Deforestation, land-use change and REDD

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Promoting forest restoration and sustainable forest management has more promise for mitigating climate change than narrowly focusing on reducing greenhouse gas emissions from deforestation and forest degradation (REDD).

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The Intergovernmental Panel on Climate Change's fourth assessment report (IPCC, 2007) estimated that the forest sector contributes 17.4 percent of all greenhouse gases from anthropogenic sources; most of this is due to deforestation and forest degradation. The Stern Review on the economics of climate change (Stern, 2007), furthermore, observed that "curbing deforestation is a highly cost-effective way of reducing greenhouse gas emissions".

Based on such scientific evidence, the thirteenth session of the Conference of the Parties to the United Nations Framework Convention on Climate Change (UNFCCC COP-13), held in Bali, Indonesia in December 2007, addressed the role of forests in climate change (UNFCCC, 2007). The Bali Action Plan, which outlines long-term cooperative action up to 2012 and beyond, calls for enhanced national and international action including: "Policy approaches and positive incentives on issues relating to reducing emissions from deforestation and forest degradation in developing countries; and the role of conservation, sustainable management of forests and enhancement of forest carbon stocks in developing countries".

The Parties adopted a decision specific to the challenge, "Reducing emissions from deforestation in developing countries: approaches to stimulate action", which encourages Parties to address the drivers of deforestation relevant to their national circumstances. Thus, negotiations of a future protocol to limit emissions and stabilize atmospheric concentration of carbon dioxide (CO_2) are likely to consider measures for reducing greenhouse gas emissions from deforestation and forest degradation (REDD).

While deforestation is a particularly visible contributor to greenhouse gas emissions, this article argues that overcoming deforestation using policy and economic tools is much less feasible than promoting carbon uptake by overcoming forest degradation and restoring forest and agricultural landscapes. It suggests that the literature and political discussion advocating REDD as cost-effective and easy to achieve may significantly undervalue the economic and political forces behind deforestation.

HOW MANY TREES QUALIFY AS DEFORESTATION?

To begin with, the term "deforestation" is used loosely in the climate change negotiations. If the concept is to be debated by parties to UNFCCC, it needs to be firmly defined. The Global Forest Resources Assessment (FRA), an existing, well-vetted process that involves all national governments in defining and measuring the change in forest extent, would offer a suitable foundation (Holmgren *et al.*, 2007).

In considering the concept of deforestation, it should be noted that the removal of tree cover can be a normal part of forest management. The number of trees harvested and the portion of the area's biomass removed are a function of forest type, species composition, management plan, market conditions and a host of other factors. Just as harvesting agricultural crops is not usually an environmental threat, removal of timber from a forested site does not necessar-

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Deforestation is land use conversion, not harvesting of timber. If a harvested forest is allowed to regenerate, the ecosystem effect of harvesting is carbon neutral; but if the forest is converted to another land use, carbon is released into the atmosphere (forest cleared for rice production, Indonesia)

ily create an enduring problem in the atmosphere. The carbon removed from the land as timber is typically only a share of the carbon on the land, with a substantial share remaining in soil and non-harvested trees. The carbon that remains after harvesting (and also the carbon in the harvested wood) is sequestered until the wood decays or is burned. If the land is encouraged or allowed to regenerate a new forest, the ecosystem effect of harvesting is carbon neutral. The atmospheric effect is minimized as the new trees take up carbon and sequester it.

The atmospheric effect becomes problematic if the cycle is broken and the land is converted to another use – a car park, a field of soybeans, a pasture or the like. When land is converted to another use the remaining biomass is often burned, which releases considerable amounts of greenhouse gases into the atmosphere. The term deforestation denotes the change of intended land use from forest to non-forest (urban, agricultural, etc.), as distinct from the cutting of selected tree stems. A definition of "reducing emissions from deforestation" can thus be proposed as follows: "Avoiding the emissions associated with the burning or natural degradation of stored forest biomass on the site as it is converted to another land use that maintains or stores a lower quantity of carbon in biomass".

Knowing what to measure and account for at the level of a forested hectare is an important starting point. However, what will really matter in the context of emission reductions will be the overall carbon flows coming from forests and the means to account for these at the national level. Globally, deforestation occurs in most countries (for example, removal of forest cover for urban uses), but considerable area also returns to forests, whether naturally, from seeding or through planting. Generally, this is land that had been in agriculture or pasture that is no longer cultivated. Thus the global net change in forest cover is the sum of all positive and negative changes in forest area (increases and decreases) (Figure 1).

HOW ABOUT FOREST DEGRADATION?

Defining forest degradation can be equally challenging. While the visual image of a degraded forest may be one of spindly trees thinned to a paltry stocking with nothing of commercial value remaining, a fixed definition of this term remains elusive. The Second Expert Meeting on Harmonizing Forest-Related Definitions for Use by Various Stakeholders, held in Rome in 2002, proposed that forest degradation be defined as "the reduction of the capacity of a forest to produce goods and services" (FAO, 2002). While forest degradation has ecological interpretations, the climate discussion appears to be concerned only with the quantity of carbon sequestered by a forest area; in this context degraded forests would be those carrying less carbon than the land is capable of retaining (FAO, 2001). Is degraded forest a transitional land use where the carbon storage values have been constrained? What is the time period to be considered (long-term or permanent reduction versus short-term reduction)? Sound definitions and measurable parameters will be essential to know with any degree of precision if

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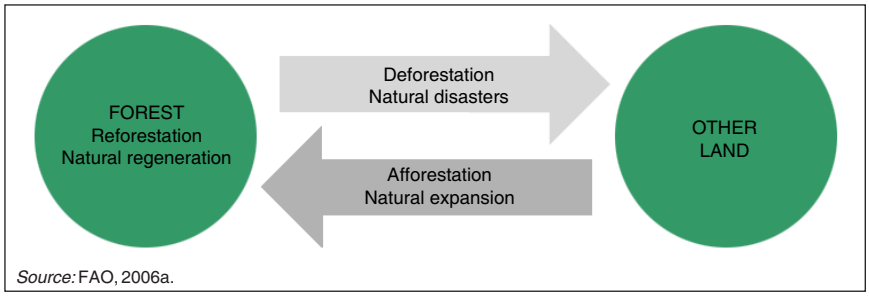
Forest change dynamics



Source: FAO, 2006a.

future initiatives to reduce deforestation and forest degradation are successful. The opportunities for carbon sequestration in forest management may well lie in using explicit strategies to boost carbon sequestration in forests – the reverse of forest degradation being forest enhancement geared towards increasing the multiple ecosystem products and services of water, biodiversity, timber and/or carbon.

Assuming that deforestation and forest degradation can be defined and measured, the search for opportunities to reduce greenhouse gas emissions from these two sources raises interesting questions. When deforestation is defined as a land use change, it is necessary to ask who intended this change. Was it an explicit public or private choice? Did it just happen largely unnoticed over time? What were the motivations? In this sense, deforestation and forest degradation are a consequence of a number of explicit actions responding to the economic, political and social situation. Distributions of wealth, information and political power within the country also play a critical part.

NOW YOU SEE THEM, NOW YOU DON'T

Deforestation has been attributed to a spectrum of causes (ECOSOC, 1996; World Rainforest Movement, 2002; Estrada Porrúra, Corbera and Brown, 2007) ranging from lack of market reward for conserving forests (market failure) (Panayotou, 1992) to inadequate specification of property rights (Pearce and Brown, 1994), policy failure, poverty (Otsuka and Place, 2001) or poor management practices. All of these perspectives probably hold some truth.

Various actors participate in forest conversion: subsistence farmers, small farm operators, large farm enterprises, government and industry (see Box). They all respond to different economic and social incentives; thus different policy instruments or incentive systems may be

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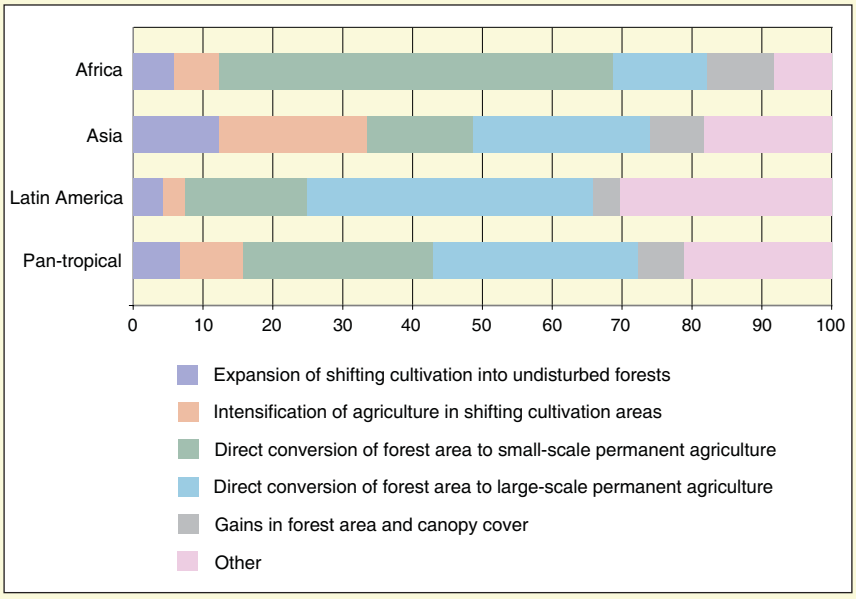
While a degraded forest is often assumed to look like this, with spindly trees and paltry stocking, no fixed definition exists; recent proposals emphasize the reduced capacity of the forest to produce goods and services

Where did all the forests go?

The Global Forest Resources Assessment 2000 (FAO, 2001) made a notable effort to document the transition of forest to other land uses and other land uses to forest, based on a pan-tropical look at land-use change using remote sensing images compared over time. The data, also available for 1980–1990 and 1990–2000, show that different forces are at work through time and in different continents. Thus remedies appropriate for Africa may be significantly different from those that might be effective in Asia or Latin America.

Percentage of total area change due to different causes, 1980–2000



Source: Based on FAO, 2001.

How agricultural policy determines the future of forests: some scenarios

A developed-country farmer with reasonably fertile land not far from a market could choose to grow maize or trees on her bare land. Since there are subsidies for agriculture, she fertilizes the soil, plants quality maize seed, protects the crop using herbicides and pesticides, harvests a bountiful crop of corn and buys a new car at the end of the year.

A subsistence farmer in a developing country has land a long way from the market. There are no agricultural subsidies, so she asks her mother to farm the land and watch over the children, and she goes to the city to find a job. Once the soil is almost drained of nutrients, she returns to take the mother and the children back to the city and trees start to grow on the land. Although the farmer abandons active farming and the land rests idle, seldom will she abandon title to her land. The land continues to serve many social and economic purposes: it represents a source of collateral for seeking finance; it represents a social anchor, the point of historical origin and a refuge in time of conflict; and it is an asset that will store value in the face of inflation.

Another developing-country farmer must decide whether to move to new land because this year's crop of maize and sorghum produced even less than last year. The only new land is covered with trees requiring considerable effort to clear. Still worse, he will have to move the family to a new unsettled area filled with uncertain dangers, where there are no schools for his children. He decides to plant the next crop and leave it in the charge of his wife, mother-in-law and sons, and he goes to start clearing new land.

needed to reduce the rate of deforestation and forest degradation, and strategies must target a multiplicity of actors.

In considering different approaches, it is first instructive to reflect on why forests exist at all – why is the earth not covered with productive farms, especially in light of current concerns over the rising prices of basic foods?

Generally, forests are found today where people could not farm sustainably in the past because of difficult market access, poor soils, slope or lack of water and the want of even meagre economic returns. Over the past two to three centuries, vast swathes of forest were cleared for cereals and cotton production in Europe and North America, and for cattle pasture and plantation production of sugar cane, tea, coffee, rubber trees and oil palm in Latin America and the Caribbean, Africa and Asia. Starting in the 1930s, after more than a hundred years of volatile fluctuation in agricultural product prices with harmful social consequences, a number of countries introduced various types of agricultural price supports to reduce the market vulnerability of farmers producing crops considered strategic for national security. Agricultural price supports in rich countries led to a cycle of investment and intensification which allowed the sector to meet demand readily with fewer and fewer farmers. As the cost of subsidies became a political issue, these countries sought to offset price supports by taking land out of agricultural production, including through tree planting. Thus the demographic transition of farmers abandoning their land for other careers facilitated a return of agricultural land to forest.

In poor countries, by contrast, farmers simply get poorer and more destitute. Some migrate to the city, while those who cannot migrate are doomed to pursue a cycle of disinvestment where they seek to survive on increasingly poor soils without nutrient inputs.

The examples in the Box above underscore the overwhelming significance of agricultural policy in determining the future of forests. They also highlight the difficulties faced by farmers without alternative income opportunities and social support systems.

In environments where soil fertility is chronically low, the poorest and weakest segments of society, those unable to stake claim to better lands, often resort to slash-and-burn agriculture as a survival strategy. Because the soils remain poor even despite their enrichment with biomass from the burned trees, only one to three years of production can be obtained from the site before the nutrients are exhausted and the farmers are forced to move on. In some areas, this method has evolved into a repetitive cycle with a fallow period allowing forest areas to regenerate.

Where the population following this cycle has increased, the negative consequences for the forest have also increased. Shorter fallow periods keep the soils drained and allow invasive grasses to take root. Farmers are forced to push ever deeper into the forest or more often further up the hillside to precariously steep lands. The profitability of this type of agricultural production is notoriously low. Production levels per hectare are low and the quality reduced. Ever-lengthening distance to markets obliterates net gains.

Based on this low profitability, some analysts have suggested that a carbon payment equal to the net returns on production, if offered to farmers for abstaining from this type of production, would be an efficient way to avoid the deforestation and burning. While it is easy to appreciate that the atmosphere would benefit if the farmers were not burning land cover, to make such REDD schemes operational it will be vital to ask why farmers undertake this strenuous, risky and dangerous work. Generally, these farmers are without alternative employment opportunities, and slash-and-burn agriculture is the last and most desperate effort for survival. In economic terms, the opportunity cost of their labour is zero or very near zero

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Slash-and-burn agriculture is carried out as a survival strategy by the poorest and weakest segments of society, those without alternative employment opportunities and unable to stake claim to better lands; a carbon payments may not be sufficient to dissuade such farmers from this type of production (shown, Bolivia)

because of a lack of non-farm rural or urban employment opportunities. The farming plot is also the farmer's residence and provides space for poultry, small animals and a vegetable garden. Thus, not having access to the farming plot as a living site has an opportunity cost.

While programmes to reduce deforestation must consider the situation of the small or landless farmer, other situations must also be considered. As the Figure in the Box on p. 5 demonstrates, forest conversion in Latin America and increasingly in Asia is often caused by commercial agriculture which is able to muster the significant capital required to clear, plant, manage, harvest and internationally market export crops at large scale. Price, export and income subsidies and trade policy are powerful agents influencing land-use change. The fixed costs of converting land from forest cover to agricultural or urban use are significant and require considerable investment capital. Deforestation depends largely on policies geared towards development and expansion of agriculture, transportation, energy and mining. In these regions, the agents of change today are largely well financed and well connected enterprises able to benefit from economies of scale in production, transportation and marketing.

Simple economic theory implies that land will be used for the purpose (forest, agricultural crops, residential or other land use) that yields the highest financial returns (greatest present net value). However, reality shows that agricultural markets are so heavily shaped by subsidies, trade policy and assistance schemes that a simple economic analysis to the individual farmer based on comparing returns to growing individual crops may cause more misunderstanding than enlightenment. Small changes in the price of corn or timber rarely cause an abrupt land-use change for small farmers like those described in the Box on p. 6. Changes in the relative prices of wheat and corn may cause a shift from year to year in a farmer's decision on what crop

Deforestation in Latin America and Asia is increasingly caused by large-scale conversion to plantation crops (shown, tropical forest removed for plantation of rubber or oil palm, Malaysia)

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to plant, but carbon payments would have to involve a significant guarantee for the future to convince an individual to give up farming. This is a major life change requiring new knowledge, skills, equipment and culture. The incentive needed to induce a farmer to make such a shift should be considered when REDD payment schemes are contemplated.

The underlying assumption with such incentive payments appears to be that an additional carbon payment will encourage existing owners to change their behaviour, favouring forest retention. In this sense, it is useful to look at the factors causing economic agents (individuals, families or business enterprise) to convert forest to another use. Conversion is time consuming, laborious and expensive.

FOREST IS LAND – AND LAND IS MONEY, POWER AND AUTHORITY

In many societies, agriculture and urban lands are privately held. Forests, however, are often deemed part of a collective patrimony serving the common good by providing, historically, meat, nuts, berries, medicinal plants, forage, fuelwood, building poles and so forth. Almost all countries, with only a few exceptions, constitutionally enshrine forested lands with a status of a public trust resource rather than a privately owned resource (FAO, 2006b). Decentralization and devolution of central government authority has sometimes transferred ownership and responsibility to a lower constitutional level (provincial, regional, municipality or commune), but a major share of the forest area across the globe – 84 percent – is publicly owned or managed (FAO, 2006a). On a regional basis, the percentage in Africa and Asia is even higher.

Over time, however, a great deal of forest area has been converted to other uses. A main motivating factor appears to be legislation allowing public land to go into private hands if the petitioner has "improved" the land – and in many countries an obvious measure of improvement is the removal of forest cover and its replacement with an agricultural crop or some other "economic" use. The conflict in logic here is that this conversion may not be legal *ex ante*. But since forests, especially in remote areas, suffer from weakness in law enforcement over vast areas, conversion, either abrupt or gradual, is difficult to control. *Ex post*, the land is improved and the economic agent petitions for regularization of title. This is not only a phenomenon of developing countries. It is likely that a number of the wildfires occurring in the Mediterranean region each summer are related to attempts to remove the vegetation as part of a land claim process.

Land conversion and land titling offer significant opportunities for building and storing wealth (de Soto, 2000). In societies troubled by a legacy of inflation, land assets are deeply treasured and sought. But this opportunity for wealth creation comes at significant risk, expense and investment. The readiness and ability of economic agents to undertake these risks is related to their wealth or poverty as well as their economic and political power.

Governments often actively or at least tacitly encourage settlement in remote or frontier areas. They effectively offer land grants in exchange for the risks and hardships that settlers will face. "Development" of remote areas allows governments to secure their perimeters, win votes and broaden their economic foundation. For example, the various governments holding Texas since the late seventeenth century – Spain, Mexico, the Republic of Texas and the United States – successively awarded land grants to settlers and to companies expected to sell the land to raise funds for transport infrastructure (Texas General Land Office, n.d.).

It is instructive to recall that settlement of forest and prairies was considered progress until recently, even in developed countries. Legal, institutional and economic systems still favour growth and development. Land grants, through titling, concession arrangements and other approaches, are among the few means available to governments to promote economic development. Thus REDD-related mechanisms must overcome powerful underlying incentives for forest conversion.

WILL MONEY MAKE A DIFFERENCE?

What are the economic arguments in favour of retaining forest cover? Moreover, will carbon payments make a difference? Is deforestation simply an economic issue, or must more be done in terms of policy, law and institutions to reduce greenhouse gas emissions from deforestation and forest degradation? The myriad factors underpinning deforestation include positive incentives for agriculture, transportation, mining, energy production and the like (Kanninen *et al.*, 2007). Where the same plot of land cannot support both uses at the same time, a positive incentive for agriculture may be a negative incentive for forests. The most efficient policy measures may well be the removal of agricultural subsidies that encourage deforestation.

As noted in the Box on p. 5, most deforestation results from conversion to subsistence farming or small-scale permanent agriculture or large-scale conversion to pasture, legumes, oil palm or plantation crops such as coffee, tea and cacao. The challenge to economic analysis of decisions leading to forest conversion lies in valuing the opportunity cost of capital and labour to the economic agents.

The economic theory underpinning financial transfers or other monetary rewards for REDD depends on three assumptions:

- market failure can be overcome through incentive payments;
- public investment in REDD is merited and can be supported politically;

- markets can achieve REDD objectives better than government controls.

The market failure argument holds that if there is no market for carbon, economic agents that convert forests to another land use lose no revenue for the carbon that would have been stored by keeping the land under forest cover. Economic theory assumes that they made the choice to convert from forestry to another land use because the new land use was more profitable. The assumption is that if a market for carbon could be created and economic agents could realize payments for carbon stored (receive an incentive), they might choose differently. Alternatively, if penalties (a disincentive) were imposed for releasing carbon, the assumption is that the economic agents would choose to avoid or minimize emissions.

The second argument is that, in the absence of transaction costs, if those who gain (the beneficiaries) from the provision of a public good could compensate those who lose and still realize overall gains, then the investment has merit. It is the economic equivalent of the greatest good for the greatest number over the long term. The public good sought in this case is an atmospheric concentration of CO_2 that does not exceed the level beyond which potential unknown consequences and processes might be set in motion, as established by the scientific community. Physically, this is said to be achievable through controls or limits on carbon emissions for the foreseeable future. The concept, therefore, is to use REDD-based incentives and other tools to mobilize investment for keeping atmospheric CO_2 below this threshold. Those who gain (everyone) must identify a way to motivate the losers, including those who would benefit financially from deforestation. The challenge is to build not only the argument for public support but also the means. A major effort under the Bali Road Map adopted at UNFCCC COP-13 is to find mechanisms for funding that would maintain public support among both the gainers and those that would forego a development opportunity. An important issue to maintain political support will be a clear definition of what is to be purchased and at what geographic scale – global or local.

Asian moist tropical forest under rehabilitation: positive incentives for forest restoration and stewardship could be a more efficient means of ensuring forest cover and could be easier to administer than avoiding deforestation

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As a first stage towards a comprehensive global cap on carbon emissions, the Kyoto Protocol established national obligations for developed countries to reduce greenhouse gas emissions. Anticipation of and finally ratification of the Kyoto Protocol have facilitated the growth of a number of trading mechanisms whereby individual emitters that are able to keep their emissions below their allocation through energy conservation or new technology are allowed to sell their excess rights to emit. Likewise, emitters that cannot reduce their emissions or maintain them below the cap, or that find it cheaper to buy credits than to adopt emission-reducing technology, can buy credits.

Under a broader global "cap and trade" agreement, emission reductions might also include investments in forestry. The third economic argument underpinning REDD – that markets will contribute to achieving emission goals more efficiently (at a lower total cost) than government controls – rests on the assumptions that emitters would seek the least expensive means to achieve their obligations, thus reducing the total economic cost of meeting the overall global emission target; and that reducing deforestation could represent a low-cost alternative to more stringent controls in the transport, energy or industrial sectors. Most industrial plants and energy facilities adopt a given production technology that becomes relatively fixed over the life of the plant – perhaps 10 to 20 years. Faced with a cap on emissions, it is assumed that some would turn to the purchase of emission offsets offered through plans to reduce emissions from deforestation and forest degradation. Still to be considered, however, are the mechanisms to transmit the revenues from these purchases to the providers of the deforestation-reducing service.

RECONSIDERING THE BASIS FOR REDD

Governments generally seek to buy something with their tax dollars – security through defence expenditures, a more prosperous future through investments in science and education, better public health through vaccination programmes, etc. Public incentive systems seldom pay people *not* to do something – especially if

the "something" is widely considered to be contrary to the public interest. In most countries, unauthorized deforestation is against the law. Incentive payments to encourage people not to deforest will strike most voters as paying people not to do what is already against the law. Governments do not pay people not to commit arson, for example, even though the public and private costs of arson may far exceed what the perpetrator would consider good compensation. Such payments are avoided because they promote antisocial or imprudent behaviour by compensation seekers who would otherwise have been inhibited sufficiently by moral or legal censure. Farm subsidy programmes, employment insurance programmes and family safety net (welfare) programmes remain widely discussed and heavily criticized in most countries. Antipathy towards the idea of being paid to "not do something" seems deeply ingrained in the human psyche.

For this reason, reversing forest degradation may have the most promising future in the REDD complex, even if less carbon is saved and monitoring could be difficult. Forest degradation is the slow-death equivalent of deforestation. Continuous impoverishment of forest stock reduces carbon balances above and below ground. Effectively, the reverse of a negative externality (carbon emissions) is a positive externality (removing and sequestering excess carbon from the atmosphere). Rebuilding the carbon storage capacity in degraded or denuded forest lands represents a positive investment producing a public good: sufficient atmospheric capacity to absorb industrial and transport-sector emissions without tripping alarm bells while new low-carbon energy technologies come into play. Within this context, countries and economic agents receive compensation for sequestering carbon and sustaining it. The voluntary carbon markets are increasingly evolving along these lines. They deal in new forest plantations, improved management of degraded lands and restoration of forested watersheds. At the global level, countries could be recognized for increasing their carbon stocks in natural environments – agricultural soils, woodlands, urban greening and forests. Indeed, positive incentives for tree planting and stewardship could be a more efficient means of ensuring forest cover and could be easier to administer than avoiding deforestation. Trees planted outside the commons on private farms and community plots have better defined tenure, allowing their stewards more clearly to claim ownership. In principle, the Clean Development Mechanism (CDM) allows for projects in land use, land-use change and forestry. In practice, however, less than a handful of afforestation/reforestation projects have been approved. This suggests that the CDM needs to be revisited in order to capture the unrealized benefits from forestry cited in the Stern Review (Stern, 2007) and elsewhere.

SUMMARY

Realizing a system of international payments or other economic incentives for countries to reduce emissions from deforestation and forest degradation will require detailed understanding of the deforestation process and the influences of agricultural, trade, development, energy and transport sector policies. Deforestation is often driven by a desire to acquire land as a source of collateral, as a store of wealth and as a hedge against inflation. Changing the trajectory of deforestation will require policy programmes that reduce incentives for forest cover removal as a basis for land titling. More importantly, developing countries will need to be able to realize development goals through other means. Otherwise governments will continue to see land development as one of the few means within their reach to meet their goals for economic competitiveness and security.

To realize contributions from forests in the context of climate change, the forestry community may need to return to its roots and explain with greater effectiveness the potential of sustainable forest management to boost the long-term carbon carrying capacity of forest biomass and soils. For the reasons indicated above, the political, social and economic costs associated with reducing deforestation are likely to be perceived as higher than the low opportunity cost from agricultural conversion. Discouraging economic agents seeking to capture land from engaging in deforestation will be politically challenging for governments. For commercial interests that can mobilize significant capital and access international markets competitively to produce the commodities in growing demand, the low level of carbon payments that could be foreseen will not be adequate to defer developments that can achieve scale economies. Furthermore, those who convert forest land may not own it, and would not necessarily be the recipients of payments made to discourage its conversion to other uses.

A more feasible scenario would be one where actions to reward carbon sequestration more broadly in the rural environment are acknowledged, and where governments have more flexibility to use funds gained under an international compensation mechanism to apply a variety of initiatives such as land-use planning, zoning, conservation easements, forest management planning and training for underemployed rural and indigenous populations. In this scenario, economic agents – government, individuals and business – would be compensated for producing something additional (new carbon stored) rather than rewarded for "not doing something" (not deforesting or not degrading). Special attention must be given to providing support to traditional forest users and subsistence farmers to promote carbon-rich, community-friendly sustainable forest management. ◆

Bibliography

de Soto, H. 2000. *The mystery of capital: why capitalism triumphs in the West and fails everywhere else*. New York, USA, Basic Books.

Economic and Social Council (ECOSOC) of the United Nations. 1996. *Underlying causes of deforestation*. Report of the Secretary General to the 2nd session of the Ad Hoc Intergovernmental Panel on Forests, 11–22 March 1996. E/CN.17/IPF/1996/2. New York, USA.

Estrada Porrúra, M., Corbera, E. & Brown, K. 2007. *Reducing greenhouse gas emissions from deforestation in developing countries: revisiting the assumptions*. Tyndall Centre for Climate Change Research Working Paper 115. Norwich, UK.

FAO. 2001. *Global Forest Resources Assessment 2000 – Main report*. FAO Forestry Paper No. 140. Rome. Available at: ftp://ftp.fao.org/docrep/fao/003/Y1997E

FAO. 2002. *Proceedings, Second Expert Meeting on Harmonizing Forest-Related Definitions for Use by Various Stakeholders*, Rome, 11–13 September 2002. Rome. Available at: www.fao.org/docrep/005/Y4171E/Y4171E00.htm

FAO. 2006a. *Global Forest Resources Assessment 2005 – Progress towards sustainable forest management*. FAO Forestry Paper No. 147. Rome. Available at: www.fao.org/docrep/008/a0400e/a0400e00.htm

FAO. 2006b. *Understanding forest tenure study in South and Southeast Asia*. Forestry Policy and Institutions Working Paper No. 14. Rome. Available at: www.fao.org/docrep/009/j8167e/j8167e00.htm

Holmgren, P., Marklund, L.-G., Saket, M. & Wilkie, M.L. 2007. *Forest monitoring and assessment for climate change reporting: partnerships, capacity building and delivery*. Forest Resources Assessment Working Paper 142. FAO, Rome. Available at: www.fao.org/docrep/010/k1276e/k1276e00.htm

Intergovernmental Panel on Climate Change (IPCC). 2007. *Climate change 2007: synthesis report*. IPCC fourth assessment report. Geneva, Switzerland.

Kanninen, M., Murdiyarso, D., Seymour, F., Angelsen, A., Wunder, S. & German, L. 2007. *Do trees grow on money? The implications of deforestation research for policies to promote REDD*. Forest Perspectives No. 4. Bogor, Indonesia, Center for International Forestry Research (CIFOR).

Otsuka, K. & Place, F. 2001. *Land tenure and natural resource management: a comparative study of agrarian communities in Asia and Africa*. John Hopkins University Press.

Panayotou, T. 1992. *Protecting tropical forests*. HIID Development Discussion Papers 416. Cambridge, Massachusetts, USA, Harvard University.

Pearce, D. & Brown, K. 1994. Saving the world's tropical forests. *In* K. Brown & D. Pearce, eds. *The causes of tropical deforestation – the economic and statistical analysis of factors giving rise to the loss of the tropical forest*, pp. 2–26. London, UK, UCL Press.

Stern, N. 2007. *Stern Review: The economics of climate change*. London, UK, H.M. Treasury.

Texas General Land Office. n.d. *History of Texas public lands*. Austin, Texas, USA. Available at: http://www.glo.state.tx.us/archives/history/toc.html

United Nations Framework Convention on Climate Change (UNFCCC). 2007. *Report of the Conference of Parties on its thirteenth session*, Bali, Indonesia, 3–15 December 2007. Geneva, Switzerland, UN.

World Rainforest Movement. 2002. *The direct and underlying causes of forest loss*. WRM Briefings. Montevideo, Uruguay. ◆