Moving Ahead with REDD

Issues, Options and Implications

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Jl. CIFOR, Situ Gede,
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Tel.: +62 (251) 8622-622; Fax: +62 (251) 8622-100
E-mail: cifor@cgiar.org
Web site: http://www.cifor.cgiar.org

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Chapter 3

What are the costs and potentials of REDD?

Ruben N. Lubowski

3.1 Introduction

Scientific evidence indicates that avoiding dangerous interference with the climate system – e.g. warming greater than 2 degrees Celsius by the end of the century – requires rapid and large-scale reductions in greenhouse gas (GHG) emissions from developed and major-emitting developing countries. Reducing emissions from tropical forests offers an immediate opportunity to mitigate a significant emissions source at relatively low estimated costs. Reducing emissions from deforestation and forest degradation (REDD) efforts could also offer an attractive 'bridge strategy' of reducing near-term emissions while buying time to adapt to a low carbon future.

This chapter looks at some important questions for decisions over the policy and architecture of REDD: What will REDD cost? How will REDD affect the overall strategy for reducing GHG emissions? How will REDD affect the carbon price and efforts to reduce emissions in other sectors? The chapter focuses on ways in which different economic models provide answers to these questions.

3.2 What will REDD cost?

3.2.1 Types of REDD costs

Estimated costs of REDD vary with the data and modelling approach used and the types of costs considered. Studies report costs in terms of supplying or buying REDD, or both. Most estimates focus on the 'opportunity costs' of avoiding deforestation from a landowner's perspective (i.e. foregone economic benefits from alternative land uses), without the costs of developing institutional capacities and actually implementing and transacting a REDD programme.

Some economic models have estimated 'supply curves' ('marginal cost curves') that indicate a cost spectrum for incremental reductions in forest emissions (Figure 3.1). The cost curves slope upwards, showing that for small emissions reductions, costs can be kept low by, for example, protecting just the lowest-cost lands; with greater reductions, the added incremental or 'marginal' costs rise as protection must extend to higher-cost lands and protection activities.. For example, estimates of total opportunity costs more than double in moving from 94% to 100% protection of the Brazilian Amazon forest, because of the high agriculture potential of just 6% of the lands (Nepstad *et al.* 2007).

The costs of implementing REDD policies comprise upfront costs of 'capacity building'; ongoing 'administrative costs' of monitoring, enforcement and other activities needed to run a REDD programme; and 'transaction costs' involved in successfully connecting buyers and sellers. Countries will differ in their ability to reduce tropical forest emissions, and implementation costs will vary with national capacities and strategies. One-time needs for capacity building and policy reform for REDD in 40 countries were recently totalled at USD 4 billion (Eliasch 2008). In addition, the costs of generating valid REDD credits will crucially depend on the baseline-setting rules for how REDD efforts shall be compensated (see Chapter 6).

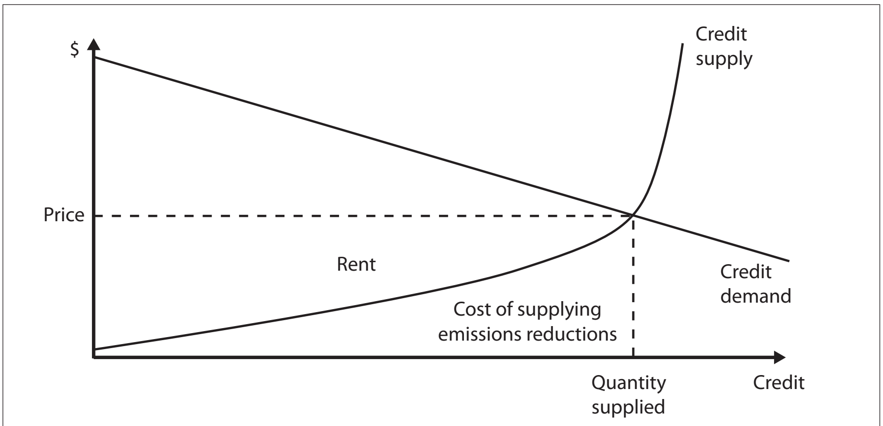

Figure 3.1. Supply and demand for REDD 'credits'

3.2.2 Modelling approaches

Most estimates of REDD costs come from 'bottom-up' or 'engineering' studies based on detailed information on particular activities in particular locations, at fixed prices. In contrast, 'top-down' models are more aggregate and take into account commodity market interactions – both demand and supply. Top-down models have generally yielded higher estimates for the costs of large-scale REDD, partly because they account for market feedbacks (see Table 3.1). Feedbacks occur as reductions in deforestation lower timber harvests and land conversion to agriculture. Consequent lower growth in supply of soybeans, cattle, and timber will raise their prices, thereby raising the incentives to deforest, as long as the unsatisfied demand does not abate completely. Such feedbacks will raise the costs of REDD and increase the risk of 'leakage', by providing incentives to shift deforestation elsewhere.

Table 3.1. Halving global deforestation: comparison between bottom-up and top-down models

	Bottom-up Analysis of eight tropical countries (Grieg-Gran in Eliasch 2008)	**Top-down** Review of three global land use models (Kindermann *et al*. 2008)
Cost of halving deforestation	USD 7 billion/year	USD 17.2-28 billion/year
Time frame	Immediate; and annual reductions assured over 30 years	By 2050
Costs included	Opportunity costs of protecting forests (e.g. the costs of supplying emissions reductions in Figure 3.1); estimated administration costs of USD 233-500 million/year for REDD; and estimated USD 50 million one-time cost for national forest inventories in 25 countries plus USD 7-17 million/year to administer them	Opportunity cost curves are estimated. Total costs above include opportunity costs of supplying emissions reductions plus the 'rents' (profits) earned by REDD providers in selling reductions at a single market price (Figure 3.1). This is the expenditure for a buyer in a competitive market; the seller's 'rents' are a redistribution of resources, not a cost to society as a whole. However, the rents affect the cost effectiveness or ability of a REDD programme to maximise reductions for a limited budget.
Comments	Commodity prices fixed	Market effects incorporated (e.g. price rises as supply falls), which tends to raise costs

Differences in the modelled 'baseline' scenario of what deforestation would be without REDD policies also affect the estimated costs of REDD. Greater forecasted deforestation under the 'business as usual' (BAU) scenario would bring higher emissions to be potentially reduced, but may also mean greater modelled pressures on forests and thus higher costs of forest protection. Other differences in data and assumptions contribute to varying estimates of REDD costs (Table 3.2).

Table 3.2. Effects of including different modelling features on the estimated costs of REDD

Select features included in the model	Effect on costs
Price feedbacks: lower supplies of timber, crops, etc. raise prices and thus opportunity costs of forest protection.	+
Number of deforestation drivers modelled: accounting for more drivers, such as timber and agriculture, will raise opportunity costs of forest protection. Accounting for new future drivers, such as biofuels, rather than extrapolating from past drivers, can also increase estimated costs.	+
Implementation and transaction costs, investment risks.	+
Land conversion benefits as opposed to costs: one-time benefits from timber harvests upon forest clearance will raise costs of forest protection.	+
Greater assumed parameter for the 'elasticity of transformation', the convertibility of forest land to other uses, raises costs in some models.	+
Carbon density/releases: greater emissions avoided per hectare protected will lower cost per ton.	–
Timber benefits from protected forests (e.g. sustainable forest management).	–
Scope of the REDD model (forestry activities, sectors, countries, gases): greater scope implies less leakage and more opportunity for low-cost global reductions.	–
Scope of incentives: more complete coverage lowers leakage and thus costs.	–
Targeting of incentives: targeting payments at emissions reductions lowers transfers to non-emitters and thus costs (to buyers), but avoiding 'leakage' and ensuring equity must also be considered.	–

3.3 How will REDD affect the overall strategy for reducing emissions?

Consideration of deforestation and other land-based options for reducing emissions within climate models is a relatively new field. Nevertheless, results from the Energy Modeling Forum 21 (Rose *et al*. 2007) and related efforts suggest that reducing deforestation, in addition to planting trees (afforestation and reforestation, A/R), changes in forest management, and other land-based options to mitigate GHGs, may provide important cost savings to reach climate stabilisation goals over the next century (Table 3.3, Fischer *et al*. 2007).

These cost savings may enable greater global emissions reductions than could be achieved without REDD for the same overall cost. Estimated savings of USD 2 trillion through global forestry mitigation could finance a 10% stricter target or 0.25°C less of warming over the century depending on the modelled scenario (see Table 3.3). The potential gains from REDD depend on the target GHG concentrations in the atmosphere and the menu of available options for reducing emissions. More alternatives bring more potential sources of cheap reductions and reduce the reliance on any single option for meeting a particular emissions target at least cost. Another critical assumption affecting the estimated role of REDD across models is the expected development of future biofuel technologies (Table 3.3). In particular, biomass production for electricity generation combined with carbon capture and sequestration could, in theory, be a powerful competitor for land if it became a feasible means to generate energy with negative carbon emissions (e.g. Obersteiner *et al*. 2001).

Most studies of REDD focus on the economic potential, assuming that institutional frameworks and capacities are readily available to immediately implement REDD worldwide. However, not all countries will choose to join an international climate agreement or be able to effectively reduce deforestation emissions in the near term. These institutional and political barriers lower the realistic scale of reductions and their effective global impact. Inconsistent incentives for REDD and other GHG reductions across countries would create the potential for international emissions 'leakage' or 'displacement', with reductions in one country potentially being offset by increases elsewhere. For example, Gan and McCarl (2007) estimate international leakage as high as 42-95% in the forestry products industry.

Table 3.3. Estimated potential of REDD to lower costs and buy additional emissions reductions: comparison of models

Model and type	Results
WITCH coupled with GTM (integrated assessment analysis; Tavoni *et al.* 2007)	Including emissions reductions from deforestation, A/R and changes in forest management enables an atmospheric target of 550 CO_2e parts per million by volume (ppmv) for the same total cost as a 600 ppmv target without forestry mitigation. Global forestry mitigation saves about USD 2 trillion; this buys the climate an estimated additional 0.25°C less warming by the end of the century at no added cost (compared with energy sector only reductions).
GLOCAF coupled with GCOMAP and IIASA cluster model (integrated assessment analysis; Eliasch 2008)	The costs of reducing global emissions to 50% of 1990 levels by 2050 (475 CO_2e stabilisation) may be lowered by 25-50% in 2030 and 20-40% in 2050 when deforestation reductions and A/R are included. The cost savings of almost USD 2 trillion could finance a 10% lower global emissions target.
MESSAGE (integrated assessment analysis; e.g. Rao and Riahi 2006; Riahi *et al.* 2006)	Includes a broad set of land-based options: avoided deforestation, A/R, agricultural mitigation, and biofuels for both liquid fuels and energy with carbon capture and sequestration. The biofuel options compete heavily with forests; forestry and biofuel options contribute 1-2% and 6-24%, respectively, over the next 50 years, and 4-8% and 14-29% over the next century when stabilising at about 650 CO_2e ppmv. Substantial conversion of primary forests to managed plantation forests is predicted.
GRAPE (integrated assessment analysis; Kurosawa 2006)	Includes avoided deforestation, A/R, agricultural mitigation, and biofuels for liquid fuels (but not for energy). It estimates a large role for forestry activities: 55% and 15% of the abatement over the next 50 and 100 years, respectively.
GTEM ('general equilibrium' model; Jakeman and Fisher 2006)	Includes avoided deforestation, A/R and agricultural mitigation; excludes biofuels. For 650 CO_2e concentrations target, estimated contribution of forestry is 11% of total abatement over the next 50 years, with all land-based mitigation options saving USD 1.6-7.6 trillion depending on the inclusion of non-CO_2 mitigation options.

3.4 How will REDD affect the carbon price and efforts to reduce emissions in other sectors?

The potential cost advantages of REDD may detract from abatement in other sectors, if REDD credits were made fully interchangeable with other GHG credits. A perceived risk is that REDD may 'flood' the carbon market, dampening the price signal to develop and deploy clean energy technologies.

The effect of REDD on carbon prices and technology incentives depends on several factors:

- How much emissions from avoided deforestation can actually be achieved and credited in practice (the supply of REDD), which depends on the total costs of REDD, the countries that participate and the crediting conditions.
- The demand for REDD, based on the overall emissions reduction target and the availability and costs of other mitigation alternatives. Under stricter targets, there will be greater demand for REDD and more expensive reductions from other sectors.
- The options for applying ('banking') early actions to reduce emissions against future obligations, thus potentially raising current demand for REDD.
- Rules on the 'fungibility' of REDD credits. Restricting the use of REDD and other mitigation options would tend to raise the carbon price (and the total costs).

Tavoni *et al.* (2007) estimate that global implementation of REDD plus A/R and changes in forest management would delay deployment of some technologies and reduce investment in energy research and development by about 10%, for a fixed emissions reduction target. Anger and Sathaye (2006) find a 40% carbon price reduction from introducing REDD into a market that also allows unlimited credits for developing country mitigation through the clean development mechanism. Other studies find more muted impacts, depending on the policy scenario.

According to Eliasch (2008), introducing REDD credits along with modest quantitative limitations on REDD has a negligible estimated effect on the European Union's carbon price, even if countries can satisfy 50-85% shares of their abatement through international credits, depending on the stringency of the European Union target. The precise proportional impact of REDD on the price depends on the assumptions determining the shape of the cost curves, including the costs of the potential alternatives.

Sufficiently ambitious and credible long-term targets anticipated by market participants also provide incentives for saving up credits for use under tighter future targets. Taking into account such 'banking,' Piris-Cabezas and Keohane (2008) estimate a global REDD programme would lower the global carbon price by 14%, while using all forestry mitigation options would reduce the price by 31%, for a fixed emissions reductions target. Doubling the estimated supply of REDD credits has a relatively small effect on the modelled price, as additional credits are 'banked' and used gradually over time. If REDD helps build a store of relatively low-cost emissions reductions, this 'bank' can also dampen price volatility by providing a buffer against unexpected price spikes in the future.

3.5 Conclusion

The latest science suggests that only a global programme that begins almost immediately and achieves large reductions in GHGs by mid-century can preserve options to avoid dangerous interference with the climate system. Despite different assumptions, a range of economic models indicates that REDD can make a significant contribution to cost-effectively stabilising GHG concentrations at this scale and speed.

The cost and timing of REDD are critically important. Estimated cost savings from REDD could buy greater and faster global emissions cuts than can be achieved for the same global expenditure without REDD. Stabilising GHG concentrations at safe levels requires ambitious efforts to reduce emissions quickly from tropical forests as well as other sectors. Most estimates of REDD policy costs focus on 'opportunity costs' without considering capacity building and transaction costs, which may amount to significant additional requirements. However, the long-term estimated costs savings from global forestry in most models provide significant scope for covering these additional expenses.

The economic impact of REDD depends on the overall climate targets and policy architecture, the design and implementation of REDD and its fungibility with the rest of the GHG market. The potential risk of REDD supply 'flooding' the carbon market can be contained by policy designs ranging from strict and long-term targets with 'banking', to modest limits on the use of REDD and other types of credits.

Early emissions reductions also have particular value as a global insurance policy for maintaining climatic options in light of scientific uncertainty (Fisher *et al.* 2007). As tropical forests are disappearing, REDD is also a cost-effective opportunity for reducing emissions that is available for a limited time only. The time-limited and irreversible nature of REDD – once deforestation occurs, it cannot be avoided in the future – adds further value to protecting tropical forests now rather than foreclosing future options for lowering global emissions.