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PERSPECTIVE

Reducing Greenhouse Gas Emissions from Deforestation and Forest Degradation: Global Land-Use Implications

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Recent climate talks in Bali have made progress toward action on deforestation and forest degradation in developing countries, within the anticipated post-Kyoto emissions reduction agreements. As a result of such action, many forests will be better protected, but some land-use change will be displaced to other locations. The demonstration phase launched at Bali offers an opportunity to examine potential outcomes for biodiversity and ecosystem services. Research will be needed into selection of priority areas for reducing emissions from deforestation and forest degradation to deliver multiple benefits, on-the-ground methods to best ensure these benefits, and minimization of displaced land-use change into nontarget countries and ecosystems, including through revised conservation investments.

Tropical deforestation makes a major contribution to emissions of greenhouse gases, especially if the additional emissions from subsequent land use are counted (*1*). The United Nations Framework Convention on Climate Change (UNFCCC) is considering the introduction of a financial mechanism to reduce emissions from deforestation and forest degradation (REDD) in developing countries. Many environmentalists have welcomed this initiative because it may direct substantial new resources to tackling this issue (*2*–*5*). A REDD mechanism would probably credit entire nations, rather than individual projects, for their achievements in reducing deforestation. However, there is ongoing debate and hence much uncertainty about the form of the mechanism, including issues such as the deforestation baseline to be used, the role of developing countries that have a low recent rate of deforestation, and the protocols for measurement and validation of emissions reductions. The UNFCCC's Conference of Parties (CoP) in December 2007 established indicative guidance for a demonstration (pilot) phase in the period to 2012. This focuses on emissions measurement and explicitly includes forest degradation, resolving one hotly debated issue. The form of any final mechanism will affect the area and location of forests encompassed and thus the scope for co-benefits (such as biodiversity conservation, livelihoods, and watershed protection) to result. It is widely anticipated that negotiations for the next emissions reduction agreement will be completed at the fifteenth CoP in December 2009. If agreement is reached, then a major new driver for forest conservation may be born.

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There is some controversy over how REDD should be funded. Some of the national parties to the UNFCCC wish to see the issue tackled through a traditional grant funding mechanism. Others, led by the Coalition of Rainforest Nations, seek an eventual market-based mechanism, on the basis that carbon is one of the more easily marketable ecosystem services (*4*, *6*, *7*). This may generate more funds over a longer time scale. A trading mechanism would allow developing countries to sell carbon credits on the basis of successful reductions in emissions from deforestation and forest degradation, to help developed countries achieve stringent emissions targets. Such credits would probably relate to national-scale emissions rather than being attached to individual sites, although discussions continue on the precise details.

Any such mechanism would generate significant additional funding to reduce deforestation rates in developing countries. One estimate, based on a relatively low carbon price of U.S. $10 per ton and an estimate of individual countries' ability to slow deforestation, suggests a potential market of U.S. $1.2 billion a year (*2*); a more recent estimate suggests that U.S. $10 billion may be a realistic figure (*8*). These are large sums in comparison with current investment in forest protection. For example, World Bank funding directed to forest biodiversity conservation and related activities in 2002 totaled U.S. $257 million (*9*). In the mid-1990s, total protected area expenditure in the developing world was estimated at U.S. $695 million annually; not exclusively invested in forests (*10*). In contrast, forestry exports from the developing world were worth over U.S. $39 billion in 2006 (*11*). By generating an income of the same order of magnitude, REDD could provide strong incentives for forest conservation.

These resources mean that the scale of intervention being discussed under the UNFCCC is truly huge, but few decision-makers are aware of the full breadth of its implications. It was initially assumed by many that the effects of REDD on forest-related livelihoods and conservation would only be positive, and it is certainly true that many species, ecosystems, and ecosystem services will benefit. However, it is unlikely that an international mechanism under UNFCCC will explicitly support forest ecosystem services other than carbon storage, and its implementation may generate pressures that adversely affect other ecosystems. It is crucial that decision-makers recognize and plan for potential risks as well as benefits from the resulting effects on land use.

REDD is unlikely to benefit all forests equally. For REDD to make a successful contribution to combating climate change, countries implementing it will have to target threatened forests with a total high volume of carbon in their biomass and soils (*12*, *13*). Although individual sites would not be "marketed" within most proposed REDD mechanisms, countries will still be implementing REDD actions at a site scale. Priority areas for tackling deforestation to reduce emissions will not always reflect other forest values (e.g., conservation, livelihoods support, or delivery of fresh water). Some sites may be less valuable from a carbon perspective but of high priority for other reasons. The need for additional resources to prevent deforestation at such sites will vary depending on the carbon price, the carbon content of the ecosystem, and the cost of avoiding deforestation (Fig. 1). Where the combination of the first two factors outweighs the latter, resources from REDD should be sufficient to enable forest retention. In some parts of the world, estimates of opportunity cost for REDD are very low. Lower costs and/or higher carbon prices could combine to protect more forests, including those with lower carbon content. Conversely, where the cost of action is high, a large amount of additional funding would be required for the forest to be protected.

The limited funds available for conservation will need to be carefully targeted in this context. To conserve the diversity of ecosystems and their related species and services, it may be more efficient to focus conservation funds on nonforest ecosystems and low-carbon forests rather than on forests covered by the new mechanism (Fig. 2). This would require revision of organizational and national investment strategies. The delay between planning and action means that these issues should be considered long before any mechanism comes into effect.

One obvious risk associated with REDD is the displacement of pressures, resulting from continuing demand for food, timber, and increasingly biofuels, to ecosystems perceived to contain low carbon levels. The least-productive forest ecosystems may become the most threatened simply because they are the only remaining accessible source of land and forest products. Other areas experiencing increased pressure could include nonforest ecosystems such as savannas or wetlands and forests in tropical countries not participating in REDD (Fig. 2). The demand for timber from temperate and boreal forests may also increase.

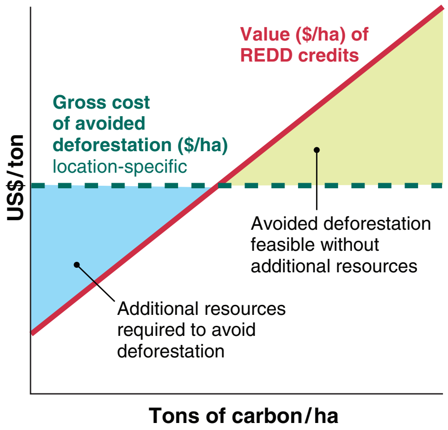

Fig. 1. Under any REDD scheme, the income generated will depend upon the total carbon stocks retained (solid line). Although the cost of avoiding deforestation (dotted line) will vary with location, it is not necessarily related to carbon stocks. Forests in the blue area of the chart contain insufficient carbon to enable avoided deforestation based on REDD funds alone. The need for additional resources to tackle deforestation within a national REDD scheme will vary depending on the carbon price, the carbon content of the ecosystem, and the cost of avoiding deforestation. As the cost of REDD and the carbon price vary, the ratio between the two shaded areas will change.

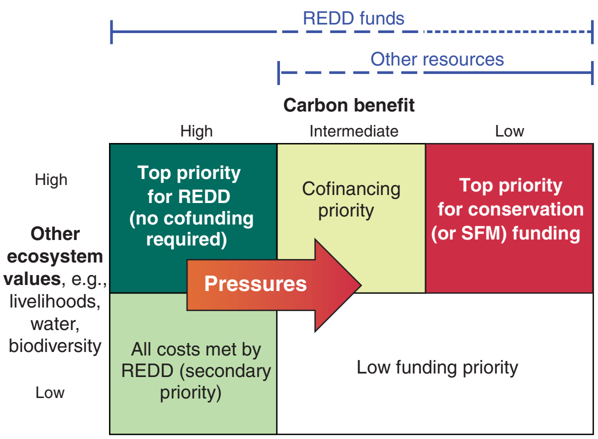

Fig. 2. Biodiversity value and carbon value are distributed differently among tropical ecosystems. Therefore funding from REDD would protect only some biodiversity values and could increase pressures on other ecosystems. Funds for other purposes such as sustainable forest management (SFM) and conservation will need to be targeted to fill the gap.

Another risk is that REDD implementation may be imperfect. Having planned for carbon savings and cobenefits from reduced deforestation, it is necessary to ensure that these are delivered. Considerable effort has been devoted to identifying the factors that influence the success of formally protected areas in limiting deforestation and in supporting and improving livelihoods, but it is often difficult to draw firm conclusions [e.g., (*14*, *15*)]. Although protected areas are typically successful in reducing deforestation, other approaches, including sustainable forest management, will sometimes be more effective in delivering a full range of benefits. Management strategies need to be designed to address local needs and deforestation drivers.

To maximize the benefits of REDD and reduce any risks, it is important to prioritize investment, both among and within countries. Various global conservation priorities have already been identified, each favoring different aspects of biodiversity (*16*). A simple approach would be to identify areas of high value for carbon and for biodiversity at either scale. However, it is also essential that deforestation pressure and the cost of preventative action are taken into account, because the primary motivation is to reduce annual greenhouse gas emissions from this sector. Multicriteria analysis is therefore required, incorporating the degree of pressure and cost as well as the forest values (*17*). Some initial analysis using a national-scale biodiversity index has been undertaken (*18*), but data specific to forest biodiversity would yield more relevant results.

A more comprehensive analysis to produce an optimized allocation of REDD and conservation funds within or even among tropical forest countries is technically feasible. Such analysis would allow the placement of each land unit within a framework like that shown in Fig. 2. Depending on the carbon price and the baseline rate of deforestation, this would help to identify those areas naturally covered by the mechanism, those requiring additional resources if they are to benefit from the mechanism, and the "losers," sites that are most at risk of loss or degradation as the result of pressures displaced by the mechanism. These may become new priorities for conservation and sustainable forest management.

It is crucial that feasibility studies and efforts to ready tropical forest countries for REDD take account of the context (resources and pressures) for biodiversity conservation and other ecosystem values. Several internationally and bilaterally funded demonstration programs are now in development. Methods for assessing their effectiveness, including the degree of displacement (leakage) of land-use change within and between countries, are urgently needed. It is vital to develop robust monitoring and reporting methods for quantifying cobenefits and assessing the impacts on them of changes in forest management and of any leakage into nontarget ecosystems. These data would help identify REDD methods that were most successful in delivering cobenefits.

There is a further need to test the agreed emissions reporting guidelines. Under current Intergovernmental Panel on Climate Change (IPCC) guidance, parties do not need to report emissions from forest areas designated as undisturbed (*13*). This leads to a risk of unrecorded anthropogenic carbon losses, such as those resulting from illegal logging or land clearance. The guidance also offers default values for accounting of soil carbon to 30 cm depth, which will certainly underestimate the effects of clearing tropical swamp forests, where peat depth can reach 20 m (*19*), and losses from drainage and fire can have substantial impacts on carbon storage.

If a REDD mechanism comes into operation, a shift in funding policies may be indicated to ensure that conservation investment is spread over the range of ecosystems not covered by REDD funding. Although many of these issues have been raised within the UNFCCC-mediated discussions, their implications for conservation investment merit attention in the world outside these carbon-focused negotiations.

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