facilitating access to forested areas, raises land values and provides opportunities for capital gains; and, eliminating subsidies which stimulate frontier land values and speculation. The extra-sectoral threat to forests also places a premium on inter-sectoral policy coordination.

The highest potential probably lies with efforts to address national level policy failures through a combination of fiscal MBIs, regulatory control and tackling the extra-sectoral causes of deforestation. But donors should recognise that sustainable forestry is not a high priority for most countries and that their influence on national policies is limited. Analysis of the distribution of the costs and benefits of forestry and of the range of IIM options implies a global negotiating table in which donors should make every effort to capture and return global public good values to forest managers (and therefore tackle an important aspect of market failure) in exchange for national commitments to tackle domestic policy failures and extra-sectoral problems. Without this and stricter international environmental legislation, it is difficult to see sustainable forestry becoming more attractive than its land-use alternatives.

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This NRP partially summarises the findings of two larger studies: Richards, 1999 and Moura Costa et al., 1999.

Annex 1

Forestry-based carbon offset trading: potential and constraints of a new market for environmental services

Carbon trading between two countries – also known as joint implementation¹ – with the simultaneous aims of achieving cost-effective reductions in greenhouse gases and providing a major boost to sustainable forestry and biodiversity conservation, was first proposed at the 1992 UN Framework Convention on Climate Change (FCCC). Forestry-based carbon offset trading, or carbon offset trading for short, potentially allows tropical countries to take advantage of a comparative advantage in providing an environmental service to industrial societies. At the micro level, forestry-based carbon offset deals involve forest users (or entities representing them) committing themselves to actions which either directly absorb carbon dioxide through plant growth (most obviously reforestation) or avoid carbon release from existing vegetation, in exchange for payments by the purchaser of the carbon offset.

It has been estimated that forestry has the potential to offset up to 15% of the world's greenhouse gas emissions, and that carbon offset trading could witness a major infusion of capital into tropical forestry (although this may be mostly project-based). By simultaneously meeting environmental and economic objectives, carbon offset trading has been described as a 'win-win' situation. This optimism is based on the political progress in establishing binding carbon emission limits, the mainly positive experiences to date (over 30 projects implemented), and its apparently favourable economics.

Specifically, tropical forestry, which has lower land and labour costs and higher biomass growth rates than temperate forestry, may represent the cheapest way of reducing CO₂; it gives public good values to the forests, these values are paid for by the polluters in the form of a market-based international transfer payment, and can be internalised by forest users including local or forest-dependent peoples. International regulation should eventually result in the evolution of a fully developed market for verifiable greenhouse gas commodities, and an associated range of structured investment instruments.

Most of the early forestry-based carbon offset deals have brought together Northern electricity companies and tropical forestry companies and NGOs, often brokered by an international NGO or multilateral agency. Article 12 of the Kyoto Protocol (Box 2) in December 1997 gave a major boost to carbon trading by establishing the Clean Development Mechanism (CDM). But there is continuing speculation over whether and how forestry will be included in the CDM given that it is not specifically mentioned in Article 12. The complex and controversial forestry issues, largely avoided by officials at CoP4 in Buenos Aires, will now be left until the Intergovernmental Panel on Climate Change (IPCC) has completed its special Land-Use Change and Forestry (LUCF) report in May 2000. Controversy particularly surrounds accounting and compliance, the permanence of sequestration and the 'eco-colonialism' issues. In spite of this and doubts about ratification, there was a dramatic increase in carbon offset projects in 1998, indicating a shift from voluntary 'good deeds' to national self-interest (Moura-Costa and Stuart, 1998).

Problems faced by carbon offset trading

The optimism for forestry-based carbon offsets from tropical countries is yet to be substantiated by actual investment flows, and will require agreement on a series of politically and technically complex issues. While some demand estimates

have reached tens of billions of dollars a year (e.g. Ellerman et al., 1998), Pearce et al. (1998) estimate that the size of the market, at least for carbon offset trading through the CDM, may be smaller than previously thought.

There are two ways of looking at the motives of industrialised countries to engage in carbon offset trading. Is it investment in SFM and biodiversity conservation, or merely a way of avoiding their environmental responsibilities? Most less economically developed countries (LEDCs) point out that carbon trading would act as a disincentive to the North to improve its pollution control, and represent another form of 'waste dumping' in the South – resulting in little reduction in carbon release at source.

A number of other concerns have been voiced by developing countries:

- the best carbon reduction opportunities in the South are likely to be captured by Northern countries through the CDM, so it will become more difficult and expensive for tropical countries to pursue their own carbon reduction programmes if and when needed
- the fear that aid could become linked to performance on emission reductions, or that development aid would simply be substituted by 'emission reduction aid', thereby compromising a country's development priorities
- the concern that a country may sell the carbon sequestration services of state-owned forest, to the cost of local users more in need of extractive products

Box 2 The Kyoto Protocol and the CDM

At the Third Conference of the Parties (CoP3) to the Framework Convention on Climate Change (FCCC), a set of nationally differentiated emission targets were agreed, subject to ratification, for industrialised and transitional economies (Annex B countries) for the first commitment period of the FCCC (2008–12). Signatory nations to the Kyoto Protocol agreed to reduce greenhouse gas emissions to an overall average level 5.2% below 1990 levels by the 2008–12 period. The CDM was established by Article 12 and refers to climate change mitigation projects undertaken between capped Annex B countries and non-Annex B (developing) countries. The CDM will probably act as a regulating body to oversee emission reduction projects by either public or private entities in developing countries. The new mechanism allows (again subject to ratification) 'Certified Emission Reductions' to be banked from the year 2000, eight years before the first reporting period.

Article 3 of the Protocol covers the mechanism of Joint Implementation of carbon of projects between Annex B countries, and allows the use of projects that result in CO₂ sequestration or that reduce the net rate of carbon release (e.g. through forest conservation, fire control, etc.). Neither 'sinks' nor 'forestry', however, were defined or even mentioned in Article 12. Kyoto also allows for QUELRO (Quantified Emission Limitation and Reduction Obligations) trading, in which capped Annex B countries with emissions below their quotas can sell surplus 'allowances' to debit polluting countries.

While the Protocol has been *signed* by more than 80 countries, it will only take effect if 55 countries also *ratify* it. Due to economic competitiveness, it is unlikely that many industrial countries will ratify it until the US Congress does. The CDM also remains poorly defined on many issues, and governments and other interest groups hold different interpretations of it. This has been the subject of complex international negotiations and domestic legislation studies.

Source: Stuart and Moura Costa, 1998

- the concern that welfare benefits will be secondary at best to the environmental gains from carbon offset deals, and thus the carbon market may offer little opportunities for sustainable development or livelihood enhancement
- low or zero profit margins for producers of carbon offsets due to the use (to date) of a supply price based on the marginal cost of supplying carbon sequestration services
- the high transaction costs of organising carbon offsets involving small farmers or communities means that purchasers are likely to prefer industrial forestry operations

There is also an equity problem within LEDCs; more progressive countries like Costa Rica with more institutional and technical capacity are likely to obtain the best deals and leave poorer countries behind. The technical complexities of establishing a carbon offset regime present a major barrier to market entry. An important task for the CDM is to ensure these concerns are addressed and an equitable allocation of carbon offset project benefits.

For the purchaser of carbon offsets, it is essential to be able to monitor and measure the net reduction in carbon emission, and to enforce the deals as necessary. The scientific and measurement problems for forestry stem from the fact that forests are both a source and sink for carbon. The measurement problems revolve around Kyoto's 'additionality' principle: initiatives to mitigate greenhouse gas emissions must be additional to existing practices. This means comparing carbon flows and stocks between a 'with project' and 'baseline scenario' in order to calculate the net carbon benefit. Monitoring and enforcement issues raise national sovereignty concerns and the likelihood of disputes over the methods and results of monitoring. The measurement and definitional problems mean that countries unable to provide baseline data (carbon emission statistics, targets, plans, etc.) and lacking the capacity to measure the impacts could be left out. What is clear is that there would be a major new service industry in the measurement and certification of carbon offsets if it 'takes off'.

In the absence of a strong regulatory framework, there may be a temptation to indulge in 'marginal practices' or 'creative carbon accounting'. Since 'net emission' projects involve a comparison with 'baseline' carbon release in contiguous areas, there is a perverse incentive to increase deforestation outside the project area, since this will make it appear that more carbon is being saved; and countries which have made significant efforts to discourage deforestation could be penalised due to the improvement in their baselines.

Other questions surround the impermanence of carbon sequestration by trees, as opposed to reduction of carbon emission at source, and 'leakage' where carbon is lost elsewhere, e.g. if felling increases outside a protected area. Although tropical forestry may be the most cost-effective approach to reducing the amount of carbon in the atmosphere at present, new energy technologies may overtake it in the coming decades. There are also substantial risks for both investors and suppliers in carbon offset trading, and the extent to which these can be mitigated will help to determine how strong the market becomes. Avoided deforestation can also carry high opportunity costs, especially to local users, and these have to be weighed up against the likely benefits.

Conclusion

For forestry offsets to become an effective incentive for SFM, there must be international agreement over a series of technical and political aspects of the Kyoto Protocol. An appropriate regulatory framework is also vital to ensure that these investments result in real greenhouse gas and other environmental benefits, and that the benefits from these

projects are equitably distributed and support domestic development strategies. As a cost-effective approach to mitigating climate change, questions surround the impermanence of forestry-based offsets (Moura Costa and Wilson, 1999) and the risks of 'leakage', as well as the difficulties and costs of measurement and verification of compliance. There is also the possibility that technological advances in the coming decades will result in more cost-effective means of reducing carbon emission at source, so carbon offset trading could prove to be more of an intermediate rather than long-term strategy.

However, if properly structured, greenhouse gas mitigation funding could assist in addressing a series of problems currently faced by forestry. As an incentive for SFM, the market for forestry-based carbon offsets remains incipient. One view is that while carbon offset payments can provide a useful additional incentive for sustainable forestry where economic, social and institutional factors are already favourable, they are unlikely to alter underlying negative market incentives for forestry. There is also the danger that carbon payments may only end up 'subsidising' fundamentally unprofitable forestry activities, when the greater need is to reduce the profitability of forest-degrading activities. On the other hand, as a means of adding value to forests for their global public good values, and in the absence of global environmental legislation and governance, it is an area of at least some hope for tropical forestry.

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Endnotes

¹ Since the early 1990s, a variety of terms have been used to refer to different project-level climate change mitigation mechanisms, including Joint Implementation (JI), Activities Implemented Jointly (AIJ), the Clean Development Mechanism (CDM) and their outputs (carbon offsets, carbon credits, emission reduction units (ERUs), certified emission reductions (CERs)). Here we use the generic terms 'joint implementation' and 'carbon offset trading' to refer to all these mechanisms.

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