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Analysis

Benefits and costs of deforestation by smallholders: Implications for forest conservation and climate policy

Oscar J. Cacho [a,*], Sarah Milne [b], Ricardo Gonzalez [c,d], Luca Tacconi [b]

[a] UNE Business School, University of New England, Armidale, NSW 2351, Australia
[b] Crawford School of Public Policy, The Australian National University, Canberra, ACT 0200, Australia
[c] School of Economics, The University of the South Pacific, Laucala Campus, Suva, Fiji
[d] Department of Forest Sciences, Faculty of Agricultural and Forest Sciences, Universidad de La Frontera, Temuco, Chile

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ABSTRACT

Deforestation is a leading cause of biodiversity loss and an important source of global carbon emissions. This means that there are important synergies between climate policy and conservation policy. The highest rates of deforestation occur in tropical countries, where much of the land at the forest frontier is managed informally by smallholders and where governance systems tend to be weak. These features must be considered when designing policies to reduce emissions from deforestation such as REDD+. Deforestation is often accompanied by fires that release large amounts of carbon dioxide. These emissions are especially high in the case of peatlands which contain thick layers of carbon-rich matter. In this paper we derive marginal abatement cost (MAC) curves using data from a farmer survey in Sumatra, where rates of peatland deforestation are high. Comparing these results with farmers' stated willingness to accept payment not to clear forest to establish oil palm suggests that REDD+ policies may be more expensive than MAC estimates suggest The extent to which this is true depends on the types of soils being deforested.

1. Introduction

Land-use change and agriculture account for approximately one third of global greenhouse gas emissions (FAO, 2011; Smith et al., 2007), but these sectors also have considerable potential as carbon sinks, mostly in the form of forests (Bloomfield and Pearson, 2000; Cacho et al., 2008; Watson et al., 2000). For this reason, there has been much interest in the synergies between forest conservation and climate policy (e.g. Kindermann et al., 2008; Pfaff et al., 2010; Venter et al., 2009). Reducing emissions from deforestation and forest degradation, in its most recent form as REDD+, is currently the most prominent international mechanism to capture these synergies (Angelsen et al., 2009; Harvey et al., 2010; Sandker et al., 2010). The key feature of this policy should be the ability for developing countries to capture carbon offset payments in return for reductions in deforestation. A core idea of REDD+ is performance-based payments that are conditional on the outcome of an action. Funds may be spent on (i) capacity building and 'readiness', (ii) policies to address the drivers of forest carbon loss and (iii) rewards for performance (i.e. quantified forest carbon change or emissions avoided).

The open-access nature of tropical forests, the contested nature of property rights, public policies that have encouraged deforestation, and alternative land uses that are more profitable than forests, have combined to result in large scale loss of forest through both legal and illegal activities (FAO, 2001; Geist and Lambin, 2002; WWF, 2006). Wertz-Kanounnikoff and Angelsen (2009) argue that the success of REDD+ within countries requires three key elements: performance-based incentives, reliable information, and effective institutions to manage information and incentives. The emerging critique of REDD+, however, suggests that there are profound challenges to achieving these conditions and meeting the in-built assumptions of REDD+ policy in practice (e.g. Mahanty et al., 2013a, 2013b; Milne, 2012).

A particular challenge for REDD+ is the fact that conservation efforts tend to be static whereas opportunity costs are dynamic. Recent empirical studies have found evidence that opportunity costs of forested land vary widely over time and space (Lu and Liu, 2013; Wheeler et al., 2013), implying that forest conservation schemes need to incorporate arrangements for adjusting compensation as economic conditions change (Tacconi et al., 2013). Another challenging factor for REDD+ implementation is its voluntary and contractual nature, meaning that REDD+ agreements should be non-coercive and attractive to stakeholders, while also adhering to social safeguards such as free prior and informed consent for local communities and land-holders. Butler et al. (2009) suggest that unless global climate policies legitimize the trading of carbon credits from forestry, REDD+ will not be able to compete with more profitable alternative land-uses, as carbon prices in voluntary markets tend to be lower than in compliance markets (Linacre et al.,

* Corresponding author.
E-mail addresses: ocacho@une.edu.au (O.J. Cacho), sarah.milne@anu.edu.au (S. Milne), ricardo.gonzalez@usp.ac.fj (R. Gonzalez), luca.tacconi@anu.edu.au (L. Tacconi).

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2011). The recent collapse of the carbon price in the EU emissions trading scheme may be another obstacle to REDD+ implementation, at least in the short to medium term.

Despite the uncertainty about the future of REDD+, given the lack of progress on a global climate change agreement, there has been continuing significant interest in REDD+ activities in the top carbon emitters from deforestation and degradation: Brazil, Indonesia and Congo. Sills et al. (2009) identified 60 REDD+ projects in the pipeline, 35 of them in Indonesia, a country that has one of the highest rates of tropical forest loss in the world, losing 64 million ha in the period 1950–2000 (FWI/GFW, 2002). This has made Indonesia one of the epicenters of deforestation and degradation, and hence REDD+ interventions.

Land-use decisions for conservation are particularly complex in the tropics for three reasons: (1) much of the land at the forest frontier is managed by semi-subsistence farmers and shifting cultivators, often informally; (2) tropical forests contain high concentrations of valuable timber and non-timber forest products, and their exploitation can be highly profitable; and (3) as global demand for agricultural commodities rises, land grabbing and encroachment into forested regions has accelerated rapidly (Borras et al., 2011; Nevins and Peluso, 2008). These factors in combination with poor governance make it extremely difficult to reduce tropical deforestation. A basic requirement for climate mitigation activities is, therefore, the willingness of farmers to participate in forest conservation efforts (Cacho et al., 2005; de Jong et al., 2000).

The high profitability of land-uses like oil palm, rubber, and forestry plantations for pulp and paper, combined with a policy environment that effectively subsidizes such land-uses, increases the opportunity costs of conserving tropical forests. The establishment of oil palm and timber plantations has now become the main drivers of deforestation in Indonesia (Butler et al., 2009; Koh and Wilcove, 2008). In this process, the political economy of forest land allocation and the incentives received by local politicians and bureaucrats play an important role in determining the rate of deforestation in Indonesia (Brockhaus et al., 2012; Burguess et al., 2012). For example, oil palm and timber plantations generate substantial royalties, fees and taxes for governments at all levels (Irawan et al., 2013).

It is normally assumed that national REDD+ systems should be designed to pass down conditional payments from the international level to the local level, but other policy options are also being considered for implementing REDD+ at the national and local levels (Sills et al., 2009). In particular, there is an emerging preference for national REDD+ systems to be compliance-based, rather than governed by voluntary carbon market transactions (UN-REDD, 2012). Clearly, the distribution of REDD+ payments among governments, firms and individuals must reflect the costs and incentives faced by each group, keeping in mind that some group members derive benefits from deforestation that is illegal or illegitimate, and should not be compensated.

In this paper we build upon previous analyses by evaluating the motivations that drive land conversion by smallholders whose collaboration is essential for the success of forest conservation policies in Indonesia. This analysis fills a gap in the understanding of economic issues faced in the implementation of REDD+, given that the focus of existing analyses has been mostly on large scale activities carried out by companies (e.g. Butler et al., 2009; Irawan et al., 2013; Koh and Wilcove, 2008). Thus, this study focuses on areas where smallholders are driving forest clearing for palm oil plantations. A particular contribution of this paper is the comparison of the estimated returns from oil palm with the farmers' stated willingness to accept compensation for avoiding deforestation.

2. Method

2.1. The Farmer's Decision

Consider the decision faced by a farmer assessing land-uses for possible adoption. The decision is motivated by a desire to maximize wellbeing in terms of expected utility. We assume that utility is positively related to both the level of income and the level of non-market benefits obtained from each land-use. Therefore, the land-use decision involves maximization of a conjoint utility function with two components: monetary net earnings and non-market net benefits associated with the alternative land uses. This utility function represents the discounted flow of expected net monetary and non-monetary benefits, evaluated in perpetuity in year t. If the farmer could capture the non-market benefits when considering the conversion from one land use to another, his decision would involve maximizing utility such that:

$$LU_{ijt} = ArgMax\left\{NPV_{ijt} + \mu_{ijt} - S_{ijt}\right\}, i = (1, \ldots, N), j = (1, \ldots, M) \quad (1)$$

where LU_{ijt} is the land use j allocated to parcel i in year t; NPV_{ijt} is the net present value of the land use; μ_{ijt} is the value of non-monetary benefits; S_{ijt} is the land-use conversion cost (the cost of switching land uses), N is the number of parcels and M is the number of alternative land uses. Each alternative could also be subject to legal, environmental, socio-economic and institutional constraints that could contribute to the conversion cost or could enter the problem as constraints on the maximization. A problem is that the variable μ cannot be directly observed and its value may be only partially considered by the landholder depending on the proportion of non-market benefits he can capture.

In practice, the landowner will choose land use k over land use j when:

$$(NPV_{ikt} + \mu_{ikt} - S_{ikt}) > (NPV_{ijt} + \mu_{ijt} - S_{ijt}), \forall i, j, t, j \neq k.$$

In practical terms, if the current use is LU_k the landholder will keep it, but if it is LU_j, he will convert the land-use from j to k. Farmers are unlikely to capture the full social and ecological benefits from tropical forests, although they may obtain food, medicine and spiritual values. This means that their decisions are mostly explained by the expected financial returns from alternative land uses, such as oil palm plantations and μ may not enter the decision.

2.2. Measuring the Opportunity Cost of Avoided Deforestation

The NPV of a farm producing J outputs using I inputs over a period of T years is:

$$NPV(T) = \sum_t \left[\sum_j y_{j,t} p_j - \sum_i x_{i,t} c_i\right] (1+r)^{-t}; t \in (1, \ldots, T); j \in (1, \ldots, J); i \in (1, \ldots, I) \quad (2)$$

where $y_{j,t}$ is the yield of output j in year t and p_j is the price per unit of output; $x_{i,t}$ is the amount of input i used in year t; c_i is the cost per unit of input; and r is the discount rate. This equation measures only the monetary value of the land use.

To compare the present value of land uses that may have different time horizons we calculate the NPV in perpetuity (NPV_{INF}) using Faustmann's formula:

$$NPV_{INF} = \frac{NPV(T)}{1-(1+r)^{-T}} \quad (3)$$

where $NPV(T)$ is the net present value calculated over T years using Eq. (2) (e.g. see Cacho et al., 2003).

For any given farm k, let NPV_{INF} for the current and proposed land-use systems be expressed as $NPV_{C,k}$ and $NPV_{P,k}$ respectively. The benefit (per hectare) of changing land use for farmer k can now be expressed as:

$$B_k = NPV_{P,k} - NPV_{C,k} - S_k. \quad (4)$$