ephemera | articles
theory & politics in organization

ISSN 1473-2866
www.ephemeraweb.org
volume 12(1/2): 206-241

Planting trees through the Clean Development Mechanism: A critical assessment

Esteve Corbera and Charlotte Friedli

abstract

The Kyoto Protocol's Clean Development Mechanism (CDM) allowed developing countries to promote Afforestation and Reforestation (A/R) activities as a means to sell carbon emissions reductions to individuals, companies and governments in developed countries. Five years after the official registration of the first CDM A/R project, very little is known about the design and implementation of these activities. This is somewhat surprising if one takes into account the current move towards the establishment of an international framework for reducing emissions from deforestation, degradation and increasing carbon stocks through forest management (REDD+), which may likely include forest enrichment activities. This paper reviews the literature on carbon forestry and examines a sub-sample of Project Design Documents (PDDs) from existing CDM A/R projects in order to highlight the projects' potential positive and negative outcomes. Our analysis reveals that CDM A/R activities often rely on inaccurate carbon accounting methods that deem their actual mitigation benefits rather uncertain. Socio-economic assessments are non-existent or lack detail, casting doubt on projects' contribution to local and socially transformative development. And, finally, projects also lack rigorous information on benefit sharing and in doing so they mask who will benefit most from carbon trading. The discussion contrasts these findings with emerging empirical and critical literature, and we raise a word of caution on the future impacts of forest enrichment activities under REDD+.

Introduction

The Clean Development Mechanism (CDM) is one of three market-based instruments designed by the Kyoto Protocol (KP) to meet the emission targets of developed countries at the lowest possible cost, alongside international emissions trading and joint implementation (Brown and Corbera, 2003). The CDM promotes the design and implementation of climate mitigation projects in developing countries that generate Certified Emission Reductions (CERs) to be used for compliance by countries (i.e. specified in Annex B of the KP) and companies with emission reduction commitments. CDM projects should be 'additional' (i.e. reduce emissions beyond a business-as-usual baseline) and contribute to the host country's sustainable development (KP, Article 12). The CDM, as any other offset-based instrument, is, at best, neutral from a climate change mitigation perspective because it is based on the premise that emissions produced in one place can be compensated by equal reductions elsewhere.

The CDM project cycle consists of several consecutive stages. Developers design the project following a Project Design Document (PDD) template.[1] This PDD is then submitted to the host-country's CDM Designated National Authority (DNA), which should endorse or reject it according to the country's sustainable development criteria. If endorsed, developers hire a Designated Operational Entity (DOE) recognised by the CDM Executive Board (EB) – the governing body of the mechanism[2] – to validate the PDD. Once this happens, project documentation is sent to the CDM-EB for further consideration. The Board may either reject or accept the project subject to revisions. If approved, the project enters the official CDM registry and can start operating officially as a CDM project. Periodical verification reports by the same or another DOE[3] should be submitted to the CDM-EB before any issuance of carbon credits to project investors.[4]

There are various types of CDM projects, including wind parks and energy efficiency activities, amongst others (Ellis et al., 2007). However, CDM forestry options are restricted to Afforestation and Reforestation (A/R)[5] activities that are subject to more procedural restrictions than other CDM projects. On the one hand, they generate temporary or long-term CERs (tCERs/lCERs)[6] and the KP Annex B countries can only offset 1% of their annual baseline emissions with these credits (Dessai et al., 2005). On the other, the European Union decided to exclude A/R credits from the region's Emissions Trading Scheme (EU ETS) thereby constraining any potential credit demand from EU ETS regulated companies (Boyd et al., 2008).

The exclusion of forest conservation activities from the CDM and the subsequent decision of the EU to exclude forestry credits altogether from the ETS responded to past and still existing controversies on the use of forest ecosystems as sinks of carbon dioxide. In the run-up to the KP negotiations during the mid 1990s and during the design of the KP rulebook by the end of 1990s and the early 2000s, some developing countries, such as Brazil, India and China, and civil society organisations, like Friends of the Earth or the World Rainforest Movement, opposed the inclusion of forestry activities on the grounds that they would divert attention from the adoption of more

1 For detailed information on the PDD contents for A/R activities see: http://www.cdmrulebook.org/483

2 The Executive Board (EB) is formed by 10 experts in climate change mitigation projects who are appointed by different countries and regional groups involved in the Kyoto Protocol. The EB evaluates project documentation according to the methodological guidelines approved by the Conference of the Parties, manages the registry of CDM projects, monitors credit transactions and follows project evaluations. More information at: http://cdm.unfccc.int/EB/index.html

3 For small-scale projects, the same DOE can produce both validation and verification reports.

4 Detailed information on the CDM project cycle can be found at: http://cdm.unfccc.int/Projects/diagram.html

5 Establishment of forests in areas not forested for at least 50 years or in those deforested before 1990, respectively.

6 These credits are designed to address the risk of permanence. A tCER expires 5 years after its issue and a lCER expires at the end of the crediting period of the project activity. Both should be replaced after their expiry date and lCERs may also be subject to replacement if a project evaluation indicates a reversal of net anthropogenic greenhouse gas removals by sinks. The crediting period for an A/R activity under the CDM is either 20 years, which may be renewed at most twice (up to 60 years), or a maximum of 30 years (Dessai et al., 2005: 107-108).

significant greenhouse gas reduction commitments by developed countries. The same actors, and even some negotiating Parties, like the EU, also expressed concerns on the unlikely permanence of standing forest sinks and the potentially negative impacts of new-established plantations (Friends of the Earth, 2002; Dessai et al., 2005; Boyd et al., 2008). As explained below in greater detail, these controversies are far from settled and the recently established international framework for *Reducing Emissions from Deforestation and Degradation, plus conserving and enhancing forest carbon stocks and sustainably managing forests in developing countries* (REDD+) has reinvigorated them.

As of June 2010, at the time this research was conducted, there were only 15 CDM A/R projects registered and another 39 were at validation stages, representing overall less than 1% of the emission reductions potentially achieved by CDM projects up to 2012 (UNEP-Risoe, 2010). This contrasted with more than 2,500 projects registered and more than 3,000 pending validation in other sectors. However, the long time necessary to generate carbon offsets from all CDM activities – one single project can take on average three years to make its way through the project cycle and issue its first CERs – combined with the uncertainty regarding the future of the KP beyond 2012 and the global financial crisis, which has undermined developers' access to up-front finance, have compromised the development of the CDM market since 2008 (Thomas et al., 2009; Kossoy and Ambrosi, 2010). It is important to remark upon the role of the World Bank in promoting CDM projects. Since 2000, it has created over a dozen unilateral and multilateral funds dedicated to source and provide carbon credits to national governments and private companies, acting as an intermediary project quality insurer and credit manager. In the forestry sector, it established the Biocarbon Fund in 2002 to promote land-use and forestry projects and, more recently, the Forest Carbon Partnership Facility to support REDD+ government-led policies and measures. In the near future, funding for forestry activities, as well as other mitigation and adaptation activities in developing countries may be funded through the *Green Climate Fund*, a new funding mechanism adopted at the last meeting of the Parties to the UNFCCC in Cancun (2010) and that may become operational in 2012.

In parallel to CDM developments, other carbon forestry offset projects have been implemented in the context of Over-The-Counter (OTC) and the Chicago Climate Exchange voluntary carbon markets (Corbera et al., 2009; Hamilton et al., 2010a).[7] These projects have represented the second most preferred option for carbon offsetting in OTC markets during 2009, after having lost appeal in previous years. This has been explained by a renewed demand for these types of offsets from non-profit organisations, and a growing political recognition of 'the importance of forests in halting rapid deforestation and deploying carbon finance to developing nations' (Hamilton et al., 2010a: 32). An existing database shows over 200 projects around the world.[8]

---

7 There are forestry carbon projects operational in developed countries selling offsets in these and other compliance markets, like New Zealand's emissions trading scheme, but they are not covered here (Kossoy and Ambrosi, 2010).

8 See: http://www.forestcarbonportal.com/projects

Currently, the UNFCCC REDD+ framework has further increased the interest of policy, academic and NGO communities in forestry offsets. REDD+ is aimed at generating incentives for developing countries to protect and better manage their forest resources, by creating and recognising a financial value for the additional carbon stored in trees or not emitted to the atmosphere (Corbera and Schroeder, 2011). REDD+ implementation will vary across countries, encompassing a multiplicity of policy programmes and sub-national activities, based on forest conservation, forest enrichment and sustainable forest management (Corbera et al., 2011). Once the KP first (and maybe only) commitment period expires by the end of 2012, the CDM is unlikely to support the further development of A/R activities, which will probably become part of host countries' REDD+ strategies.

As REDD+ is nowadays in an incipient phase and CDM A/R activities have been under implementation for a few years only – the first project being registered in 2006 – carbon forestry research has mostly focused on examining the design and implementation of voluntary projects. A review of 23 projects in Africa (Jindal et al., 2008) shows that some initiatives contribute to converting grasslands into ecologically damaging tree plantations, as shown also in other previous studies (Granda, 2005), and it also demonstrates that some projects result in positive development outcomes, such as increased local incomes and improved natural resource management. Bozmoski and Hultman (2010), for example, show that two projects in Tanzania have contributed to improved forest management due to the high level of social capital present in participant communities. In contrast, other studies based in Mexico and Belize argue that carbon projects failed to involve poor landowners as a result of high political and transaction costs, and a strong bias in favour of efficiency and effectiveness as against equitable and legitimate outcomes (Brown et al., 2004; Corbera et al., 2007a).

Evidence on CDM A/R projects is still scarce. Thomas et al. (2009) rely on PDDs and secondary literature to explore four A/R projects and shed light on the factors influencing design and implementation. They show that projects are led by large organisations with technical expertise and that significant up-front funding is critical for projects' development. Private property rights seem to be preferable for developing plantations while they show that a substantial share of CERs revenue is likely to return to landowners. Gong et al.'s (2010) empirical assessment of the first registered project highlights that it facilitated local participation by establishing a carbon pooling and share-holding system that brought together communities, individual villagers and forest logging companies and should guarantee a fair distribution of carbon and timber revenues in the future.

Overall, research has shown that voluntary carbon forestry activities can result in both positive and negative impacts for local ecosystems and that, from a livelihoods perspective, property rights, land availability, social organisation and political networks constitute key factors in accessing and benefiting from carbon offsets (Corbera and Brown, 2010). The remainder of this paper aims to contribute to these debates by providing an in-depth, desk-based analysis of a sub-sample of CDM A/R registered projects. This exercise involves a larger project sample than similar research (Thomas et al., 2009) and critically confronts projects' documentation with their supposed objectives of mitigating climate change and promoting sustainable development. The following section reviews a series of concepts and debates that prove useful in discussing our collected data and in understanding forestry offsets more generally. The third section introduces methods and presents the results organised around six themes (participant actors, carbon accounting and monitoring, other environmental outcomes, institutional effects and livelihood benefits). The fourth section discusses the findings and the fifth summarises and concludes the paper.

Approaching the study of carbon forestry offsets

Carbon forestry projects are one of the multiple constituents of what some have called a 'new carbon economy' (Brown and Corbera, 2003) and others 'climate capitalism' (Newell and Paterson, 2010). In terms of economic activity and offsets value, forestry projects represent a small fraction of the carbon economy that in 2009 alone was worth €144 billion[9] (Kossoy and Ambrosi, 2010: 1). Beyond economic considerations, the relevance of these projects lies in the fact that they are unfolding in rural contexts to transform the ways in which landowners and communities value and manage landscapes and natural resources (Brown and Corbera, 2003; Corbera and Brown, 2010). Community forests are discursively becoming reservoirs of a tradable, yet invisible, commodity, and lands used for grazing can be, temporarily at least, reorganised as forest plantations or agro-forestry systems for carbon trading purposes. Carbon forestry projects thus emerge as a new form of environment-friendly development, built on the commodification of ecosystem services and the involvement of rural actors in international carbon markets. They are also part of a broader policy agenda promoting the use of Payments for Ecosystem Services (PES) as a means to value these services and promote conservation and rural development (Muradian et al., 2010).

The carbon accounting and trading component introduces a difference in the way that these projects are introduced to local communities that differs from previous attempts to promote conservation and development through certified forest management or markets for non-timber forest products. These projects are accompanied by a new discourse on ecosystem services, carbon sequestration and climate change and they entail the development of contracts defining rights, responsibilities and liabilities, and potentially involving actors that communities are not familiar with, such as consultants and carbon traders. Furthermore, in contrast with other PES schemes focusing on watershed regulation that prioritise local or regional self-sustaining funding frameworks, carbon forestry projects are embedded in broader governance processes and global carbon markets that influence the projects' operational rules and the type of buyers, predominantly from developed countries.

The measurement of carbon stocks and flows at national, regional or local levels to understand forestry activities' potential impact on GHG emissions has been a

9 This figure includes data from regulated markets like the EU ETS, the CDM, the Regional Greenhouse Gas Initiative in the United States, and the OTC and the Chicago Climate Exchange voluntary carbon markets. It excludes all other funding related to the promotion of energy efficiency, renewable energy and other technologies for climate mitigation.

flourishing field since the 1990s, of particular relevance for those interested in project design and implementation, and in the management of GHG land use emissions on broader scales (Brown, 2002; Sathaye and Andrasko, 2006; Skutsch and Ba, 2010). In spite of an increasing refinement of the methods and data available, plus the existence of good practice guidelines for calculating emissions from land-use, land-use change and forestry developed by the Intergovernmental Panel on Climate Change (2003), some concerns and limitations in carbon accounting have been raised. It has been argued that it is impossible to predict and to know exactly how much carbon is sequestered in a plantation and for how long because there are too many uncertain variables embedded in carbon sequestration models (Lohmann, 1999). Others have suggested that carbon accounting contributes to individuate and abstract an ecological function from its broader ecological and social context in order to facilitate valuation and commodification, which may over time result in environmental impacts and the loss of any formerly existing conservation logic (Bumpus and Liverman, 2008; Kosoy and Corbera, 2010).

Some authors have stressed that new planted trees can help to control flooding, soil erosion, salinization and sedimentation (Landell-Mills, 2002; Scherr et al., 2004) and that they can be particularly beneficial if they restore historically forested lands, use native species, and employ ecologically sensitive techniques for ground preparation, planting, and management (Orlando et al., 2002). However, ecological science is increasingly emphasising the need to recognise trade-offs in the provision and management of ecosystem services (Raudsepp-Hearne et al., 2010). Bäckstrand and Lövbrand (2006), for example, highlight the risk of prioritising single-species plantations that would offer large volumes of carbon offsets at the expense of other services, such as non-timber forest products. This approach could also increase erosion associated with poor land management and road building, reduce underground water supply and degrade soils and water quality if fertilisers are excessively used (FERN, 2001).

Besides the interaction of carbon forestry activities with their local (through reforestation) and global (through accounting) environment, another analytical domain of carbon forestry research has addressed the relationship with the local context, particularly through the lens of institutional analysis (Corbera and Brown, 2008). Succinctly, institutions are a major determinant of the relations between humans and the environment that can be generally described as systems of rules, decision-making procedures, and programs that give rise to social practices, assign roles to the participants in these practices, and guide interactions among the occupants of the relevant roles (Young et al., 1999). Institutions can take the form of formal legal rules, or they may be informal norms or conventions. Carbon forestry projects can thus be shaped by formal institutions such as agricultural and forestry policies, and by informal institutions such as traditional practices for natural resource management (Corbera et al, 2007a). Land tenure regimes have a particular relevance in the design and implementation of project activities, as do the type of activities promoted by the project (i.e. conservation, reforestation or forest management). For instance, operating the project on individual, privately owned plots over a large territory or on a large area under communal property would result in different project transaction costs and benefit sharing arrangements (van Kooten et al., 2004). A land tenure regime involving multiple resource users with specific 'bundles of rights' and divergent land-use management interests can also challenge project design and implementation (Corbera and Brown, 2010; Corbera et al., 2011). Complex land tenure systems are the common rule in developing countries as multiple and overlapping rights are often found in one single location (Lynch and Alcorn, 1994) and ambiguities within law, customs and conventions are frequent (Ribot and Peluso, 2003).

Projects can also contribute to create new institutions and modify existing ones. They can alter access relations over natural resources, including subsistence and marketed products, thus affecting rural actors unevenly and inducing social conflict (Brown and Corbera, 2003). Projects can also reinforce the socio-political status of local elites acting as intermediaries between the project and the community, which can translate into new natural resource management rules that are unfavourable to already marginalised resource user groups and households (Lele, 2003). More positively, however, they can facilitate the establishment of farmer groups and cross-scale social networks connected through land-use management and labour contracts driven by carbon trading, as well as promote the exchange of forest management best practice across participant landowners and communities (Corbera and Brown, 2010). Carbon forestry projects have thus been regarded as vehicles for rural development that can contribute to the diversification of livelihood by providing labour opportunities, new income sources and support community well-being, facilitating local demands (e.g. tenure security) and funding infrastructure (Boyd et al., 2007a/2007b; Jindal et al., 2008; Bozmoski and Hultman, 2009). Furthermore, if landowners and communities undertake carbon accounting and monitoring, projects can allow local people to become familiar with satellite positioning gadgets and related software, contributing towards their 'integration' into a knowledge and technology-driven global society (Skutsch, 2010).

In the same way that carbon forestry projects do not unfold in institutional or political vacuums, they are not ahistorical artefacts disconnected from development, policy and governance processes at national and international levels. Projects can act synergistically or conflict with rural development discourses and agendas that promote or challenge the idea of carbon markets (Kosoy et al., 2009) and subsequently change their operational design and implementation approach. Lansing (2009) has shown that a carbon forestry project in Costa Rica was originally designed on the basis of a rural development discourse that problematized some elements of the indigenous land-use system and according to the project's own cost-benefit calculations regarding planting options within such land-use system. Such calculations, however, led to unexpected carbon profitability scenarios that, in turn, challenged project developers' original conception of the project (i.e. developing agro-forestry systems) and ended up transforming – through planting – those elements of the system considered less problematic (e.g. fallow lands). What had to be a carbon forestry project, concerned with increasing the profitability of cacao agroforestry systems, became a reforestation project on fallow lands, which had implications for some resource users and the productive dynamics of the overall system. As we discuss later in the paper, A/R projects may critically contribute to transform fallow lands into carbon sinks and, in doing so, they may disrupt landscape productive dynamics that required such lands for temporal grazing and for recovering soil fertility levels before the next cultivation cycle.

The empirical assessment of carbon offsets 'production' has been recently accompanied by an interrogation of their 'distribution' and 'consumption'. Lovell et al. (2009) have offered a neat account of how offsetting has slowly transformed consumption practices through the development of appealing narratives on the role of offsets in climate change mitigation, social responsibility and pro-poor development. Looking at the governance of tree-based offsets in particular, Boyd (2009) has argued that there are competing narratives on the desirability and transformative character of these offsets that differ across and within participant actors and that in turn relate to underlying values and conceptions of environmental governance. She has noted that 'governance challenges facing the institutional design of tree offsets include the trade-offs between the global priorities for forest protection and local priorities for forest use' and, furthermore, highlighted that global climate and forest governance policies 'often depend on simplifying notions of nature and making carbon the same, while the diversity of local institutions, priorities, and the pluralist nature of forest protection diverges from grand blueprints' (*ibid*.: 2093).

Selecting and analysing CDM A/R activities

This section is based on the review of a sample of eight out of 15 CDM A/R registered projects as of June 2010. These were selected following geographical and design criteria. We chose the only two projects registered in African countries at the time, three projects in Asia, and three in South America, which in turn covered both small-scale (6) and large-scale (2) activities. According to the CDM rulebook, small-scale activities are those that are expected to result in net anthropogenic GHG removals by sinks of less than 8,000 tonnes of carbon dioxide and that are developed or implemented by low-income communities and individuals as determined by the host country (UNFCCC, 2005). Subsequently, large-scale activities are those that are expected to result in removals above 8,000 tonnes of carbon dioxide. At the same time, we ensured that the selected cases included planting on communal, individual and/or state property, and we made sure that projects funded by the World Bank's Biocarbon Fund were also included (3) (Table 1).

We relied on PDDs submitted by project developers and validation reports submitted by DOEs to infer present and future impacts on forests and livelihoods. All these documents are listed in the references section and are publicly available at http://cdm.unfccc.int. Our review also relied on academic literature published on CDM A/R projects (Thomas et al., 2009; Gong et al., 2009), and additional information available in project developers and the Biocarbon Fund websites. We organised and summarised all the information compiled in an Excel database that contained 44 criteria. This became the main source for the results and discussion presented below (Table 2).

Table 1: Projects description

Project Name	Location	Parties involved	Project Participants	Type of activities	Scale	Registration Date	Tenure System
Facilitating Reforestation for Guangxi Watershed Management	Guangxi Zhuang Autonomous Region, southern China	People's Republic of China + Italy + Spain	Four logging companies + Biocarbon Fund	Reforestation	Large	November 2006	Private & communal lands
Humbo Ethiopia Assisted Natural Regeneration Project	Southern Nations Nationalities and Peoples Region (SNNPR), South Western Ethiopia	Federal Democratic Republic of Ethiopia + Canada	World Vision Ethiopia + Biocarbon Fund	Afforestation & reforestation activities	Large	December 2009	Communal lands
Uganda Nile Basin Reforestation Project	Rwoho Central Forest Reserve, South Western Uganda	Uganda + Italy	National Forest Authority (NFA) + Biocarbon Fund	Reforestation	Small	August 2009	Public & communal lands
Nerquihue Small-scale CDM afforestation project	Provincia Colchaqua , Region VI of Central Chile	Chile + United Kingdom	Mikro-Tek Inc. + Natsource Europe Limited	Afforestation	Small	May 2010	Private lands
Reforestation in the Bolivian Tropics by Smallholders of 'Federación de comunidades Agropecuarias de Rurrenebaque' (FECAR)	Department of Beni, Northeastern Bolivia	Bolivia + Belgium	FECAR (community organisation) + Foundation Centro Tecnico Forestal (CETEFOR) + Asociacion Accidental Cetefor-Sicirec + Flemish Government	Reforestation	Small	June 2009	Private & communal lands
The International Small Group and Tree Planting Program (TIST), Tamil Nadu, India	Tamil Nadu, Southern India	India + United Kingdom	TIST (NGO) + Climate Change Carbon Fund II	Reforestation	Small	January 2010	Private lands
Reforestation of croplands and grasslands in low income communities of Paraguarí Department, Paraguay	Paraguarí Department, Southern Paraguay	Paraguay + Japan	Japan International Research Center for Agricultural Sciences (JIRCAS) + Instituto Forestal Nacional (INFONA)	Reforestation	Small	September 2009	Private lands
Cao Phong Reforestation Project	Hoa Binh province, Northwestern Vietnam	Socialist Republic of Vietnam + Japan	Japan International Cooperation Agency (JICA) + Vietnam's Forest Development Fund (FDF)	Reforestation	Small	April 2009	Private & public lands

Table 2: Collected data (split in four consecutive sub-tables)

Project location	Project Developers	Other intermediaries	Up-front investors	Buyers	Local participants	Community based/ individual based management	Carbon price	Financial additionality	Benefits-sharing	Size (scale)	Type of land
China	Four logging companies	Local forestry agencies	Government of Guangxi, Logging companies (via local commercial bank loans) and in-kind contributions from farmers (labour, land, fire control monitoring)	Biocarbon Fund on behalf of Spain and Italy	27 rural communities. 5000 households involved	Community based (2900 ha) + individual based (1100 ha)	Expected to be around 4 US$/tCO2	Financial internal rate of return attractive on the basis of different carbon price scenarios	Case 1: Farmer groups obtain tCERs + forest products revenue Case 2: Forest companies pay for farmers' labour while farmers obtain 60% of tCERs revenue and 40% of the income obtained from forest products	4000 ha (large)	Shrub land, grassland, and open tree degraded land
Ethiopia	World Vision Ethiopia	Ethiopian Agriculture, Rural Development & Forestry Coordination Office (ARDFCO)	Long-term grant from World Vision Australia, and community in-kind contributions (land, labour)	Biocarbon Fund on behalf of Canada	7 community-based cooperatives	Community based	Expected to be around 4 US$/tCO2	n.a.	tCERs revenue will be used to meet the costs of the project and to improve local infrastructure and food security. Forest products benefits will be shared between project managers and local communities	2728 ha (large)	Degraded land
Uganda	National Forest Agency (NFA)	The Rwoho Environmental Conservation and Protection Association (RECPA)	NFA main Investor (through the sale of harvesting licenses) and community in-kind contribution (land, labour)	Biocarbon Fund on behalf of Italy	About 700 workers on site, from which 250 members belong to community groups	Initially, NFA planting area (93%) and community based planting area (7%)	n.a.	n.a.	Communities will receive revenue from forests products and tCERs revenues from their own trees. NFA will get the revenues from its own trees	341.9 ha (small)	Degraded grassland
Chile	Mikro-Tek (Environmental biotechnology company)	n.a.	Mikro-Tek + plantations established by Sociedad Agricola Nerquihue Ltda (with temporary loans from government), and Inversiones y Forestal JBT Ltda.	Natsource Europe Limited, on behalf of the United Kingdom	Sociedad Agricola Nerquihue Ltda. PDD mentions only one landowner involved	Individual based	n.a.	n.a.	tCERs revenue will be shared between Mikro-Tek and the other participants. Forest products will be shared between Sociedad Agricola Nerquihue Ltda, and Inversiones y Forestal JBT Ltda.	312.1 ha (small)	Degraded grassland

Project location	Project Developers	Other intermediaries	Up-front investors	Buyers	Local participants	Community based/ individual based management	Carbon price	Financial additionality	Benefits-sharing	Size (scale)	Type of land
Bolivia	FECAR (Community org); Centro Tecnico Forestal (CETEFOR) (NGO); Sicirec Bolivia Ltd (Green/ethic investment fund)	n.a.	Asociacion Accidental CETEFOR-Sicirec (Dutch ethical timber fund) + in-kind contribution from farmers (land, labour)	Flemish Government	137 small landowners + 3 communal areas in 5 syndicates (of 20-60 families each)	95% individual based, 5% community based	n.a.	n.a.	tCERs revenue will be used to cover project costs. Forest products will be shared equally between farmers and CETEFOR-Sicirec	317 ha including 70 ha of silvopastoral systems (small)	Degraded cropland (rice and maize) and grassland
India	TIST India (The International Small Group and Tree Planting Program) (NGO)	Clean Air Action Corporation (CAAC) (consulting company)	TIST India + Clean Air Action Corporation (CAAC) (no information about the source of the funds)	Climate Change Carbon Fund on behalf of the UK	111 Small Groups of small landowners (1200 people in total)	Individual based	n.a.	n.a.	70% of tCERs revenue will be allocated to farmer groups and 30% to CAAC and TIST. Farmers will get all benefits from forest products	106 ha (small)	Degraded cropland and grassland
Paraguay	Japan International Research Center for Agricultural Sciences (JIRCAS) + Instituto Forestal Nacional (INFONA)	n.a.	JIRCAS + INFONA (providing seedlings and trainings), In-kind contribution from farmers (land, labour)	Japan	170 landowners	Individual based	n.a.	n.a.	tCERs revenue to be shared between JIRCAS and INFONA. Farmers will get all benefits from forest products	215 ha including 52 ha of agro-forestry (small)	Degraded cropland and grassland
Vietnam	Forest Development Fund (FDF) (NGO) (founding members composed of Vietnam Forestry University and Cao Phong district People's Committee)	Vietnam Forest University (VFU) (state university) + Research Center for Forest Ecology and Environment (RCFEE)	Donation by undisclosed Japanese company, In-kind contributions from farmers (land, labour)	n.a.	321 landowners + community labourers to plant trees on public land	Individual based + state owned	n.a.	Financial internal rate of return attractive even if tCERs are not sold	tCERs and forest products revenue shared equally between project management and farmers	365 ha (small)	Degraded grassland and shrub land

Project location	**Species**	**Tree species' selectors**	**Fertilizers**	**Pesticides**	**Reference to Sustainable Forest Management Standards**	**Environmental impact assessment + monitoring of environmental impacts**	**Environ-mental benefits claimed**	**Environ-mental risks claimed**	**Start date and duration of the crediting period**	**Estimation of net anthropo-genic GHG removals over the crediting period (tonnes of CO_2e)**	**Annual average of GHG removals over the crediting period (tonnes of CO_2e)**
China	6 species. Fast growing trees. 75% native trees, 25 % Eucaplyptus	Local farmers + logging companies	To be used in Eucalyptus plantations	Limited application	No	EIA undertaken + monitoring plan	Biodiversity, soil erosion control, protection watershed, regulation hydrological flows	No negative impacts identified	April 2006. 30 years, non-renewable	773,842	25,795
Ethiopia	A variety of indigenous trees + fast growing species used on 500ha (e.g. Eucalyptus and Acacia)	n.a.	None	Not mentioned	No	Preliminary environmental assessment undertaken + Monitoring plan	Flood and land erosion control, Watershed protection, Biodiversity conservation	No negative impacts identified	December 2006. 30 years, non-renewable	880,296	29,343
Uganda	Three species. 75% Pinus Caribaea (non-native), 20% Maesopsis (native), 5% Prunus African (native)	Project developer	None	Used as a last resort	No	EIA required by host country & conducted by auditing firm + Monitoring plan	Biodiversity conservation, Soil erosion control, Improved quality of downstream water supply	Reduction in total flows of water from the watershed	April 2007. 20 years, potentially renewed twice	111,798	5,590
Chile	Pinus Radiata (non- native) + 60000 Quillaja saponaria seedlings (native) distributed to 120 honey producers (not included in the plantation)	n.a.	Yes	Not mentioned	No	Project endorses the DNA criteria. No EIA required by the host party + No monitoring plan	Flood and soil erosion control, Watershed protection, Biodiversity conservation	n.a.	January 2003. 20 years, potentially renewed twice	185,836 (but only 152,000 are accounted in order to be eligible as a small scale project)	9,291 but only 7,600 accounted

Project location	Species	Tree species' selectors	Fertilizers	Pesticides	Reference to Sustainable Forest Management Standards	Environmental impact assessment + monitoring of environmental impacts	Environ-mental benefits claimed	Environ-mental risks claimed	Start date and duration of the crediting period	Estimation of net anthropo-genic GHG removals over the crediting period (tonnes of CO_2e)	Annual average of GHG removals over the crediting period (tonnes of CO_2e)
Bolivia	12 native species + Tectona grandis (non-native) only on a small scale	Project developer	None	No herbicides. Pesticides used as a last resort	No	Required by Bolivian law. EIA done by an accredited consultant. Mitigation measures & monitoring put in place	Creation of ecological corridors, Improved soil conditions	Negative impacts qualified as minor compared to environmental benefits	February 2008. 21 years, non-renewable	91,165	4,341
India	3 main species. Casuarina equisetifolia (native); Eucalyptus grandis (native); Tectona grandis (native)	Small groups	Not forbidden but refrained	Small groups trained to use local natural techniques to manage pests	No	No EIA + No monitoring plan	Soil degradation control	n.a.	January 2004. 30 years, non-renewable	107,810	3,594
Paraguay	3 species. Eucalyptus grandis, Eucalyptus camaldulensis, and Grevillea robusta (all fast-growing and non-native). 52ha of an agro-forestry scheme	Farmers supported by JIRCAS and INFONA	Synthetic fertilizers forbidden	Not mentioned	No	No EIA + No monitoring plan	Soil erosion control, Development of wind shields	Fears from farmers that crops could lack water due to Eucalyptus plantations	July 2007. 20 years, non-renewable	30,468	1,523
Vietnam	Acacia mangium and Acacia auriculiformis (non-native, fast-growing)	Farmers supported by government foresters and consultants	Use of fertilisers	Can be applied following the Vietnamese regulations	No	No EIA + No monitoring plan	Soil erosion control, Rehabilitation of degraded land, Improved land productivity	n.a.	May 2009. 16 years, potentially renewable	42,645	2,665

Project location	Former land use	Leakage	Leakage monitoring	Frequency of carbon sequestration assessment	DOE contracted for validation	Land tenure regime	Land tenure regime history	Likely effects on bundles of rights	Description of customary rights over project lands	Management response to potential conflicts
China	None	19,852 tCO_2e associated with fossil fuel combustion	Monitored regularly (PDD does not indicate the exact frequency)	Every 5 years before verification	TÜV SÜD	Communal lands (2,900 ha) + farmers' plots (1,100ha)	In the 1980s, the state leased the land to farmers for 50 years	Conflicts regarding communal lands boundaries (Corbera and Brown, 2010)	n.a.	None identified
Ethiopia	Fuel wood collection, Charcoal making, Grazing	No leakage. Establishment of fuel wood plantations, Identification of alternative community grazing areas	Leakage monitored the first five years (PDD does not indicate the frequency after that)	Every 5 years before verification	JACO CDM LTD	Allocation of the legal ownership of the communal land to 7 community cooperatives	Prior to the project, the area was owned by the government	Rights over lands issued to community cooperatives	n.a.	The existing beneficiaries of grazing lands were included in project consultations
Uganda	Cattle grazing, Subsistence agriculture	No leakage. Grazing displaced but enough grazing area around the project. (Nothing said about displacement of subsistence agriculture)	No monitoring	Every 5 years before verification	JACO CDM LTD	Planting area property of NFA, and NFA can issue tree planting licenses to communities	n.a.	Allocation of land licenses within the reserve to communities	PDD mentions that villagers have been using the project area for subsistence agriculture and grazing	PDD expresses potential conflict over reduced land for illegal grazing
Chile	Occasional goats grazing	No leakage. Goats displaced to other grazing lands	No monitoring	Every 5 years before verification	TÜV SÜD	Private land. One landowner.	n.a.	n.a.	n.a.	No

Project location	Former land use	Leakage	Leakage monitoring	Frequency of carbon sequestration assessment	DOE contracted for validation	Land tenure regime	Land tenure regime history	Likely effects on bundles of rights	Description of customary rights over project lands	Management response to potential conflicts
Bolivia	Cattle grazing, annual and perennial cropping	24,124 tCO_2e due to displaced grazing activities. Croplands displaced but no leakage as enough surrounding areas for cropping	Only monitoring of cattle needed (PDD does not indicate the exact frequency)	Every 5 years before verification	JACO CDM LTD	95% private lands, 5% communal lands	Private lands since the mid 1980s	n.a.	n.a.	No
India	Cropping and grazing	No leakage. Displacemen t of croplands on the farmers' existing farm plots	Once before verification	Every 5 years before verification	TÜV SÜD	Private lands owned by subsistence farmers	The land is either of old ownership or it has been transferred only a few years ago	n.a.	n.a.	No
Paraguay	Cropping and grazing	18,983 tCO_2e due to the displacement of croplands and grazing activities	Once before verification	Every 5 years before verification	TÜV SÜD	Land owned by farmers: 56% are legal owners while 44% have an occupation certificate	At least a hundred years ago	n.a.	n.a.	No
Vietnam	Extensive grazing of livestock, Occasional slash and burn cultivation, Fuel wood collection	11,090 tCO_2e due to the displacement of croplands and grazing activities	Once before verification	Every 5 years before verification	JACO CDM LTD	Common land with land use rights distributed to households and Public lands managed by two communes	The District issued land use right certificates in 1995 to encourage reforestation (valid for 50 years)	n.a.	PDD mentions that the project area is considered as a "common access" area by all the villagers	No

Project location	Creation of new organisations	People displace-ment	Level of life	Participatory methods	Number of farmers interviewed during validation	Economic benefits	Labour inputs	Calculation of local opportunity costs	Non-economic benefits for local communities	Socio-economic impact assessment and monitoring
China	Farmers are organized in groups	No	Mean annual income per capita in the project areas estimated at US$145. Many farmers live below the national poverty line	Participatory Rural Appraisal methods (PRA)	No farmer interviewed	Average income per capita increased by US$34, through the sale of credits and forests products, or employment + Sustainable fuel-wood supply	5 million person-days of temporary employment + 40 long-term positions	Estimated on the basis of mean annual agricultural income (i.e. US$145)	Forest management training	Socio-economic impact assessment undertaken. + Monitoring plan including social considerations
Ethiopia	Establishment of seven community cooperatives	No	The mean annual income per capita in the region is US$81. 80% of the region's population are below the poverty line	Participatory Rural Appraisal methods (PRA)	No farmer, but 11 representatives of the cooperatives were interviewed	Revenue from forest products + sustainable fuels source	9,000 temporary jobs + 12 long-term positions	n.a.	Forest management, Agro-forestry, Eco-tourism, Livestock management training	No impact assessment. Establishment of a social mitigation monitoring and action plan
Uganda	n.a.	No	No economic opportunities Average salary in the area US$2 per day	Participatory approach. Particular attention to women and leaders' involvement	No farmers, but representatives of communities were interviewed (no details on how many)	Wages will be in the range of US$2 per day. Communities planting their own trees will benefit from tree products, tCERs and the provision of fuel wood	700 jobs for local population: 500 jobs during planting and 200 jobs during ongoing management	Hardly any income generation opportunities in the area	Forest management training	Not required by the host party but carried-out by NFA. Socio-eco monitoring on the ground by NFA
Chile	n.a.	No	Low-income communities	Meetings with local stakeholders	No landowner or local villagers interviewed	Revenue from forest products and tCERs for the landowner + Salary for the farmers employed + Quillaja Saponaria seedlings distributed to 120 small-scale honey producers	Community employment and job creation (no detailed information provided)	n.a.	Technology transfer regarding the use of Mycorrhizal inoculation technology	Criteria developed by the DNA respected according to the PDD

Project location	Creation of new organisations	People displace-ment	Level of life	Participatory methods	Number of farmers interviewed during validation	Economic benefits	Labour inputs	Calculation of local opportunity costs	Non-economic benefits for local communities	Socio-economic impact assessment and monitoring
Bolivia	Creation of a forestry committee to coordinate farmers	No	Low-income communities	Participatory approach	No farmer, but 2 community representatives interviewed	Payments to farmers (US$21 /year/farmer) + Revenue from timber + Income from more efficient land use	151 people employed the first year. Average amount of jobs per year during 40 years: 32	Cattle breeding (net income 151 US$/year), Rice cultivation (net income 234 US$/year)	Forest management and agro-forestry training	Socio-economic impact assessment carried out by CETEFOR
India	111 small groups of farmers	No	41% of the members earn between US$21 and US$250 per year. More than 60% of the members earn less than U$1 a day	Monthly meetings and annual seminars + Consultation of the women's association	10 farmers out of 1200	Small groups earn about US$16,5 per hectare per year as an advance on carbon payments. In total they can potentially cash in US$95/ha/year + Revenue from forest products	13 employees including the program director, coordinators, and quantifiers	Average net farm income per hectare per year: US$102	Transfer of technology through workshops + Training on health issues (HIV/AIDS)	No
Paraguay	n.a.	n.a.	Average income per year on the project area around US$162 (half of the national average)	Consultation through meetings and surveys. Encouragement of participation through village leaders	13 farmers out of 170	Income generation through the sell of forest products + Sustainable fuel-wood supply	No employment. Each landowner provides its own labour	n.a.	Forest management and agro-forestry training	No
Vietnam	n.a.	n.a.	Low-income communities	4 meetings were held but there is not detailed information on farmers' participation	4 villagers out of 854	Revenue from tCERs and timber + Improved household economy due to the fodder production plan	n.a	n.a.	Forest management training	No

Project actors

All CDM A/R activities involve a project developer, one or more investors, a carbon buyer, and one or more carbon sellers. Project developers include profit-driven businesses, such as logging companies (China), biotechnology firms (Chile) and investment companies (Bolivia), as well as non-governmental organisations (Vietnam, India, Bolivia, Ethiopia) and public entities from the host or another country (e.g. Uganda and Paraguay). Many project managers do not have skills in community-based capacity building (e.g. China, Uganda, Chile, Paraguay, Vietnam) and some therefore rely on local forestry and community organisations to facilitate project implementation and liaise with farmers and communities (Chile, Uganda). Most project developers lack the expertise required for carbon accounting, monitoring and trading, and therefore hire experts and consulting companies for these purposes (e.g. Ethiopia, Uganda, Paraguay, China, Vietnam, India). Only the Bolivian and Chilean project developers have skills in carbon trading and specifically claim to be developing A/R activities to make a profit.

Organisations providing up-front investment for project development are also diverse. In Paraguay, the government's National Forestry Institute provided up-front funding whilst in India funding was provided by a local NGO in partnership with a consulting company. The Vietnamese project relied on financial support from the Japanese cooperation agency and a private company, while the establishment costs of the Chinese project were covered by local commercial bank loans and funds from the local government. Up-front investment for the Ethiopian project was provided by a long-term loan and a grant from an international NGO. The National Forestry Agency supports the Ugandan project through the sale of harvesting licenses. The Chilean project is funded by government loans to the landowner and by the biotechnology and logging companies involved. Finally, a Dutch ethical investment has supported the start-up of the Bolivian project. Most up-front investors, with the exception of Vietnam and Uganda, expect to recover all or at least a share of their funds through the sale of tCERs and timber in the future. The presence of only one investment fund may be explained by the fact that sequestration activities are not the most profitable financial placements compared to other GHG reduction activities.

As tCERs cannot be traded in the EU ETS, buyers for CDM A/R offsets are often Annex B country governments channelling funds directly to the project or through the World Bank's Biocarbon Fund in order to receive, in exchange, credits for meeting their countries' KP emission reduction commitments. The Biocarbon Fund supported one third of the 15 registered projects as of July 2010, demonstrating the Bank's role in fostering CDM A/R activities (Boyd et al., 2009). As noted above, the Bank's interest in forestry activities as a mitigation strategy was renewed in 2008 through the establishment of the Forest Carbon Partnership Facility to support the development of REDD+ activities (Corbera and Schroeder, 2011). In our sample, three projects will sell tCERs to the Biocarbon Fund (China, Ethiopia, Uganda), two will sell tCERs to investment companies managing carbon funds on behalf of the British government (Chile, India), while the Bolivian and Paraguayan projects will sell directly to the Flemish and Japanese governments, respectively. The Vietnamese project's PDD does not specify who will buy future tCERs.

It is relevant to note here that only the Chinese PDD includes detailed information on the price of the tCERs and the expected carbon revenues over the project lifetime. Lack of financial data in the other reviewed cases suggests that tCERs economic value may be negotiated *ex-post* (once credits are verified) and that such value will be influenced by future carbon prices. The seller becomes a 'price taker', insofar as the value of carbon will not depend on the relative costs of A/R activities in each particular context. When the purchaser is the Biocarbon Fund, as in the Chinese and Ethiopian cases, the carbon price is set up-front at approximately US$4 per tonne of carbon dioxide equivalent (CO_2e). This figure is lower than the US$4.76 for transacted tCERs up to 2009 and than forest offsets in the OTC market, which traded at an average of US$8.44 per tonne of CO_2e (Hamilton et al., 2010b: viii). However, it is higher than the average US$3.03 of forestry credits traded under the Chicago Climate Exchange offsets market (*ibid*.). Forestry credits always trade below the average CERs price, which was US$12 in 2010 (European Climate Change Limited, 2010). This lower economic value[10] of forestry offsets can be explained by buyers' perception of risk, which includes the already highlighted issues of permanence, the exclusion of tCERs from the EU ETS, and presumably also the projects' potential failure to deliver reductions in the long-term due to changing socio-political and land-use circumstances.

Carbon accounting and monitoring

In order to calculate the potential net benefits of forest plantations in terms of carbon offsets, A/R projects must select and adopt a methodology previously approved by the CDM Executive Board. As of June 2010, there were 6 approved methodologies for small-scale A/R projects and 10 for large-scale ones. Six out of the eight projects analysed in this paper use the same methodology related to small-scale afforestation and reforestation projects implemented on grasslands and croplands. The methodological requirements for small-scale projects are simpler than for large scale, and carbon accounting methods in both cases consist of calculating the difference between the actual net GHG removals achieved by A/R activities and the carbon stocks and emissions baseline without the project, taking into account the likely potential leakage attributable to the project (i.e. carbon emissions generated by project activities). In turn, the actual net GHG removals by project activities (i.e. reforestation) are equal to the sum of the changes in biomass carbon stocks in the project scenario minus the total biomass loss (above ground biomass + below ground biomass) due to clearance of pre-existing vegetation, and should be monitored approximately every five years.

In order to estimate the actual GHG benefits of the project, developers should therefore know the average carbon sequestration capacity and carbon content of the different carbon pools and sinks, including trees, shrub and grassland species. This data is highly context-specific because it depends on ecosystems' composition, species types and local environmental factors, such as rainfall, temperature and soils, among others. In most cases, projects define baseline and sequestration scenarios on the basis of existing data for similar ecosystems and some key species but rarely calculate empirically such data in the project context. The Ethiopian PDD indicates that it lacks data on growth rates for

10 Prices for forest carbon credits have ranged from U$ 0.65 to more than U$ 50 per tone of CO_2-e in some cases (Hamilton et al., 2010b).

native species and thus finds it difficult to estimate carbon stock changes. Apparently, the Chilean project builds the carbon baseline scenario, relying on regional estimates of above and below ground biomass for similar grasslands, following IPCC guidelines. Although both projects claim to take a conservative approach to minimise the risk of over or underestimating future and present carbon stocks, these two examples remind us of the fact that data assumptions very often underlie carbon content assessments.

Projects generally assume that the baseline carbon stock is equal or close to zero. They argue that 'degraded' croplands and shrub lands are unlikely to increase their carbon content over time, with vegetation growth limited or constrained by poor soils. In the CDM A/R context, 'degraded' lands are understood as lands with significant levels of soil erosion and reduced organic content that have already translated into a recession or the actual disappearance of vegetal cover due to climatic factors and unsustainable land management practices such as overgrazing (UNFCCC, 2008). Some PDDs thus provide sound arguments justifying the current degradation levels of project areas on the basis of a historical analysis of land-use change and existing alternatives under current policy frameworks for land management and restoration. Others, like the Chilean case, fail to provide convincing explanations of what would have occurred with carbon stocks in the project area without the project, thereby compromising the actual GHG benefits reported and casting doubt on the project's environmental additionality and the credibility of project developers and validators.

In small-scale projects, leakage accounting is limited to understanding and accounting for the displacement of people, grazing and cropping activities. In large-scale projects, methodologies are stricter and more factors have to be accounted, such as the use of fertilisers, emissions from vehicles (China), or the use of woodpost fencing and the displacement of firewood collection (Ethiopia). Three out of six small-scale projects account for leakage due to displacement of activities in the calculations of GHG benefits (Vietnam, Paraguay, Bolivia) and will therefore monitor it before verification. The other projects assume that there will be no leakage and argue that no monitoring is therefore required in this respect.

Uncertainties in carbon pools and sinks data, as well as very divergent levels of leakage accounting and monitoring across projects, may translate into either under or overestimations of climate mitigation benefits. Figures in Table 1 for carbon sequestration rates vary from 6.5 tonnes of CO_2e (China) to 29.8 tonnes (Chile) and 33.1 tonnes (India), with most projects reporting sequestration rates between 6 and 16 tonnes. Different tree species, forestry systems and management methods explain these divergences. The Chilean project, for example, uses *Mycorrhizae* to favour plantation growth, and projects in Paraguay and Bolivia promote agro-forestry or silvopastoral systems that generate fewer carbon offsets than plantations.

Other environmental outcomes

Five projects note that implementation will combine native and non-native fast-growing trees, such as *Eucalyptus sp.*, *Acacia sp.* and *Tectona grandis*. Two of these (China and Ethiopia) involve large-scale plantations, which may probably mean that non-native species are left for planting along the margins, or on smallholders' agricultural plots.

The other three projects involve only fast-growing native (India) and non-native (Vietnam, Paraguay) trees. Overall, most projects reproduce a plantation-based model that has been heavily criticised in other voluntary carbon projects in Ecuador and Brazil for their negative impacts on soils, groundwater flows, and for providing poor labour conditions and excluding local people from decision-making, among others (Albán and Argüello, 2004; Granda, 2005; Boyd et al., 2007a; Kruter Flores et al., 2009). The information on the PDDs also seems to reinforce the idea that project developers and farmers are inclined to select species that can quickly generate timber and carbon credits, ignoring slow-growth trees that can produce benefits for other community members, particularly women (Corbera et al., 2007a).

In spite of such planting schemes, all PDDs highlight that projects will enhance biodiversity, control soil erosion, and improve water infiltration. Yet, they fail to explain in detail how they will guarantee the realisation of such environmental benefits. Only three out of eight projects included an Environmental Impact Assessment (EIA) during their design (China, Uganda, Bolivia) and only five are planning to monitor their environmental impacts over time. Only three projects explicitly forbid the use of fertilisers (Ethiopia, Uganda, Bolivia) while the rest provide very vague information in this respect. Furthermore, projects do not explicitly contemplate the adoption of international management standards, such as those developed by the Forest Stewardship Council (FSC), and they also ignore existing guidelines for carbon forestry projects as promoted by the Plan Vivo Foundation or the Climate, Community and Biodiversity Alliance (Dutschke et al., 2005). We are obviously aware that EIAs and certification standards do not guarantee *per se* the development of a social and environmentally sound project. Evidence from other sectors, such as infrastructure projects, has shown that EIAs have often acted as a smokescreen to get rather damaging projects approved (Tullos, 2009). Seemingly, both activists and academics have exposed the FSC for certifying plantations that compromised the livelihoods of surrounding populations and ecosystems (Lang, 2006; FSC Watch, 2011) or have shown the inherent contradiction of promoting standardisation while sustaining trans-national and socially uneven commodity chains that do not effectively engage with the demands of social movements (Klooster, 2010).

Institutional effects: tenure regimes and organisational change

As suggested in section two, CDM forestry projects are likely to alter existing local institutions related to resource management, including property rights and existing rules for natural resource management. They can at best facilitate the strengthening of existing institutions for sustainable resource management and promote sustainable practices among participants and their communities (Vatn, 2010). At worst, they can induce conflict by limiting access to natural resources and changing power relations among community members (Corbera et al., 2007a; 2007b). It is evident that project impacts on local institutions are difficult to assess without conducting on-site empirical research. Therefore, we only highlight below the type of tenure regimes in which projects operate and we infer their likely impact on local 'bundles of rights' (Ostrom and Schlager, 1996) based on the PDDs and validation reports.

The projects reviewed operate in diverse tenure regimes. Three projects are developed exclusively with private landowners (India, Chile, Paraguay), one project plants trees on communal lands (Ethiopia), and four projects combine different property regimes. The Chinese and Bolivian projects are developed on communal and private lands, the Ugandan project encompasses state and communal lands, and the Vietnamese project operates on public and private lands. Most PDDs note that land tenure regimes will not be significantly altered as a result of the project (e.g. by changing the legal provisions of the regimes) but some recognise that activities may involve a reallocation of rights and responsibilities among resource users. In the Ethiopian project, for example, communal lands will be formally distributed across seven community cooperatives that have been created purposively for the project. However, the consequences over those who have access to communal lands but do not belong to the cooperatives are not discussed. In the Ugandan project, the National Forest Agency will issue land licences for tree planting to communities within the reserve area and this is regarded as a means to establish trust and encourage local populations to protect plantation sites from fire or illegal activities (e.g. grazing or firewood harvest). In this respect, we would argue that existing relationships between forest officers and community members, including patronage, kinship or corruption practices, may play a key role in the processes of granting licenses or prosecuting those who carry out forbidden activities.

The Vietnamese PDD notes that the project's plantation was before 'a common access area', where right holders and other households developed grazing and firewood collection activities but, as in the Ethiopian case, nothing is said about any possible impacts that may unfold with such restrictions (PDD, 2010: 35). Seemingly, the Ugandan PDD highlights that, in the past, villagers used the project lands for subsistence agriculture and grazing, and notes that 'these communities will be entitled and supported to grow trees within the project boundary and to earn carbon credits in the project activities if they join RECPA – a community organisation – or form a community association' (PDD, 2010: 10). Nothing is said about the re-allocation of land management activities or what would happen if not all farmers join the RECPA. There is already evidence in the Chinese project, for example, that conflicts over access to land and labour as a result of project activities are slowing down reforestation plans (Gong et al., 2010; Corbera and Brown, 2010).

In addition to changing tenure relations and people's access to land, some of the examined PDDs contribute to establish and formalize groups of farmers (India and China) or cooperatives (Ethiopia) that are aimed to exchanging experiences across participant groups and communities, establishing rules for plantation management, strengthening social cohesion, and decreasing project transaction costs for farmers and developers. Other projects rely on existing institutions for project development, such as the Ugandan case where land licenses are distributed through a community-based conservation organisation (i.e. REBCO), or the Bolivian project that was designed with the participation and support of an association of rural communities (i.e. FECAR). The extent to which projects are successful in creating or reinforcing institutions for forest management needs to be assessed empirically. Some evidence from voluntary carbon projects already shows that existing organisations can help to reduce conflicts and transaction costs (Bozamoski and Hultman, 2010), but it has also been demonstrated that creating project-based groups can be time and resource consuming, extremely political, and be riddled with conflicts between and amongst project managers and farmers (Nelson and de Jong, 2003; Boyd et al., 2007a; Corbera et al., 2007a).

Participation, livelihood benefits and benefit sharing

Local participants in CDM forestry projects are generally described as 'low-income communities' who will be able to develop forestry activities by accessing up-front funding provided by project developers. They will become involved in the project either as an individual landowner (China, Chile, Bolivia, India, Paraguay, Vietnam), a community owning the land (Bolivia, Uganda, Ethiopia, China) or by providing labour to whoever owns the land. Some PDDs explain in detail participants' income level while others, like the Chilean and Bolivian cases, do not even mention it. Only two of the projects involving rural communities (India and Uganda) acknowledge the need to include women and the landless in project decision-making. And only the Chinese and the Ethiopian projects have adopted Participatory Rural Appraisal methods in project design although they fail to justify the degree of representativeness and legitimacy of selected interviewees. For example, communities' perceptions on the Chinese project are sourced from 121 out of 14724 households and the PDD says little about the representativeness of the selected households in terms of decision-making power and poverty levels (Corbera and Brown, 2010). Reports from projects' validation are also revealing in this respect: in two out of the eight selected projects, villagers or community representatives have not been interviewed during the auditing process (China, Chile); in three projects, only key local representatives have been interviewed (Ethiopia, Uganda, Bolivia), and in the remaining cases, only some villagers have been interviewed (India, Paraguay, Vietnam), with a ratio of 'interviewed people/participant population' of 10/1200, 13/170, and 4/854 households, respectively.

Regarding expected impacts on livelihoods, PDDs distinguish between economic and non-economic benefits. In some cases, as explained earlier, farmers involved in plantation activities as landowners or community members will benefit from future (yet uncertain) carbon and timber revenues. Other farmers will also benefit by accessing labour and/or improving their land-use systems, potentially increasing agriculture-based income (Bolivia, Chile and Vietnam). However, only four PDDs include an opportunity cost analysis to verify that the project is actually additional for individual participants and communities (Bolivia, India, Uganda, China). Projects also aim to provide non-economic benefits to farmers and communities, including technical assistance and training regarding tree planting activities (all projects), training in agro-forestry activities (Bolivia, Chile, Ethiopia, India, Vietnam), and supporting the local health clinic while expanding the use of new technologies such as the internet and GPS (India).

Projects' benefit sharing system, broadly understood here as the social arrangement defining the allocation of economic and non-economic benefits derived from the governance and management of ecosystem goods and services, is presented in contrasting detail. For instance, while the Chinese PDD explains how much money each participant will potentially get along the project lifetime from both timber and carbon revenues, the Vietnamese PDD does not provide any data, thus making it impossible to define how much farmers and communities will earn from participating in the project. Other PDDs (Chile and Ethiopia) indicate that contracts among participants are available for DOE inspections but remain confidential to the general public. The lack of detailed information on revenue sharing renders projects rather unaccountable because independent researchers or other interested parties cannot contrast project-based documentation with ex-post, on-site evaluations.

We have identified various forms for distributing projects' economic benefits. Temporal CERs revenues are in four cases shared between project managers and participant farmers or communities (China, Chile, India, Vietnam), accrue directly to the project manager to cover project management costs (Ethiopia, Bolivia, Paraguay) or accrue to the owner of the land, be it the government, the farmer or the rural community (Uganda). Revenues from timber and non-timber forest products are shared between project managers and landowners in five cases (China, Ethiopia, Chile, Bolivia and Vietnam) while in the other cases accrue uniquely to landowners (i.e. farmers, communities or the government). Nothing is said however about how the non-financial benefits mentioned above have been prioritised and which local actors will be targeted, for example, to participate in forest management training.

Discussion

Uncertainties over benefits claimed

The purpose of CDM A/R projects is to contribute to climate mitigation while promoting local and national sustainable development – however loosely defined by the host countries. The analysis presented above shows that projects involve a variety of actors and that their implementation requires up-front funding (provided by various international and national actors), land (provided by private landowners, communities and/or the government) and technical expertise regarding forest management, community capacity building and carbon accounting, monitoring and trading (see also Thomas et al., 2009). Worryingly, however, the findings demonstrate that project developers often lack expertise on carbon monitoring and trading and have limited experience in undertaking community-based, participatory development projects. Furthermore, PDDs contain a number of information gaps and design inconsistencies that may render the projects unaccountable from environmental and development perspectives.

From a climate mitigation point of view, PDDs do not allow to accurately judge whether projects will actually sequester carbon beyond a 'business as usual' scenario. At least two of the selected projects acknowledge difficulties in getting accurate data on carbon sequestration rates and flows across carbon pools and in drawing baseline scenarios, while the others are based on existing estimates as suggested by the IPCC international guidelines, rather than relying on field-based assessments. To be developed properly, projects would have to measure not only tree growth, rates of decay and gas transfer at canopy level, but also 'the effect on soil carbon production both inside plantation boundaries and downstream, and the effects of plantations on the human groups displaced or otherwise affected' (Lohmann, 1999: 515-516). However, this would be a very timely and costly process that is not contemplated by the CDM A/R small-scale methodology. In any case, it is impossible to draw an exact counter-factual baseline for biomass and soil carbon without the project because many uncertain factors have to be taken into account such as 'trade patterns involving commodities produced on forest lands,… as well as predictions about future currency exchange rates' (Lohmann, 2009: 516).

The PDDs also fail to explore in-depth leakage risks. This may be seen as rather logical insofar as project managers may have a vested interest in underestimating it. It is unrealistic to expect that DOEs will be able to accurately account for leakage processes (at both validation and verification stages) because they lack knowledge of local land-use dynamics and they do not remain on project sites for a long period of time. As of June 2010, there were sixteen DOEs accredited by the CDM Executive Board to validate, verify and certify A/R projects but our selected cases have been validated by only two of those, namely the Japanese JACO CDM and the German TÜV SÜD. In fact, TÜV SÜD was temporarily suspended in March 2010 for validating projects that were not necessarily additional and for delivering an opinion that was influenced 'by undue pressure' (CDM Executive Board, 53rd meeting, March 2010). Therefore, it has been argued that the CDM is heavily mediated by the expertise and decision-making power of intermediary consultants and DOEs, which inevitably leads to 'questionable carbon dumps' (Lohmann, 2005).

For some analysts, these accounting and monitoring uncertainties do not challenge the climate mitigation benefits associated with carbon forestry because they also characterise other CDM sectors (Chomitz, 2002) or because the 'objective of carbon finance is to provide financial incentives to promote a new paradigm, in this case related to a better utilization of forests by valuing them as carbon pools' (Aukland et al., 2003: 135). Furthermore, they argue that the consideration that carbon sequestered in trees is 'fragile' because it can be released into the atmosphere anytime through wildfires and political and institutional changes (Lohmann, 1999) is also irrelevant insofar as the question of permanence has been addressed with the recognition that forestry CERs can only be temporary, and buyers should replace them with energy-based offsets in the long term. Although we would agree with the fact that offsets in general are characterised by accounting and monitoring uncertainties, we would challenge the view that they induce behavioural change. In the case of A/R activities, the focus is not on changing the behaviour of deforestation agents but on involving communities and landowners in reforestation activities developed on so-called 'degraded' lands that in many cases would be probably used by some people. The creation of carbon plantations becomes then a change of behaviour and practice that may undermine others' subsistence activities. The questions are therefore what and whose purposes do the enhancement of carbon pools actually serve, and which people may consequently win or lose – two aspects that are shallowly addressed in the reviewed PDDs.

Almost all PDDs present no information on ecological conditions and trends, and they assert uncritically that tree planting activities would contribute to regulate local and regional hydrological flows and reduce soil erosion, without presenting empirical or simulation-based analyses testing such assumptions on-site. In fact, they seemed to disregard existing studies suggesting that tree plantations 'can help control groundwater recharge and upwelling but reduce stream flow and salinize and acidify some soils' (Jackson et al., 2005). This indicates that they fail to apply emerging theories and models that consider trade-offs across ecosystem services to the context of land-use management for mitigation (Bennett et al., 2009; Raudsepp-Hearne et al., 2010), and they also ignore the application of ecological research models – as well as of qualitative and statistically relevant approaches involving control groups – in projects' design (Caplow et al., 2011). PDDs also uncritically assume that they will promote biodiversity conservation when at best they re-introduce some native tree species on existing shrub and grasslands without accounting for possible negative impacts on existing flora and fauna, for example through the use of fertilisers or by changing the local ecology. Plantations are not forests and aligned trees may not become a biodiversity-richer ecosystem than existing grasslands (Hunt, 2009; Friends of the Earth, 2010).

From a socio-economic perspective, all PDDs, except the Chinese case, fail to provide detailed short and long-term economic estimations due to production and price uncertainties, thus making it difficult to monitor projects' performance against alternative economic scenarios. Our review also shows that most projects rely on in-kind labour contributions from farmers and communities and that, in some cases, they also require the latter to invest capital up-front (e.g. the Chilean project). Evidence of indebted farmers due to carbon contracts is still anecdotal (Granda, 2005) but may be something worth considering in the future as current projects develop and REDD+ activities take off. Seemingly, the effects of displaced labour towards timber and carbon-earning activities on subsistence production and the household economy is only beginning to be explored (Osborne, 2011). As it has been pointed out elsewhere, time and risk are critical factors in forest sink projects that inevitably collide with the interests of the poorest farmers; only the richer may have sufficient land, labour or capital to spare on planting activities that generate too far into the future (Corbera et al., 2007a; Gutiérrez, 2011).

Specifically, the extent to which these activities distribute risks, contribute to generate winners and losers, or to reproduce uneven development, is intrinsically linked to social, productive structures and the benefit sharing arrangements defined by the projects. In our reviewed sample, community-based projects may in theory adopt a more inclusionary approach and may thus have the potential to provide a wider range of benefits to the local community, including jobs and improvements in local infrastructure. However, as highlighted by existing literature, this may not always be the case. Community-based carbon projects can also result in internal disputes and project managers can prioritise some individuals and social groups over others (Corbera et al., 2007a). In fact, there have been cases where the local elite has persuaded the community to participate in forestry projects against the interests of both, the majority or minority groups (Lele, 2003; Boyd et al., 2007). In our review, only two of the four community-based projects have considered gender specificities in designing and implementing the project while the rest conceptualise 'the community' as a homogeneous entity, thereby contributing to mask and reinforce gender inequities in accessing natural resources (Corbera et al., 2007b; Lele, 2010). Furthermore, project design has rarely involved a large number of local participants. This echoes Lövbrand

and colleagues' concerns on the lack of 'input legitimacy' of the CDM at local level, which contrasts with the well-developed mechanisms to ensure participation from international actors in the CDM project cycle through internet-based procedures (*ibid*.: 84-86). Nonetheless, these authors highlight that chances to comment on CDM projects at their validation stage is compromised by NGOs lack of resources and technical knowledge, and they claim that 'although procedural rules are in place for local stakeholder participation, the communities directly affected by CDM projects are likely to have less voice in the CDM project cycle than project developers' (*ibid*.: 86).

Intimately related to the question of whose voice counts in project planning and development, is the importance of interrogating projects' uncritical claims on the feasibility of developing plantations on 'degraded' lands. Such terminology is a subjective value judgment because the whole community may not share this perception and competing understandings on land use often exist among local resource users (Gerber et al., 2009; Lele, 2010).

> There is a long global history to the kind of claim… that a certain set of common lands are "waste", "degraded" or "unused", and are idly waiting to be brought into the commodity market before they can become "productive". It is a claim that was used in the Americas during the colonial era to seize indigenous peoples' cropland and hunting and gathering grounds and transform them into the private property of Europeans. (Lohmann, 2006: 229-230)

These considerations underscore the importance of highlighting whose views are prioritised when project sites are established and how such sites fit into the reproductive and socio-cultural spaces of households and communities, which are issues clearly underdeveloped by the reviewed PDDs.

A lesson inferred from the cases analysed and the empirical assessment of voluntary projects is that land tenure regimes play a key role in defining benefit-sharing arrangements, often stipulated in the carbon contract between participants and project managers (Corbera et al., 2007a; Corbera and Brown, 2010). When planting activities occur on public lands, carbon revenues are captured by the state (Uganda) and participant farmers and communities benefit from employment. When planting on private lands, carbon and forest products' revenues generally accrue to the landowner (Chile) who then may share the benefits with project managers depending on the latter's previous level of financial support. Benefit sharing becomes more complex when project activities are developed on multiple land tenure regimes or involve communal lands. Carbon and forest products revenues are then shared across participants in different proportions depending on the project's design, and in some cases tCERs revenues are allocated exclusively to cover project management costs (Ethiopia, Bolivia and Paraguay). This evidence suggests that the economic benefits of CDM A/R for communities and farmers will result from the interplay of tenure and project design, including up-front investment criteria (e.g. the use of loans, grants, and in-kind contributions) and procedural considerations. In all cases, economic benefits will be realised unevenly over time: short-term economic benefits will derive from employment in the plantations and potential tCERs revenues after the first verification, while long-term economic benefits will depend on the continuous realisation of carbon credits and the commercialisation of timber and non-timber forest products. In turn, these somewhat distant benefits are uncertain because they are subject to policy and economic changes in carbon and other forest products markets. All these uncertainties will contribute to people's poor understanding of benefit sharing in carbon projects and negatively impact the latter's accountability, as demonstrated in the Ugandan case (Fisher, 2011).

Implications for REDD+

Contrary to some analysts (Thomas et al., 2009), our review suggests that A/R projects would require more rather than less regulation if the CDM were to continue in the future. There is clearly a need for further substantiation of project assumptions and expectations, and improved guidelines and standardised methods for participatory and inclusionary design. But improved regulation is difficult if not impossible due to the very nature of carbon markets, which are concerned with maximising carbon trading volumes at the lowest possible cost. In this regard, they are no different than other commodity markets where stricter regulation, particularly on environmental and social aspects, is deemed unnecessary. As one of us has argued elsewhere, the emphasis of carbon markets on efficiency and effectiveness will probably undermine most attempts to develop sound ecological and social projects, unless these count with substantial additional and sustained funding (Corbera et al., 2007a).

The present and future of A/R CDM activities was related to REDD+ as soon as international negotiators accepted in Copenhagen to recognise countries' efforts in halting deforestation and degradation *as well as* in conserving, enhancing and sustainably managing forest carbon stocks as a source of positive carbon incentives. The additional focus on carbon enhancement and management now contributes to legitimise the development of forest enrichment activities by governments and private companies, which can now be further pursued in the name of climate stabilisation and can potentially render additional benefits through the international trading of carbon offsets. In light of our review, however, this should be seen as a worrying move because, on the one hand, nothing can guarantee that enrichment of existing forests to increase biomass is legitimately designed and, on the other, that such activity results in positive environmental and social outcomes.

The overall REDD+ framework has been both praised and criticised by academics and civil organisations from both developed and developing countries. Some perceive it as a new opportunity for biodiversity conservation and for increasing the financial value of forest management and its role in rural development (Venter et al., 2009). Others have warned about the potentially insurmountable governance challenges that such a framework actually faces (Burgess et al., 2010; Melick, 2010; Corbera and Schroeder, 2011) and some have seen it as a form of carbon colonialism instituted by the CDM and voluntary offset markets, now expanding into the realm of forest conservation (Cabello and Gilbertson, 2011). In this regard, they have warned against the risk of it becoming a tool used by governments and interested parties to alienate people from the land, ignore customary tenure arrangements, and impose a global blueprint for forest conservation and management based on purely commercial interests (for another review see Corbera, 2010). As highlighted by the Cochabamba declaration[11]:

> We condemn market mechanisms such as REDD…, which are violating the sovereignty of peoples and their right to prior free and informed consent as well as the sovereignty of national States, the customs of Peoples, and the Rights of Nature. Polluting countries have an obligation to carry out direct transfers of the economic and technological resources needed to pay for the restoration of forests in favour of the peoples and indigenous ancestral organic structures.

The international REDD+ framework is evolving in a similar way as the CDM did, i.e. with international negotiators progressively introducing safeguards and standards for the development of policies and project activities in developing countries, such as methodologies for developing national carbon baselines or including the Free Prior Informed Consent (FPIC) of affected parties. However, as our analysis of A/R PDDs has proven, the existence of regulatory guidelines is not a guarantee of their effective application and enforcement. Governments are tempted to endorse projects based on nationally standardised criteria without paying attention to the actual procedures for projects' design and assessment. At the same time, developers have a range of tools at their disposal to monitor ecological effects and to secure equitable and legitimate decision-making and outcomes but fail to apply them thoroughly. REDD+ may not contravene this evidence.

Furthermore, so-called independent evaluators of REDD+ activities will probably face the same time and knowledge constraints as CDM evaluators, which may lead them to overlooking environmental and social impacts at regional and local levels. The use of FPIC, for example, has been regarded as a positive but probably unfeasible approach because in order to apply it properly transaction costs would increase considerably (Goldtooth, 2011). This goes against the interests of REDD+, particularly if it takes a market-based approach where payments are subject to performance and prices are left at the vagaries of carbon markets, which should lead governments and developers to minimise costs to reduce financial risks and maximise potential profits. In any case, it is very likely that governments and developers lack the necessary requirements to guarantee that such carbon results from ecologically sound activities and it can produce positive livelihood benefits, particularly if voluntary, up-front funding dries up.

Our analysis has also shown that reforestation activities are based on a very limited number of mostly non-native species. This is a well-documented impact of plantation-based developments that REDD+ can contribute to extend (Gerber et al., 2009). In this regard, the presumed biodiversity benefits of REDD+ may be at stake while social unrest may increase, particularly if governments are unable (and unwilling?) to curb deforestation and advocate instead for increasing carbon stocks to counter-balance forest loss elsewhere. The political and economic costs of increasing existing biomass stocks are likely to be lower than those related to enforcing environmental laws or compensating deforestation agents (Corbera et al., 2011).

---

11 World People's Conference on Climate Change and the Rights of Mother Earth, 22 April, 2009, Cochabamba, Bolivia [http://pwccc.wordpress.com/2010/04/24/peoples-agreement/].

Conclusions

This paper was set to review a sub-sample of CDM A/R PDDs in order to shed light on critical issues for the environment, people's livelihoods and the future of REDD+ activities. In doing so, we have dissected the projects' key characteristics, including the type and number of participant actors, their carbon accounting methods and their likely environmental and livelihoods outcomes, including benefit sharing, and we have been able to identify critical gaps in project design that may hamper their successful implementation from both environmental and social perspectives. The projects' contribution of CDM A/R activities to climate mitigation may be undermined by existing uncertainties in carbon accounting scenarios and ill-defined leakage accounting systems, while their contribution to sustainable development may be hampered by a lack of rigorous, inclusionary and participatory planning, by their failure to assess and monitor socio-economic impacts and by the likely emergence of local conflicts due to competing rights over 'degraded lands' or misunderstandings on benefit sharing.

It has been acknowledged that it is critical to analyse carbon markets more thoroughly to understand their consequences (MacKenzie, 2007). With these objectives in mind, this paper has shown that empirical evidence available on CDM A/R activities is scarce and that there is a need to test carbon offset ecological and development assumptions with robust quantitative and qualitative data. Nonetheless, such a recommendation is by no means a suggestion to encourage the development of new projects. On the contrary, we are inclined to think that the further development of A/R carbon activities under the CDM, combined with forest enrichment activities through the REDD+ framework, can result in environmental and social conflicts. Our review already suggests that projects' design gaps are too wide to be addressed through regulation and safeguards, while their implementation will very likely fail to guarantee short- and long-term benefits for their participants and the global climate, except under very particular circumstances.

Climate policy negotiators would be on safer grounds if they reconsidered their decision and excluded forest enrichment activities as part of national REDD+ strategies in order to avoid incentivising the expansion of carbon and timber valuable species in existing forests, which involve the risk of simplifying ecological systems and marginalising certain actors from accessing and using the forests for grazing and other activities. REDD (without the '+') may also dangerously endorse a renewed emphasis on exclusionary conservation and therefore should ideally be redesigned to become a more flexible funding mechanism for sustained environmental cooperation. Why could not REDD be reconsidered as an Ecological Debt Fund? The fund could serve as the main financial instrument of developed countries to pay back the ecological debt acquired with poorer countries as a result of sustained ecologically unequal exchange (i.e. poor countries bearing the burden of environmental degradation associated with mineral extraction and agricultural exports) and the historically uneven contribution to global GHG emissions (Martinez-Alier, 2002).

Paradoxically, the fund's resources could be generated by a share of the future auctioning of carbon credits under the EU ETS or similar approaches adopted in carbon markets. They could also come from increasing taxation on the consumption of fossil fuels and of imported minerals and goods contributing to land-use change in tropical and sub-tropical countries, such as oil palm or other export-based crops, or they could also come from the projected taxation of international financial operations. Recipient countries could, in turn, use all or part of these additional resources to responsibly foster their own environment and development agendas, without carbon accounting and trading conditionalities. Among others, they could seriously attempt to halt illegal deforestation activities by powerful economic actors, to extend and improve forest tenure and community-based resource management programmes, and to further regulate environmentally damaging activities without the fear of seeing their national budgets reduced by the falling profits of irresponsible companies. As for REDD+, this approach would not be a panacea but it would be a better starting point for helping poor countries and rural populations to deal with forest governance complexities under a more ecologically and socially just international framework.

references

Albán, M. And M. Argüello (2004) Un análisis de los impactos sociales y económicos de los proyectos de fijación de carbono en el Ecuador. El caso de PROFAFOR-FACE. *Markets for environmental services No 7*. London: International Institute for Environment and Development,.

Aukland, L., Moura Costa, P. and S. Brown (2003) 'A conceptual framework and its application for addressing leakage: the case of avoided deforestation', *Climate Policy*, 3: 123-136.

Bäckstrand, K. and E. Lövbrand (2006) 'Planting trees to mitigate climate change: contested discourses of ecological modernization, green governmentality and civic environmentalism', *Global Environmental Politics*, 6(1): 50-75.

Bennett, E.M., Peterson, G.D. and L.J. Gordon (2009) 'Understanding relationships among multiple ecosystem services', *Ecology Letters*, 12: 1394-1404.

Boyd, E., P. May, M. Chang, and F. Veiga (2007a) 'Exploring socioeconomic impacts of forest based mitigation projects: lessons from Brazil and Bolivia', *Environmental Science And Policy*, 10: 419-433.

Boyd, E., M. Gutierrez, and M. Chang (2007b) 'Small-scale forest carbon projects: adapting CDM to low-income communities', *Global Environmental Change*, 17: 250-259.

Boyd, E., E. Corbera, and M. Estrada (2008) 'UNFCCC negotiations (pre-Kyoto to COP-9): What the process says about the politics of CDM-sinks', *International Environmental Agreements: Politics, Law And Economics*, 8: 95-112.

Boyd, E. (2009) 'Governing the Clean Development Mechanism: Global rhetoric versus local realities in carbon sequestration projects', *Environment and Planning A*, 41: 2380-2395.

Bozmoski, A. and N. Hultman (2010) 'Participant perceptions of risk and benefit in carbon forestry: evidence from central Tanzania', *The Journal Of Environment And Development*, 19(1): 4-27.

Brown, S. (2002) 'Measuring carbon in forests: current status and future challenges', *Environmental Pollution*, 116: 363-372.

Brown, K. and E. Corbera (2003) 'Exploring equity and sustainable development in the new carbon economy', *Climate Policy*, 3(S1): 41-56.

Brown, K., W. N. Adger, E. Boyd, E. Corbera and S. Shackley (2004) 'How do CDM projects contribute to sustainable development?' *Technical Report 16*. Norwich: Tyndall Centre.

Bumpus, A. and D. Liverman (2008) 'Accumulation by decarbonisation and the governance of carbon offsets', *Economic Geography*, 84: 127-155.

Burgess, N.D., B. Bahane, T. Clairs, F. Danielsen, S. Dalsgaard et al. (2010) 'Getting ready for REDD+ in Tanzania: a case study of progress and challenges', *Oryx*, 44(3): 339-351.

Cabello, J. and T. Gilbertson (eds.) (2011) *No REDD+. A Reader*. Carbon Trade Watch.

Caplow, S., P. Jagger, K. Lawlor, and E. Sills (2011) 'Evaluating land use and livelihood impacts of early forest carbon projects: lessons for learning about REDD+', *Environmental Science And Policy*, 14: 152-167.

Clean Development Mechanism (CDM) Executive Board (2010) 'Report of the 53rd CDM Executive Board meeting, Bonn, 26th March 2010' [https://cdm.unfccc.int/EB/053/eb53_repan02.pdf].

Corbera, E. (2010) 'REDD+: oportunidades y riesgos', *Ecología Política*, 39: 37-44.

Corbera, E., M. Estrada, P. May, G. Navarro and P. Pacheco (2011) 'Rights to land, forests and carbon in REDD+: insights from Mexico, Brazil and Costa Rica', *Forests*, 2(1): 301-342.

Corbera, E. and H. Schroeder (2011) 'Governing and implementing REDD+', *Environmental Science And Policy*, 14: 89-99.

Corbera, E. and K. Brown (2010) 'Offsetting benefits? Analysing access to forest carbon', *Environment and Planning* A, 42: 1739-1761.

Corbera, E., M. Estrada and K. Brown (2009) 'How do regulated and voluntary carbon-offset schemes compare?', *Journal of Integrative Environmental Sciences*, 6(1): 26-50.

Corbera, E. and K. Brown (2008) 'Building institutions to trade ecosystem services: marketing forest carbon in Mexico', *World Development*, 36(10): 1956-1979.

Corbera, E., K. Brown and W.N. Adger (2007a) 'The equity and legitimacy of markets for ecosystem services', *Development and Change*, 38(4): 587-613.

Corbera, E., N. Kosoy, N and M. Martinez Tuna (2007b) 'Equity implications of marketing ecosystem services in protected areas and rural communities: case studies from Meso-America', *Global Environmental Change*, 17: 365-380.

Dessai, S., E. L. Schipper, E. Corbera, A. Haxeltine, B. Kjellen and M. Gutierrez (2005) 'Challenges and outcomes at the ninth session of the conference of the parties to the United Nations Framework Convention on Climate Change', *International Environmental Agreements: Politics, Law And Economics*, 5: 105-124.

Dutschke, M., B. Schlamadinger, J.L.P. Wong and M. Rumberg (2004) 'Value and risks of expiring carbon credits from CDM afforestation and reforestation', HWWA Discussion Paper, 290.

Ellis, J., H. Winkler, J. Corfee-Morlot and F. Gagnon-Lebrun (2007) 'CDM: taking stock and looking forward', *Energy Policy*, 3: 15-28.

European Climate Change Limited (2008) 'CER price curve shifting as new ECX contracts boost transparency' [http://www.ecx.eu/General/CER-price-curve-shifting-as-new-ECX-contracts-boost-transparency].

Fisher, J.A. (2011) *Payments for ecosystem services in forests: analysing innovations, policy debates and practical implementation.* Thesis submitted for the Degree of Doctor of Philosophy, School of International Development, University of East Anglia, June 2011.

Forest Stewardship Council Watch (2011) 'A new film exposing FSC: "Sustainable on Paper"' [http://www.fsc-watch.org/archives/2011/01/31/A_new_film_exposing_].

Forests and the European Union Resource Network (FERN) (2001) 'Sinks in the Kyoto Protocol: A dirty deal for forests, forest people and the climate', *Briefing Note*.

Friends of the Earth (2002) *Carbon sequestration: Climate change and planting forests*. Summary report of the conference held at the Department for Environmental Science and Technology, Imperial College, London.

Friends of the Earth (2010) 'Plantations are not forests. Position paper, July 2010' [http://www.foei.org/en/resources/publications/pdfs/2010/position-paper-plantations-are-not-forests/view].

Gerber, J.F., S. Veuthey and J. Martínez-Alier (2009) 'Linking political ecology with ecological economics in tree plantation conflicts in Cameroon and Ecuador', *Ecological Economics*, 68: 2885-2889.

Goldtooth, T.B.K. (2011) 'Why REDD/REDD+ is not a solution', in: J. Cabello and T. Gilbertson (eds.) *No REDD+. A Reader*. Carbon Trade Watch.

Gong, Y., G. Bull and K. Baylis (2010) 'Participation in the world's first clean development mechanism forest project: The role of property rights, social capital and contractual rules', *Ecological Economics*, 69(6): 1292-1302.

Granda, P. (2005) 'Carbon sink plantations in the Ecuadorian Andes: Impacts of the Dutch FACE-PROFAFOR monoculture tree plantations' project on indigenous and peasant communities', Acción Ecológica and World Rainforest Movement, Brazil.

Gutiérrez, M. (2011) 'Making markets out of thin air: A case of capital involution', *Antipode*, 43(2): 639-661.

Hamilton, K., M. Sjardin, M. Peters-Stanley and T. Marcello (2010a) 'Building bridges: state of the voluntary carbon markets', Washington DC: Ecosystem Marketplace and Bloomberg New Energy Finance.

Hamilton, K., U. Chokkalingam and M. Bendana (2010b) 'State of the forest carbon markets 2009. Taking root and branching out', Washington DC: Ecosystem Marketplace and Bloomberg New Energy Finance.

Hunt, C.A.G. (2009) *Carbon sinks and climate change. Forests in the fight against global warming*. Cheltenham: Edward Elgar.

Intergovernmental Panel on Climate Change (IPCC) (2003) 'Good practice guidance for land use, land-use change and forestry' [http://www.ipcc.ch/ipccreports/sres/land_use/index.php?idp=0].

Jackson R.B., E.G. Jobbágy, R. Avissar, S. Baidya Roy, D.J. Barrett, C.W. Cook, K.A. Farley, D.C. Le Maitre, B.A. McCarl and B.C. Murray (2005) 'Trading water for carbon with biological carbon sequestration', *Science*, 310: 1944-1947.

Jindal, R., B. Swallow and J. Kerr (2008) 'Forestry-based carbon sequestration projects in Africa: Potential benefits and challenges', *Natural Resources Forum*, 32(2): 116-130.

Klooster, D. (2010) 'Standardizing sustainable development? The Forest Stewardship Council's plantation policy review process as neoliberal environmental governance', *Geoforum*, 41: 117-129.

Kosoy, N., E. Corbera and K. Brown (2009) 'Participation in payments for ecosystem services: case studies from the Lacandon rainforest, Mexico', *Geoforum*, 39(6): 2073-2083.

Kosoy, N. and E. Corbera (2010) 'Payments for ecosystem services as commodity fetishism', *Ecological economics*, 69: 1228-1236.

Kossoy, A. and P. Ambrosi (2010) 'State and trends of the carbon market', Washington DC: World Bank.

Kruter Flores, R., F. Silva and P. Volkmann (2009) 'Shall we still keep our eyes cerrados?', in S. Böhm and S. Dabhi (eds.) *Upsetting the offset: The political economy of carbon markets*. London: May Fly Books.

Landell-Mills, N. (2002) 'Developing markets for forest environmental services: an opportunity for promoting equity while securing efficiency?' *Philosophical Transactions of the Royal Society of London*. *Mathematical Physical and Engineering Sciences*, 360: 1817-1825.

Lang, C. (2006) 'FSC plantations review: raising the bar or lowering standards?' *World Rainforest Movement Bulletin*, 3-4 [http://www.wrm.org.uy/bulletin/108/viewpoint.html].

Lansing, D.B. (2009) *The spaces of carbon: Calculation, technology, and discourse in the production of carbon forestry offsets in Costa Rica*. Ph.D. dissertation, Ohio State University.

Lele, S. (2003) 'Participatory forest management in Karnataka, at the crossroads', *Community forestry*, 2(4): 4-11.

Lele, S. (2010) 'Forest governance in a globalising world: Some insights from India', paper presented at the Judge Business School, University of Cambridge, 9 June.

Lohmann, L. (1999) 'The carbon shop: planting new problems' [http://www.wrm.org.uy/plantations/material/carbon.html].

Lohmann, L. (2005) 'Marketing and making carbon dumps: Commodification, calculation and counterfactuals in climate change mitigation', *Science as Culture*, 14(3): 203-235.

Lohmann, L. (2006) Carbon trading: A critical conversation on climate change, privatisation and power. Uppsala: Dag Hammarskjöld Foundation.

Lohmann, G. (2009) 'Toward a different debate in environmental accounting: The cases of carbon and cost-benefit', *Accounting, Organizations And Society*, 34: 499-534.

Lynch, O. and A. Janis (1994) 'Tenurial rights and community-based conservation', in D. Western, M. Wright and S. Strum (eds.) *Natural Connections: Perspectives in Community Based Conservation*. Washington DC: Island Press.

MacKenzie, D. (2007) 'The political economy of carbon trading', *London Review of Books*, 29(7) [www.lrb.co.uk/v29/n07].

Melick, D. (2010) 'Credibility of REDD and experiences from Papua New Guinea', *Conservation Biology*, 24(2): 359-361.

Muradian, R., E. Corbera, U. Pascual, N. Kosoy, N. and P. May (2010) 'Reconciling theory and practice: An alternative conceptual framework for understanding payments for environmental services', *Ecological Economics*, 69: 1202-1208.

Nelson, K.C. and B.H.J. de Jong (2003) 'Making global initiatives local realities: Carbon mitigation projects in Chiapas, Mexico', *Global Environmental Change*, 13: 19-30.

Newell, P. and M. Paterson (2010) *Climate capitalism. Global warming and the transformation of the global economy.* Cambridge: Cambridge University Press.

Orlando, B., D. Baldock, S. Canger, J. Mackensen, S. Maginnis, M. Socorro, S. Rietbergen, C. Robledo, and N. Schneider (2002) *Carbon, forests and people: Towards the integrated management of carbon sequestration, the environment and sustainable livelihoods*. Gland: IUCN.

Osborne, T. (2011) 'Carbon forestry and agrarian change: access and land control in a Mexican rainforest', *Journal Of Peasant Studies*, 38(4): 859-883.

Ostrom, E. and E. Schlager (1996) 'The formation of property rights', in S. Hanna, C. Folke and K.G. Maler (eds.) *Rights to nature: Ecological, economic, cultural and political principles of institutions for the environment*. Washington, DC: Island Press.

Project Design Document (PDD) of Cao Phong C, version 2.1 (2008) [http://cdm.unfccc.int/UserManagement/FileStorage/PQALNVT8O325XK7JS1BFDWHZ9EIM0Y].

Project Design Document (PDD) of carbon sequestration through Reforestation in the Bolivian tropics by smallholders of The Federación de Comunidades Agropecuarias de Rurrenabaque (FECAR), version 2.03 (2008) [http://cdm.unfccc.int/UserManagement/FileStorage/DMP6NK2ZFUOSAWJQTBYR18CG5X0E3H].

Project Design Document (PDD) of facilitating reforestation for Guangxi watershed management in Pearl River basin, version GIFDCP02 (2006) [http://cdm.unfccc.int/UserManagement/FileStorage/H5218OI0ZWU4CTWLPLKEIETBIODYED].

Project Design Document (PDD) of Humbo Ethiopia assisted natural regeneration project, version 3 (2009) [http://cdm.unfccc.int/UserManagement/FileStorage/W57JTARN2IZCOHG09DYVMS1XF8Q4LK].

Project Design Document (PDD) of Nerquihue small-scale CDM afforestation project, version 7 (2009) [http://cdm.unfccc.int/UserManagement/FileStorage/90UM2RZBP1WHYE8NJ6IFKGVACT735S].

Project Design Document (PDD) of Reforestation of croplands and grasslands in low income communities of Paraguarí department, Paraguay, Version 3 (2009) [http://cdm.unfccc.int/UserManagement/FileStorage/A1MDGJCXR75WN23P6FQILVHKOS0YTU].

Project Design Document (PDD) of The International Small Group and Tree Planting Program (TIST), Tamil Nadu, India, version 1 (2008) [http://cdm.unfccc.int/UserManagement/FileStorage/UMS239OWCDFKVAB5QETJPHRNX671LI].

Project Design Document (PDD) of Uganda Nile basin reforestation project No 3, version 1 (2006) [http://cdm.unfccc.int/UserManagement/FileStorage/TDZ9UK3DIRAD87MWA90E4SV3MILG3F].

Raudsepp-Hearne, C., G.D. Peterson and M. Bennet (2010) 'Ecosystem service bundles for analyzing tradeoffs in diverse landscapes', *Proceedings of the National Academy of Sciences*, 107: 1-6.

Ribot, J. and N. Peluso (2003) 'A theory of access', *Rural Sociology*, 68(2): 153-181.

Sathaye, J.A. and K. Andrasko (2006) 'Special issue on estimation of baselines and leakage in carbon mitigation forestry projects', *Mitigation and Adaptation Strategies For Global Change*, 12(6): 963-970.

Scherr, S., A. White and A. Khare (2004) 'Current status and future potential of markets for ecosystem services of tropical forests: an overview' [www.foresttrends.org/whoweare/publications.htm].

Skutsch, M.M. and L. Ba (2010) 'Crediting carbon in dry forests: The potential for community forest management in West Africa', *Forest Policy And Economics*, 12(4): 264-270.

Skutsch, M.M. (ed.) (2010) *Community forest monitoring for the carbon market. Opportunities under REDD*. London: Earthscan.

Thomas, S., P. Dargusch, S. Harrison and J. Herbohn (2010) 'Why are there so few afforestation and reforestation Clean Development Mechanism projects?', *Land Use Policy*, 7(3): 880-887.

Tullos, D. (2009) 'Assessing the influence of environmental impact assessments on science and policy: an analysis of the three gorges project', *Journal of Environmental Management* 90: s208-S223.

Validation report of Cao Phong restoration project (2008) [http://cdm.unfccc.int/UserManagement/FileStorage/L1096WAG253DZQIMBVUKO8EHYFSCNR].

Validation report of carbon sequestration through reforestation in the Bolivian tropics by smallholders of 'The Federación de Comunidades Agropecuarias de Rurrenabaque (FECAR)' (2009) [http://cdm.unfccc.int/UserManagement/FileStorage/H56C84P7GYEWT9U3XDNB1ZVFSORLQA].

Validation report of facilitating reforestation for Guangxi watershed management in Pearl River basin (2006) [http://cdm.unfccc.int/UserManagement/FileStorage/CSTDPFLFNXA7S8C3J45ZCBHRQ3IV0X].

Validation report of Humbo Ethiopia assisted natural regeneration project (2009) [http://cdm.unfccc.int/UserManagement/FileStorage/0C9F8OIKRN72G4WH31JPDTAYES5UQB].

Validation report of Nerquihue small-scale CDM afforestation project (2010) [http://cdm.unfccc.int/UserManagement/FileStorage/15TQHY4RKIF69732ESJNPGCZLM0OVU].

Validation report of reforestation of croplands and grasslands in low-income communities of Paraguarí department, Paraguay (2009) [http://cdm.unfccc.int/UserManagement/FileStorage/MQK691CA8402VJTLGN7SIYUPFEZXHD,].

Validation report of The International Small Group and Tree Planting Program (TIST), Tamil Nadu, India (2009) [http://cdm.unfccc.int/UserManagement/FileStorage/5JHELYB46MWPA2RUVTSQK89F0ZGCX3].

Validation report of Uganda Nile basin reforestation project no.3 (2009) [http://cdm.unfccc.int/UserManagement/FileStorage/UGD1OS64X9NHVFPKRT805IQ2WZJ3LA].

van Kooten, G.C., A.J. Eagle, J. Manley and T. Smolak (2004) 'How costly are carbon offsets? A meta-analysis of carbon forest sinks', *Environmental Science And Policy*, 7: 239-251

Vatn, A. (2010) 'An institutional analysis of payments for environmental services', *Ecological Economics*, 69: 1245-1252.

Venter, O., E. Meijaard, H. Possingham, R. Dennis, D. Sheil, S. Wichs, L. Hovaniz and K. Wilson (2009) 'Carbon payments as a safeguard for threatened tropical mammals', *Conservation Letters*, 2: 123-129.

Young, O., A. Agrawal, L.A. King, P.H. Sand, A. Underdal and M. Wasson (1999) Institutional dimensions of global environmental change science plan [http://www.ihdp.uni-bonn.de/html/publications/reports/report09/].

United Nations Framework Convention on Climate Change (UNFCCC) (2005) Decision 6/CMP.1. Simplified modalities and procedures for small-scale afforestation and reforestation project activities under the clean development mechanism in the first commitment period of the Kyoto Protocol and measures to facilitate their implementation. [http://cdm.unfccc.int/Reference/COPMOP/08a01.pdf#page=81]

UNFCCC (2008) Report of the CDM EB 41. Annex 15 - A/R methodological Tool "Tool for the identification of degraded or degrading lands for consideration in implementing CDM A/R project activities" (version 01) [http://cdm.unfccc.int/methodologies/ARmethodologies/tools/ar-am-tool-13-v1.pdf].

UNEP-Risoe (2010) 'CDM/JI pipeline analysis and database' [http://cdmpipeline.org].

the authors

Esteve Corbera is a 'Ramón y Cajal' senior research fellow at the Institute of Environmental Science and Technology, Universitat Autònoma de Barcelona (Spain), and a research associate at the School of International Development, University of East Anglia (UK). His research focuses on the governance of clean development and land-use management, including analyses of carbon offset projects and payments for environmental services.
E-mail: esteve.corbera@uab.cat

Charlotte Friedli is an economist (Institute of Political Sciences, Strasbourg, France) and has an MPhil in Environmental Policy from the University of Cambridge (UK), where she is currently undertaking another MPhil in Real Estate Finance. Prior to Cambridge, she worked for the French Diplomatic Corps in Fiji doing research on environmental management.
E-mail: charlotte.friedli@cantab.net