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The costs of REDD: lessons from Amazonas

Reducing tropical deforestation is a major climate and development issue: forest clearing is responsible for roughly a fifth of greenhouse gas emissions, and the forest-dependent poor number over a billion. In the runup to the Copenhagen climate summit, REDD – reducing emissions from deforestation and (forest) degradation by providing incentives to tropical forest countries – has been touted as one of the most cost-effective mitigation mechanisms on the table. But the benefits would be only temporary if forests saved today are cleared once incentives cease. Would the expense of maintaining such incentives over decades raise the price to uncompetitive levels? A forest reserve in Amazonas, Brazil, offers some of the first real-world data on the costs of REDD. Even with pessimistic assumptions about future pressures, the project's carbon cuts look highly affordable.

Policy pointers

- **Past price tags for REDD** have been based largely on 'opportunity' costs of avoided land use change, not spending for real-world conservation initiatives.
- **Juma, an acclaimed REDD** project in Brazil, is expected to avoid greenhouse gas emissions at a cost per tonne comparable to current carbon market prices – and perhaps much cheaper. This is even under conservative assumptions about its long-term ability to control deforestation.
- **Juma shows that significant** expenditure is likely to be needed over and above the rewards to local communities and up to 40 per cent of the total costs to ensure that permanent emission reductions are generated.
- **REDD's cost-effectiveness** around the world will depend on local conditions, and especially on how isolated forests are.

How cost-effective is REDD?

Tropical deforestation accounts for over 17 per cent of global greenhouse gas emissions – more than the entire transport sector. Schemes that reward local communities in the developing world for conserving their forests (known as REDD, for 'reducing emissions from deforestation and [forest] degradation') can reduce these emissions while also alleviating poverty. But how cost-effective are such projects?

A REDD mechanism is likely to be included in the new climate change accords being negotiated under the UN Framework Convention on Climate Change (UNFCCC).[1] And with the international community aiming to sign an agreement in Copenhagen in December, debate over REDD and the magnitude and distribution of costs is intense.

Two questions of cost are at issue:

- What is the cost of eliminating emissions by reducing deforestation?
- How long will investment need to continue to ensure that the climate benefits are permanent?

There has been little field data from real-world projects to inform policy dialogue over the cost of REDD. Published estimates are based largely on the so-called 'opportunity costs' of refraining from expanding farming or other uses of forest land, rather than on money actually spent in communities to protect forests.

But new information is now available from one of the largest REDD programmes in the world: Bolsa Floresta in Amazonas, Brazil – the country's largest state, nearly 98 per cent covered by rainforest. Under Bolsa Floresta, local forest communities are rewarded for committing to avoid clearing primary forest and burning vegetation.

For one of the forest reserves included in Bolsa Floresta – the Juma Sustainable Development Reserve (see below) [2] – the expected cost per unit of avoided greenhouse gas emissions is competitive with current prices on international markets for carbon offsets.

Even if long-term investment through 2050 or beyond is needed to lock in benefits, the costs of REDD in the Juma reserve are expected to match or beat recent carbon prices.

Test case: the Juma reserve

Established in 2006 by the government of Amazonas, in a region currently fairly isolated but expected to face high deforestation pressures in the

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future, the Juma reserve covers 589,612 hectares (ha) and is home to 370 families. The reserve's acclaimed REDD project (see 'Standing tall', below), implemented by Brazilian NGO the Amazonas Sustainable Foundation (FAS), is expected to prevent the deforestation of around 330,000ha of tropical rainforest.

According to an audit carried out by German firm Tüv-Süd for the Climate, Community and Biodiversity Alliance (CCBA), Juma's REDD scheme will prevent an estimated 3.6 million tonnes of greenhouse gas emissions (measured as carbon dioxide equivalent, or CO_2e – the amount of CO_2 that would produce an equivalent greenhouse effect) over the first crediting period, from 2006 to 2016. By the project's end in 2050, it is expected to have generated about 190 million tonnes of CO_2e credits.

In Juma, the incentives include payments to families, grants to community associations for social programmes and promotion of sustainable income-generating activities (see 'Payment plan', below) as well as support programmes (see Table 2, page 4). The aim is to 'make forests more valuable standing than cut', by delivering concrete and direct benefits to local communities. They count among Brazil's most marginalised and vulnerable groups, and depend on the forest for their survival.

The initial funding for the project comes from the Amazonas state government and Bradesco Bank, one of Brazil's largest. In a pioneering partnership, the Marriott International hotel chain agreed in 2008 to contribute US$2 million to cover the first four years of the project. In addition, the Marriott's guests will be offered the option to offset their emissions at US$1 per night.

Calculating the cost range

REDD costs can range from opportunity costs to those for actual implementation, and for transactions such as contract negotiation with carbon buyers. In estimating the costs of Juma, the focus was on upfront costs such as preparing communities for participation and setting up the payment scheme, as well as ongoing costs, including payments, administration and monitoring.

Spending by the Amazonas government on preparatory activities before FAS was established was also included. The analysis was based on budgeted costs of preparatory activities from 2005 to 2008 listed in the project design document, and the budgeted costs for 2009 from FAS.

The objectives were twofold: to see whether credible emissions reductions can be delivered by Juma at a cost competitive with other REDD projects and mitigation options; and to estimate the money required for an endowment fund to ensure permanence of the project and associated emissions reductions. A number of factors discussed below are likely to affect the results. In view of these uncertainties, the calculations here are based on several scenarios of payment duration and achievement of emission reductions.

Achieving future large emission reductions The amount of emissions avoided annually by the scheme is expected to grow over time. In the first half of the crediting period (2006-2011), emissions credits are expected to be less than 10 per cent of the total for 2006-2016. Emission reductions are also expected to increase significantly after 2030 and to be particularly high in the five years 2046-2050.

Achieving these large reductions could demand future annual expenditures greater than the current budget. Juma's success in obtaining CCBA validation (see 'Standing tall') provides some assurance that the anticipated emission reductions to 2016 are achievable with the current expenditure levels. But for emission reductions from 2016 to 2050, there is greater uncertainty.

Population growth There is also the question of future population growth, which is likely to increase

Standing tall: the world's first Gold-level REDD scheme

The Juma Sustainable Development Reserve Project for Reducing Greenhouse Gases Emissions from Deforestation is the first Brazilian project involving REDD to obtain validation from the Climate, Community and Biodiversity Alliance (CCBA). The CCBA certifies schemes that simultaneously address climate change, support local communities and conserve biodiversity.

Juma is also the first project worldwide to receive the top score in the CCBA's Gold category, signifying exceptional social and environmental benefits that go beyond reducing greenhouse gas output. These additional aims include strengthening environmental monitoring and control, promoting sustainable businesses that increase community income, and enhancing community development, education and scientific research.

Payment plan: how Bolsa Floresta distributes funding

Individual families *(Bolsa Floresta Familiar)*	Monthly payment of US$25[3] transferred through a debit card issued to the wife.
Families' associations *(Bolsa Floresta Associação)*	Cash grant averaging US$500 per month per association plus in-kind grant of equipment (such as boat or internet connection).
Social programmes *(Bolsa Floresta Social)*	Grant towards social activities, approximately US$70,000 per year for each reserve, in the form of small investments (for example, in education or health) complementing state and local government programmes.
Sustainable income generation *(Bolsa Floresta Renda)*	Equivalent to US$70,000 per year for each reserve to support income-generating activities based on sustainable land and resource use.

pressure to clear forests for subsistence agriculture. To counter this threat, the number of households receiving payments over the period will need to increase, as will the coverage of the support programmes.

To assess these effects, a steady rate of population growth of 2.24 per cent per year was assumed[4] with payments to families, support programmes and administration increasing accordingly.

Permanence How long do payments to families and other incentive measures need to be maintained to ensure that emissions reductions are permanent?

If Bolsa Floresta is discontinued, it is possible that households will start to clear forest again at rates similar to those prevailing before the project. But would they start deforesting much faster than before to make up for the years of restraint, or be unable or unwilling to stop outsiders from doing so?

This would in effect reverse the emission reductions achieved during the programme's lifetime. Much will depend on whether activities for generating sustainable income succeed in making the forests more valuable standing than cut.

Discount rate A discount rate of 5 per cent was used to make costs incurred at different points in the future comparable to costs incurred today.[5] This rate is based on the real rate (that is, over and above the inflation rate) of interest currently available in Brazil. For sensitivity analysis (which determines robustness of the model), a lower discount rate of 2 per cent was used.

- **Scenario 1: short-term scheme** Project spending continues up to 2016 and emission reductions are achieved from 2006 to 2016, estimated at 3.6 million tonnes as projected in the CCBA validation.[6] But permanence of emission reductions is uncertain, once project spending ceases.
- **Scenario 2: long-term scheme** Spending continues up to 2050 and emission reductions are achieved from 2006 to 2050 estimated at 171 million tonnes.[7] But there is uncertainty over the magnitude and permanence of emission reductions in the later years.
- **Scenario 3: protection financed forever** Emission reductions are achieved from 2006 to 2050 estimated at 171 million tonnes[7] but subject to some uncertainty over their magnitude towards the end of this period. Spending continues forever, backed by an endowment fund, to ensure the permanence of the reductions achieved up to 2050.
- **Scenario 4: long-term scheme locking in short-term benefits with strong guarantee of permanence** No further emission reductions are achieved after 2016, but spending continues to 2050 to ensure the permanence of the reductions made from 2006 to 2016.

The bottom line: dollars per tonne

Depending on the scenario, the cost of delivering a tonne of CO_2 emission reductions falls in a wide range, from around US$0.1 to US$11.5 (see Table 1). The choice of discount rate also makes a big difference: for the worst-case scenario, in which project spending has to be maintained until 2050 to secure the permanence of emission reductions achieved up to 2016, the cost drops to US$6.7 per tonne of CO_2e if the discount rate increases to 5 per cent.

Table 1. Cost per tonne of CO_2e emissions avoided

Scenario	Cost (US$/t CO_2e)	
	At 5% discount rate	At 2% discount rate
Scenario 1: short-term scheme Spending 2005-2016, reduced emissions 2006-2016	2.2	2.5
Scenario 2: long-term scheme Spending 2005-2050, reduced emissions 2006-2050	0.14	0.24
Scenario 3: protection forever Spending forever, reduced emissions 2006-2050	0.16	0.44
Scenario 4: long-term scheme locking in short-term benefits Spending 2005-2050, reduced emissions 2006-2016	6.7	11.5

The total cost of the programme over the project's lifetime (2005-2050), discounted to 2009, is around US$24 million at a discount rate of 5 per cent and US$41 million at a discount rate of 2 per cent (see Table 2). A little under 60 per cent of this is expected to go to cash payments and in-kind support programmes for communities. Some 10 per cent of the costs will be needed for monitoring of carbon emissions. If an endowment fund is set up to allow the project to continue on a permanent basis (scenario 3), the fund would have to be about US$75 million at a 2 per cent discount rate, and a little over US$28 million at a discount rate of 5 per cent.

Regardless of discount rate, an endowment-backed plan ensuring permanence of emission reductions could be extremely cost-effective at less than US$0.5 per tonne of CO_2e if the full 171,000 tonnes of emission reductions are achieved. This excludes the costs of managing the fund, but including these is unlikely to increase the unit costs to beyond US$1.

Table 2. Total costs

Cost category	Present value of costs 2005-2050 at 5% discount rate		Present value of costs 2005-2050 at 2% discount rate	
	2009 US$	Share of total (%)	2009 US$	Share of total (%)
Preparation (community meetings, etc.)	306,449	1.3	293,190	0.7
Bolsa Floresta payments	7,110,769	29.2	12,500,817	30.2
Support programmes to communities	6,362,066	26.1	11,142,729	26.9
Administration (including staff costs)	3,650,261	15.0	6,303,079	15.2
Protected area management and law enforcement	4,669,251	19.2	7,583,791	18.3
Carbon monitoring (including project design document)	2,262,189	9.3	3,568,819	8.6
Total	**24,360,985**	**100%**	**41,392,425**	**100%**

How does Juma compare?

The costs calculated for Juma are in line with recent carbon market prices:

Compliance market The Juma project's costs per tonne of avoided emissions are relatively low compared to prices in the carbon market of the EU Emission Trading Scheme, which peaked at €30 (currently US$47) per tonne of CO_2e (EUA) in 2008 and fell to about €11 (US$16) per tonne of CO_2e as of March 2009.[8] The costs are also low compared to the average price of emission reductions in the UN's Clean Development Mechanism, which in 2008 was US$16.78, although prices declined sharply in the later part of the year due to the financial crisis.[9]

Voluntary market A more relevant comparison is with the prices commanded by avoided deforestation projects in the voluntary carbon market. The average price reported for 10 such projects in 2008 was US$6.3 per tonne CO_2e and the maximum a little under US$30 per tonne.[10] Prices for afforestation and reforestation projects for conservation were a little higher, with an average from 17 projects of US$7.5 per tonne of CO_2e and a maximum of around US$22 per tonne.

The global perspective

The REDD costs for Juma and Bolsa Floresta should not be extrapolated to all tropical forest regions. Inevitably, the economic, social and environmental landscapes vary dramatically among and within regions. Opportunity costs will be more important in areas where economic returns from agricultural conversion are higher than in Juma. Forest protection costs are likely to be higher in regions with poor governance and high illegality.

Compared with other forest communities, the Juma reserve is moderately isolated. It has not yet been exposed to high levels of deforestation, but is likely to experience growing pressures in the next few decades. Its REDD costs are therefore likely to be greater than those of very isolated forest areas. But REDD for Juma will be cheaper than for frontier forest areas, which have already been highly exposed to deforestation and are facing intense pressures in coming decades. Even under a worst-case scenario, however, the cost per unit of reduced emissions in Juma is comparable to, and often lower than, prices on the carbon markets set up by existing international climate policies. In a global context, this confirms that REDD can play an important role in reducing the costs of preventing climate change.

To pin down the worldwide cost for REDD, future case studies should examine both very isolated forests and more exposed frontier forest areas. Implementation of Juma and the Bolsa Floresta programme should be monitored so that cost estimates can continually be refined. REDD projects have other significant benefits (such as biodiversity conservation and poverty reduction) that also need to be considered. Meanwhile, the programme's promising outlook gives policymakers a reason to aim for inclusion of REDD as a cost-effective element of the global climate deal now being drafted.

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Notes

■ [1] Eliasch, J. 2008. Climate change: financing global forests. In: *The Eliasch Review.* Earthscan, London. ■ [2] Viana, V.M., Ribenboim, G., Cenamo, M.C. 2008. *The Juma Sustainable Development Reserve Project: Reducing greenhouse gas emissions from deforestation in the state of Amazonas, Brazil.* See www.fas-amazonas.org/arquivos/juma_executive_summary.pdf. ■ [3] Exchange rate of 1 US$=2BRL used throughout. ■ [4] This is the midpoint of the area's 2001 population growth rate range (1.14 to 3.34 per cent). ■ [5] Discounting is used to convert costs (or benefits) incurred (or received) in the future to their present value. This is based on the proposition that a dollar received several years in the future will be valued less than one received today. One of the reasons for this is that a dollar received today can be invested or put in a savings account and will generate a return. ■ [6] Emissions reduction figures are lower than in the project design document because the CCBA validation applied a further discount of 10 per cent as a buffer to reflect overall risks and further leakage. ■ [7] Based on 190 million tonnes as in the project design document, minus a buffer of 10 per cent. ■ [8] *Cost-effectiveness of CDM projects.* Carbon Finance: CDM/JI Analysis. See www.carbon-financeonline.com/index.cfm?section=cdmjianalysis&action=view&id=11663. ■ [9] World Bank. 2009. *State and Trends of the Carbon Market 2009.* World Bank, Washington DC. ■ [10] Hamilton, K. *et al.* 2009. *Fortifying the Foundation: State of the voluntary carbon markets 2009.* Ecosystem Marketplace/New Carbon Finance, Washington DC/New York.

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