Divergent opportunity costs of REDD on private lands in the Brazilian Amazon

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Does REDD make sense in the Brazilian Amazon?

In 2006, 1.4 million ha of primary forest equivalent to 218 ±33 million tons of carbon were lost in the Brazilian Amazon. Current forest laws prohibit most deforestation in the Amazon, but are *de facto* weakly enforced. One option is thus to use money for Reduced Emission from Deforestation and Degradation (REDD) to improve command-and-control systems. However, on privately held land, the root problem is land-use profitability: farmers gain from converting forests, but may accept to forego these profits if they can be duly compensated for conservation through Payments for Environmental Services (PES). In this study, we test the economic viability of REDD payments on private lands: Can REDD compete with alternative land uses? We look at two large states in the Brazilian Amazon, Mato Grosso and Amazonas, with divergent land-use trajectories: Mato Grosso has expansive commercial agriculture (soy, cattle), lies in the 'Arc of Deforestation', and has a history of aggressive forest conversion. Amazonas is remotely located, has Brazil's largest forest stock, only little conversion pressure, and a recent history of innovative conservation policies.

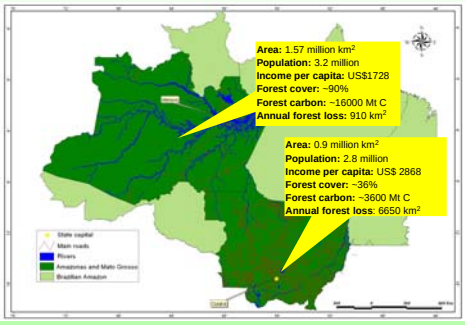

Figure 1: Case studies: Mato Grosso and Amazonas federal states in the Brazilian Amazon

Data and methods

We use official Brazilian statistics, supplemented by case-study parameters. First, we estimate private land areas, and forests on those, using INCRA data for Amazonas and for Mato Grosso, due to deficient INCRA data, the sample of about 30% of all farms registered in the state's own licensing system (SLAPR). We assume that our deforestation baseline between 2007 and 2016 follows the municipal average deforestation rate for 2001-06 derived from INPE PRODES observations. Municipal land use is calculated from IBGE's PAM and PPA databases. We combine cost-benefit ratios for representative land-use types from AGRIANUAL 2007, ANUALPEC 2006, and CONAB with municipal average gross returns to get net returns per land-use category. Average per-hectare timber yields and extraction costs from the literature are combined with municipal timber values per m^3 from IBGE. For cattle ranching, we rely on average estimates for Mato Grosso and low-end estimates for Amazonas, where ranching is less productive. To deduct transport costs, we compute an index taking zero value in the state capitals, and increasing to max. 20% of gross product value with higher distance. We then calculate the net present value (NPV) of typical deforestation land-use cycles, combining sequences of timber extraction, crops (with and without fallow periods) and pastures. The mix of NPVs determines municipal REDD opportunity costs.

Results

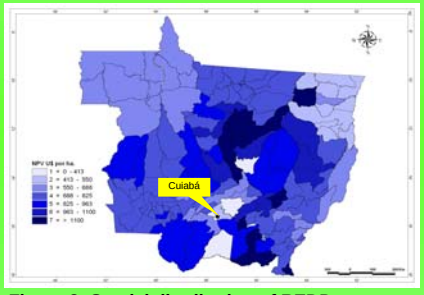

Figure 2: Spatial distribution of REDD opportunity costs in Mato Grosso

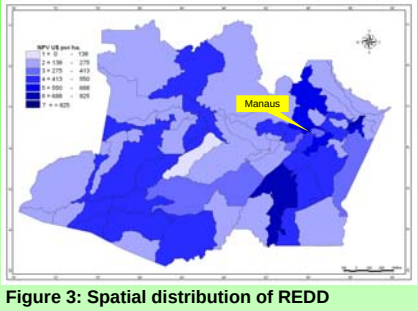

Figure 3: Spatial distribution of REDD opportunity costs in Amazonas

Figures 2 and 3 compare per-hectare REDD opportunity costs (municipal NPVs of deforestation) in Mato Grosso and Amazonas. Market-near Mato Grosso state features higher returns to both timber and soy bean production than remote Amazonas. Within both states, high returns accrue from high-value crops or cattle operations, in municipalities with open deforestation fronts and along major transport ways. To simplify, we assume zero returns to standing forests.

Figures 4 and 5 show state-wide REDD carbon supply curves, with sensitivity analyses for product prices and per-ha forest carbon content (ranges of ±30%). At 2006 Chicago Climate Exchange (CCX) carbon prices, about half (47%) of Mato Grosso's expected forest loss on SLAPR registered farms until 2016 could be compensated at US$287 mill. In Amazonas, carbon prices would cover the costs of 92% of private forest loss (US$123 mill). Carbon prices of US$12/ t CO_2 would be needed to fully cover opportunity cost in Mato Grosso; 100% of forest loss could be compensated at one third of this price in Amazonas.

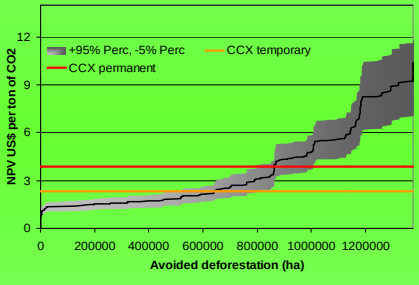

Figure 4: Emission abatement costs in Mato Grosso

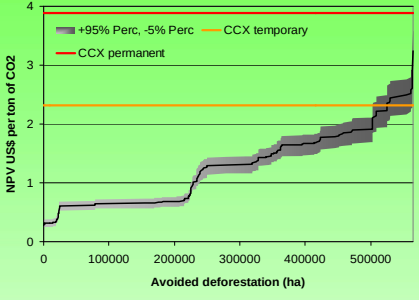

Figure 5: Emission abatement costs in Amazonas Note: Carbon credits from REDD are assumed to be temporary (orange line). Assuming a 10% discount rate, we calculate a 39% rebate on the permanent credit price (red line).

Perspectives and challenges

Mato Grosso and Amazonas are at the high, and respectively, low ends of the REDD opportunity cost spectrum in the Brazilian Amazon. Our findings indicate that REDD is a competitive proposal for most lands in Amazonas, although the absolute amounts are less than half of those to be spent in Mato Grosso's SLAPR – or only one sixth if upscaled to all Mato Grosso's private lands, because deforestation threats, size, profits – and thus opportunity costs – are superior in Mato Grosso. Some high-value forest conversion, e.g. for mechanized soy crops, would make it expensive to buy out all of Mato Grosso's forest loss: zero deforestation in SLAPR areas would cost US$671 mill -- on all of Mato Grosso's private lands, about three times that amount. Yet, if timber values are set to zero, as much as 82% of forest loss in Mato Grosso's SLAPR areas (US$242 mill.) and 100% in Amazonas (US$70 mill.) can be compensated. It may thus be cost efficient to separate the "two D's" in REDD, i.e. compensate separately for avoided degradation (from timber extraction) and deforestation (from conversion to alternative uses).

Some caveats apply. First, adding transaction and direct protection costs moves the curves upwards and reduces REDD profitability, adding forest benefits does the opposite. Second, our municipal averages mask large spatial differences in land uses and returns, thus underestimating true variation in NPV. This lacking precision might be alleviated through the use of inverse auctions where producers 'self-reveal' their costs and preferences. Third, we assume all forest loss is on private lands, ignoring that private land tenure is often established through forest clearing itself. Fourth, we assume threatened areas can be fully spatially predicted. In practice, this narrow targeting would relocate some conversion pressures to non-program areas (leakage). Payments thus have to adopt broader spatial coverage, which will raise costs. Finally, throwing roughly 160 Mt CO_2/yr from Mato Grosso and Amazonas into the carbon market will depress prices, unless higher reduction commitments resulted in increasing demand.

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